INTERROBANG: THE SOCIAL CONSEQUENCES OF NUCLEAR WAR

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PREFACE

This research sought to establish the social effects of the hypothetical detonation of a nuclear device over the Oklahoma City area. Data concerning population distribution and the locations of various key facilities making up the economic and political institutions in the Oklahoma City area were collected to gauge the physical and concomitant social impacts of the detonation. The physical effects were determined through the use of a Nuclear Weapons Effects Computer developed for the Department of Defense which allowed the author to plot the parameters of destructive effects.

The objectives of the study were to: determine the extent of physical damage to the Oklahoma City area, develop an estimate of the number of casualties, determine if a preattack form of social organization could be maintained after attack and, if not, determine the characteristics of postattack social organization, and discuss postattack social problems.

Data generated from the hypothetical detonation indicate a traumatic failure of the social system. This conclusion is founded upon an analytical synthesis of postattack data, structural-functional theory, and historic evidence of human responses under stressful conditions.

The study emerges with a scenario of violence and postattack social degeneration.

I wish to express my gratitude to all of the people and organizations who assisted me in this work and who were supportive of my efforts at Oklahoma State University.

I am particularly thankful to Dr. Jack Bynum, my major adviser, who suggested the topic of this study and who has been a true friend and mentor. I am also thankful to the other committee members, Dr. Donald Allen, Dr. Gene Acuff, and Dr. Walter Ward for their advise, guidance, and encouragement.

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TABLE OF CONTENTS

LIST OF TABLES

Table		Page

LIST OF FIGURES

Figure | Page

Figure	Page

CHAPTER I

INTRODUCTION

The term 'interrobang', characterized by a question mark over an exclamation point, was coined by a group of theologians and scientists at the Battelle Seattle Research Center in 1970. It symbolizes a change in attitudes held by man with regard to the future. In short, it represents man's fearful questioning of his future as opposed to his anticipation of good things to come.

This study applies the term 'interrobang' to nuclear war. This is appropriate as war in a nuclear form is viewed with apprehension because of the knowledge we have of the effects of nuclear weapons and our lack of knowledge concerning the effects of nuclear war. This study suggests some answers to the question of the social impacts of nuclear war.

Nuclear War As A Social Problem

War can be defined as ". . . a complex, socially organized form of aggression that involves violent, armed conflict between nations . . ." (Henslin and Light, 1983: 562). War is one of the options that national groups may choose to deal with disagreements or with particular situations in which they may find themselves.

War has been viewed in the past as a means through which nations attempt to solve a problem. To put it simply, war is a political act, the most elementary expression of political forces. "Generally speaking, one may say that war is politics in its original, noninstitutional, nonrational form . . ." (Park, 1941:570). It is a form of behavior to which a nation resorts when all else fails or when it is viewed as most expedient.

Timasheff (1965) has identified three essential conditions that must exist before the outbreak of war:

1. A cultural tradition for war;

2. A specific antagonistic situation in which two or more states confront incompatible objectives; and

3. A fuel that heats the antagonistic situation to the point that both leaders and the people cross the line from thinking about war to engaging in war.

Timasheff (1965) has identified seven such fuels or motives for war:

1. To gain revenge or settle old scores from previous conflicts;

2. To dictate one's will to a weaker nation;

3. To protect or enhance prestige or save the nation's honor;

4. To court offense with another nation in order to unite rival groups within the nation;

5. To protect or exalt the position of the leaders of the armed forces;

6. To satisfy the national aspirations of ethnic groups, incorporating "our people" living in another country; and

7. To forcibly convert others to religious and ideological beliefs.

To these fuels an eighth should be added:

8. To secure needed scarce resources.

It is evident from the material presented above that war is a nation-state behavior that is goal-directed. In other words, war is engaged in by nations because it is viewed as being functional.

> Traditionally, war has been extremely functional for the victors. They gained natural resources and more land. They sometimes were also able to enslave the vanquished. For example, Rome extended its empire throughout the known world, subjugating one people after another and exploiting their resources. They extracted annual taxes or tributes of grain, seized extensive amounts of gold, silver, and art treasures, and enslaved hundreds of thousands, whom they brought back to Rome to perform the drudge work. They also enslaved many of Greece's intellectuals, using these educated men as personal tutors for the children of the wealthy and politically powerful (Henslin and Light, 1983:566).

For the winners, war is functional. For the losers, war is dysfunctional in that it disrupts fulfillment of their needs and desires. Applying the label of 'social problem' to war in general, then, clearly is dependent upon the perspective of the observer.

> Sociologists usually consider a social problem to be an alledged situation which is incompatible with the values of a significant number of people who agree that action is necessary to alter the situation (Rubington and Weinburg, 1971:5-6).

Applying such a definition to nuclear war, we easily can see it is a social problem, as no sane person desires such a development. However, this has not always been the case for conventional or traditional forms of war. With the advent of nuclear weapons, war has had its status transformed from a largely socially acceptable method used to solve intra- and international social problems to that of a social problem. This is so because of certain qualitative differences between nuclear war and conventional armed conflict.

Previously it has not been clear whether war could be considered a social problem. For example, it would seem the aggressive behavior of the Axis powers in World War II would have been considered a national social problem, especially after the Japanese bombing of Pearl Harbor, while the armed conflict itself was perceived as the only available solution to that problem. Other examples, such as the U.S. Civil War as a solution to the problem of slavery and the Korean and Vietnam police actions attempting to halt the spread of world communism, also come to mind.

This is not meant to suggest, however, that people have viewed war as a desirable societal undertaking. For example, history tells us that the majority of the United States' populace, following an isolationist policy, was strongly opposed to America becoming involved in the European conflict in 1941. They felt safe and secure being separated from this situation by the Atlantic and Pacific oceans. While concrete evidence is lacking, it has been suggested that, to change the American public's perception of the world situation to that of a national social problem, or as a threat to their well-being, President Roosevelt and high-ranking members the U.S. armed forces actually staged the Pearl Harbor disaster with the unwitting help of the Japanese navy (Toland, 1983).

Moreover, there is no denying that conventional war results directly in various undesirable consequences for any participating nation. Among these consequences, the most obvious are deaths and injuries. Statistics indicate that, since 1917, close to 500,000 Americans have been killed and over one million have been wounded in armed conflicts. On an international scale, deaths from these conflicts number in the many millions. This total not only includes military deaths but civilian deaths which have increased as military operations are now extended to population and industrial centers.

Evident from an examination of Table I, war-related injuries are greater in number than battle deaths. These vary in range of seriousness from minor wounds to extremely serious chronic injuries which impinge upon the recipients' quality of life and can be very costly because of resulting medical care and disability pensions required in the post-war period.

This leads to an examination of the monetary costs of war for a nation. According to an old saying, "Death and

TABLE I

UNITED STATES CASUALTIES IN 20th-CENTURY CONFLICTS (THOUSANDS)

War	Wounds Not Mortal	Battle Deaths
World War I	204	53
World War II	671	292
Korea	103	34
Vietnam	304	47
Total	1,282	426

Source: Statistical Abstract of the United States, (1980: 377)

TABLE II

COSTS OF MAJOR AMERICAN 20th- CENTURY CONFLICTS (BILLIONS)

War	Original War Costs	Estimated Ultimate Costs
World War I	26	112
World War II	288	664
Korea	54	164
Vietnam	128	352
Total	496	1,292

Source: Statistical Abstract of the United States, (1974: 309) taxes are inevitable . . . war has produced a substantial amount of the former; it is also responsible for much of the latter" (Manis, 1984:55). An examination of Table II reveals that the estimated costs of 20th-century American conflicts is slightly over 1.25 trillion dollars. Americans are paying for these past and possible future wars with tax money. There is no doubt war is expensive. Bossard (1941) estimates that each death during World War II cost about $50,000. Furthermore, remaining battle-ready as a nation is also costly. Henslin and Light (1983:570) suggest that "some idea of the meaning of these military expenditures can be obtained by looking at what could be bought with the money". The government can:

1. Purchase one aircraft carrier or build 12,000 high school buildings;

2. Construct one naval weapons plant or build twenty-six 160 bed hospitals;

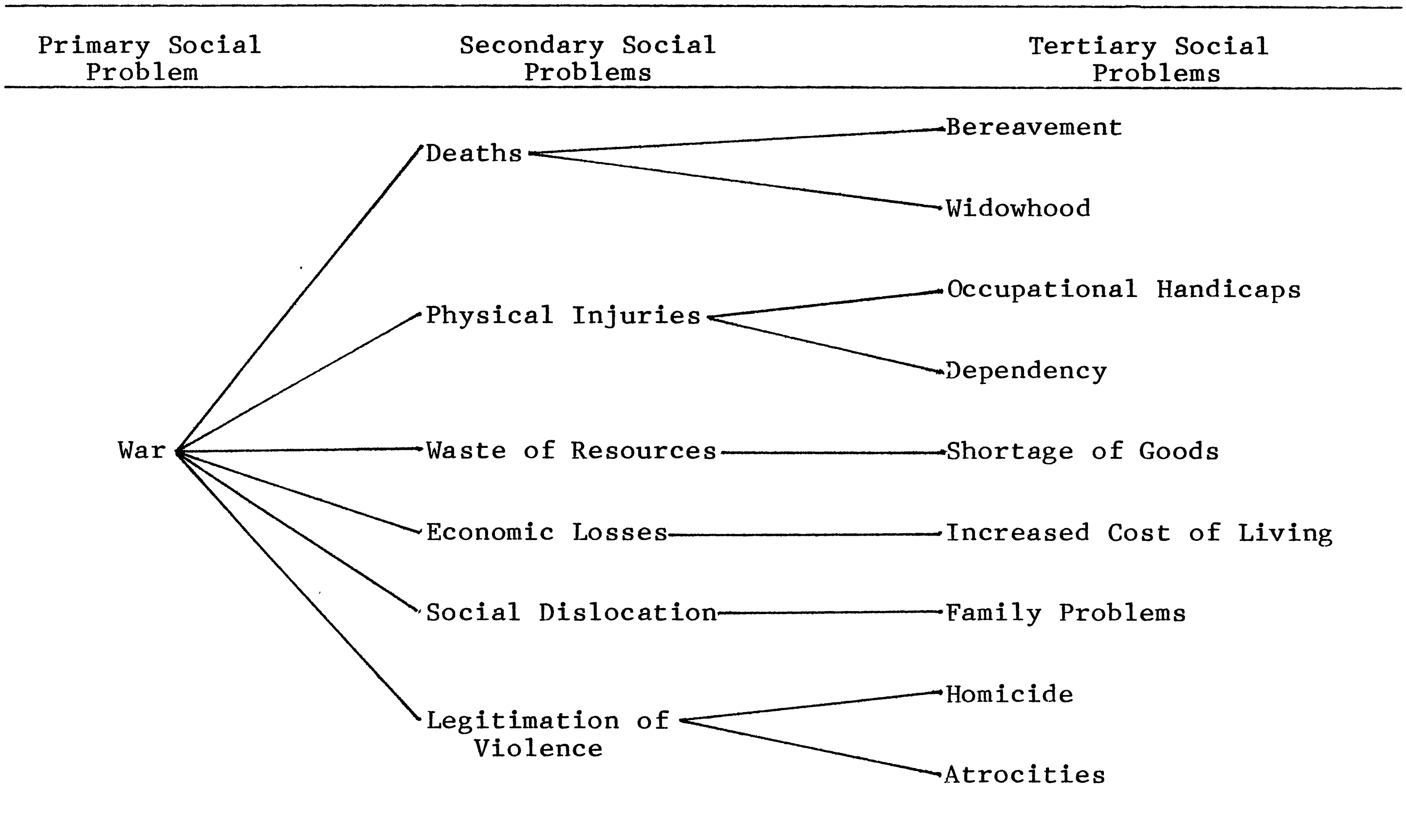
3. Build fourteen jet bombers or provide school lunches for 14 million children for one year;

4. Develop one new prototype bomber or pay the annual salaries of 250,000 teachers.

Because of various unattractive consequences of conventional armed conflict, it has been classified by one author as a primary social problem that leads to other social problems as outlined in Figure 1.

However, when compared to nuclear war, conventional military actions pale to insignificance as far as their

Figure 1. Classification of Conventional War As A
Social Problem



Source: <u>Serious Social Problems</u>, Manis (1984:57) consequences are concerned. Also, as mentioned, conventional war can be viewed as a necessary, if unattractive solution to an undesirable international development while nuclear war cannot be sanely regarded as a solution to anything.

> These [nuclear] bombs were built as 'weapons' for 'war', but their significance greatly transcends war and all its causes and outcomes. They grew out of history yet they threaten to end history. They were made by men, yet they threaten to annihilate man. They are a pit into which the whole world can fall - a nemesis of all human intentions, actions, and hopes (Schell, 1983:3).

Thus, the use of nuclear weapons to solve a social problem can be likened to suicide as a method of dealing with personal problems. In short, the problem is solved but at what cost? The social problems caused by a nuclear war logically would be quite different from those shown in Figure 1. Figure 2 presents those social problems caused by nuclear war. In addition, not only would the social problems be of a different nature (i.e., much greater in impact), but, because of this qualitative difference, their tenure also would be unique. A comparison of Figures 3 and 4 helps illustrate these differences.

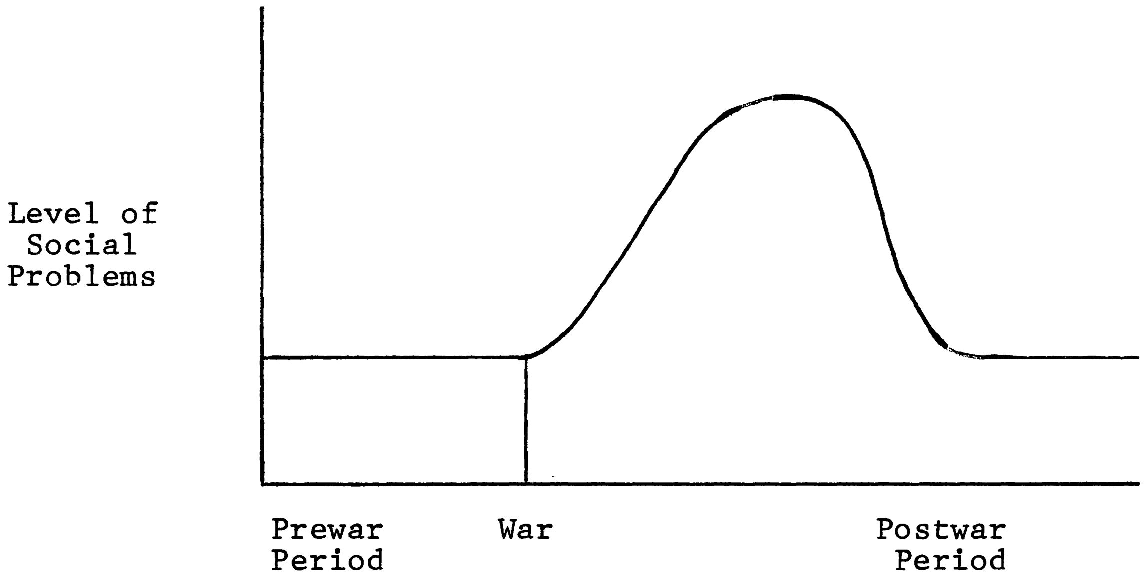
Moreover, the postwar social problems that accompany a nuclear war may be the best scenario for which one can hope. If the ecological damage to the earth transcends its recuperative limits, then the level of social problems will drop to zero, but only because human life has ceased to exist.

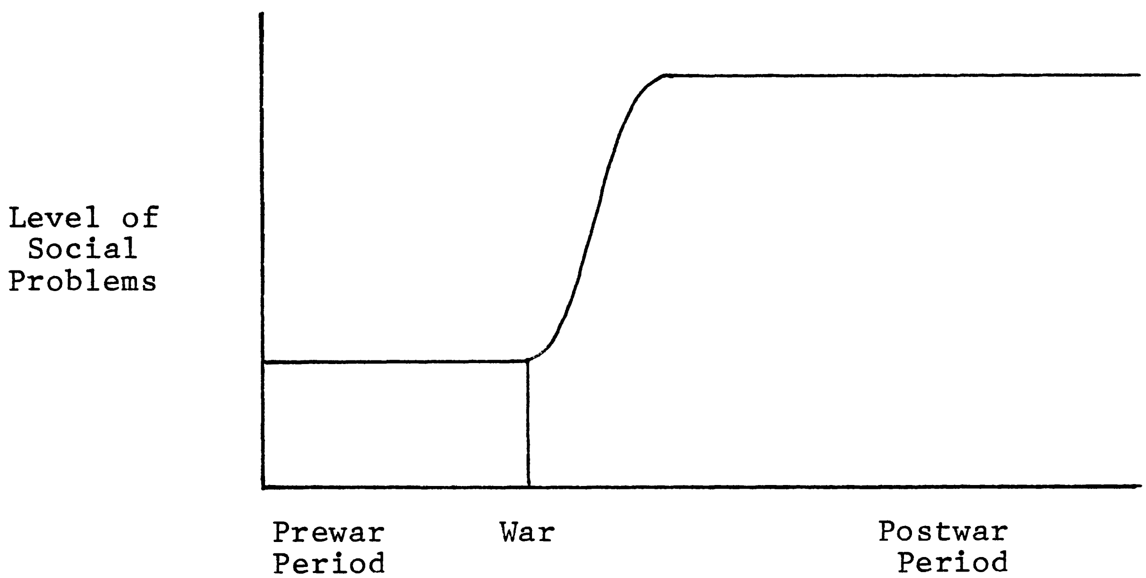
Figure 2. Classification of Nuclear War As A Social Problem

Primary Social Problem	Secondary Social Problems	Tertiary Social Problems
War	Deaths	Dead too numerous to bury, causing epidemics
	Injuries	No proper medical care, thus many injured die
		Crippled will probably not survive
	Waste of Resources	Majority of material culture is destroyed
	Lower Quality of Life	Increased cost of living (mentally and physically)
	Social Dislocation	Transportation, records, known locations of friends and relatives are destroyed
	Legitimation of Violence	Breakdown of normative structure leads to rise in criminal activity
	Ecological Damage	The world may be uninhabitable due to: depletion of ozone, radiation, changes in climatic conditions

Figure 3. Level of Social Problems in A Conventional War

Figure 4. Level of Social Problems in A Nuclear War


Level of
Social
Problems
Prewar
Period
War
Postwar
Period


Level of
Social
Problems
Prewar
Period
War
Postwar
Period

However, as unbelievable as it might seem, nuclear weapons are not all bad. They do have some functional characteristics. For example, as expensive as nuclear weapons are, they are much cheaper than conventional weaponry to produce. The threat supplied by a few tactical weapons secures Western Europe from conventional Soviet aggression, while, at the same time, strategic nuclear weapons protect the middle-east from a similiar threat. The cost to the U.S. of developing and maintaining an adequate conventional military force in either of these areas would be many times greater than that of the nuclear strike force now held in readiness.

Another functional characteristic of nuclear weapons is that they seem to act as a governor on the scale of armed conflict.

> Modern wars are all conducted in the shadow of nuclear threat, so that all conflict is, to a greater or lesser extent, limited conflict, for fear of precipitating a general nuclear war (Yarmolinsky, 1971:4).

In less than fifty years, the world experienced two wars on a scale unprecedented in human experience, with the end of this era giving birth to nuclear weaponry. In the approximately 41 years following World War II, the United States has been involved in two major military actions. However, in both cases, care was taken to keep these actions from escalating into nuclear war. The United States and Soviet Union now mainly engage in ideological battles through third parties and are quite careful in their direct dealing with each other. For example,

> In the Cuban missile crisis, Nikita Khrushchev risked a direct confrontation with the United States over the highly sensitive issue of the secret deployment of nuclear weapons ninety miles off the coast of Florida, but when the crisis came to a head, both sides acted with extraordinary care and delicacy, the United States controlling even the smallest details of military action directly from the White House; and when the burden of escalation had been shifted to the Soviets, they chose to back down. Even in much less direct and dramatic military confrontations a double calculation must be and is attempted. What will be the immediate military consequences of a proposed action; and what effect will that action have on the possibility of escalation toward nuclear war? (Yarmolinsky, 1972:101).

Thus, one could argue convincingly the point that nuclear weapons have kept the world out of a conventional World War III. In this sense, nuclear weapons are functional as long as they are never used. It has even been argued that nuclear weapons could have functional consequences when used. An official of the

> . . . Office of Civil Defense wrote a few years back that although it might be 'verging on macabre' to say so, a nuclear war could alleviate some of the factors leading to today's ecological disturbances that are due to current high population concentrations and heavy industrial production (Schell, 1982:7).

Taking a position of greater social responsibility, it is more realistic to state that the dysfunctions of nuclear war far outweigh its functions. Nuclear weapons have become a sword of Damocles to modern man, threatening a swift, cataclysmic death any minute. Science has given man the capability virtually to destroy a society and possibly the world. In the years to come, the possibility appears to become more favorable to this fear actually becoming a reality. For example, technology has now apparently removed the deterrent effects of the 'balance of terror' or the assurance that even if attacked first, a nuclear superpower would still be able to inflict unacceptable damage upon an aggressor. Technology has accomplished this dubious progress by producing increasingly more accurate delivery systems able to destroy a nuclear power's land-based missiles and thus reduce its second-strike capabilities.

> This state of affairs is deadly dangerous, according to a very elementary and scarcely disputed theory of nuclear strategy. Richard Perle . . . put it like this: 'Where the difference between a first and second nuclear strike is large, the temptation to preempt a crisis is a major source of instability. Where not only one side but both can minimize damage by striking first, the resulting instability becomes the mechanism by which a nuclear war could break out' (Calder, 1981:17).

It is reasonable to speculate that these crisis states may become more numerous with competition over scarce natural resources such as oil, and nuclear proliferation increasing (Klare, 1982). Moreover, not only do the chances of nuclear war becoming a reality seem to be increasing, but this is a problem that apparently will never go away. Schell (1982:99-100) states that if some type of organization such as a Council were formed and given a mandate by the people of the earth to do away with nuclear weapons we still would not be free of the threat of nuclear destruction. He imagines a logical sequence of necessary steps that this hypothetical Council would have to take. First, it would have to have all of the nuclear weapons in the world destroyed. On the surface it would seem that we might be safe until one remembers that some nuclear weapons could be secreted or rebuilt in a very little time.

The second step would be to order the destruction of plants where these weapons are built. However, factories may be rebuilt also.

A required third step then would be to destroy our ability to build nuclear weapons factories. This would require destruction of a large part of our industrial capabilities and lifestyles. Even after this drastic action we still would not be safe because we still could rebuild these industries. The Council would slowly conclude that achievement of its goals is impossible because no change in our material culture could put many years between the population on earth and nuclear destruction.

What must be destroyed to make the world safe is our knowledge, in the final analysis, our definition of physical reality.

> As long as the world remains acquainted with the basic physical laws that underlie the construction of nuclear weapons - and these laws include the better part of physics as physics is understood in our century - mankind [will] have failed to put many years between itself and doom.
>
> For the fundamental origin of the peril of human extinction by nuclear arms lies not in any particular social or political circumstances of our time but in the attainment by mankind as a whole,

> after millennia of scientific progress, of a certain level of knowledge of the physical universe. As long as that knowledge is in our possession, the atoms themselves, each one stocked with its prodigious supply of energy, are in a manner of speaking, in a perilously advanced state of mobilization for nuclear hostilities, and any conflict anywhere in the world can become a nuclear one. To return to safety through technical measures alone, we would have to disarm matter itself, converting it back into its relatively safe, inert, non-explosive nineteenth-century Newtonian state - something that not even the physics of our time can teach us how to do (Schell, 1982:100).

The next logical step one would think of - when he learns that the world may not be made safe by modifying our material culture - is to attack knowledge itself. After-all, our knowledge of the physical universe seems to be, in this case, the real problem of mankind. Perhaps this knowledge could be classified or kept secret. But, even this measure obviously is doomed once one realizes that

> . . .mankind as a whole has now gained possession once and for all of the knowledge of how to make them [nuclear bombs], and that all nations - and even some groups of people which are not nations, including terrorists groups - can potentially build them (Schell, 1982:108).

The knowledge is more available than we might imagine. John Aristotle Phillips, an undergraduate student at Princeton University, majoring in aerospace engineering, decided to design an atomic weapon as a class project for a physics course. He gathered information from public libraries and guessed at the triggering mechanism. He received an 'A' for his project as well as offers from a number of foreign governments who wanted to see his plans. After turning down these offers, he made this alarming statement: "Today a college undergraduate with a basic foundation in physics is capable of doing just what I did" (Henslin and Light, 1983:584).

The threat of nuclear destruction thus is a chronic social problem. It is a social problem that will never leave mankind unless the increasing progress of man's knowledge gives him weapons that are even more destructive or efficient at killing.

> According to the Bible, when Adam and Eve ate the fruit of the tree of knowledge God punished them by withdrawing from them the privilege of immortality and dooming them and their kind to die. Now our species has eaten more deeply of the fruit of the tree of knowledge, and has brought itself face to face with a second death - the death of mankind (Schell, 1982:115).

Physical Effects of A Nuclear Detonation

To understand why the acquisition of such knowledge threatens the very existence of mankind, one must examine the destructive effects of a nuclear detonation. According to a study by the Office of Technology Assessment (OTA) (1980:15), nuclear explosions release their energy in these ways: 1) An explosive blast, which is similar to a conventional chemical explosive blast, but which has vastly different effects upon the physical environment because it is so much more powerful; 2) Direct nuclear radiation, which occurs immediately at the time of explosion; 3) Residual radiation, which results from the creation of airborne radioactive particles which later fall back to the earth's surface; 4) Thermal radiation, which consists of an intense flash of visible and invisible light; and 5) An electromagnetic pulse which is a very intense wave of electrical and magnetic energy. These are the known by-products of a nuclear explosion.

Our knowledge of the local primary effects of nuclear bombs, based on both the physical principles that made their construction possible and on experience gathered from the bombings of Hiroshima and Nagasaki, and from testing, is quite solid. Nevertheless, it may be that our knowledge even of the primary effects is incomplete, since, during our test program, new effects continually were discovered. One example is the electromagnetic pulse, whose importance was not recognized until around 1960 (Shell, 1982:21). Thus, the list above could be incomplete. However, this should not negate or lessen the importance of the known primary effects. These now will be examined in more detail.

Exolosive Blast

According to the OTA (1980), most damage to cities from large weapons comes from the explosive blast. The blast drives air away from the explosion site, producing static overpressure (sudden changes in air pressure that can crush hollow objects), and dynamic pressure (high winds that can move hollow objects suddenly or knock them down).

In general, large buildings are destroyed by overpressure, while people and objects, such as trees and utility poles, are destroyed by the dynamic pressure.

Strength of the blast effect, generally measured in pounds per square inch (psi), decreases with distance from the center of the explosion. It also is related to height of the burst above ground level. A burst on the surface produces the greatest overpressure at very close ranges. Raising the height of the burst widens the area at which a given smaller overpressure is produced.

It seems then that the effects of height on overpressure are similar to effects of distance on traveling artificial light. For example, a flashlight held close to an object intensely illuminates a small portion of that object. This is similar to overpressure characteristics of a surface burst. Holding the flashlight at a distance of several feet produces a weaker illumination of a wider area which is characteristic of a high altitude burst. Thus,

> . . . an attack on factories with a one-megaton weapon might use an air burst at an altitude of 8,000 feet which would maximize the area (about 28 square miles [7,200 hectacres]) that would receive 10 psi or more overpressure (OTA, 1980:17).

Table III reveals the relationship between distance from ground zero and the strength of blast effects of such a detonation.

Direct Nuclear Radiation

Direct radiation is that occurring at time of

TABLE III

BLAST EFFECTS OF A ONE-MEGATON EXPLOSION 8,000 FEET ABOVE THE EARTH'S SURFACE

Distance from Ground Zero (stat. miles)	Distance from Ground Zero (kilo-meters)	Peak Over-pressure (psi)	Peak Wind Velocity (mph)	Typical Blast Effects
.8	1.3	20	470	Reinforced concrete structures are leveled.
3.0	4.8	10	290	Most factories and commercial buildings are collapsed. Small wood-frame and brick residences destroyed and distributed as debris.
4.4	7.0	5	150	Lightly constructed commercial buildings and typical residences are destroyed; heavier construction is severely damaged.
5.9	9.5	3	95	Walls of typical steel-frame buildings are blown away; severe damage to residences. Winds sufficient to kill people in the open.
11.6	18.6	1	35	Damage to structures; people endangered by flying glass and debris.

Source: The Effects of Nuclear War, OTA (1980:18) explosion. This is radiation ". . . emitted from both the fireball and the radioactive cloud within the first minute after the explosion" (Glasstone and Dolan, 1977:42). This "initial burst of neutrons and gamma rays would be lethal in the immediate vicinity of the explosion . . ." (Ground Zero, 1982:39). However, it would be of little real hazard to life if it results from a large nuclear detonation because its range is extremely limited.

> For explosions of moderate and large energy yields, thermal radiation can have harmful consequences at appreciably greater distances than can initial nuclear radiation. Beyond about 1 1/4 miles, the initial nuclear radiation from a 20 kiloton air blast, for instance, would not cause observable injury even without protective shielding. However, exposure to thermal radiation at this distance could produce serious skin burns. On the other hand, when the energy of the nuclear explosion is relatively small, e.g. a few kilotons, the initial nuclear radiation has the greater effective range (Glasstone and Dolan, 1977:325).

Thus, for nuclear detonations in the megaton class, direct nuclear radiation would be of importance, only in that it could make the immediate vicinity of the explosion uninhabitable for a period. People positioned close enough to the detonation to be harmed would be killed by other products of a nuclear explosion such as the blast wave or the thermal pulse.

<u>Residual Radiation (Fallout)</u>

Residual radiation is defined as that radiation produced by a nuclear explosion emitted one minute after explosion. Any nuclear explosion in the atmosphere produces some fallout, however, the fallout is much greater if the detonation is on the surface, or at least low enough so the fireball touches the ground.

> When a nuclear explosion occurs in contact with the ground, the fireball and blast pick up many tons of dirt and carry them up into the radioactive cloud. These dirt particles become covered with molten droplets of radioactive material. When the turmoil of the explosion quiets down, these radioactive grains begin to fall back to the ground. This is the 'fallout' (Clayton, 1980:27).

The extent and nature of the fallout can range between wide extremes. The actual situation is determined by a combination of circumstances associated with the energy yield and design of the weapon, the height of the explosion, the nature of the surface beneath the point of the burst, and the meteorlogical conditions (Glasstone and Dolan, 1977:36). Weapon design and yield are important because they will determine how much fissionable material will be available for formation of fallout (it is usually only the fission portion of the bomb that produces fallout) and in part how wide an area will be covered by fallout. For example:

> A 1-megaton 100 percent fission bomb will produce the same amount of fallout as a 2-megaton weapon using 50 percent fission and 50 percent fusion. Although the total amount of fallout is the same, the 2-megaton bomb may produce less severe exposure on the ground because of the greater size of the cloud will spread the fallout more thinly over a larger area (Clayton, 1980:29).

"The speed of the wind which carries the dissipating mushroom cloud away from the target is very important to distribution of the fallout" (Clayton, 1980:30). In general, the higher the wind velocity, the larger the area covered by fallout which usually will be cigar shaped. However, as the area covered by fallout increases, the amount of fallout decreases.

Fallout can be broken into two types: early or local fallout and delayed or worldwide fallout. Early fallout is defined as that which falls back to the earth's surface within 24 hours of the detonation. Delayed fallout is that which falls to the earth after 24 hours, although it may take months or years. Primary determinant as to what radioactive debris will be early or delayed seems to be size of the particle.

> The sizes of these particles range from that of fine sand, i.e., approximately 100 micrometers in diameter, or smaller, in the more distant portion of the fallout area, to pieces about the size of a marble, i.e., roughly 1 cm (0.4 inch) in diameter, and even larger close to the burst point (Glasstone and Dolan, 1977:37).

Thermal Radiation

> In an ordinary air burst, i.e., at altitudes up to some 100,000 feet, roughly 35 to 45 percent of the total energy yield of the explosion is emitted as effective thermal radiation (Glasstone and Dolan, 1977:277).

The thermal pulse or radiation is nothing more than a flash of light. However, this light is so intense, it can burn flesh and start fires. Thermal radiation has an effective range just as the blast wave. This is due to attenuation of radiation or pulse by the atmosphere. This is due to two major causes: absorption and scattering. Absorption takes place as atoms and molecules in the air absorb, and thus remove, a portion (particularly shorter wavelengths) of thermal radiation. Scattering takes place as molecules in the atmosphere such as oxygen and nitrogen divert waves of all lengths from their original paths in a random manner (Glasstone and Dolan, 1977:278).

Weather conditions also can affect the strength of the thermal pulse. For example, if an air burst takes place above a layer of dense fog, smoke or cloud, a large portion of the pulse will be reflected upward into the atmosphere.

Because this by-product of a nuclear explosion comprises light, it travels at approximately the speed of light and it will be the first effect of a nuclear detonation experienced, as it precedes the blast wave by several seconds. Moreover, because it is intensely hot, it is one of the more physically destructive consequences of a nuclear explosion. The maximum radii of thermal effects are shown on Table IV.

Electromagnetic Pulse

All types of nuclear explosions, from underground to high altitude bursts, produce an electromagnetic pulse (EMP). In a sense, EMP radiations are similar to radiowaves, but their strength can be millions of times greater than ordinary radiowaves. As the electromagnetic pulse

TABLE IV

MAXIMUM RADII OF THERMAL EFFECTS

Thermal Effect	Radius in Miles 1-megaton	10-megaton
Retinal spot burns	200.0+	200.0+
Visible charring to some paper and cloth	11.0	30.0
Ignition of dry leaves	11.0	26.0
1st degree skin burns	11.0	25.0
Ignition of inky parts of dry newspaper	11.0	22.0
2nd degree skin burns	10.0	22.0
Ignition of dry grass	9.3	23.0
Visible charring of unpainted wood	8.4	20.0
Ignition of light blue cotton bedspread	8.2	20.0
3rd degree skin burns	8.0	19.0
Ignition of old dry pine needles	7.0	16.0
Ignition of cotton venetian blind tape	6.5	16.0
Ignition of brown cardboard box	6.2	13.0
Ignition of khaki cotton shirt	6.0	15.0
Ignition of new blue denim	5.4	15.0
Ignition of new white typing paper	5.3	11.0

Source: Life After Doomsday, Clayton (1980:26) travels through the atmosphere or ground, it can be picked up by metallic objects or other conductors. The EMP then can be converted into strong electrical currents of high voltages and electrical or electronic equipment attached to these conductors can suffer severe damage when they receive this high surge of electrical current.

Typical collectors of EMP energy are:

1. Long runs of cable, piping or conduit,

2. Large antennas, antenna feed cables, guy wires, antenna support towers,

3. Overhead power and telephone lines and support towers,

4. Long runs of electrical wiring, conduit, etc., in buildings,

5. Metallic structural components (girders), reinforcing bars, corrugated roof, expanded metal lath, metallic fencing,

6. Railroad tracks,

7. Aluminum aircraft bodies.

The strength and effective range of the EMP are strongly related to weapon yield and the altitude at which it is detonated. It seems the strongest electromagnetic pulses are produced by nuclear detonations on the ground and at high altitudes. EMP produced by a ground burst are the strongest, but limited in range, while detonations at high altitudes are weaker but still strong enough to cause damage to electrical equipment.

> For a nuclear explosion at an altitude of 50 miles, for example, the affected area on the ground would have a radius of roughly 600 miles and for an altitude of 100 miles the ground radius would be about 900 miles. For an explosion at 200 miles above the center of the (conterminous) United States, almost the whole country, as well as parts of Canada and Mexico, could be affected by the EMP (Glasstone and Dolan, 1977:519).

Because the electromagnetic pulse travels at the speed of light, this whole area would be affected simultaneously.

Glasstone and Dolan (1977) suggest that electric power systems, television and radio stations and, to a lesser extent, telephone systems, are vulnerable to the electromagnetic pulse. These electrical systems have been designed so as to be protected from natural sources of electrical surge such as lightning. However, the rise in voltage from an EMP typically is a hundred times faster. "This means that most equipment designed to protect electrical facilities from lightning works too slowly to be effective against EMP" (OTA, 1980:22).

Biological Effects of Nuclear Attack

In addition to the physical damage resulting from a nuclear detonation, biological effects also can be expected. With the exception of electromagnetic pulse which poses no threat to human life, the other three by-products of a nuclear explosion (blast, thermal radiation, and nuclear radiation) can cause death and injury to individuals exposed to them.

Blast Injuries

Injuries from a nuclear blast wave are direct and indirect. Direct blast injuries are caused by the overpressure of the blast wave which increases air pressure. Indirect injuries are caused by missiles and debris as well as by displacement of the body (throwing the body through air until it impacts with a physical object). These same types of injuries are produced by conventional weaponry. However, nuclear weapons are more effective at producing direct injuries because ". . . the human body is sensitive to the duration of the pressure pulse and this is relatively long in a nuclear explosion unless the yield is much less than one kiloton" (Glasstone and Dolan, 1977:541). As a person is engulfed by overpressure . . .

> the sudden compression of the body and the inward motion of the thoracic and abdominal walls cause rapid pressure oscillations to occur in the air containing organs. These effects, together with the transmission of the shock wave through the body, produce damage mainly at the junctions of tissues with air-containing organs and at areas between tissues of different density. . . . The chief consequences are hemorrhage and occasional rupture of abdominal and thoracic walls (Glasstone and Dolan, 1977:548).

Table V summarizes tentative criteria for direct blast effects in man from fast-rising, long-duration pressure pulses.

> For the most part, blast kills people by indirect means rather than by direct pressure. While a human body can withstand up to 30 psi of simple overpressure, winds associated with as little as 2 to 3 psi could be expected to blow people out of typical office buildings. Most blast deaths

TABLE V

TENTATIVE CRITERIA FOR DIRECT (PRIMARY) BLAST EFFECTS ON MAN FROM FAST-RISING, LONG-DURATION* PRESSURE PULSES

Effect	Effective Peak Pressure (psi)
Lung Damage:	
Threshhold	12 (8-15)
Severe	25 (20-30)
Lethality:	
Threshhold	40 (30-50)
50 percent	62 (50-75)
100 percent	92 (75-115)
Eardrum Rupture:	
Threshhold	5
50 percent	15-20 (> 20 years old) 30-35 (< 20 years old)

*Long-duration, 0.1 second or more

Source: The Effects of Nuclear Weapons, Glasstone and Dolan (1977:552)

> result from the collapse of occupied buildings, from people being blown into objects, or from buildings or small objects being blown onto or into people (OTA, 1980:18-19).

Burn Injuries

Thermal radiation causes burns on humans in three ways: directly by burning exposed skin, indirectly by heating or igniting cloth covering the skin, or by causing combustion of flammable materials. Burns from direct absorption by the skin of thermal radiation are termed flash-burns while burns caused indirectly by the heating of other materials are called contact or flame burns. The latter

> . . . are identical with skin burns that result from touching a hot object or those that would accompany (or be caused by) any large fire no matter what its orgin" (Glasstone and Dolan, 1977:560).

Burns resulting directly or indirectly from a thermal pulse, as well as other sources of heat, are classified into three categories which indicate severity of the burn as - first-, second-, and third-degree. The type of burn depends upon the amount and duration of increase in skin temperature.

The yield of the weapon seems to be another important determiner of burn severity. "The thermal flash from small (kiloton-class) weapons is actually more dangerous than that from megaton weapons" (Clayton, 1980:25). This is because the flash of light from those weapons of smaller yield is emitted over a much shorter period. The kiloton-class bomb dropped on Hiroshima, which caused some severe flashburns, emitted its thermal radiation in less than a third of a second. Megaton weapons, in contrast, release their thermal radiation between five to twenty seconds. This longer time makes the thermal pulse safer for two reasons. First, skin can absorb more heat without damage if it does so over a longer period, because blood circulation will carry the heat to other parts of the body. Second, a person will have time to react so as to protect himself. The initial pain from heat will drive the person to seek cover and, thus, not be exposed to the total thermal pulse. In Hiroshima, victims were burned before they realized what was happening (Clayton, 1980:25).

Also, distance from ground zero is an important determinant of severity of burns. For example, a person exposed to the thermal pulse of a one-megaton weapon will not be burned if he is at least 11 miles from ground zero. First-, second-, and third-degree burns occur at approximately 10, 8.25, and 7 miles, respectively.

Nuclear Radiation Injuries

Unlike the blast wave and thermal pulse, which are present in both nuclear and conventional (chemical) explosions, nuclear radiation, as a cause of injuries, is present only when nuclear weapons are utilized.

According to Glasstone and Dolan

> The harmful effects of nuclear radiation appear to be caused by the ionization (and excitation) produced in the cells composing living tissue. As a result of ionization, some of the constituents, which are essential to the normal functioning of the cells, are altered or destroyed. In addition, the products formed may act as poisons. Among the observed consequences of the action of ionizing radiations on cells are breaking of the chromosomes, swelling of the nucleus and the entire cell, increase in viscosity of the cell fluid, increased permeability of the cell membrane, and destruction of cells. In addition, the process of cell division (or mitosis) is delayed by exposure to radiation. Frequently, the cells are unable to undergo mitosis, so that the normal cell replacement occurring in the living organism is inhibited (1977:575).

Nuclear radiation is measured in various ways which indicate the simple presence of radioactivity, the amount absorbed, or the biological damage incurred. A roentgen is defined as a measure of how much radiation is present. A rad is a measure of radiation absorbed by the body. A rem is a measure of biological damage. According to Clayton (1980) and the OTA (1980) study, these various measuring units may be assumed equal.

> These terms are complex, and substantial 'fudge factors' are involved in converting one unit to another, depending on the energy of the radiation, the type of living tissue exposed, and the species of animal involved. Fortunately, for humans exposed to gamma rays from fallout, the three units are approximately the same. In the civil defense context they are treated as essentially interchangeable (OTA, 1980:19).

Thus, ". . . it may be assumed that 100 roentgens produces 100 rads and 100 rems" (OTA, 1980:19).

One should take into account two variables - duration and extent - when determining seriousness of exposure to radiation. This is important for nuclear and thermal radiation. Thus, the longer the duration of exposure, the less serious the damage. Exposure to 50 rems for 24 hours (acute) is much more dangerous than the same exposure spread over a period of years (chronic). If the dose is not too large, the body can achieve some recovery. Extent of exposure also seems to affect chances of recovery. It is thought that, if only portions of the body are exposed and injured, the uninjured parts may be able to aid recovery. If the whole body is exposed, many organs are effected and recovery is much more unlikely. According to Glasstone and Dolan (1977:579), Table VI is the "best available summary of the effects of various whole-body dose ranges of ionizing radiation on human beings."

Ecological Effects of Nuclear Attack

Possibly, the large-scale detonation of nuclear weapons could produce serious negative ecological consequences. Among these are: a degeneration of the protective ozone layer in the atmosphere and extinction of many plant and animal species, due to long-term exposure to nuclear radiation and ultraviolet light. Final result of such ecological consequences would be transformation of the earth into a hostile environment unfit to support many types of life. For example, Schell (1982) suggests that the earth may be a fit habitat only for some species of grass and insects.

Probability of this situation coming to pass in the aftermath of a nuclear war is unknown, since this is an

TABLE VI

SUMMARY OF CLINICAL EFFECTS OF ACUTE IONIZING RADIATION DOSES

Range	0 to 100 rems Subclinical range	100 to 1,000 rems Therapeutic range			Over 1,000 rems Lethal range	
		100 to 200 rems	200 to 600 rems	600 to 1,000 rems	1,000 to 5,000 rems	Over 5,000 rems
		Clinical surveillance	Therapy effective	Therapy promising	Therapy palliative	
Incidence of vomiting	None	100 rems: infrequent 200 rems: common	300 rems: 100%	100%	100%	
Initial Phase Onset Duration	 — —	 3 to 6 hours ≤ 1 day	 ½ to 6 hours 1 to 2 days	 ¼ to ½ hour ≤ 2 days	 5 to 30 minutes ≤ 1 day	 Almost immediately**
Latent Phase Onset Duration	 — —	 ≤ 1 day ≤ 2 weeks	 1 to 2 days 1 to 4 weeks	 ≤ 2 days 5 to 10 days	 ≤ 1 day* 0 th 7 days*	 Almost immediately**
Final Phase Onset Duration	 — —	 10 to 14 days 4 weeks	 1 to 4 weeks 1 to 8 weeks	 5 to 10 days 1 to 4 weeks	 0 to 10 days 2 to 10 days	 Almost immediately**
Leading organ	Hematopoietic tissue				Gastrointestinal tract	Central nervous system
Characteristic signs	None below 50 rems	Moderate leukopenia	Severe leukopenia, purpura, hemorrhage; infection Epilation above 300 rems.		Diarrhea; fever; disturbance of electrolyte balance	Convulsions, tremor; ataxia, lethargy
Critical period post-exposure	—	—	1 to 6 weeks		2 to 14 days	1 to 48 hours
Therapy	Reassurance	Reassurance, hematologic surveillance	Blood transfusion; antibiotics	Consider bone marrow transplantation	Maintenance of electrolyte balance	Sedatives
Prognosis	Excellent	Excellent	Guarded	Guarded	Hopeless	
Convalescent period Incidence of death	None None	Several weeks None	1 to 12 months 0 to 90%	Long 90 to 100%	— 100%	
Death occurs within	—	—	2 to 12 weeks	1 to 6 weeks	2 to 14 days	< 1 day to 2 days
Cause of death	—	—	Hemorrhage, infection		Circulatory collapse	Respiratory failure, brain edema

*At the higher doses within this range there may be no latent phase

**Initial phase merges into final phase, death usually occurring from a few hours to about 2 days, this chronology is possibly interrupted by a very short latent phase

Source: The Effects of Nuclear Weapons, Glasstone and Dolan (1977:580) unprecedented event. But in such a situation, immediate physical and biological consequences of nuclear detonations discussed above would be of no substantive importance. Destructive effects of the blast wave, thermal pulse and nuclear radiation would be purely academic.

Another possible ecological consequence is sugested in a study by Ehrlich et al. (1984) which points out the likelihood of the development of what is termed "nuclear winter" or the cooling of the earth's surface brought about by large amounts of dust and smoke which would be injected into the atmosphere as a result of a large number of nuclear detonations. It is predicted that

> temperatures would be reduced drastically, even in summer, to levels well below freezing; most daylight would be cut off; these conditions could last for several months . . . (Ehrlich et al., 1984:XIV).

While this situation would not necessarily lead to the death of mankind, as is predicted above as a consequence of the depletion of the ozone layer, it would certainly make living conditions difficult and food production impossible, for a significant period of time, and would thus have an important influence upon postattack social organization.

CHAPTER II

REVIEW OF PAST RESEARCH ON NUCLEAR ATTACKS

The foregoing discussion of physical and biological effects of nuclear detonations does not constitute a complete discussion of a nuclear explosion's parameters of impact. If it did, a nuclear war would really be no different from conventional war. After all, with conventional weapons, man has the ability to destroy large urban areas. For example, the Axis bombing of Coventry and the Allied bombing of Dresden virtually destroyed these urban centers.

Unfortunately, there is a difference between nuclear and conventional war. According to Mills

> Once upon a time - perhaps as late as World War II - 'war and peace' was a reasonable choice. The cost of a war could be balanced against its possible results. The total war of absolute weapons has ended the reasonableness of this choice (1958:2).

Mills (1958:4) further states that, because of this difference, "we are at the very end of the military road. It leads nowhere but to death. With war, all nations will fall . . . War has become total. And war has become absurd." This absurdity, is the result of two radical differences between conventional and nuclear war - timing and scope (Katz, 1982:197). Timing refers to length of time it takes to wage war. Total wars, fought with conventional weapons, characteristically have lasted for months or years and have required herculean effort from participating nations. In contrast, a nuclear war's duration could be measured in minutes. This has lead the authors of one hypothetical account of the postnuclear war world to entitle their book, Warday. This shortened time span required for destruction could have serious consequences. The long duration of World War II probably did much to exacerbate many social and economic problems, such as rates of juvenile delinquency and food shortages. However, time required to achieve military goals also allowed the civilian population a chance to acclimate itself to war and its resultant destruction and to reestablish some semblance of normalacy. In nuclear war, as noted, destructive effects will occur much more rapidly.

> In the absence of an adaptive period, the strains imposed on political, social, and economic institutions and mechanisms are likely to be even harsher than those confronted incrementally in World War II. The possible consequences of these enormous stresses would retard seriously an adequate national response to postattack conditions for periods of up to several years, while individuals and society readjust to dramatically changed circumstances (Katz, 1982:199).

Furthermore, the scope of destruction of a nuclear attack, in comparison to conventional warfare, could be incredible. According to Schell. . .

> without serious distortion . . . we can begin by imagining that we would be dealing with ten thousand weapons of one-megaton each, although in fact the yields would of course, vary considerably (1982:55).

If 2,000 of these warheads were directed at military installations, that would leave 8,000 remaining warheads. This would be enough to hit every city in the United States from the largest to those with populations as small as 1,500 people with a megaton bomb.

> Ten thousand targets would include everything worth hitting in the country and much more; it would simply be the United States (Schell, 1982:55-56).

As a result, those areas attacked could not count on aid from areas not directly attacked. Consequences of such a situation for recovery would be most serious. In Hiroshima, electricity, train, streetcar and telephone service were restored within ten days after the atomic bomb was dropped. This rapid recovery was possible, for the most part, by the fact the attack was isolated and, as a result, human and material resources for recovery were obtained from other urban areas.

Scale of destruction, and the speed with which it can be accomplished, enlighten us as to the true consequential parameters of nuclear war. These include not only physical destruction and death of large numbers of individuals, but also severe disruption of a nation's social organization and possible extinction of human society at the national level. Thus,

> to understand fully the consequences of nuclear war for society it is necessary to examine some of the possible effects of nuclear war on the complex relationships among the economic, social, and political elements that define a modern industrial state (Katz, 1982:11).

Past research on effects of nuclear weapons and nuclear war characteristically has not concerned itself with social impacts of such an event (except in the short-term) by calculating the quantities of resources destroyed and the number of people killed and injured. Furthermore, usual emphasis of those studies that examine possible societal conditions after a nuclear war characteristically examine quality of life for survivors and generally ignore possible human responses to such conditions. Those that do examine human responses usually do so from a psychological framework.

Limited Nuclear Attacks

Few studies present information concerning the consequences of real or hypothetical nuclear attacks on particular metropolital areas. Hersey (1946) provides a picture of the after-effects of the atomic bombing of Hiroshima from the vantage point of six individuals who actually experienced this event. They describe the death and suffering following the bomb-blast wave, thermal pulse and radiation. For example, "in a city of two hundred and forty thousand, nearly a hundred thousand people had been killed or doomed at one blow; a hundred thousand more were hurt" (Hersey, 1946:35). Most importantly, the medical personnel within the city almost were exterminated. Of 150 doctors in the city, 65 were killed and the majority of the others were wounded. Also, of the 1,780 nurses, 1,654 were killed or wounded too badly to perform their duties (Hersey, 1946:33). As a result, medical attention was almost nonexistent at first. The excessive destruction also apparently affected the victims psychologically in that "those who were still capable of action often acted in an absurd or an insane way" (Schell, 1982:43).

The destructive effects of a hypothetical nuclear attack on Detroit and Leningrad were examined by the Office of Technology Assessment (OTA, 1980). This study concentrated mainly on the physical damage from the four by-products of a single or multiple nuclear detonation. The social impacts of an attack were examined only for Detroit. Medical care would be quite problematic. For example, hospital bedspace would be available for only one percent of the number of injured, largely because 70 percent of available medical facilities was calculated to have been destroyed. There was also expected to be a complete loss of utilities (electricity and gas) and a corresponding loss of water as the "loss of electric power to the pumps and the breaking of many service connections to destroyed buildings immediately will cause loss of all water pressure (OTA, 1980:33). Transportation also is expected to be problematic, as debris will clutter much of the urban street system. Thus, transportation may not be restored for weeks or months. In addition, communications would be nonexistent due to damage from electromagnetic pulse. The OTA (1980) study thus implies that Detroit would become an area in which survival would be quite problematic. It is estimated that outside assistance to the damaged area would be essential for recovery.

As noted, however, probable scope of destruction would prevent such a development. Schell (1982:46) states that ". . . the immediate devastation caused by today's bombs would be similar to the devastation in these cities [Hiroshima and Nagasaki]." Immediate physical destruction might be similar. However, the long-range effects, assuming a large-scale nuclear conflict, would be another matter. Destruction of Hiroshima and Nagasaki were isolated incidents. These cities secured outside assistance. In event of a 'total war', nuclear holocaust, no outside help would be forthcoming. Loss of life, thus, would be much greater and the individual and societal disorientation would be greater.

Thus, previous studies of attacks on single urban areas underestimate the true extent of damage and societal disruption. To gain a better understanding of the full consequences of a nuclear attack for individual areas or nations as a whole, it is necessary to examine, effects of large-scale nuclear attack.

Large-Scale Nuclear Attacks

Several studies, Heer (1965), OTA (1980), Katz (1982), and the World Health Organization (WHO, 1984), have addressed the effects of large-scale nuclear attacks.

However, they focus on differing consequences of such an event. Heer (1965) examines the influence of a nuclear attack on demographic variables. The WHO (1984) study examines consequences of a nuclear attack on health and medical care. The OTA (1980) and Katz (1982) both examine the effects of a large nuclear attack on the United States' society from a more holistic perspective, examining the possible social, economic, political and medical effects.

In addition to the differing foci of these studies, they differ in assumptions about size and type of attack. These differences have an important effect on numbers of casualties resulting from such an event. The OTA (1980) study, assumes a Soviet attack utilizing 'thousands of warheads' with primary targets being military and economic centers of activity. Based on various assumptions such as size of the attack, protective actions by people, and proportion of air to surface bursts it was estimated that fatalities would range from a high of 155 to 165 million, to a low of 20 to 55 million. However, it is emphasized these figures represent what usually is thought of as prompt fatalities (those occurring within 20 days following the attack). As a result, they are lower than the total resultant fatality levels.

The WHO (1984) study presents a scenario of global nuclear war. In its scenario, it is assumed that 10,000 megatons of nuclear weapons are detonated with 90 percent of explosions taking place over Europe, Asia, and North

America. The remaining 10 percent are exploded over Africa, Latin America, and Oceania. Half the weapons are surface bursts and half airbursts. The airbursts are targeted at population centers greater than 60,000. According to this study, such a war would result in 1.2 billion people killed and 1.1 billion injured. In total, approximately one-half the world's population would be immediate casualties.

Katz (1982) assumes a Soviet attack against military and industrial targets, with 500 one-megaton bombs directed against the 71 largest urban areas in the United States and an additional 200 to 300 one-hundred-kiloton weapons directed at 50 smaller urban centers. Casualties in this attack are predicted to range from 70 to 90 million people, with 20 to 30 million being injured in a moderate to severe manner. Altogether, it is predicted that about 35 to 45 percent of the population of the United States directly would be affected.

Heer (1965) examines effects of a nationwide nuclear attack directed at military targets and 71 of the major population and industrial centers in the United States which involves the use of 1,466 megatons. Heer estimates approximately 30 percent of the population would not survive. However, as with the OTA (1980) study, Heer's (1965) estimate of the casualty level probably is somewhat conservative. His estimate is based on number of people killed immediately. Many more deaths, in fact, could be expected because of disruptive effects of nuclear attack on medical facilities.

Impacts on Medical Care and Health

Within the first few hours following the attack, the situation could be described as chaotic. The OTA (1980) study predicts the first most pressing problem for survivors would be caring for the wounded. This would be next to impossible. First, rescuers would be faced with severe logistical problems.

> Rescuing and treating the injured will have to be done against insurmountable odds. Fire and rescue vehicles and equipment not destroyed will find it impossible to move about in any direction. Fires will be raging, water mains will be flooding, powerlines will be down, bridges will be gone, freeway overpasses will be collasped, and debris will be everywhere. People will be buried under heavy debris and structures, and without proper equipment capable of lifting such loads, the injured cannot be reached and will not survive (OTA, 1980:95).

Second, the loss of human and material resources would preclude any effective medical attention. Most medical facilities and supplies in downtown areas would be destroyed. The WHO study gives some indication of the impact of damage to facilities, using Boston as a hypothetical target area:

> Boston has some 13,000 hospital beds, but they are in the urban target area and 38 of the 48 acute care hospitals would be destroyed or badly damaged, so only about 2,000 beds would be left for the injured. The whole infrastructure required for dealing with serious injuries - operating rooms, nurses, blood, antibiotics, drugs, water supplies, electricity, telephones,

> heating, transport services - would be in disarray (1984:24).

In addition, many types of injuries received in a nuclear war would be impossible to treat adequately. For example, of the nation's 6,000 hospitals, less than 100 have burn centers. "Two hundred severe burn cases would saturate existing facilities" (Katz, 1982:173). However, few, if any, of these facilities would survive nuclear attacks on urban areas. Also, while individuals who have been exposed to 300 rems of radioactivity can be successfully treated with bone marrow transplants, the likelihood of survival of sophisticated medical facilities needed is doubtful. Treatment of almost any kind of injury will be problematic as the pharmaceutical industry is viewed as a critical industry and is specifically targeted for destruction (Katz, 1982).

In the United States, 57 percent of the hospital beds and 71 percent of the physicians are located in larger urban areas (Katz, 1982). Thus, not only will lack of facilities be problematic but the situation will be further complicated by a shortage of medical personnel. As a result, the doctor-patient ratio will change drastically due to the lowered number of physicans and to increased number of patients. The WHO study, again using a hypothetical attack on Boston for illustration, states that:

> A 1-MT bomb airburst over Boston would cause about 700,000 immediate deaths and a similiar number of injuries, i.e., 50 percent of the population would be killed or injured

> initially. If 50 percent of the 5,200 physicians in Boston survived to treat the 700,000 injured, the absurd calculation would be made that it would take physicians more than 4 days to do so, working for 16 hours a day and devoting 15 minutes to each patient (1984:24).

The WHO (1984) study gives some indication of the inadequacy of the Boston area medical personnel and facilities to treat the wounded when they state that even if the rest of the United States was untouched by nuclear weapons, the medical facilities existing nationwide would be insufficient to treat the casualties in the Boston area alone. In short, most of those needing immediate medical care would receive none and those given attention would receive nothing better than first aid. "Even with resources existing in normal or optimal conditions, the health services would be inadequate to deal with the casualties from a nuclear war" (WHO, 1984:26).

In addition to the problematic nature of medical care for the injured, a nationwide nuclear attack would create many postattack health problems (WHO, 1984). The short-term impacts of a nuclear war would be increased health problems not only for those injured in the attack, but for the uninjured. First, water and food supplies would be critical. The normal supply of water in cities would be interrupted. Fresh foods also would be contaminated, with the only safe food supply being canned or stored in such a way as to prevent contamination. Second, sanitation problems would arise in densely populated areas such as refugee camps. This problem particularly would be serious in crowded shelters with people existing inside for weeks or months. Third, infection would be a serious problem because of lack of medical care and lower resistance to infection and disease caused by exposure to radiation. Finally, as in Hiroshima and Nagasaki, possible mass psychological problems could develop such as anxiety about the possibilities of contracting cancer or of having children with genetic defects.

According to the WHO (1984) study, the long-term impacts of a nuclear war probably are more difficult to predict but they probably would be just as deterimental to the health of survivors as would be the short-term effects. The long-term effects would include continued disruption of social and economic structure and the development of a long-term rise in the incidence of cancer and genetic effects.

The social and economic changes are predicted to be radical in nature. In short, it is predicted that the modern industrial nation-state will cease to exist. Since industrial sites, sources of raw resources, energy supplies, modern means of communication and transportation, and skilled workers would all be casualties, "there would be a reversion from the present world economy to a more primitive economy, survivors existing at a mere subsistence level" (WHO, 1984:29). Monetary systems would collapse and barter probably would come to characterize future commerce.

Furthermore, the destruction of institutions and skilled workers, which are repositories of knowledge necessary to rebuild technologically and economically, would delay or prohibit such a recovery. The lack of a centralized governing body would result in complete social and political disorganization.

Deteriorations in the social and economic spheres of those societies attacked are expected to prohibit efforts to improve, on a large scale, any of the health hazards reulting from the war. For example, shortages of food, especially in regions which were more industrial than agricultural, would continue unabated due to the destruction of the means of transportation and uncontrolled growth of insect populations. Without organized efforts to decontaminate and clean up areas of human habitation, adequate water supplies would become problematic as, "water supplies would be contaminated not only by radioactivity, but by pathogenic bacteria and viruses" (WHO, 1984:28). Furthermore, presence of uncountable rotting human and animal corpses and mounds of untreated waste and sewage could produce disease of epidemic proportions.

In summary, the OTA (1980), Katz (1982) and the WHO (1984) studies suggest that the nuclear destruction of material and human resources will lead to an inability by the United States society or any other society so attacked to give medical aid to the injured or to eradicate serious health hazards in the postattack world. This destruction of material and human resources also would effect other components of a modern industrial society such as industrial and agricultural production.

Industrial and Agricultural Production

Assuming a large attack, it is not clear that economic recovery would be possible. According to the OTA

> In effect the country would enter a race, with economic viability as the prize. The country would try to restore production to the point where consumption of stocks and the wearing out of surviving goods and tools was matched by new production. If this was achieved before, stocks ran out, then viability would be attained otherwise, consumption would necessarily sink to the level of new production and in so doing would probably depress production further, creating a downward spiral. At some point this spiral would stop, but by the time it did so the United States might have returned to the economic equivalent of the middle ages (1980:99).

Recovery would depend on survival of sufficient production facilities and resources as well as a sufficient number of people with the technical skills to restart production. Katz (1982), in a discussion of the economic impacts of a nuclear war, explains why this would be problematic. His discussion concentrates on food and energy supplies.

Food Production

The availability of food involves several factors: production, distribution, and processing. Food production would suffer from lack of fertilizers, pesticides, and irrigation. These three requirements of production are heavily dependent on petroleum. Fertilizers and pesticides are petroleum-based, while irrigation would be impossible without petroleum based forms of energy. An additional food production requirement would be petroleum and electricity needs for the operation of farm machinery. "Farms require about 4 to 5 percent of all oil refinery production, but total U.S. postattack production would be 2 to 3 percent of normal" (Katz, 1982:153).

An additional problem concerning availability of food will develop because various regions of the United States, such as the Northeast and Mid-Atlantic states, depend heavily on food supplies shipped from areas west of the Mississippi River. Nuclear attack would seriously disrupt the food distribution and processing system within the United States in two ways: damage to physical resources (means of transportaion, routes of transportation, and fossil fuel production) and damage to organizational resources (technical and managerial personnel). This problem would be magnified, by the fact that retail and warehouse inventories contain two or three weeks' supply of goods at maximum.

Energy

Industrial production also is heavily dependent on energy intensive fuel sources. The United States relies on fossil fuel (petroleum, gas and coal) for approximately 93 percent of its energy requirements. Petroleum is the most used energy source, satisfying 49 percent of energy needs, while gas and coal provide 26 and 18 percent, respectively. The hypothetical attack would destroy 98 percent of the petroleum refining capacity of the United States. "The vulnerability of refining capacity is emphasized by the fact that . . . two-thirds of the U.S. capacity could be destroyed by eighty weapons" (Katz, 1982:161). Destruction of refining capacity would pose the most serious problem the United States would face in attempts to develop short-term stability and long-term recovery, as only 10 percent of petroleum needs are met by refineries outside the U.S.

Coal is the most abundant fossil fuel resource in the United States. It could be substituted for petroleum as an energy source in some instances. In fact, it now produces 45 percent of the electricity generated in the United States. However. mining of coal requires substantial quantities of petroleum fuels and electricity and, as the foregoing discussion indicates, petroleum will be in short supply in the postattack period. As a result, mining and transportation of coal will be problematic and will probably prohibit its use as a petroleum fuel substitute for quite some time.

Another energy source, natural gas, is transported completely by pipeline, and an attack on these supply lines virtually would eliminate it as a fuel source.

Physical damage to electrical generating plants probably would be substantial. Since most generating plants have a three-to-six-month supply of fuel, power may be available in areas, assuming availability of skilled operators and maintenance personnel. However, it may not be possible to utilize available electricity in urban areas due to destruction of powerlines and damage to the electrical system of the United States, which utilizes computers to distribute electricity. Computers are susceptible to electromagnetic pulse produced by nuclear detonations.

It should be obvious from the foregoing that industrial capability of the United States is extremely vulnerable to nuclear attack. This is so because of the complex, interdependent relationships between differing industries in a modern industrial nation. As a result

> . . . selective attacks against key industrial targets are especially potent since they can bottleneck the economy, exposing the dependencies of many parts of the economic system on pivotal industrial sectors such as steel and aluminum production, oil refining, and turbine and engine manufacture (Katz, 1982:138).

Social Impacts of Nuclear War

Obviously, the survival of a viable medical, industrial, and agricultural remnant is vital to postattack recovery in the United States. However, the extent of damage to the social system will, by far, be the most important indicator of the recuperative powers of society. It should be noted that damages to medical and economic institutions and to the social system are interactive because they are interdependent - the first supplying material resources and facilities and the latter suppling human resources.

> In the final analysis, the question of how, when, or whether a nation will effectively recover from a nuclear attack will depend in large measure on the damage to complex social relationships. Without the political and social consensus that binds disparate groups into a nation, the organization necessary to guide and focus recovery effort and the individual's ability to confront and overcome disruptive personal emotional demands, all the surviving economic and military capability will be of little use (Katz, 1982:192).

Heer (1965) has examined effects of a large-scale daytime nuclear attack upon two demographic variables - population composition and population migration.

Population Composition

Regarding population composition, Heer (1965) examined changes in marital and family status, age and sex, fertility rates, race, education, labor-force status, occupation, income, and means of transportation to work.

Marital and Family Status

Heer (1965) found only one area which would be significantly impacted, this being marital and family status. An estimated 17 percent of all husbands and wives would lose a spouse and 26 percent of the nation's children would lose one or both parents. Additional stress on the family, according to Katz (1982:211), will result if families have to undergo evacuation, either in a pre- or postattack situation, and if parents become subject to labor-force conscription.

Age and Sex

With regard to age and sex ratios, it was found that a nuclear war would result in only slight changes. "These changes would be minute compared to changes many nations have undergone in previous wars" (Heer, 1965:53). Concerning sex, this would seem to be a logical conclusion, since many of these nuclear weapons would be directed at a heterogeneous civilian population. However, Heer (1965: 53-54) states that data from non-nuclear disasters show higher death rates for persons under 10 years old and those 60 years old and over. Katz (1982:219) concurs when he states that "typically, strategic war has a particularly severe effect on the young and elderly, the age groups requiring the most care in society." During disasters, the young and old die from neglect. Heer's (1965) finding that there would not be an overabundance of fatalities in any age group is due to the fact that he based his conclusions on immediate deaths from the detonation and did not consider postattack hardships.

Fertility Rates

It was estimated that there also would be a slight increase in fertility. This is due to the fact that women who live outside of Standard Metropolitian Statistical Areas (SMSA) have a higher fertility rate and would be less affected by the attack, although it would seem the crude birth rate would drop.

Race and Education

Furthermore, it was found the proportion of the white population would increase slightly in relative size as blacks tend to concentrate in central cities. A nuclear attack also was predicted to " . . . reduce slightly the nationwide proportion of persons with high educational attainment and increase the proportion with lower attainment" (Heer, 1965:184). Those of higher educational attainment are more concentrated metropolitian areas, even in the central city, during the day.

Labor Force Status, Occupation and Income

Also, for a daytime attack, there would be a slight reduction in the nationwide proportion of persons 14 years old and older in the labor force, some decrease in people in white collar occupations, and an increase in the proportion of farm workers. Heer (1965) also predicts that income levels would decline slightly because income is lower outside of SMSAs.

Means of Transportation to Work

Finally, a change in the means of transportation to work is predicted, with a slight shift from public transportation in central cities to other methods such as automobiles or walking.

Critique of Heer

Heer's (1965) prediction of changes in population composition probably are invalid, due to his methodology. He has simply plotted the geographic distribution of variables and assumed that those variables with higher concentrations in central cities would suffer disproportionately. By concentrating on immediate changes which are quantitatively measurable, he reaches inaccurate and, at times, absurd conclusions. Thus, as mentioned, he probably is incorrect in conclusions about effects of a nuclear attack upon the population composition of the United States. By ignoring the long-term effects of nuclear war and the interdependent nature of an industrial society, he seems naively to imply that a nuclear strike would be surgical in nature, removing workers and not jobs, or removing only certain forms of transportation to jobs, almost as if small portions of society or facilities are removed, while the remainder functions normally. This flaw is no more apparent than in his conclusions about the decrease in income. According to Heer (1965:240), "after a nationwide daytime attack, 1959 family income would decline from $6,280 to $6,067."

However, while Heer (1965) may be inaccurate in his specific conclusions, he is correct in his over-all view that changes in population composition would produce problems in a postattack society. Heer (1965:245-247) suggests several dysfunctional aspects of these changes.

First, the lower educational attainment level and reduced population proportions in higher status (white collar) occupation groups

> . . . would have consequences not only for the amount of economic goods and services which could be produced . . . but also for the quality of political decisions made during the postattack period (Heer, 1965:246).

Second, the decrease in the proportion of the population 14 years old and over also would decrease the goods and services available, even if new people were recruited, because newcomers would lack experience and thus be less skillful.

Third, the higher fertility patterns of surviving women also could prove dysfunctional if it leads to a decrease in female labor force participation.

Fourth, the large number of widows and orphans would prove quite dysfunctional to postattack recovery. Heer (1965:392) states their large numbers would

> . . . represent a social problem of staggering magnitude because of the very large amount of financial and emotional support from outside sources which these widows and orphans would require.

Furthermore, according to Katz (1982), availability and motivation of individuals with all types of skills needed to aid in economic and social recovery may be impeded by family considerations.

> Concern for the well-being and safety of relations will often be in conflict with the needs of the larger society, causing some to drop out of the work force entirely or, at a minimum, producing high absentee rates and lower productivity. For some adults, the loss or injury of spouses and children will rob them of any incentive to care for themselves, much less contribute to the general rebuilding of society (Katz, 1982:212).

Population Migration

According to Heer (1965), postattack United States could expect some degree of internal migration. However, it is stated that the volume of migration depends on "the magnitude of the difference between its perceived rewards and its percieved costs" (Heer, 1965:280). As both rewards and costs of migration would be high, it is impossible to estimate the volume of migration, but there is no doubt it will take place.

Migration costs would be quite high for two reasons: difficulty of travel and psychological readjustment. Travel over any significant distance would be quite a hardship because conventional means of transportation would be unavailable due to lack of fuel. As a result, most migration would take place by foot. Walking no doubt would deter many would-be migrants such as the elderly. Besides logistical hardships, psychological costs would be hard to pay. Many would not favor the idea of leaving familiar areas for the unknown. Heer (1965:278) says that

> we can, however, make one significant generalization with regard to the psychological cost of migration. This is that having relatives or close friends at the point of destination reduces it.

Whatever the costs of migration, the rewards, real or percieved, definitely will be great. Motivation for migration can be expected to develop following a nuclear attack, according to Heer (1965) for the following reasons.

The first is a lack of adequate housing. Heer (1965: 253) cites data from his hypothetical attack which indicate that, although 70.08 percent of the population would survive an attack, less than 25 percent of the housing stock would be inhabitable immediately. His data indicate that 27.5 percent of homes would be so heavily damaged as to be unsalvageable, and an additional 18.5 percent would be so damaged that evacuation would be necessary until they were repaired. In addition, fallout would make another 30 percent of homes uninhabitable for a minimum of 60 days. Based on these data, Heer (1965:255) states that ". . . it appears inevitable that, after any attack, there would be pressures for migration due to lack of housing."

Another reason for migration is lack of adequate home heating. According to Heer (1965), in almost all of the United States for aproximately one half of each year, adequate housing demands residential heating. This may not be possible in a postattack situation, since availability of fuel would be restricted if petroleum refineries and natural gas pipelines were damaged.

The third reason is the perceived threat of lingering radiation. As noted in Chapter One, the threat of fallout from a surface burst is not existent. However, even in fallout areas where 4,000 roentgens were produced in the first hour, Ralph Lapp (1960:169) has written:

> After the first month, the fallout hazard in most areas would no longer be the overriding problem of life. The outdoors dose in the second month would still be about 220r, but this could easily be reduced to ten or twenty r by cautious living - using shelter much of the time.

Heer (1965:259) concludes, then, that "for many if not most communities lingering radiation would not be an important ground for mass migration following an attack."

The fourth reason is freedom from violence. Heer (1965) expects that violence in and around attacked areas will be most likely. Ikle (1958:186) believes violence will be less of a problem after a nuclear attack. Ikle has stated:

> Law and order will be maintained by the inertia of cultural traits and the persistence of people's habits. The great devastations may offer opportunities for looting, but law-abiding citizens will not suddenly turn into criminals. There is absolutely no evidence from past disasters of a precipitate increase in crime, although a gradual rise in the delinquency rate usually occurs during prolonged wars.

Heer (1965) argues that Ikle's general statement and optimistic view applying under all conditions is unconvincing. Heer provides an example from Leon Goure's (1962) report of the reactions of the citizens of Leningrad during the 1941-42 siege when approximately one million died from cold and starvation.

> It was natural that under these circumstances an increasing number of desperate and hungry people began to engage in theft and looting, their object was always food, and they either stole the food itself or took away any goods that they could sell in order to obtain food. The theft of ration cards, especially from older women and people who had collapsed in the streets became more and more frequent. In December, 24,000 ration cards were lost or stolen. People returning home from the store with their rations were often robbed. In fact, it became so dangerous to carry rations openly that people began to hide them on their persons.
>
> During this period there were also some instances of cannibalism. How often this happened is not known, but all informants report hearing about it or even having seen evidence of it. Most instances appear to have involved the mutilation or dismemberment of corpses found in the streets or stored in the morgues, before they were removed to the cemeteries. It was rumored that some of the meat obtained in this fashion was sold in the black market in exchange for more conventional food or resellable objects, but sometimes the despoilers ate it themselves. There were even said to be cases of crazed parents eating their children and vice-versa (Goure, 1962:215-216).

The WHO study supports Heer's thinking on this subject when it states

> in the struggle for survival, hostilities would erupt between individuals, families, or communities over possession of the remaining food and other resources (1984:29).

Heer concludes that

> . . . one cannot reject the possibility that large-scale violence will be a motive for migration following a nuclear attack on the United States (1965:262).

A fifth reason for migration is the lack of plumbing and sewage, light, and facilities for cooking and cold storage of food. Due to structural damage caused by the blastwave, it is quite possible all these conveniences would be scarce.

Another reason for migration is the lack of potable water. As noted, water pumping stations and water mains probably would be destroyed as they were in World War II. A water shortage would be a strong incentive to migrate.

A lack of food is also a possible reason for migration. The existing food supply in each state would, in general, be proportionate to its preattack food production. Heer (1965) states that existing supplies in states would last from 90 to 1,000 days at a per capita consumption of 3,000 calories a day. Thus, the main problem would be distribution which will be most difficult due to destruction of vehicles with electronic ignitions, damage to highways, ports and railroads, and a general lack of fuel.

The eighth possible reason for migration is existing job opportunities. Many people may find in the postattack community that their job skills have become meaningless or that their jobs no longer exist, while, there may be a demand for these skills elsewhere.

The ninth and final possible reason for migration is the freedom from repeated attack. A fear of additional detonations could be a strong motivation to move to what are considered less-attractive target areas, especially if the initial attack had been light.

In the event of migration,

> the direction of migration would be away from the areas where resources for living are

> perceived to be least and toward the areas where resources for living appear greatest (Heer, 1965:281).

Migration thus would be from areas which had been attacked to surrounding areas which had survived unscathed. In other words, from metropolitan areas to non-metropolitan areas. Heer (1965:288) also states that it is likely that violence and criminal activity will take place at points of departure and destination. These problems will develop if the means of migration are scarce, supplies are scarce, and resentment is high among natives at the point of destination.

This would be a particularly common development in rural areas adjacent to attacked urban areas. Thus, migration in the postattack period, which will probably result in a stream of city people flowing into the country, producing strain on rural housing and subsistence facilities, could produce urban-rural conflict.

According to Katz (1982), it is ironic, but the fact may be that a nuclear war may have a greater impact upon the social structure by killing less people in the initial detonation and forcing large numbers of people to evacuate to other less damaged areas.

> The implications for a society with racial, ethnic, cultural, or economic differences and tensions is clear. With the range of potential conflicts that could emerge in a postattack society, the assumption, based on previous disaster experience, that for at least the initial postattack period conflict would be minimized in an atmosphere of cooperation may be tenable only if the period of stress is quite

> short. A prolonged period of stress, uncertainty, and inadequate resources coupled with rising numbers of incoming evacuees may in turn seriously erode this mood. This loss of cooperative attitudes may in turn seriously undercut an effective national mobilization of human resources for the recovery effort (Katz, 1982: 223).

In short, a population divided against itself in such a manner would easily undermine large-scale efforts to organize a cooperative effort aimed at economic recovery.

Political Impacts of Nuclear Attack

The optimal recovery of the United States demands the survival of the federal government as a viable political entity for two reasons. First, without the existence of a central governing structure, the nation could cease to exist, dissolving into various regional or smaller, loosely structured political entities, if organizational efforts develop on a scale smaller than the national level. This particularly is likely when one considers the foregoing discussion concerning possible antagonisms over scarce resources between geographic areas that have suffered differentially. Second, speedy recovery nationwide requires some coordinating body at the national level to distribute material and human resources where most needed.

According to Heer (1965:363), a nation-state has six basic needs:

1. Adequate production of goods and services to meet or maintain the highest standard of living possible;

2. Distribution of goods, services, privileges, and obligations in a manner that is felt to be equitable;

3. Maintenance of social order within society by maintaining normative standards;

4. Protection of the nation against external enemies;

5. Maintenance of an appropriate birth rate that neither dries out nor outgrows its resources;

6. Socialization of the society, especially the young, so that they can be functional members of society.

Meeting these needs of a nation involved in a nuclear war will be difficult because of radical changes in our material culture. Economic changes making this difficult include the destruction of much of the means of production, as well as corresponding problems with transportation to distribute goods and services, and deaths of many workers. The inequalities of distribution may cause a breakdown in normative standards and result in rising crime and violence. The nation probably will be in a weak position to protect itself from external enemies due to the destruction of much of its military capabilities. Furthermore, socialization of the nation's youth will be problematic due to destruction of facilities of socialization, such as schools, churches, and libraries.

Because of shortage of resources, facilities, and personnel, these six national needs may conflict as society attempts to fulfill them. Heer (1965:364) points out three particularly important conflicts.

The first concerns entrance of adolescents and young adults into the labor force instead of continuing their education. Here the dilemma consists of having an adequate production of goods and services versus the education of the young. The conflict, according to Katz (1982), would be between the short-term, well-being of society in the form of gratification of immediate needs and long-term progress through education. The demand for industrial and agricultural labor resulting from losses in equipment, fuel, and labor force could necessitate the diversion of students and teachers, or would-be students and teachers from academic pursuits. At the same time, satisfying material requirements of the educational system (classrooms, libraries, laboratories, teaching aids) will face competition from more urgent needs (Katz, 1982:180). However, Katz (1982:180) states that "the existence of a viable system for higher education is an essential component of national military and industrial strength . . . " It also could be important to general quality of life in post-attack society. For example, there probably will be a long-term shortage of medical doctors, without the preservation of adequate institutions of primary, secondary, and and higher education, as well as opportunities for the young to attend.

The second conflict involves quantity of labor resources to be funneled to child-bearing and upbringing. The dilemma is the need for an adequate production of goods and services for the adult population versus the need for population replacement and the needs of goods and services of the young.

The third important conflict identified by Heer (1965) involves entrance of the young into the industrial labor force versus their being drafted into military service. The dilemma is between the need for the adequate production of goods and services versus the protection of the country from external enemies. It is possible this could become a critical choice. For example, Strieber and Kunetka (1984) develop a scenario of the United States in a war-weakened position being invaded by Mexico in the southwest.

To alleviate conflicts between these national needs and, in general, assure all these needs are met, Heer (1965) has suggested six possible institutional changes that may develop in the postwar United States.

1. Partial relinquishment of the free labor market. Heer predicts that, as in a society gearing up for war, conscription by government will take the place of attractive wages in securing people to meet occupational demands. This is so because using high wages as a lure is slow and many jobs would be undesirable. Thus, for example, doctors and decontamination workers would be conscripted if enough did not volunteer.

2. Controls on goods and services. In the postattack period, many goods and services, such as medical care, drugs, medicines, new housing and food would be in great demand. Without rationing and price controls, a very skewed distribution of use and ownership of such things would result and would be considered unfair by many. This possibly could result in rising crime and a decreased work force due to death and malnutrition.

3. Sharp increase in welfare payment and in taxation. Financial support for children orphaned in the attack would require large sums of money which would have to come from increased taxes.

4. Diminuation of families functioning as the primary child care unit. Because of the large number of orphaned children resulting from a nuclear attack, the government would be forced to assure their well-being, resulting in at least a temporary decline in the family as the primary child-care unit in society.

5. A cessation of laissez-faire with respect to fertility. Size of the postattack population would have an impact on domestic and international conditions of the attacked nation. Increasing population size would reduce conflict between needs for military and industrial personnel. At the same time increasing the population at too great a rate would drain goods and services from the existing population in the short-term. Thus, population growth would have to be controlled carefully.

6. Relative increase in power of the federal government at the expense of state and local governments. The federal government will probably be required to take over many governmental functions normally performed at state and local levels, especially in those states which are hardest hit and have lost much of their preattack governments and resources. The federal government thus may need to take responsibility for rebuilding and maintenance of schools and police forces among other things.

The manifestation of institutional alterations assumes the existence of a strong centralized government, but according to Heer (1965), Katz (1982), WHO (1984), and the OTA (1980), this may indeed be problematic. The ability of the United States' political structure to recover depends for the most part on two things. First, damage to communication and transportation systems will be very important in this respect as

> . . . heavy and widespread damage to larger political units. . . will severely strain the ability of central control mechanisms - the federal government and other institutions - to make and execute nationwide plans and policies (Katz, 1982: 198).

Second, the number of political officials who survive will be important. National, state, and local officials, presumably will evacuate to outlying areas in event of nuclear conflict. Their ability to do this will depend on the amount of prior warning time. The certain loss of many public officials will impede the ability of governmental agencies to function effectively at a time when this ability is most needed.

> At the same time, certain political forms and conventions (such as electoral procedures and administrative law) will have to be ignored or suspended temporarily, due to the lack of time for their observance or because of the loss of personnel, such as the members of state legislatures or city councils. Where executive authorities (mayors, city managers, governors) do not survive, their duties will fall upon individuals either not competent in terms of ability or not regarded as competent to assume their duties from a legal standpoint. The loss of recognized political leaders and the disruption of political norms could call into question the political legitimacy of those attempting to exercise leadership in the immediate postattack period (Katz, 1982:224-225).

Thus, confidence in the postattack political leadership may be low and may drop further as changes in an already weakened structure, such as setting aside of many normal political practices and routines, are instituted to facilitate recovery. For examole, the government may have to direct the use of private property for the general good such, as forcing those persons having homes to provide shelter for those who had lost their homes. As normative changes such as those listed above take place, widespread resentment and dissatisfaction could result, thus further weakening the effectiveness of the existing governmental structures (OTA, 1980). Thus, these unpopular decisions, combined with the perceived lack of political legitimacy, may, in the minds of some people, be sufficient reason for radical disobedience.

Psychological Impacts of Nuclear Attack

A lack of ability by the larger surrounding society to grant aid to attacked areas, could have a debilitating psychological effect on the survivors. In the event of a large-scale nuclear attack, such outside aid will probably be impossible for some time. This impossibility is due to differences between small- and large-scale disasters. According to Katz,

> The magnitude of a disaster has an important influence on its effects. This becomes clearer when the attributes of large-scale catastrophes are contrasted with the patterns of activity typically found following or during small-scale disasters. Unless this distinction is made, the attributes that make small-scale disasters frightening but tractable could be assumed to exist in large-scale catastrophes (1982:193).

Allen Barton (1969) has developed a model of the activities during a small-scale disaster. First, a period of unorganized response develops in which individuals help others, followed by a period of more organized response when a group of leaders emerges to direct the recovery. The second stage follows with an organized response, as disaster organizations and further help from a larger surrounding society take over recovery efforts. The most significant development, as part of the response of the larger society, is 'mass convergence,' a movement of individuals and resources into the disaster area. During this stage, the most crucial task is organization of relief efforts and reestablishment of communication with the surrounding unaffected society. During the third stage, an altruistic society develops and focuses on rebuilding of a normal society with normal societal relationships.

Katz (1982) suggests that, after nuclear war, the situation will be quite different. The decision of most survivors will be to flee the area because of the destruction and fear of radioactive contamination. Any organization to help others will be impossible.

> Personal accounts of Hiroshima and Nagasaki suggest that the main pattern of behavior was to help family members and sometimes neighbors and then to escape from the city of ruins and fires into the countryside ignoring the plight of strangers (Katz, 1982:195).

The overwhelming scale of the destruction seems to have prevented spontaneous development of rescue groups (Katz, 1982:195). Furthermore, outside help also will have been attacked and smaller towns probably would be limited in amount of help they could provide (OTA, 1980). Survivors in each area will thus be left to their own coping devices. In addition to resultant problems of scarcity an equally important by-product of a large scale nuclear attack would be in Katz's terms, "a sense of isolation" or a loss of touch with reality of the larger national society.

In this regard, assistance from outside the stricken area is important for its material benefits and for the psychological benefits of creating a bond with the larger society it comes to symbolize. This connection with a more normal society helps to provide the impetus for rebuilding the damaged society, creating a sense of social viability and support to dispell continuing perception of isolation. These psychological benefits are important because symbols - in this case linkages to the familiar outside would - have important functions in binding societies together. They restate a common thread of hope and shared aspirations (Katz, 1982:205-206).

Thus, lack of organized outside help, creation of scarcity and perpetuation of a 'sense of isolation' would result in the dissipation of the preattack social bond. Survivors probably would no longer possess feelings of social responsibility or a strong guiding sense of community. In such a social milieu, recovery would be problematic to say the least.

Present State of Research

Existing literature concerning effects of nuclear war indicates that what has been accomplished is largely a study of direct weapons effects and, to a lesser extent, estimates of recovery abilities. According to a study by the British Medical Association (BMA):

> Calculations of weapons effects and resulting casualties tend to concentrate on those physical effects which are more easily predicted: blast wave and to a lesser extent, short-term fallout. Those results which are more difficult to estimate, such as fires caused by thermal radiation, or many longer-term consequences of the collapse of the social and technological infrastructure, tend not to be taken into account (1984:47).

> The picture clouds considerably, . . . [when] we go beyond both the certainties of physics and our slender base of experience, and . . . encounter the full complexity of human affairs (Schell, 1982:22).

The 'full complexity of human affairs' must be taken into account if one is to analyze accurately the effects of nuclear war. Schell (1982) states that nuclear war assails human life at not just the individual level but at the societal level.

> Nuclear weapons thus do not only kill directly, with their tremendous violence, but also kill indirectly, by breaking down the man-made. . . systems on which individual lives collectively depend. Human beings require constant provision and care supplied. . . by their societies and if these are suddenly removed people will die just assuredly as if they had been struck by a bullet (Schell, 1982:23).

Thus, the fragile interdependent nature of the social system, and the human consequences of its breakdown, must be examined before one can understand the true consequential limits of nuclear attack. However, even those studies such as Katz's (1982), which examine the social consequences of such an attack, lack a systematic, sociological analysis of the consequences in that they are not guided by sociological theory. For example, no study mentions the fact that the suicide rate among the survivors could be very high. However, Durkhiem's analysis of the effects of rapid social change upon the rates of anomic suicide would lead us to believe these rates would increase greatly in the aftermath of a nuclear war. Such theory based research into the consequences of nuclear war is needed to understand just what is at stake when a nuclear conflict seems imminent. Indeed, in a recent issue of The Sociological Quarterly, a special feature dealt with the sociology of nuclear threat. This feature calls for an increase in sociological investigation in this area by suggesting that sociologists

> have a responsibility to speak out on the social, psychological, and societal consequences of nuclear war. Drawing on our knowledge of social organization and social psychology, we should question those who try to normalize nuclear war, plan civil defense procedures for surviving such a war, and in general are under the illusion that a nuclear exchange could be quickly followed by a working social system (Kramer and Marullo, 1985:285).

CHAPTER III

THEORY

The preceding chapter gave us a description of disruptive effects a nuclear war could have for a modern industrial society such as the United States. However, as noted, to gain an understanding of why nuclear war could be so devastating, one must go beyond mere description and enter the realm of social theory which allows one to examine the topic from a systematic, analytical perspective. Because this study concerns the consequences of massive damage to a complex social system (i.e., a modern, urban society), structural-functionalism has been selected as an appropriate theoretical perspective upon which to base this research.

The Emergence of Structural-Functionalism

Structural-functionalism owes its conception to the social unrest (i.e., French Revolution) in Europe during the 18th-century. This social instability caused early 19th-century social thinkers to consider the problem of maintaining social order. Social thinkers began to ask questions such as: Why and how is society possible and what holds society together? Answers to these questions initially were influenced by successes in the biologcal sciences in the 19th-century.

August Comte

According to Turner (1978:20) ". . . emergence of the functionalist perspective began with Comte's work and was carried forward by other thinkers in the latter half of the 19th-century." Comte's life was dedicated to establishing sociology as a legitimate science. "His most important tactic for legitimizing sociology was to borrow terms and concepts from the highly respected biological sciences" (Turner, 1978:21).

Comte saw the affinity between sociology and biology to reside in their common concern with "organic bodies." For Comte, there existed a correspondence between the individual organism in biology and the social organism in sociology. As a result, he drew analogies between biological and social structures. Comte observed that in biology

> we may decompose structure anatomically into elements, tissues, and organs. We have the same things in the social organism, and may even use the same names (1875:240).

Thus, Comte states

> I shall treat the social organism as definitely composed of the families which are the true elements or cells, next of the classes or castes which are its proper tissues, and lastly of the cities and communes which are its real organs (1875:242).

Comte implies that societies are made of interdependent structures. This interdependence and the functions fulfilled by the interdependent structures were later dealt with explicitly by Herbert Spencer.

Herbert Spencer

Spencer's theory of society contained two interrelated doctrines. The first involved a theory of social dynamics; that is, that all societies grow from simple to complex forms. The second, involved an organic analogy. According to Timascheff (1976:37), Spencer noted several likenesses between biological and social organisms:

1. Living organisms and human groups such as societies differentiate themselves from inorganic matter by growth or, in other words, a process of maturation for the largest part of their existence.

2. As organisms and societies increase in size, they develop a more complex structure.

3. The increasing differentiation of structure in organisms and societies is matched by an increasing differentiation of function.

4. For both organisms and societies, evolution establishes differences in structure and function that make each other possible. Thus, interdependence develops.

5. Finally, as an organism can be regarded as a nation of individual units (cells) so can a nation of individuals (human beings) be regarded as an organism.

> Thus, structure and function are distinguished in Spencer's work, a division which was to become more thoroughly developed by Emile

> Durkheim, but which provided the basis for functionalism as a unique orientation in the social sciences (Turner, 1978:23).

Spencer was not the originator of the organic analogy. However, ". . . Spencer was the first to give to that analogy the value of scientific theory. . ." (Timascheff, 1976: 38).

Emile Durkheim

"It is Durkheim who clearly established the logic of the functional approach to the study of social phenomena" (Coser, 1977:140). According to Durkheim,

> The determination of function is . . . necessary for the complete explanation of the phenomena. . . To explain a social fact it is not enough to show the cause on which it depends: we must also, at least in most cases, show its function in the establishment of social order (1950:97).

Following this, as one would expect, the ". . . concept of function played a part in all of Durkheim's work . . ." (Coser, 1977:141).

Thus, Durkheim (1933) studied the effects of increasingly complex social structures, manifested in the form of a division of labor on social solidarity. Most importantly, Durkheim viewed the various parts of the social system as fulfilling the system's functional needs. For Durkheim, social systems could exist in normal or pathological states. Pathological states develop when these functional needs are not met. It was thus implied in Durkheim's work that systems have equilibrium states around which normal functioning occurs (Turner, 1978:25-26). For example, the failure of structures to meet the proper functional needs of society with regard to levels of social regulation and social integration were viewed by Durkheim as producing abnormally high levels of suicide.

In the final analysis, "whether he investigated religious phenomena or criminal acts . . . Durkheim always shows himself a masterful functional analyst" (Coser, 1977:142).

> The brilliance of his analysis of substantive topics, as well as the suggestive features of his work, made a 'functional' mode of analysis highly appealing to subsequent generations of sociologists and anthropologists (Turner, 1978:28).

Functionalism and the Anthropological Tradition

The conception of a social system as having functional needs was elaborated further by anthropological theorists, most notably, Malinowski. "Malinowski's conceptual perspective was built around the dogmatic assertion that cultural items exist to fulfill basic human and cultural needs" (Turner, 1978:32).

Malinowski's (1944) functional analysis began with a description of basic human needs which must be met to ensure individual and group survival. Table VII is an example of such needs and the cultural responses which arise to meet these needs. In addition, once these cultural responses or social systems develop to meet basic needs, they

TABLE VII

BASIC HUMAN NEEDS AND CULTURAL RESPONSES

(A) Basic Needs	(B) Cultural Responses
1. Metabolism	1. Commissariat
2. Reproduction	2. Kinship
3. Bodily Comforts	3. Shelter
4. Safety	4. Protection
5. Movement	5. Activities
6. Growth	6. Training
7. Health	7. Hygiene

Source: A Scientific Theory of Culture and Other Essays, Malinowski (1944:91) in turn have needs. Malinowski termed these, derived needs, which must be met to ensure the system's survival. Table VIII is a summary of derived needs or imperatives, and the cultural responses for their satisfaction.

Malinowski thought that meeting these derived needs was just as important for individual survival as meeting basic human needs. By meeting needs of social systems that develop to meet basic human needs, indirectly basic human needs are satisfied. In other words, without development of institutions of economics, social control, education and political organization, the cultural responses designed to meet basic human needs could not be maintained.

From this conception of need satisfaction, Malinowski developed several general axioms of functionalism:

A. Culture is essentially an instrumental apparatus by which man is put in a position the better to cope with the concrete specific problems that face him in his environment in the course of the satisfaction of his needs.
B. It is a system of objects, activities, and attitudes in which every part exists as a means to an end.
C. It is an integral in which various elements are interdependent.
D. Such activities, attitudes and objects are organized around important and vital tasks into institutions such as the family, the clan, the local community, the tribe, and the organized teams of economic cooperation, political, legal and educational activity (Malinowski, 1944:150).

Summary of Early Functional Perspective

One may outline the emergence of structural-functionalism by examining the various contributions of early

TABLE VIII

DERIVED NEEDS AND CULTURAL RESPONSES

IMPERATIVES	RESPONSES
1. The cultural apparatus of implements and consumers' goods must be produced, used, maintained, and replaced by new production.	1. Economics
2. Human behavior, as regards its technical, customary, legal or moral prescription must be codified, regulated in action and sanction.	2. Social Control
3. The human material by which every institution is maintained must be renewed, formed, drilled, and provided with full knowledge of tribal tradition.	3. Education
4. Authority within each institution must be defined, equipped with powers, and endowed with means of forceful execution of its orders.	4. Political Organization

Source: A Scientific Theory of Culture and Other Essays, Malinowski (1944: 125) functional theorists. Comte was responsible for its conception within sociology. He viewed the human condition from a systematic perspective, using the organismic analogy. Spencer then expounded by emphasizing the relationship between structure and function. Following Spencer, Durkheim talked of system needs and this concept was developed further by Malinowski.

According to Turner (1978:37), work of early functional thinkers can be summarized in the following manner:

1. Because the social world was viewed as a system, it was seen as comprising interdependent components which functioned to maintain system viability or equilibrium.

2. Social systems were viewed as having needs which must be met to survive.

Contemporary Functionalism

Contemporary functional theorists have followed in the footsteps of early functional theorists, especially regarding the functional needs of social systems. This is particularly true of Marion Levy and Talcott Parsons.

Levy

Levy has developed a number of what he terms 'functional requisites,' which he defined as conditions necessary for maintenance of the social system. The following discussion of these requisites is taken from Levy's (1952: 149-197) work entitled The Structure of Society.

Levy identifies and discusses ten functional requisites. They are: 1. provision for an adequate physiological relationship to the setting and for sexual recruitment; 2. role differentiation and role assignment; 3. communication; 4. shared cognitive orientations; 5. shared and articulated goals; 6. regulation of the choice of means; 7. regulation of affective expression; 8. adequate socialization; 9. effective control of disruptive forms of behavior; and, 10. adequate institutionalization.

As with Malinowski, Levy's first concern is with the needs of the biological organism. Thus, his first requisite is identified primarily as dealing with biological needs of members of a society. The biological needs of the human organism are food, shelter and clothing. These are not immediately forthcoming from an environment but must be secured. Because of a lack of instincts for securing these needs and a concomitant scarcity of resources, it is felt that some form of cooperative social organization is a necessity for survival of the organism. Thus, "the absence of any human social elements would . . . result either in biological extinction or the war of all against all" (Levy, 1952:154). Furthermore, for society to maintain itself, members must be replaced in adequate numbers to offset deaths.

"The remainder of Levy's functional requisites may be characterized as emergent social properties, less closely linked to mere biological survival . . ." (Bottomore and

Nisbet, 1978:345). These latter requisites identified by Levy thus are similar to Malinowski's derived needs.

The second functional requisite is a division of labor or the need for a system of heterogeneous roles and the active instruction and assignment to these roles. This organization is viewed as allowing for the carrying out of important tasks in an orderly and dependable manner. For example, "without provision for child-rearing activities, and without their assignment to specific persons or groups, the society invites extinction" (Levy, 1952:164). Without such organization "everyone would be doing everything or nothing."

The ability to elicit a similar feeling or mental construct within the mind of another member of the social system is termed communication and this is the third functional requisite. Without ability to communicate, especially with the use of learned linguistic symbols, no complex human society could exist because such a situation would preclude the development of common value structures or any but the simplest skills and social organization. In complex societies, forms of communication, in addition to speech, are needed because much communication is not face to face. Thus, written communication is necessary. This especially is evident when one considers workings of modern industrial societies.

The fourth functional requisite - shared cognitive orientations - refers to the fact that a system of shared knowledge is necessary for social system survival. For example, without shared knowledge, adaptation to, and manipulation of, the non-human environment, at the societal level, would be impossible. This is so because a lack of such shared knowledge would not allow for orderly interaction. "Private definitions could lead only to mutually incompatible actions . . . . In the absence of shared cognitive orientations, serious clashes would ensue" (Levy, 1952:169). Thus, shared cognitive orientations are essential for any stable social organization and thus for the existence of the social system.

The fifth functional requisite of social systems is the existence of a societally-shared set of goals. In other words, coordination and cooperation necessary for maintenance of a social system depends on existence of a well-defined and shared set of ideas about various states of affairs which are viewed as desirable or undesirable. while there may be many goals not subscribed to by society as a whole, it is necessary there be a set of goals that have near universal societal acceptance.

> For example, in all societies the members must hold some acts of murder to be bad. The range of definition of this basic value [or goal] orientation for different societies ranges from a radical outlawing of all forms of taking life. . . to societies in which vendettas of the bloodiest sort are part of the social structure. However liberal may be the definition of those eligible for slaughter, there is always some limitation placed upon it, and if those limitations break down completely, the society will dissolve into a war of all against all (Levy, 1952:175).

The regulation of the choice of means by which societal goals may be achieved is Levy's sixth functional requisite. Thus,

> . . . patterns of role differentiation tell who is to act, while the common articulated set of goals defines what is to be done. There must be regulation of the choice of means to tell us how these goals may be won (Levy, 1952:182).

Without such regulation, social order would be threatened by a societal state of anomie, leading to a breakdown of the social system through apathy or civil war, as individuals attempt to achieve goals without regard for others by using methods based solely on 'instrumental efficiency'.

Control of emotional states of societal members is a seventh functional requisite. In other words, affective states must be allowed only in certain situations, if society is to function orderly. For example, in the United States, the familial institution is dependent on existence of love and, to preserve social order, love (especially its sexual aspects) must be restricted to the husband-wife relationship, if conflicts are to be avoided. Furthermore, given the existence of social stratification systems that lead to social inequalities, certain affective states such as anger must be regulated or the social system would break down into class war.

The eighth functional requisite is adequate socialization of sufficient number of members of society. Adequate socialization is accomplished when a sufficient number of members have been taught the "structure of action" of society well enough to enable them to fill roles that meet functional requisites of their society. In other words, a member must become familiar with socially-recognized forms of communication, shared cognitive orientations, goal systems, attitudes involved in the regulation of means, proper affective expression ". . . and the like, as will render him capable of adequate performance of his several roles throughout life, both as respects skills and attitudes" (Levy, 1952:189).

The ninth requisite of social systems is the effective control of disruptive forms of behavior. This is necessary because the use of force or fraud will always be a part of the social system due to the scarcity of resources which leads to a frustration and, thus, can act as a motivation for disruptive behavior. This motivation is strengthened by imperfections in socialization. If disruptive behavior is restricted only by a lack of opportunities, social breakdown would be the result, ending in anarchy.

The tenth and final functional requisite identified by by Levy is adequate institutionalization. Institutionalization involves the development of normative patterns of action which demand conformity and mechanisms for sanctioning those who do not conform. Institutionalization is

> 'adequate' if its conformity and sanction aspects are carried sufficiently far to permit the persistence of the minimal normative structures involved in other functional requisites. In structural terms, this means the existence of a full set of crucial institutions, that is to say, the structural requisites of a society

> must be institutionalized for a society to persist. The absence of such institutionalization would a situation of indeterminacy incompatible with the existence of a society (Levy, 1952:196).

In sum, Levy's first functional requisite designates the necessity of social elements if the human organism is to survive. The following nine requisites, if met, assure orderly and efficient functioning of those forms of social organization that allow existence of human life.

At first glance, the extensive number of functional requisites identified by Levy (1952) seem to indicate a much more extensive examination of the topic than those presented by others such as Malinowski. However, this has drawn some criticism. Bottomore and Nisbet (1978:348) state that "the attempt to map the territory in detail may lead to distinctions without fundamental differences." They give, as an example, the fact that the functional requisite, adequate institutionalization, logically would include other functional requisites such as regulation of choice or effective control of disruptive behavior. They suggest Levy's list may be unnecessarily long and redundant and state that " ... the only advantage in the more extended list is to alert the theorist or observer to aspects of structural behavior that might otherwise be neglected" (Bottomore and Nisbet, 1978:348). Parsons has avoided this problem by identifying and discussing four major functional requisites.

Parsons

Parsons begins an analysis of functional requisites or imperatives in his examination of action systems. Parsons (1951:27) states that, if an action system ". . . is to constitute a persistent order or to undergo an orderly process of developmental change, certain functional prerequisites must be met." These functional imperatives concern characteristics of the integrational interrelationships among personality, cultural and social systems. Parsons paints a picture of the social system and its two sister systems co-existing in a symbiotic relationship.

First, the social system cannot, if it is to develop and survive, interfere with the proper functioning of the personality system. Thus, it ". . . cannot be so structured as to be radically incompatible with the conditions of functioning of its component individual actors as biological organisms and as personalities. . ." (Parsons,1951:27). In other words, the social system must allow for the meeting of biological needs such as nutrition and physical safety. At the same time, it must allow for conditions that promote "stability of personality" such as affectional support (Parsons, 1951:28). Also, the social system cannot interfere, or be incompatible " . . . with, the relatively stable integration of a cultural system" (Parsons:1951:27). According to Parsons (1951:33), ". . . there are minimum social conditions necessary for production, maintenance and development of cultural systems. . . ." For example,

> . . . the individual does not develop language spontaneously without undergoing a socially-structured learning process in relation to others. It is quite definite that this process must be part of a system of social relationships which is orderly within certain limits . . . . (Parsons, 1951:34).

A social system which disrupts its culture, for example, through the blocking of the process of its acquisition or language, would be subject to social as well as cultural destruction (Parsons, 1951:34).

Secondly, as the social system must meet conditional requirements of the personality and cultural systems, it, in turn, depends on a minimum level of support from these two sister systems. From the personality system, it must have a "sufficient proportion of component actors adequately motivated to act in accordance with the requirements of its role system" (Parsons, 1951:27). To accomplish this, the cultural system must define a "minimum of order" and not place impossible demands on people. Failure to accomplish either of these requisites will result in generation of deviance.

The functional requisite of the motivation of a sufficient number of actors from the personality system to conform to the social system's structure of statuses and roles is a task fulfilled by cultural mechanisms of socialization and social control. Thus, these mechanisms integrate the personality system into the social system. The mechanisms of socialization allow for internalization of cultural patterns such as values and beliefs by the personality system, thus allowing for conformity to status and role requirements. The mechanisms of social control ". . . involve those ways in which status roles are organized in social systems to reduce strain and deviance" (Turner, 1978:50). These are necessary because "both within the individual actors as personalities, and in the situation in which they act, are factors tending to upset the equilibrium" (Parsons, 1951:205).

> There are numerous specific control mechanisms, including (a) institutionalization, which makes role expectations clear and unambiguous, while segregating in time and space contradictory expectations; (b) interpersonal sanctions and gestures, which actors subtly employ to mutually sanction conformity; (c) ritual activities, in which actors act out symbolically sources of strain that could prove disruptive, and which at the same time reinforce dominant cultural patterns; (d) safety-valve structures, in which pervasive 'deviant' propensities are segregated in time and space from 'normal' institutional patterns; (e) reintegration structures, which are specifically charged with coping with and bringing back into line deviant tendencies; and, finally, (f) the institutionalization into some sectors of a system which have the capacity to use force and coercion (Turner, 1978:50).

In summary, Parsons' concern in <u>The Social System</u> is to outline ways in which the three subsystems of the social action system - personality, social, and cultural systems - are integrated in such a way that as a whole they are able to facilitate the orderly operation and maintenance of the action system.

In later work, Parsons (1961) broke the functional requisite of system integration into four dimensions which he viewed as analytically distinguishable functional requisites of any system of action. These are termed: latency, integration, goal-attainment, and adaptation.

Latency, concerns two related problems: pattern maintenance and tension management. In pattern maintenance ". . . the essential function is maintenance, at the cultural level, of the stability of institutionalized values . . ." (Parsons, 1961:38). Pattern maintenance is the task of mechanisms of socialization. Tension management concerns "motivational commitment" of the individual personality. This is problematic, as mechanisms of socialization are not 100 percent effective, and because there are system characteristics that produce strain or the inclination to deviate from commitment to values. Tension management is the function of mechanisms of social control such as those discussed above.

The necessity of integration

> . . . implies that all systems. . . are differentiated and segmented into relatively independent units . . . which are subsystems of the same, more inclusive system.
>
> The functional problem of integration concerns the mutual adjustments of these 'units' or subsystems from the point of view of their contributions to the effective functioning of the system as a whole" (Parsons, 1961:40).

The system of legal norms is viewed as having the primary function of integrating highly differentiated societies in that they "govern the allocation of rights and obligations of facilities and rewards between different units of the complex system" (Parsons, 1961:40). In short, integration as a functional requisite concerns ". . . the problem of coordinating and maintaining viable interrelationships among system units" (Turner, 1978:51).

Goal attainment ". . . refers to the problem of establishing priorities among system goals and mobilizing system resources for their attainment" (Turner, 1978:51). According to Parsons (1961:39), most systems have more than one goal and ". . . to protect the integrity of the system, the several goals must be arranged in some scale of relative urgency . . . . " Concerning the mobilization of system resources Parsons states,

> For the social system as such, the focus of its goal-orientation lies in its relation as a system to the personalities of the participating individuals. It concerns, therefore the motivation to contribute what is necessary for the functioning of the system . . . (1961:39).

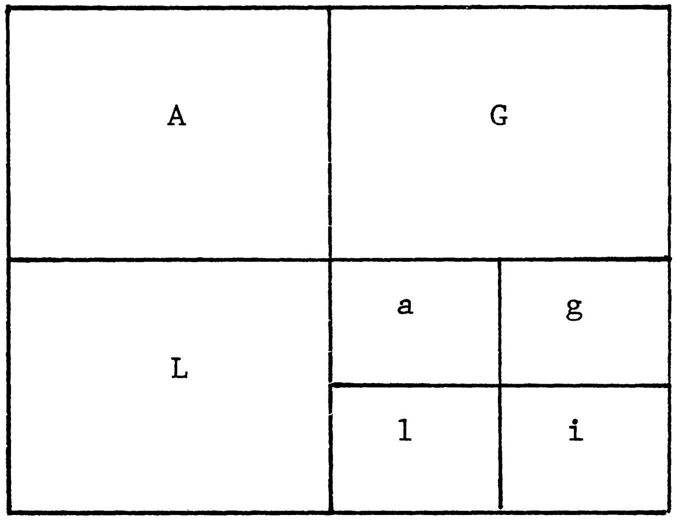
In contrast, "adaptation involves the problem of securing from the environment sufficient facilities and then distributing these facilities through the system" (Turner, 1978:51). Parsons states

> . . . at the macroscopic social-system level, the function of goal-attainment is the focus of political organization of societies while that of adaptation is the focus of economic organization (1961:40).

Finally, according to Parsons (1953:192), while the total action system has to fulfill the four functional requisites to survive, so also does each sub-system have these same requisites. This 'microcosm' - 'macrocosm' relationship is diagramatically represented as in Figure 5.

Figure 5. Microcosm to Macrocosm Relation

Figure 6. Production Subsystem



Source: *Working Papers in the Theory of Action*, Parsons et al. (1953:192)

Procurement of Facilities a	g Production, Distribution and Sales
l Technical Production (Flow of Production Line)	i Production Co-ordination

Source: *Economy and Society*. Parsons, Smelser. (1956:199)

With the concrete example of the economic sector of a system, this relation may be illustrated. The economic microcosm or subsystem of the macrocosm or total action system, has as its primary purpose the fulfillment of the functional requisite of adaptation or the securing and distribution throughout the total system of facilities from the environment. At the same time, the economic subsystem has the identical functional requisites as the total social system, as illustrated in Figure 6.

One thus sees that any social system depends on fulfillment of these four functional requisites. It is clear that even social systems as small and primary as the family are so dependent if they are to maintain viability.

> Toward the end of the 1950s, Parsons turned attention toward interrelationships among rather than within what were then four distinct action systems: culture, social structure, personality, and organism (Turner, 1978:53).

By so doing, Parsons emphasized interdependence of these systems. Each of these was viewed by Parsons as a subsystem of an over-all action system fulfilling one of the total system's four functional requisites.

> The organism is considered to be the subsystem having the most consequences for resolving adaptive problems, since it is ultimately through this system that environmental resources are made available to the other action subsystem. As the goal-seeking and decision-making system, personality is considered to have primary consequences for resolving goal-attainment problems. As an organized network of status-norms integrating the patterns of the cultural system and the needs of the personality system, the social system is viewed as the major system. As the repository of

> symbolic content of interaction, the cultural system is considered to have primary consequences for managing tensions of actors and assuring that the proper symbolic resources are available to assure the maintenance of institutional patterns (Turner, 1978:53-54).

The interrelations of these four subsystems of action in an over-all system of action can be represented as in Figure 7.

Thus, cultural value orientations limit the range of variation in the status and normative structure of the social system. These limiations on the social structure would circumscribe the motives and decisions in the personality systems. The personality system then would control the 'bio-chemical process' in the organism. In turn, the lower systems supply the 'energic conditions' necessary for higher level systems.

> That is, the organism provides the energy necessary for the personality system, the personality system provides the energic conditions for the social system, and the organization of personality systems into a social system provides the conditions necessary for a cultural system (Turner, 1978:54).

In the over-all action system, the subsystems are thus interdependent and the disruption of the informational flow or the energic conditions which operate smoothly as long as functional requisites are met, would result in disintegration or a breakdown in equilibrium of the overall action system. Thus, as in his earlier work in <u>The Social System</u>, the later theoretical developments of Parsons also stress the symbiotic characteristics of systems.

Figure 7. Subsystem Interrelations

FUNCTION	SYSTEM
Latency	Cultural System
Integration	Social System
Goal Attainment	Personality System
Adaptation	Organismic System

INTERRELATIONS

Informational Controls ↑

↓ Energic Conditions

Source: The Structure of Social Theory, Turner (1978:54)

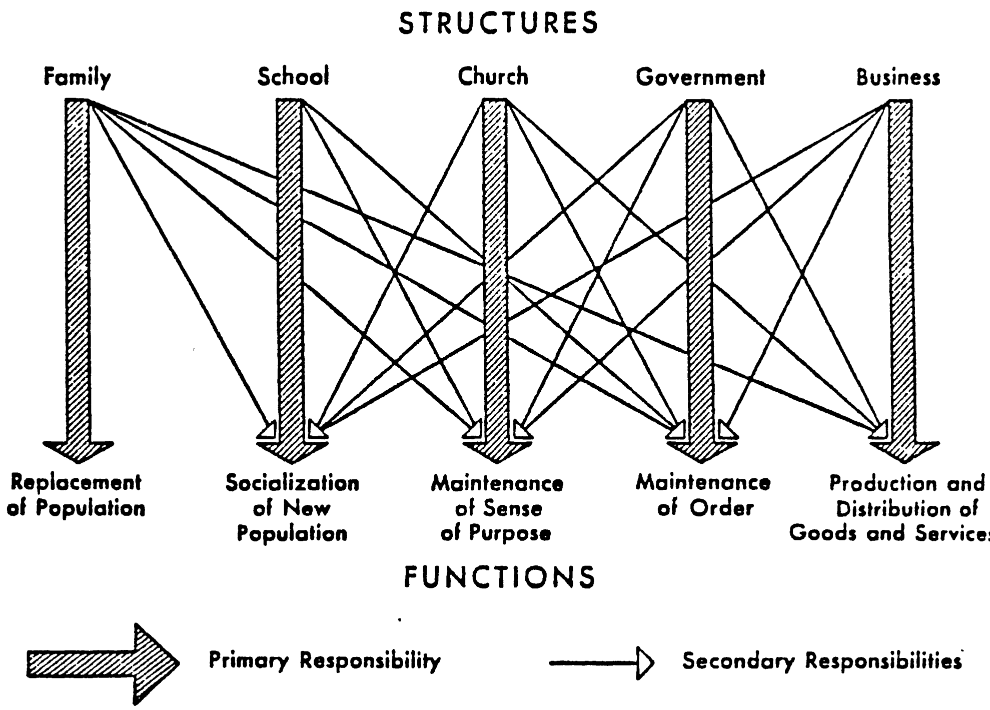
An overview of Parsons' theory indicates he has drawn a very complex and what some would feel to be an unduly abstract model whose importance to the structural-functional perspective cannot be denied. Not only has Parsons elaborated greatly upon the early organismic basis upon which structural-functionalism developed, but he continued in the tradition of earlier functional theorists such as Durkheim, Malinowski, and Levy by stressing the topic of functional requisites.

A Structural-Functional View of the Impact of Nuclear War

In brief, structural-functionalists view a society as an orderly system composed of differentiated, interdependent structures which meet certain needs necessary for the system's survival. Figure 8 is a diagramatic representation of a functional theorist's conception of various structural components of a social system and the functional imperatives they satisfy. This model is viewed as representing the basic structural characteristics and the functional requisites of a social system for the theoretical strategy in this study. The functional requisites of Malinowski (1944), Levy (1952), and Parsons (1961) all can be subsumed under categories outlined in the model as shown in Table IX.

The city, as a microcosm of the social system, may be viewed as containing the same structural components as the

Figure 8. The Interrelationship of Social Structures and Functions



Source: Sociology and Social Life, Mack and Young (1968:108).

TABLE IX

RELATIONSHIP OF FUNCTIONAL REQUISITES OF MALINOWSKI, LEVY, AND PARSONS TO STRUCTURAL-FUNCTIONAL MODEL OF MACK AND YOUNG

Social Institutions	Family	School	Church	Government	Business
Function	Replacement of population	Socialization of new population	Maintenance of sense of purpose	Maintenance of order	Production & distribution of goods & services
Malinowski (1944) Functional Requisites	The human material by which every institution is maintained; must be renewed, formed, drilled, and provided with knowledge of tribal tradition.		Human behavior as regards its technical, customary, legal or moral prescription; must be codified, regulated in action and sanctioned. Authority within each institution must be defined, equipped with powers, and endowed with means of forceful execution of its orders.		The cultural apparatus of implements and consumers' goods must be produced, used, maintained, and replaced by new production.

TABLE IX (Continued)

Levy (1952) Functional Requisites	Provision for an adequate physiological relationship to the setting and for sexual recruitment.	Role differentiation and role assignment. Communication. Shared cognitive oreintations. Adequate socialization. Shared articulated set of goals.		Regulation of choice of means Regulation of affective expression. Effective control of disruptive forms of behavior. Adequate institutionalization. Shared articulated set of goals.	Provision for an adequate physiological relationship to the setting and for sexual recruitment.
Parsons (1961) Functional Requisites	Adaptation	Latency integration		Goal-attainment latency integration	Adaptation

social system. Furthermore, it also may be said to have the same functional requisites as the social system. In short, the city may itself be viewed as a social system as it has been described in this study.

We must now examine the effects of damage upon the social system and its subsystems. It is evident that, when the social system is viewed as a form of social organization having certain needs or requisites that must be met for it to survive, it approximates the characteristics of an organic body or mechanical device comprised of various interdependent subsystems or parts which function to maintain the whole. Furthermore, while social, biological, or mechanical systems still can function with a small amount of damage, extensive damage to the general system or such damage to a critical subsystem which precludes the possibility of meeting functional requisites of the system and its subsystems, will lead to death or ruin of the system. Thus, the biological system can survive and recuperate from small infections and mechanical devices, such as an automobile can function at less than 100 percent efficiency with a fouled spark plug. However, more serious damage, such as an inability of the lungs to supply oxygen to the biological system or a nonoperable lubricating system in an automobile, inevitably will lead to destruction.

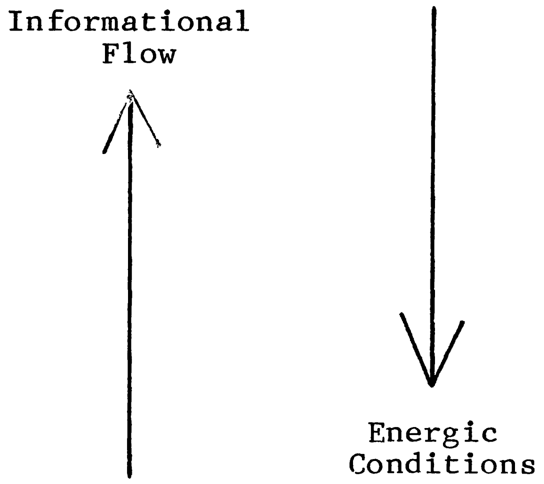
Regarding war, a social system finds itself in a similar situation. Since the beginning of recorded history, social systems have engaged in war and survived, even though destructive effects were relatively great. For example, during the Second World War, England sustained severe damage, but survived as a social system. In England, no doubt, the functioning of critical subsystems or institutional structures such as the family, government, church, business and school was disrupted, but none of these subsystems was damaged enough to preclude their fulfillment of goals or functional requisites. In a large nuclear war, as Chapter Two indicates, a different situation likely would come to pass. In short, research indicates that, in aftermath of a nuclear war, the meeting of functional requisites by various critical institutions will be impossible, or at least not possible to any extent that would allow adequate satisfaction of requisites. The consequence of such a development for the social system is illustrated through adaption and modification of Parsons' subsystem interrelations discussed earlier and shown in Figure 9.

This study sought to establish that destruction of the institutional components of high importance in the interrelationship for meeting the needs of information flow or guidance and control would result in the disorientation and disintegration of the social system. In turn, destruction of institutions, as sources of energic necessities such as human and, especially, material resources, will exacerbate further the disintegration. Thus, interdependence and

Figure 9. Structural Interrelations

INSTITUTIONS	FUNCTION
Government	Maintenance of Order
School & Church	Socialization, Maintenance of Sense of Purpose
Business	Production, Distribution of Goods and Services
Family	Reproduction of Population

INTERRELATIONSHIP

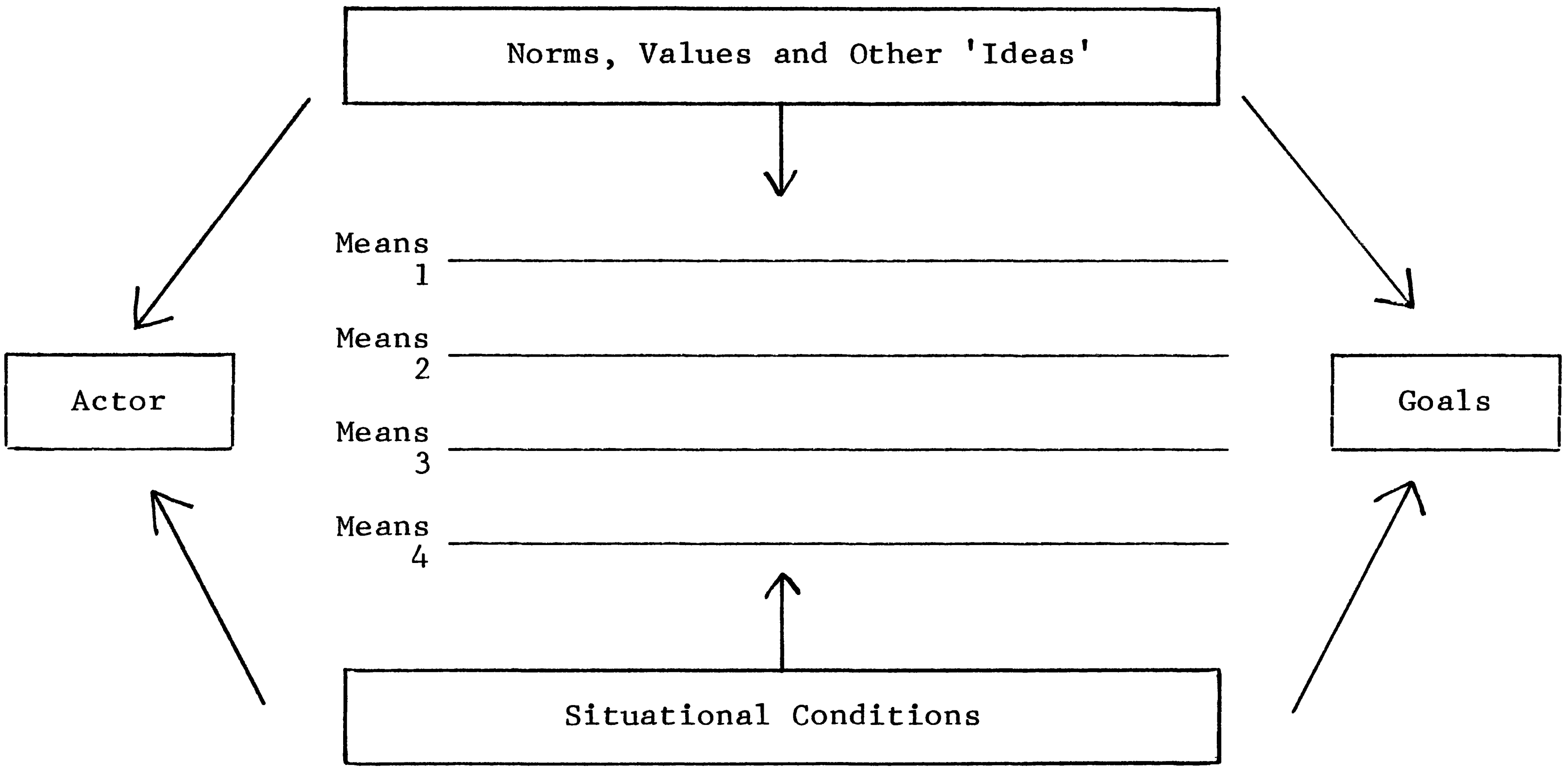


division of labor, so necessary for the existence of large industrial social systems, increase their vulnerability.

Reaction of the human element in the social system is particularly important to survival of the social system. The relationship of the human element as an individual or as a collective to the social system can be represented as an exchange process. In other words, the human element meets the needs of the social system by conforming to status and role requirements as long as the social system meets the individual's biological needs or necessities for life, such as food and shelter. According to Maslow (1954), individuals have both social and biological needs, but before social needs are deemed to be of urgent importance by the individual, biological or survival needs must be satisfied. Malinowski (1944) and Levy (1952) both state that human social systems are at base the result of human efforts to meet biological needs. As such, they will be maintained only by their possessors as long as they successfully meet such needs. If they prove unsatisfactory, they become an unnecessary encumbrance and possibly an obstacle to individual survival.

Parsons (1973:43-51) discusses what he terms the 'unit act' or basic human social action. It is represented diagramatically in Figure 10. Parsons views human social action as a goal-oriented process. The actor chooses from among various goals and means to achieve those goals. According to Turner (1978:43), the range of means and goals

Figure 10. The Unit Act



Source: The Structure of Sociological Theory, Turner (1978:4) available for selection by the actor is constrained or limited by normative conditions or ideas ". . . which influence what is considered a goal and what means are selected to achieve it . . ." and situational conditions such as the actor's ". . . biological makeup and heredity as well as various ecological constraints which influence the selection of goals and means . . ."

Normative and situational conditions thus may be viewed as motivators which direct the actor to manifest a desire for certain goals and select means to achieve such goals. Drastic alterations in situational conditions and institutions whose function is to maintain normative standards would either widen or further constrain the goals and means available to the actor. As an agent of change, nuclear war would narrow the goals of the individual and widen the range of means by which those goals could be achieved.

In a system suffering from mass disorientation and overwhelming physical damage, a situation in which survival or meeting biological necessities was problematic, a preoccupation with preattack social goals, such as the maintenance of social standing within the community, would seem ridiculous or even psychotic. The individual's goal (not goals) would be survival. The means of survival would be chosen on basis of instrumental efficiency, rather than narrowly-defined preattack normative standards.

Development and maintenance of norms and values supporting such social behavior as tolerance and social responsibility, depend on abundance, or at least a sufficient level, of material resources. Without such abundance, and lacking mechanisms of social control, a situation which Levy (1952) describes as the "war of all against all" likely would resuslt. In short, survival of some semblance of preattack social organization will depend heavily on existence of necessities of life and mechanisms of social control. For long-range recovery, other functional requisites also will have to be satisfied.

CHAPTER IV

METHODOLOGY

Objectives of Study

The present chapter discusses the research methodology utilized to achieve the five research objectives outlined below.

1. Determine the extent of physical damage expected in the Oklahoma City area as a result of the detonation of a nuclear device.

2. Develop an approximation of the number of those surviving and of the dead and injured after the explosion.

3. Based upon a knowledge of the probable damage to the social system of Oklahoma City, determine if it would be possible to maintain a preattack form of social organization.

4. If it is concluded that society and community, as they are now known, can no longer exist, determine the hypothetical social and economic characteristics of the post-attack social system.

5. Identify and describe the social problems that could emerge or be intensified as a latent social consequence of nuclear attack.

Research Design

The research design of this study is a variation of the quasi-experimental design known as a time-series design. This design incorporated a before and after observation of the Oklahoma City area, focusing on the effects of the introduction of an experimental stimulus or the hypothetical detonation of a one-megaton nuclear bomb. Figure 11 outlines the research design.

The preattack observation comprises data based upon the combination of information taken from the 1980 United States census, and the current Oklahoma City telephone directory. Data were gathered by interviews with employees of various governmental and commercial organizations, such as the Department of Civil Defense and Oklahoma Gas and Electric. Data from other sources, such as past nuclear war research and other literature, also were used.

The postattack observation was hypothetical, based upon the combination of the destructive effects of the hypothetical nuclear detonation upon the preattack data. Those effects were gauged with use of Glasstone's and Dolan's Nuclear Weapons Effects Computer, a circular slide rule which measures various destructive effects of nuclear detonations. In addition, the detonation's effects upon social organization, and the rise of postattack social problems, were gauged through use of structural functional theory discussed in Chapter 3.

Figure 11. Research Design of Present Study

Observation 1	Introduction of Experimental Stumulus	Observation 2
Oklahoma City Before Detonation	Detonation of 1 Megaton Bomb	Oklahoma City After Detonation
-Distribution of population by selected demographic variables -Location of vital physical and social facilities and institutions (government centers, etc.)		-Assess extent of physical damage -Develop approximation of the number of deaths and survivors -Determine characteristics of post-attack social organization -Discuss potential resultant social problems

This design was, by necessity, quasi-experimental in nature for a number of reasons. Obviously it was impossible to actually introduce the experimental stimulus into unit of analysis under question (a nuclear bomb on Oklahoma City). Furthermore, there was no control group necessary, as control groups are used primarily in experimental designs to test for effects of the experimental stimuli which sometimes can be rather subtle. In the present research, the immediate physical and biological effects of the experimental stimulus were without question attributable to that stimulus and they were easy to identify. Thus, a control group's purpose of isolating effects of an independent variable serves no purpose here. Moreover, the preexisting population distribution and social organization before the introduction of the nuclear blast served as a control group.

As a time-series design, this study which incorporated a single before and after observation, can be loosely termed what Cook and Campbell (1979:228) classify as a "short time-series design." Most time-series designs incorporate about 50 observations. However, Cook and Campbell (1979) suggest this may not be necessary. For this study a number of preattack observations served no real purpose, as Oklahoma City was observed only to measure characteristics of its social organization. Any changes that take place in Oklahoma City over time are considered inconsequential here as it is assumed they would have no confounding influence upon effects of the experimental stimulus, since they have no relationship to that stimulus in the preattack phase. Postattack observation also was of a one-shot nature. This was desirable because the more removed in time from the detonation, the more tenuous become conclusions as to what the postattack nature of Oklahoma City social organization may be. That is to say, accurate projections based upon data which suggest the characteristics of postattack social organization can be made shortly after the introduction of the experimental stimulus. However, for a time of ten or twenty years after the detonation, conclusions would tend to verge more and more on speculation.

Primary Data (Preattack Situation)

Census Variables

Information concerning the census variables examined was taken from the Census of Population and Housing for 1980 for the Oklahoma City area which is broken down by by census track. Those variables utilized by the present study are: 1) the total number of people in each census tract and 2) the number of year-round housing units in each census tract.

Use of census data as an information base from which to estimate population casualty rates is an acceptable method in nuclear weapons studies. Census data were utilized in such a manner by Openshaw and Stedman (1982), Butler (1982), Greene et al. (1982), Katz (1982), the United States Arms Control and Disarmament Agency (1979), the OTA (1980), and Heer (1965).

Distribution of Physical Resources

As noted in Chapter 3, from a structural-functional perspective, a social system may be broken into five basic institutions. They are business, government, education, church, and family. A distribution of specific physical facilities making up these institutions was plotted through use of a current Oklahoma City telephone directory as an information base which provides both listings and locations of physical facilities. Government and business facilities were plotted on a map.

Government facilities include federal, state, county and local governmental offices such as the capital building, the Department of Civil Defense, police stations, fire departments, Tinker Air Force base, National Guard armories, etc.

Business facilities include utilities, wholesale groceries, hospitals, communications facilities, pharmaceutical wholesalers, blood banks, etc. Certain components of the economic institution, because of their extreme dependence on a system of distribution and procesing, of which a particular community is only a small part, could not be dealt with adequately at a community level. They were not plotted on a map. The geographic locations of the food distribution system in Oklahoma City were plotted. Data concerning the characteristics of food production, storage, and distribution in the United States, taken from past research also are used in Chapter 5 to determine functional viability in the postattack period.

In addition, while production of petroleum products in Oklahoma City is slight to nil, they are vital to maintenance of the Oklahoma City social system. Research on availability of petroleum products after nuclear attack is utilized in Chapter 5. The institutions of education, religion, and family were not plotted for the following reasons. As basic institutions making up a social system, churches and families, in essence, are more than physical structures or facilities. Thus, they are not dependent upon physical structures for existence. Furthermore, these institutions are important from a long-term perspective for the survival of society. However, in the short-term, economic and governmental institutions are most vital, and if damage to these two institutions precludes maintenance of a preattack social organization, survival of education, religion, and familial institutions is inconsequential.
Those other facilities were located on an Oklahoma City Metropolitan Area map obtained from the graphic support division of the engineering department of the Oklahoma City Community Development Office. It allowed for plotting of approximate locations of these facilities, since it showed block address numbers. Maps detailing the characteristics

of electrical and water systems were obtained from the Oklahoma Gas and Electric Company and the Oklahoma City Engineering Department.

Secondary Data

Once geographic distribution of the population and physical resources is known, it was possible to estimate effects of a nuclear detonation. However, it should be kept in mind that methods for calculating those effects are hypothetical and statistical. According to the British Medical Association (BMA),

> They depend on extrapolations from the effects of the bombs on Hiroshima and Nagasaki which were small by today's standards; on the results of various countries' programs of weapons testing, especially the American above ground tests of the 1950s and early 1960s, and on theoretical models. In some respects, the physical effects of nuclear weapons can be predicted reliably. But since large weapons have never been exploded over cities, or in large numbers simultaneously, and since no nuclear weapons have been used in war since 1945, predictions of the outcome of nuclear explosions in modern times must remain speculative (1983: 46).

In large part, the speculative nature of estimates of the effects of nuclear detonations relates to certain unknowable circumstances that influence those effects. For example, size of the attack greatly determines the level of postattack destruction and also the nature of the concomitant social changes. Studies of nationwide nuclear attacks have been conducted based upon estimates of as few as 80 megatons to thousands of megatons. The size of the attacker's utilized arsenals and other conditions are impossible to predict with certainty. When examining a topic such as nuclear war, one must base conclusions upon certain assumptions.

This study's assumptions concerning conditions of the attack were as follows.

1. Oklahoma City was one target in a nationwide nuclear attack. As discussed in Chapter 2, there would be great differences in after-effects of an isolated single detonation and the simultaneous detonation of many warheads over targets from coast to coast. It seemed wise to develop a worst-case scenario to understand the possible consequences of a large-scale nuclear war -- in short, to judge whether survival on a societal level is possible.

In addition, it is unlikely that Oklahoma City would be targeted for an isolated nuclear attack, as it has no unqiue strategic attraction. It would be targeted only in a nationwide attack such as that proposed by R. L. Goen, et al. (1970) in which Oklahoma City was included as one of the 71 largest Standard Metropolitan Statistical Areas targeted by the Soviet Union. Oklahoma City was included in this attack, since it contained several important strategic industries as did other targeted areas. Oklahoma City likewise was a target in a United States Arms Control and Disarmament Agency (USACDA) study (1979), which examined vulnerability of the urban population to nuclear attack.

While this study assumed a nation-wide attack, it examined results only for the Oklahoma City area. This is a common practice. The BMA study (1983:138) states that "to make the effects of nuclear war more comprehensible . . . military planners and civil defense specialists usually examine the effects of a single weapon on a single target."

2. Detonation of the bomb was of the type known as an aerial detonation. Following the worst-case scenario, the weapon was assumed to be detonated in the air. This maximized the size of area destroyed by atmospheric overpressure or blast wave. This type of detonation is thus designed to create maximum general industrial and economic damage. An aerial detonation not only increases physical damage, but produces fewer long-range deaths. Initially, however, the number of deaths would be much larger. The OTA (1980) study compared death rates for a one-megaton ground burst and a one-megaton air burst weapon over Detroit and found initial casualties would be doubled in the aerial burst. However, they state later that, in the long term, deaths would be greater for ground-burst weapons, due to fallout.

While an aerial detonation may sound, at least as far as human deaths are concerned, as if it runs counter to the worst-case scenario. In fact, it does not. The larger number of people surviving will actually lower the quality of life for survivors and encourage the breakdown of any existing social cohesion by intensifing human competition over increasingly scarce resources.

3. The bomb had a nuclear yield of one-megaton. According to Fetter and Tsipis (1981:41) "a one-megaton yield is typical of a warhead on an intercontinental ballistic missile in the arsenal of the U.S.S.R." Most studies dealing with the effects of nuclear detonations over populated areas assume a weapon with a yield of one-megaton.

> It is a measure of the terrifying growth of nuclear arsenals over the last 30 years that the standard unit of nuclear currency for . . . calculations is a one-megaton weapon, only a medium-sized warhead in present day stockpiles but 80 times more powerful than the weapon that leveled Hiroshima (Geiger, 1982:138-139).

4. The detonation occured during the hours of darkness, early in the morning. This assumption was necessary due to the fact that census data were used as a data base from which to calculate population deaths and injuries. The BMA (1983) study and the OTA (1980) study both assume a night attack. Census data indicate the distribution of people at home and thus were representative of the distributive characteristics of a night-time population. According to the OTA study

> if an attack took place during a working day, casualties might well be higher since people would be concentrated in factories and offices (which are more likely to be targets) rather than dispersed in suburbs (1980:11).

This possibly is born out by Heer's (1965) study which compares the day and night population levels of the central business district of Chicago shown below in Table X. As

TABLE X

NET ACCUMULATION OF PERSONS ENTERING CHICAGO CENTRAL BUSINESS DISTRICT BY AUTOMOBILE PUBLIC TRANSPORTATION, MAY, 1937 WEEKDAY*

Time	Net Accumulation
6:00 a.m.	2,405
7:00 a.m.	13,746
8:00 a.m.	61,601
9:00 a.m.	173,592
10:00 a.m.	221,145
11:00 a.m.	249,624
12:00 Noon	268,285
1:00 p.m.	278,684
2:00 p.m.	283,748
3:00 p.m.	275,527
4:00 p.m.	263,349
5:00 p.m.	227,303
6:00 p.m.	132,570
7:00 p.m.	89,894
8:00 p.m.	77,851
9:00 p.m.	67,125
10:00 p.m.	52,270
11:00 p.m.	37,471
12 Midnight	24,833
1:00 a.m.	16,017
2:00 a.m.	11,269
3:00 a.m.	7,271
5:00 a.m.	6,564

*Base period for accumulation is 5 a.m.

Source: After Nuclear Attack, Heer (1965:19) the BMA (1983:57) study states, "the higher the density of the population, the greater the number of casualties caused by a given size of bomb."

As mentioned above, a night attack might well be preferred by the offensive nation. It could increase social breakdown in the aftermath of attack by increasing an individual's chance of surviving. Katz (1982:102) states that possible development of target plans that produce a maximum of industrial damage and a minimum number of civilian casualties are current subjects of discussion by American strategists. Reasons for such types of target plans are unknown, but possibly they may be viewed as more effective than would large numbers of immediate deaths.
A greater number of survivors would increase the number of individuals demanding satisfaction of survival needs and increase competition for scarce resources. Thus, the greater chance for total breakdown.

5. The attack took place during winter. This assumption is congruent with the "worst-case scenario" as it assumed a relatively hostile environment for a population without adequate food and shelter.

Projection of Physical Damage

Blast (Overpressure)

As noted in the first chapter, most damage from large nuclear weapons comes from atmospheric overpressure resulting from the detonation. This damage was calculated as follows:

A. With the use of Glasstone's and Dolan's (1977) Nuclear Weapons Effects Computer, determine locations of various facilities among the various rings of overpressure based upon their distance from ground zero.

B. Subtract the number of each type of facility destroyed from the total preattack number to determine the proportion surviving.

Estimates of the destructive powers of the various strengths of overpressure, measured in pounds per square inch (psi) were taken from the Glasstone and Dolan (1977) Nuclear Weapons Effects Computer. They are shown in Table XI.

Severe damage was defined as degree of damage that precludes further use of the structure or object for its intended purpose without essentially complete reconstruction. For a structure or building, collapse is generally implied.

Light damage was defined as degree of damage to buildings resulting in broken windows, slight damage to roofing and siding, blowing down of light interior partitions, and slight cracking of curtain walls in buildings. Minor repairs are sufficient to permit use of the structure or object as intended. Any damage other than light damage up to, but not including severe damage, results in

TABLE XI

ESTIMATES OF DESTRUCTIVE POWERS OF THE VARIOUS STRENGTHS OF OVERPRESSURE*

Type of Structure	Damage and Overpressures	
	Severe (PSI)	Light (PSI)
Buried Concrete Arch	200-280	120-160
Buried Steel Arch	45-60	30-40
Seismic Structure	15-30	1
Reinforced Concrete	7-15	1
Ordinary House	2-4	1
Glass Windows	.5-1	.2-.1

*Taken from Nuclear Weapons Effects Computer

Source: The Effects of Nuclear Weapons, Glasstone and Dolan (1977)

> . . . a degree of damage to principal members that precludes effective use of the structure or object for its intended purpose unless major repairs are made (Glasstone and Dolan, 1977:212).

Thus, any type of above ground structure in the 2 to 7 psi areas was damaged and unusable while those in the higher psi areas were demolished. Katz (1982:21) concurs when he states that ". . . the area receiving blast damage at 5 psi or above is usually considered destroyed and unuseable." The OTA (1980:18) study offers similiar statistics. (See Chapter 1).

Utilities

Regarding utilities in general, extensive damage was expected for some above-ground equipment in relatively high overpressure zones but underground equipment is comparatively safe. In Japan, for example, above-ground electrical equipment, such as utility poles and overhead powerlines, were severely damaged, while buried electrical circuits were unaffected.

A test conducted in 1955 in Nevada confirmed this situation. In this test, a power system was erected and subjected to 5 psi of overpressure. An electrical substation in this range of overpressure sustained only minor damage and still was operable with minor repairs. The above-ground distribution system sustained more extensive damage. "Of the 15 wood poles used to carry lines from the substation to the houses, four were blown down and two others were extensively damaged" (Glasstone and Dolan, 1977:198).

Furthermore, because telephone service equipment frequently is attached to utility poles, it is vulnerable.

> When the poles failed. . . the communications systems suffered accordingly. Although the equipment operated satisfactorily after repairs were made to the wire line, it appears that the power supply represents a weak link in the communications chain (Glasstone and Dolan, (1977: 206-207).

According to the OTA (1980:33), there would be a ". . . total loss of all utilities in areas where there has been significant physical damage to the basic structure of buildings. . . ." Thus any area subjected to an overpressure of 5 psi or more was without electricity and telephone communications. In addition, gas and water service were non-existent as broken pipes caused a loss of pressure.

Aircraft

Because one of the important targets residing within the Oklahoma City area is Tinker Air Force Base, the effects of overpressue on aircraft also were examined. According to Glasstone and Dolan (1977:194), aircraft receive damage at overpressures as low as 1 to 2 psi and are detroyed by overpressure in the 4 psi range.

Thermal Pulse and Fire

> It is possible that individual fires whether caused by thermal radiation or by blast damage to utilities, furnaces, etc. would coalesce into

> a mass fire that would consume all structures over a large area. This possibility has been intensely studied, but there remains no basis for estimating its probability (OTA, 1980:21).

The OTA (1980) study states that the most likely area in which fires may start are in the 2 psi ring since fires are more likely to start in damaged buildings than flattened ones. It estimates in the Detroit simulation that fire would destroy half the buildings in this area. However, it cautions that these estimates are ". . . extremely uncertain, as they are based on poor data . . ." (OTA, 1980:32).

Best estimates are that, in the area receiving 5 psi, about 10 percent of the buildings would develop serious fires. In the 2 psi area, about 2 percent of the buildings would burn, but these fires most likely would have as their source, blast damaged utilities rather than the thermal pulse (OTA, 1980:21).

Electromagnetic Pulse

There is no way to predict accurately the damage from electromagnetic pulse, since type and size of attack determines its influence.

> It can be caused by the detonation of a few nuclear weapons at high altitude (12.5 to 25 miles above the surface of the earth) or many air or ground bursts around the nation (Katz, 1982:171).

The Defense Civil Preparedness Agecy (DCPA) states that

> High-altitude bursts are no longer unlikely. . . the effectiveness of EMP in interrupting

> communications would make it probable that some of the thousands of warheads . . . would be used for this purpose (1973:5).

According to the DCPA (1973), commercial and amateur broadcasting antennaes and high overhead powerlines leading to electrical substations are highly vulnerable to the EMP. As this study assumed a large-scale attack, damage caused by electromagnetic pulse was extensive. Types of electrical equipment listed in Chapter 1 as being susceptible to the EMP were assumed non-operable.

Projection of Deaths and Injuries

Blast (Overpressure)

As with the calculation of damage to physical facilities from overpressure, a series of concentric rings were drawn from ground zero to represent selected peak overpressure contours. The radii of those circles were calculated again with the Nuclear Weapons Effects Computer.

Total population falling within each of these rings was counted, and casualties were calculated for blast, using a series of values which give percentages killed and injured in the selected peak overpressure ranges. The numbers killed by blast were subtracted from the surviving population, and the numbers of injured and uninjured noted.

As noted, it is necessary to derive some set of relationships between different ranges of peak overpressure value and the percentages of population killed or injured and uninjured in the corresponding overpressure zones. The OTA (1980) utilizes the relationships shown in Figure 12. "The principal source of the OTA rates . . . is the analysis of the American weapons tests conducted prior to the 1963 test ban treaty" (BMA, 1983:63). These blast casualty rates were obtained from the United States Department of Defense. According to the BMA (1983:63), most nuclear war studies use the OTA blast casualty rates.

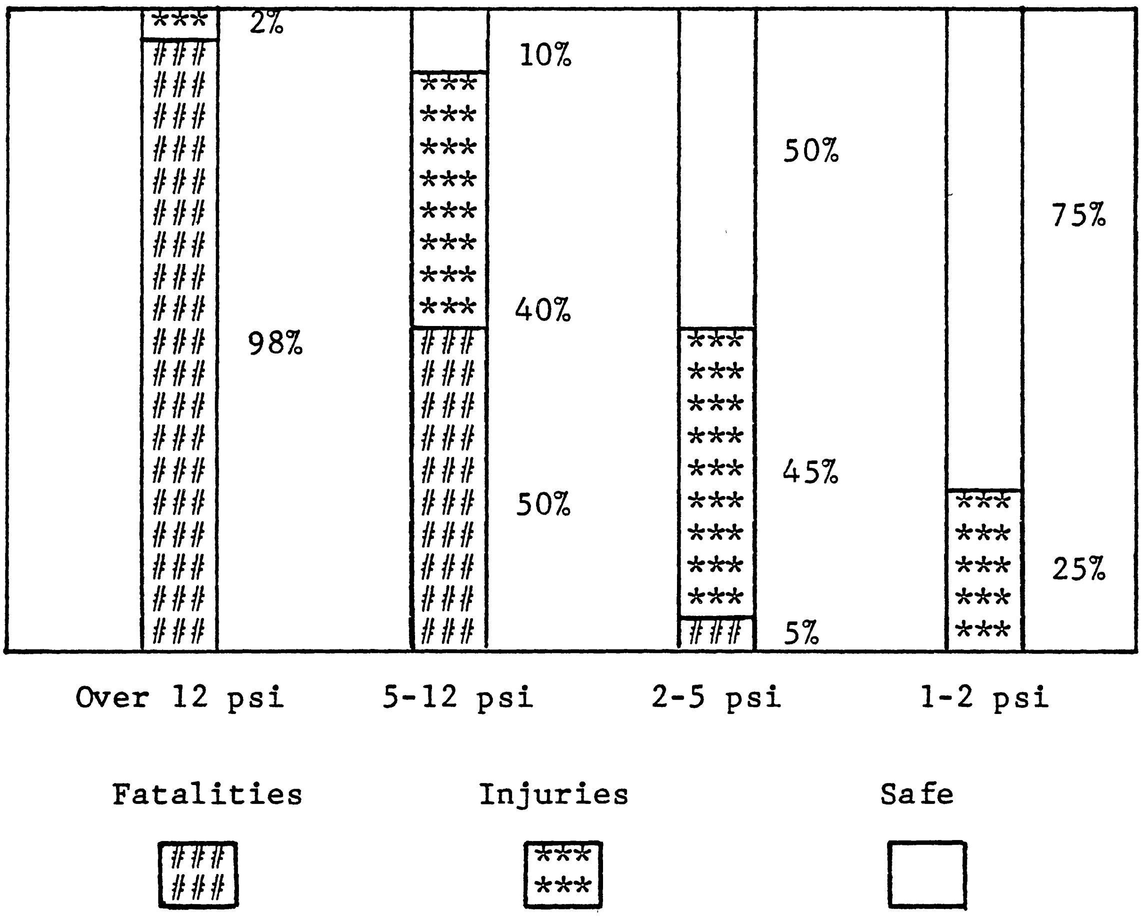
The Katz (1982) study utilizes a slightly different set of blast casualty rates for distances from ground zero. However, it states that casualty rates utilized are ". . . consistent with population impact criteria used by the . . . Office of Technology Assessment" (Katz, 1982:99). Those casualty rates are shown in Figure 13.

The OTA (1980) and the Katz (1982) studies were the only two encountered which give relatively precise casualty rates for various peak overpressure strengths.

> Some studies use a simpler technique, they assume that the number of people who survive in areas receiving more than 5 psi equal the number of people killed in areas receiving less than 5 psi and hence that fatalities are equal to the number of people inside the 5 psi ring (OTA, 1980:19).

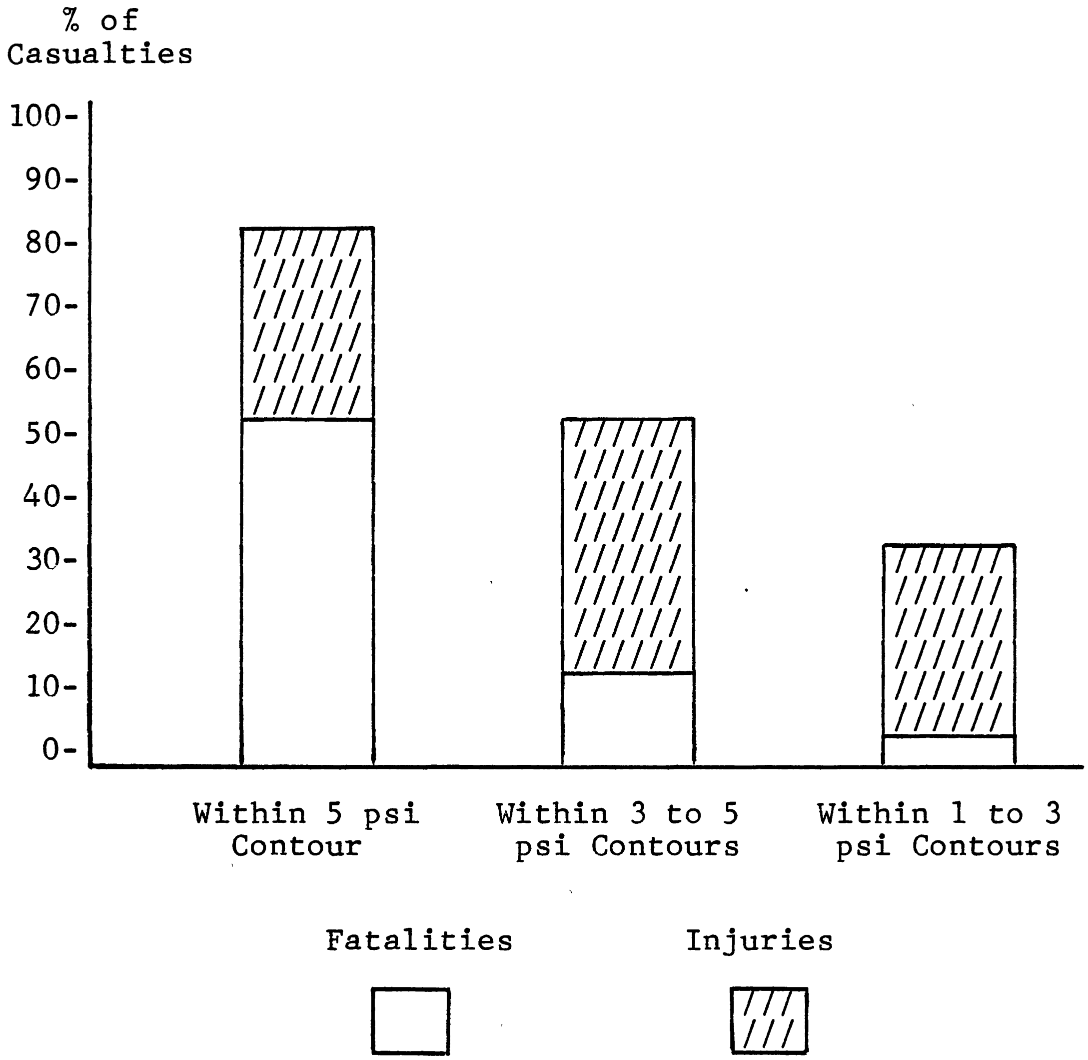
This method is considered flawed since it does not account for variations in population density. This study utilized the OTA population casualty estimates. They are more comprehensive than those used in the Katz (1982) study.

Figure 12. Vulnerability of Population in Various Overpressure Zones



Source: <u>The Effects of Nuclear War</u>, The Office of <u>Technology Assessment</u> (1980:19)

Figure 13. Casualties (Death and Injuries) Versus Distance (Contours) from Blast Site



Source: Life After Nuclear War, Katz (1983:101)

Thermal Pulse and Burns

> The number of casualties from thermal burns depends on the time of day, season and atmospheric visibility. Modest variations in these factors produce huge changes in vulnerability to burns. For example, on a winter night less than 1 percent of the population might be exposed to direct thermal radiation, while on a clear summer weekend afternoon more than 25 percent might be exposed (that is, have no structure between the fireball and the person) (OTA, 1980:31).

The OTA (1980) study estimates a one-megaton bomb detonated over Detroit on a winter night with 2 mile visibility would produce only 1,000 deaths and 500 injuries from the effects of thermal pulse.

In this study, burn casualties due directly to the thermal pulse were expected to be slight to nil, as the population was not in the direct path of the thermal pulse, given assumptions of a winter night attack. Burns also may be received indirectly by fires resulting from the thermal pulse. However,

> . . . attempts to calculate fire damage to property and possible resulting casualties are generally excluded, not because these would not occur, but because of the problems of estimation (BMA, 1983:71).

Radiation and Casualties

Casualties due to initial radiation were not calculated in this study since a weapon in the megaton range produces lethal levels of overpressure exceeding ranges of lethal initial radiation. Thus, would-be casualties of initial radiation were killed by overpressure. For example, this study assumed 98 percent fatalities in the over 12 psi overpressure range which, in a one-megaton detonation would cover an area with a radius of 2.5 miles from ground zero. However, survivors at this range would receive less than a 100 rem dose of radiation which, according to Table VI in Chapter I, would have little or no effect. The BMA (1983) study states that fallout casualties are calculated only in the event of a ground burst weapon. As this study assumed an aerial burst, fallout was not considered a factor in population casualties.

Projection of Social Impacts

Social impacts were extrapolated from a combination of estimates of the level of damage to the Oklahoma City population and vital facilities and structural-functional theory. Postattack social dynamics depend upon available resources, human and physical. The preattack social system maintains itself through various levels of sufficiency with regard to both resources. The important question to answer was: Did resources necessary for the maintenance of a preattack social organization survive nuclear detonation?

Supplies of food, water, and medical provisions would by necessity, need to be available to meet the requirements of the postattack population. In addition, structural components of the social system require sufficient personnel and facilities to function effectively.

As noted in Chapter 3, the social system comprises five basic institutions. For the short-term survival of society, economic and governmental institutions are most critical. The economy supplies the social system with the material necessary for proper functioning, and government provides leadership, order and protection. Figure 14 outlines the relationship of these two institutions with each other and the three remaining institutions -- church, school and family. One sees from Figure 14 that in Parson's terms, government has primary responsibility for latency, integration, and goal-attainment. However, it also performs the adaptive function of maintaining the system's water supply. The economy, on the other hand, has as its primary goal, adaption.

In addition, Figure 14 indicates that, to function, the economic and governmental institutions require:

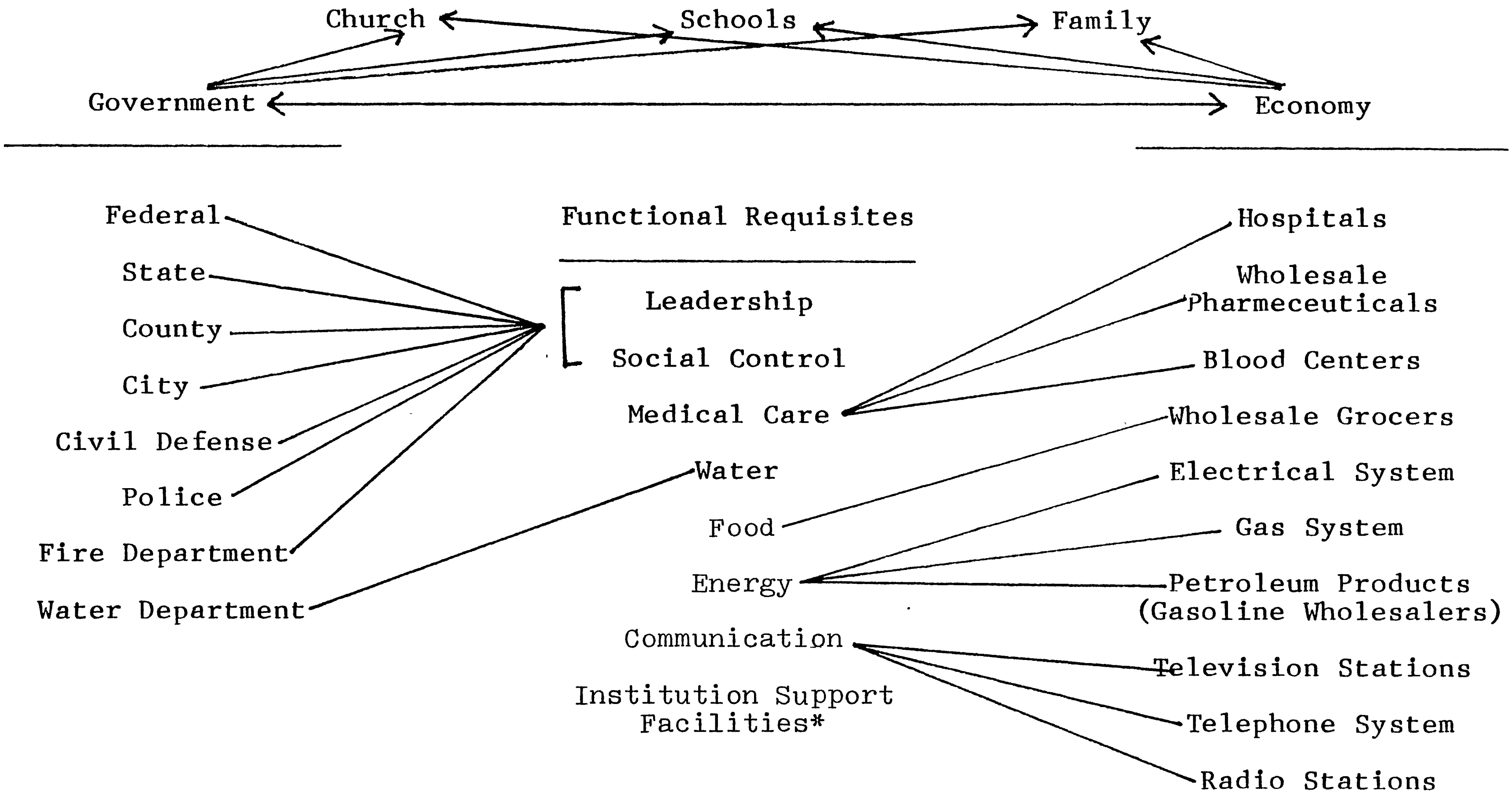
Trained Personnel

Adequate numbers of trained personnel (who require water, food, and medical care) were necessary.

Water

An adequate supply of potable water was the most critical necessity for postattack population recovery. Adequate supplies of water were needed for drinking and bathing, laundering, firefighting, and commercial uses. While it was not expected that water under pressure was

Figure 14. Institutional Relationships by Which Societal and Institutional Functional Requisites Are Supplied



*Support facilities, such as buildings and roads, are not continually supplied but already exist before the attack for each commercial concern and governmental agency available in the metropolitan area, due to damage to the water distribution system, there are several large resevoirs or lakes in close proximity to the Oklahoma City metropolitan area. These should have been safe supplies of water, assuming no fallout from an aerial burst. However, using these lakes as sources of water required some migration unless it were possible to transport the water into the city.

Food

Availability of a continuous supply of adequate food stocks is dependent upon the three stages of production, processing, and distribution. According to a DCPA (1973:8) study, immediately available food stocks, that is, those stocks existing at the processing and distribution points, would last approximately 70 days with the local sources (wholesale grocers and supermarkets) and home supplies maintaining 25 days of that 70 day preattack supply. Destruction of local sources and interstate distribution would lead to an immediate food shortage. It was predicted that food rationing if possible would be necessary on the part of governmental agencies.

Medical Care

Adequate medical care for survivors depended upon the existence of an adequate number of functional medical facilities and the availability of medical supplies in suitable amounts. All the studies reviewed in Chapter 2 concerning medical care in the postattack period indicate that adequate medical care in the aftermath of a nuclear attack would be impossible, due to the numbers of injured, even if medical care facilities survived such an attack, unscathed. The DCPA states that

> . . . medical care would have only a limited effect on the number of fatalities because most of the injured would either be beyond help when they could be treated or would survive in any event (1973:11).

It also suggests approximately 75 percent of the injured would survive without medical treatment.

Leadership and Social Control

This government function is vital (See Chapter 2). Recovery on a societal level depends upon coordination and cooperation which, in turn, are dependent upon direction from legitimate authority. In addition, for the population to view recovery as an activity that encompasses more than just individual problems, the government must assure competent control, coordination, and guidance of activities and protection of the population. In other words, government must demonstrate its competence by providing for the population's functional requisites.

Energy

Energy supplies in the form of natural gas, petroleum products, and electricity, as Chapter 2 indicates, are extremely important. Without such energy sources, food processing and distribution, as well as industrial production and distribution in general, would be extremely problematic. In addition, most forms of mass communication would be nonexistent. In short, without traditional energy supplies, existence of an industrial form of social organization is impossible. The same situation holds for governmental agencies and modern medical care.

Physical Support Facilities

The economy and governmental agencies require support facilities such as buildings and roads. Destruction of such facilities would severely handicap, if not prevent, functioning of these structural components of the social system.

Communications

Communications in industrial societies primarily consist of radio, television, and telephone systems. Communication systems are threatened by two of the five by-products of nuclear detonations -- blast and electromagnetic pulse.

Past research indicates that, in general, functioning communications systems will be nonexistent, due primarily to the electromagnetic pulse. However, car radios, as used by the police, for example, will be functional due to their power source (a battery) and relatively short antennas.

As noted in Chapter 2, a breakdown in communication systems of society would severely limit recovery efforts. This primarily is because such a situation would severely limit any large-scale organization and coordination of those recovery efforts.

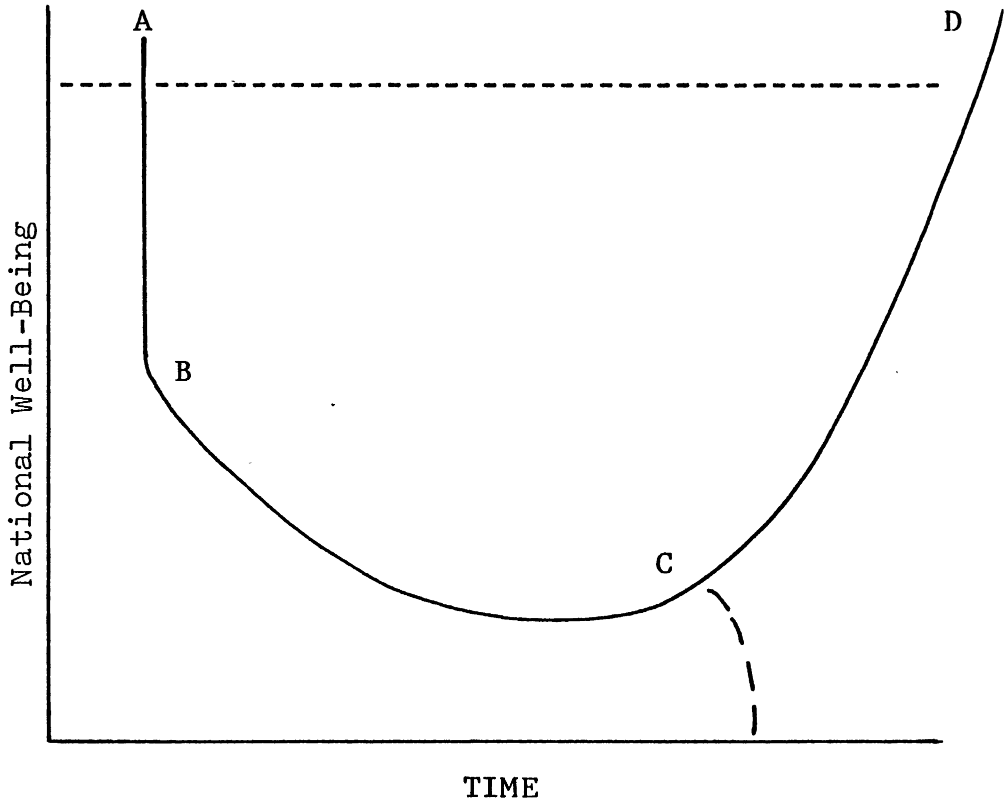
National Well-Being

According to the DCPA (1973:2), national well-being, and thus the well-being of subsystems of the nation or isolated urban areas, depend upon population composition, material resources and social and economic structural components of the social system. It represents alternative outcomes of nuclear attack diagramatically as in Figure 15.

After nuclear attack, the preattack societal well-being, represented as point A, declines immediately after attack to point B, with continued decline to point C until recovery efforts begin to show results when well-being will rise to point D at a preattack level. The study states that it is possible that societal well-being, as it declines to point C, may continue to decline, as represented by the dashed line if recovery efforts are ineffectual due to damage too severe to overcome or to incompetent recovery efforts.

The difference between a rise in well-being from point C to point D, or a continued decline from point C, depends

Figure 15. Possible Postattack Societal Dynamics



Source: DCPA Attack Environment Manual, Civil Defense Preparedness Agency (1973:2) upon the ability of society to implement and set in motion national goals for recovery with the nation utilizing all its resources in the most efficient manner. The DCPA (1973) study states that no local government or wider region can recover by itself. However, as Katz (1982) and Schell (1982) point out: in a nationwide attack, isolated communities could expect no outside assistance. In other words, resources outside the community would not be available. Availability of nonlocal resources for recovery is dependent upon existence of functioning urban areas. Assuming a large-scale nationwide attack, functioning urban areas will exist only if they can recover through individual efforts. If due to the extent of damages, recovery of the Oklahoma City Metropolitan Area is improbable, possible societal responses to such a development on the part of the population was explored through structural-functional theory and past research of human reaction to stress situations.

CHAPTER V

PHYSICAL IMPACTS OF HYPOTHETICAL NUCLEAR DETONATION

Ground zero for detonation over Oklahoma City was chosen to result in the maximum possible damage and, at the same time, engulf Tinker Air Force Base in an overpressure region sufficient to damage parked aircraft. Based upon location of ground zero, ranges of various strengths of atmospheric overpressure were calculated and plotted upon the maps utilized by this study to determine the extent of damage.

Population Impacts

Figure 16 shows location of census tracts within various overpressure rings. Most all the Oklahoma City area population lives within areas affected by overpressure. Tables XII and XIII show population impacts of detonation.

Examination of Table XIII shows that, with 25% of the Oklahoma City population dying as a result of the explosion, the City is left with a surviving population of little over one-half million. These numbers closely approximate those of a United States Arms Control and Disarmament Agency

Figure 16. Location of Census Tracts Within Various Overpressure Rings

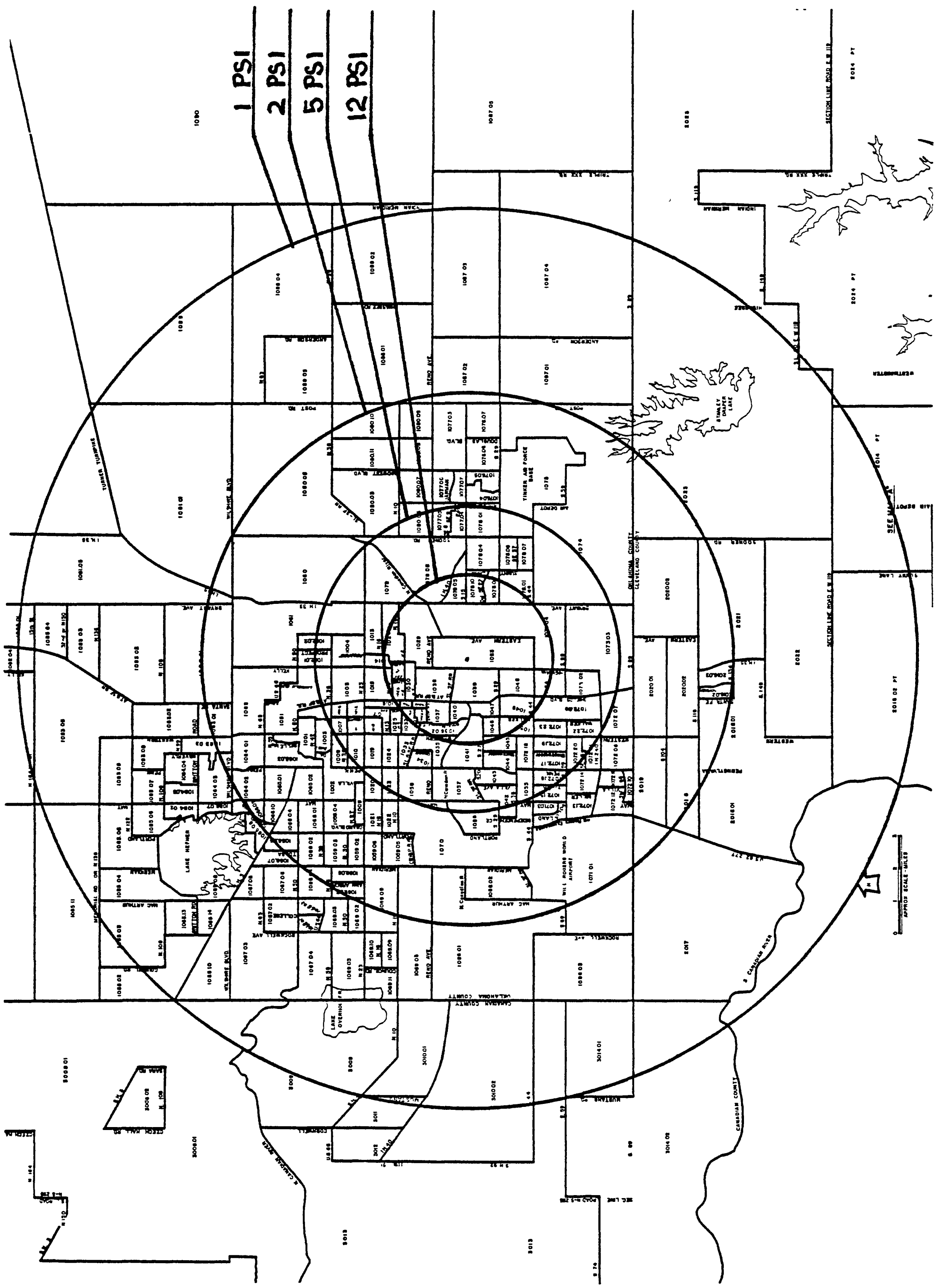

1 PSI
2 PSI
5 PSI
12 PSI

TABLE XII

IMMEDIATE EFFECT ON THE POPULATION OF OKLAHOMA CITY OF THE HYPOTHETICAL DETONATION

	Number	Percentage
Dead	120,100	18
Injured	197,281	29
Survivors	358,215	53
TOTAL	675,596	100

TABLE XIII

FINAL POPULATION DISPOSITION FROM DETONATION

	Number	Percentage
Dead*	169,421	25
Survivors	506,175	75
TOTAL	675,596	100

*As discussed in Chapter 4, an estimated 25% of the injured would die without significant medical attention. Thus, 25% of the number injured added to the number of deaths.

(USACDA) Study (1979) which calculated that a one-megaton bomb detonated over Oklahoma City would produce 221,000 fatalities. This study's number of fatalities is smaller. The USACDA study targeted weapons to produce the highest number of population casualities rather than the most extensive economic damage, while this study targeted the nuclear warhead to produce maximum damage to the physical facilities making up the important structural institutions of the Oklahoma City social system.

Physical Impacts

Housing

As mentioned in Chapter 4, shelter from elements would be of particular importance to survivors of the Oklahoma City detonation. For this reason physical damage to housing units in the Oklahoma City limits was calculated. The overpressure rings in Figure 16 were used to calculate damage to housing. Table XIV indicates extent of damage to housing. The pattern of damage to housing runs the opposite of population deaths. Whereas 75% of the population survived, 63% of the housing units were destroyed and an additional 27% were uninhabitable without moderate to minor repair. As a result, without large-scale migration, the people of Oklahoma City faced a severe shortage of housing due to structural damage.

TABLE XIV

DAMAGE TO HOUSING IN THE OKLAHOMA CITY AREA

Type of Damage	Number of Housing Units	Percentage of Housing Units
Severe (+2 psi)	174,102	63
Light (2-1 psi)	75,528	27
Safe (-1.0 psi)	28,182	10
TOTAL	277,812	100

The Economic Institution

As Figure 14 in Chapter 4 indicated, the economic institution is viewed as comprising important components which fulfill the functional requisites of other institutions and the population of Oklahoma City. These components are:

1. Hospitals
2. Wholesale Pharmeceuticals
3. Blood Centers
4. Wholesale Grocers
5. Television Stations
6. Telephone System
7. Radio Stations
8. Electrical System
9. Natural Gas System
10. Wholesale Gasoline and Diesel Fuel Stations

Table XV lists damage to these components with the exception of the telephone system, radio stations and the natural gas system, since data for these were unavailable. In addition, the electrical system for which data was available is not listed. These systems are dicussed below.

Medical Care

Figures 17, 18, and 19 indicate locations of medical care components within the various overpressure rings. The medical care components, one through three would be unable to meet the requirements of the postattack population. All

TABLE XV

DAMAGE TO COMPONENTS OF THE ECONOMIC INSTITUTION

Type of Component	Total Number of Facilities	Destroyed (+7-5 psi)		Damaged† (5-2 psi)		Functional* (-2 psi)	
		#	%	#	%	#	%
Hospitals	12	5	42	5	42	2	17
Wholesale Pharmeceuticals	4	0	0	2	50	2	50
Blood Centers	6	4	67	2	34	0	0
Wholesale Grocers	18	12	67	4	22	2	11
Gas and Diesel Wholesalers	16	8	50	6	38	2	13
Television Stations	9	0	0	6	67	3	33

†These are not able to function without substantial structural repair
*Assuming only structural damage from overpressure to the facility itself

Figure 17. Location of Hospitals Within the Overpressure Rings of A Hypothetical One-Megaton Detonation

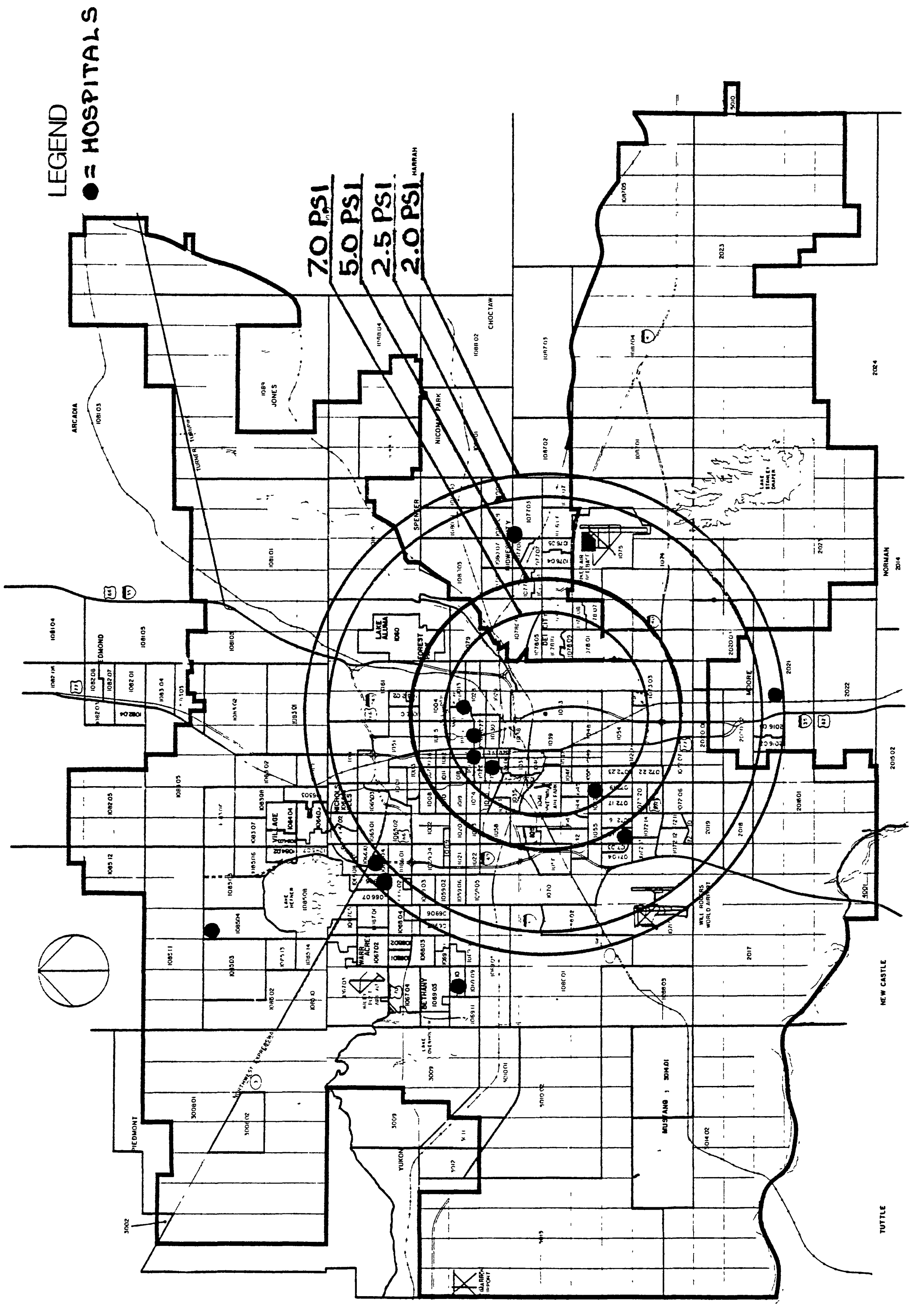

LEGEND
● = HOSPITALS
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
HARRAH
CHOCTAW
NICOMA PARK
SPENCER
JONES
ARCADIA
EDMOND
LAKE HEFNER
BETHANY
MOORE
NORMAN
NEW CASTLE
MUSTANG
YUKON
PIEDMONT
TUTTLE
WILL ROGERS WORLD AIRPORT

Figure 18. Location of Wholesale Pharmaceutical Outlets with the Overpressure Rings of A Hypothetical One-Megaton Detonation

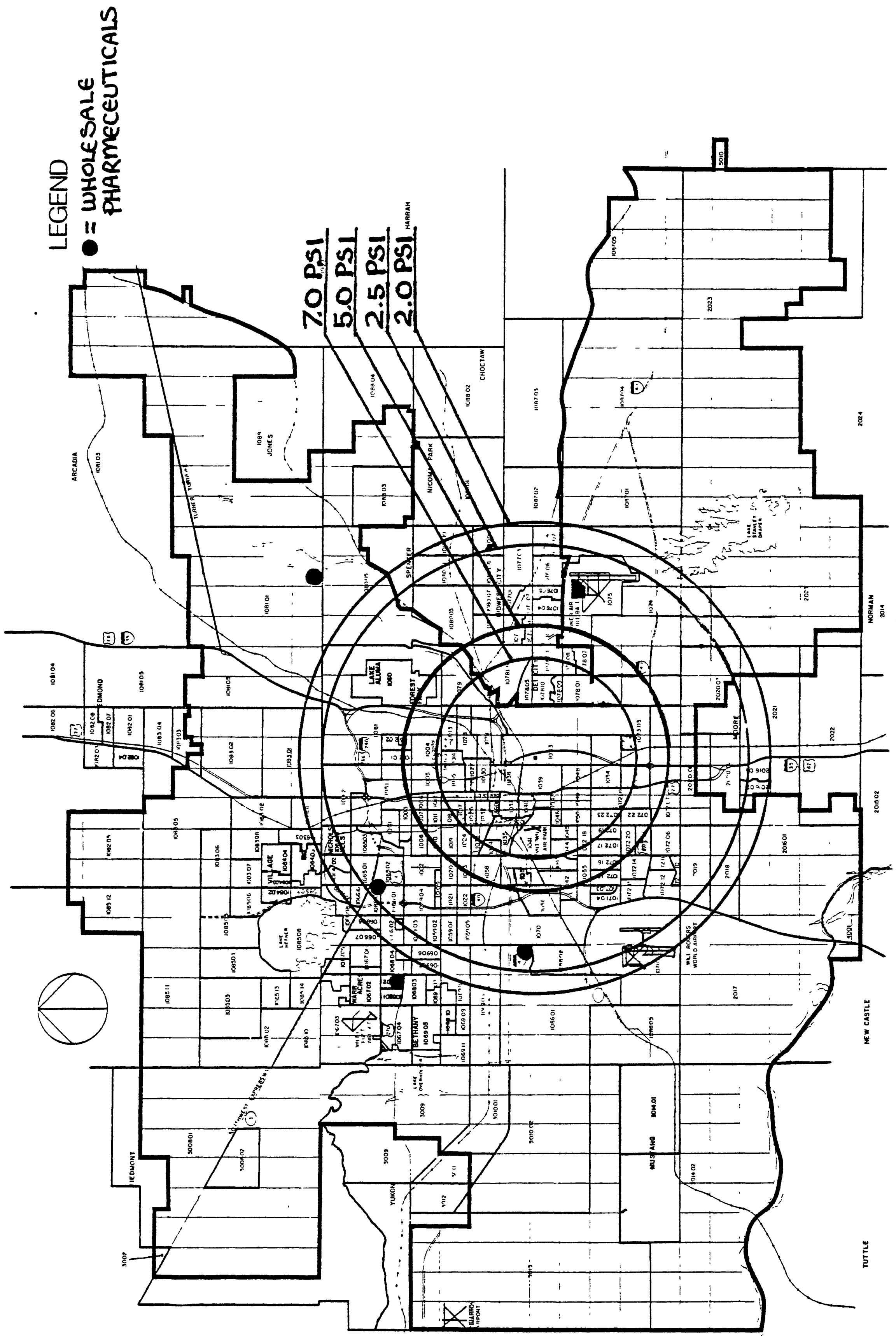
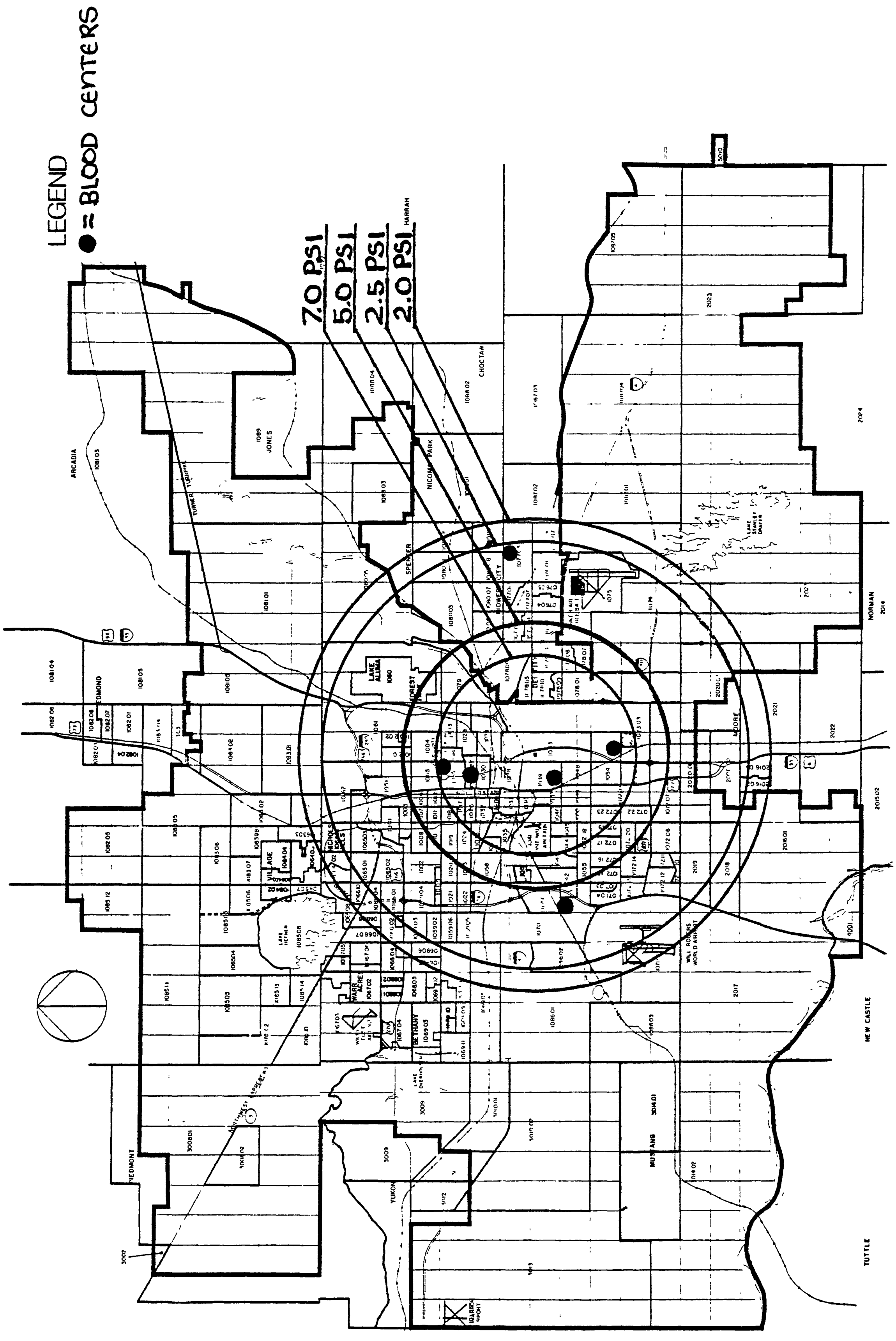

LEGEND
● = WHOLESALE PHARMACEUTICALS
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI

Figure 19. Location of Blood Centers Within the Overpressure Rings of A Hypothetical One-Megaton Detonation


LEGEND
● = BLOOD CENTERS
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
HARRAH
CHOCTAW
NICOMA PARK
SPENCER
JONES
ARCADIA
EDMOND
MOORE
NORMAN
NEW CASTLE
TUTTLE
MUSTANG
YUKON
BETHANY
PIEDMONT

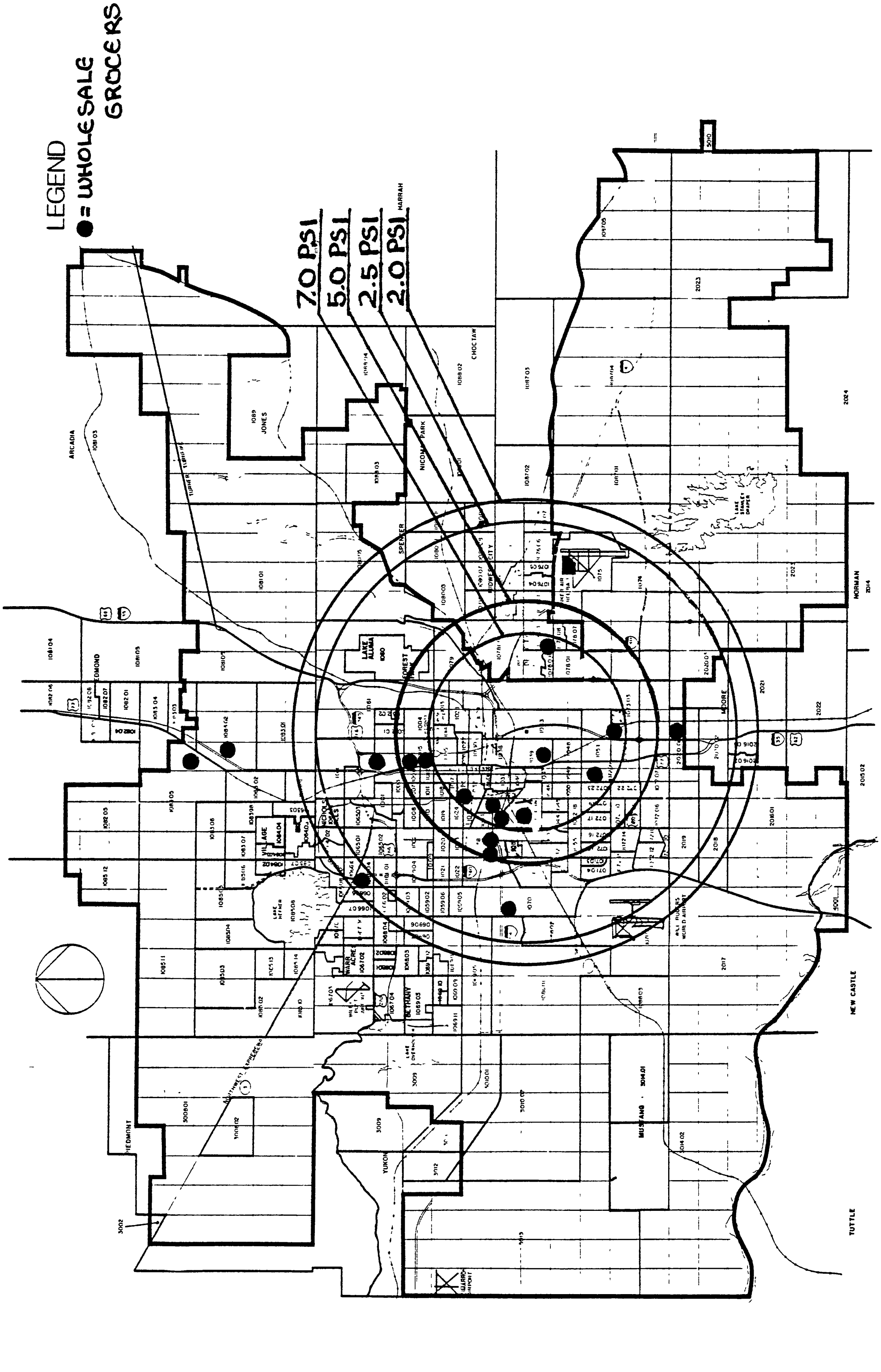
previous studies (see Chapter 2) indicate that medical care facilities would be inadequate to cope with postattack population requirements. Given that the hospitals in Oklahoma City have a total of 3,500 beds and the number of injured is approximately 197,280, it is obvious that, even if the medical care components survived the attack unscathed, they would be inadequate to meet medical requirements of injured. However, damage has been extensive.

Food

Food availability is extremely important in the aftermath of nuclear attack. As discussed in Chapters 2 and 4, the food system comprises three stages: production, processing, and distribution. Food products are ready for consumption and become available to the consumer only at the distribution stage which consists of interstate and local wholesale warehouses and grocery stores. As noted in Chapter 4, these various sources of processed food maintain approximately 70 days' supply of food, combined with local warehouses, retailers, and households contributing 25 days of that 70-day supply.

There were 18 wholesale grocery warehouses in Oklahoma City and a large number of retail food stores. Table XV shows that of these 18 local wholesalers, 12 (67 percent) were destroyed and an additional 4 (22 percent) were moderately damaged leaving 2 (11 percent) functional. Figure 20 shows location of wholesale grocers within the overpressure

Figure 20. Location of Wholesale Grocery Installations Within the Overpressure Rings of A Hypothetical One-Megaton Detonation

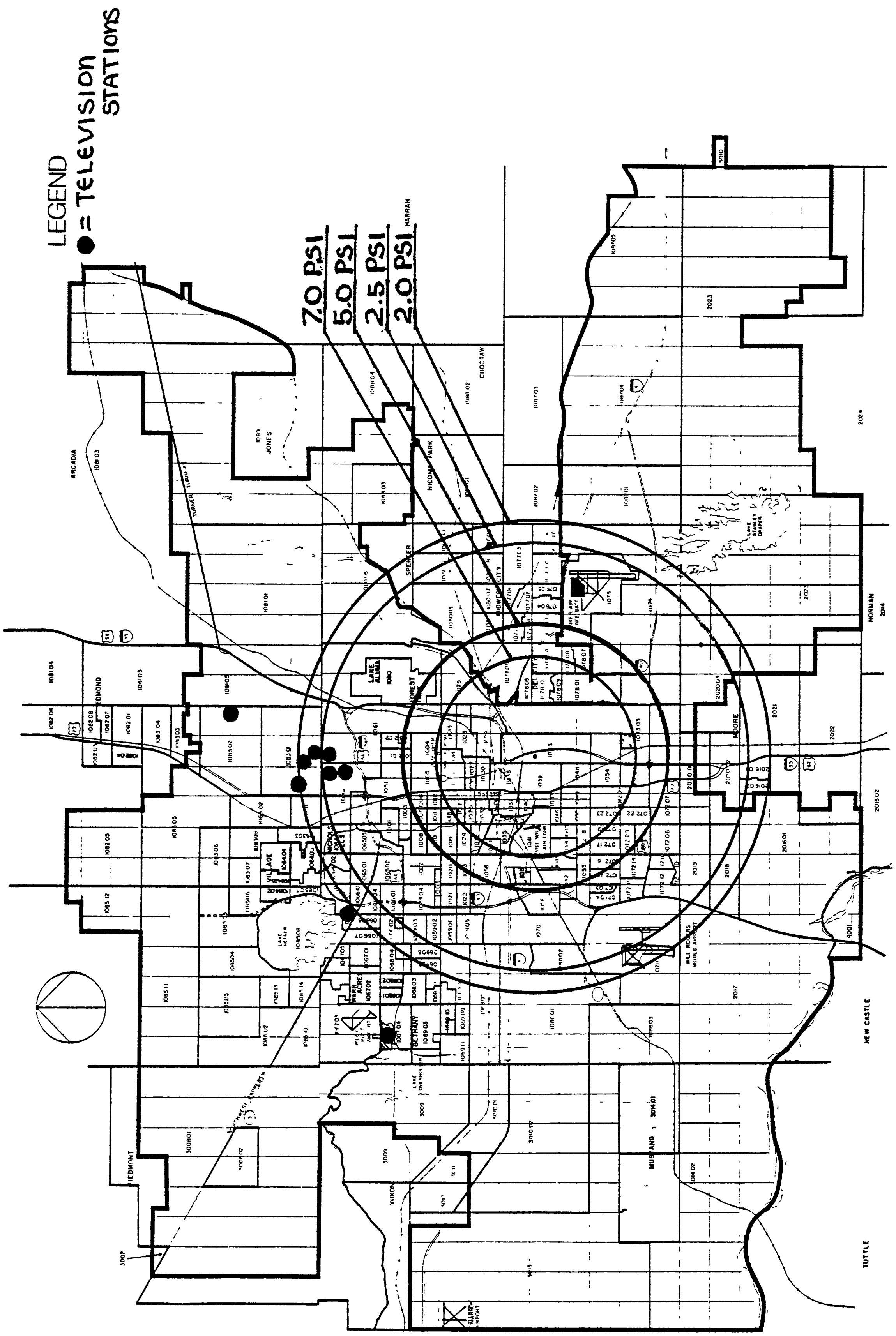

LEGEND
● = WHOLESALE GROCERS
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI

rings. According to Christenson et al. (1984), food retailers would not be able to contribute greatly to food supply, even though a large number of them could be expected to suffer only light damage, given that most large supermarkets have relocated from the inner cities to suburbs, as they keep at most a 2 to 3 day supply of stocks on hand. Thus, commercial sources of food in Oklahoma City were practically nonexistent. In addition, past research (Christenson et al. 1984) indicates that urban homes in general maintain supplies of food that would last for approximately 7 days. Given that 75 percent of the Oklahoma City population survived the attack, all combined supplies of processed food would last only a few days at most without food shipments from outside the city. However, as noted, even under normal conditions, supplies of food in cities would last only 25 days without food shipments from outside the city. Food shipments from outside the city would not be a viable food source since this study assumed a nation-wide strike. As a result, other urban areas suffered damage similiar to Oklahoma City and were unavailable to assist. In addition, certain strategic industries vital for food production and transportation, such as the petroleum industry, would undoubtably be deliberately targeted.

Communication

Locations of television transmitters protected then from the heavier overpressure ranges. Figure 21 indicates

Figure 21. Location of Television Stations Within the Overpressure Rings of A Hypothetical One-Megaton Detonation



LEGEND
● = TELEVISION STATIONS
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
HARRAH
CHOCTAW
ARCADIA
JONES
NICOMA PARK
SPENCER
EDMOND
MOORE
NORMAN
NEW CASTLE
TUTTLE
MUSTANG
YUKON
BETHANY
VILLAGE

their position among the overpressure rings. As a result, as shown in Table XV, none was destroyed. However, none was functional due to electromagnetic pulse. Furthermore, while the locations of radio transmitting stations were unavailable, it can be stated that none of these facilities was operational after attack, also because of electromagnetic pulse.

Data were unavailable for another means of communication - the telephone system. As a result, damage to these facilities was unestimatable. However, given the fact that the overwhelming majority of housing in the Oklahoma City area was rendered uninhabitable and, also that the telephone is not an efficient means of communication where large-scale social organization is a goal (it limits communication to one-to-one interactions), estimates of damage to this system of communication are inconsequential. On the other hand, television and radio being means of mass communication and, therefore, a quite efficient means of organizing and directing human masses, were rendered ineffectual by over-pressure and the electromagnetic pulse. Before these communication systems could become operational again, structural damage from the blast would have to be repaired and components of the system damaged by the electromagnetic pulse such as high-voltage capacitors, would have to be replaced.

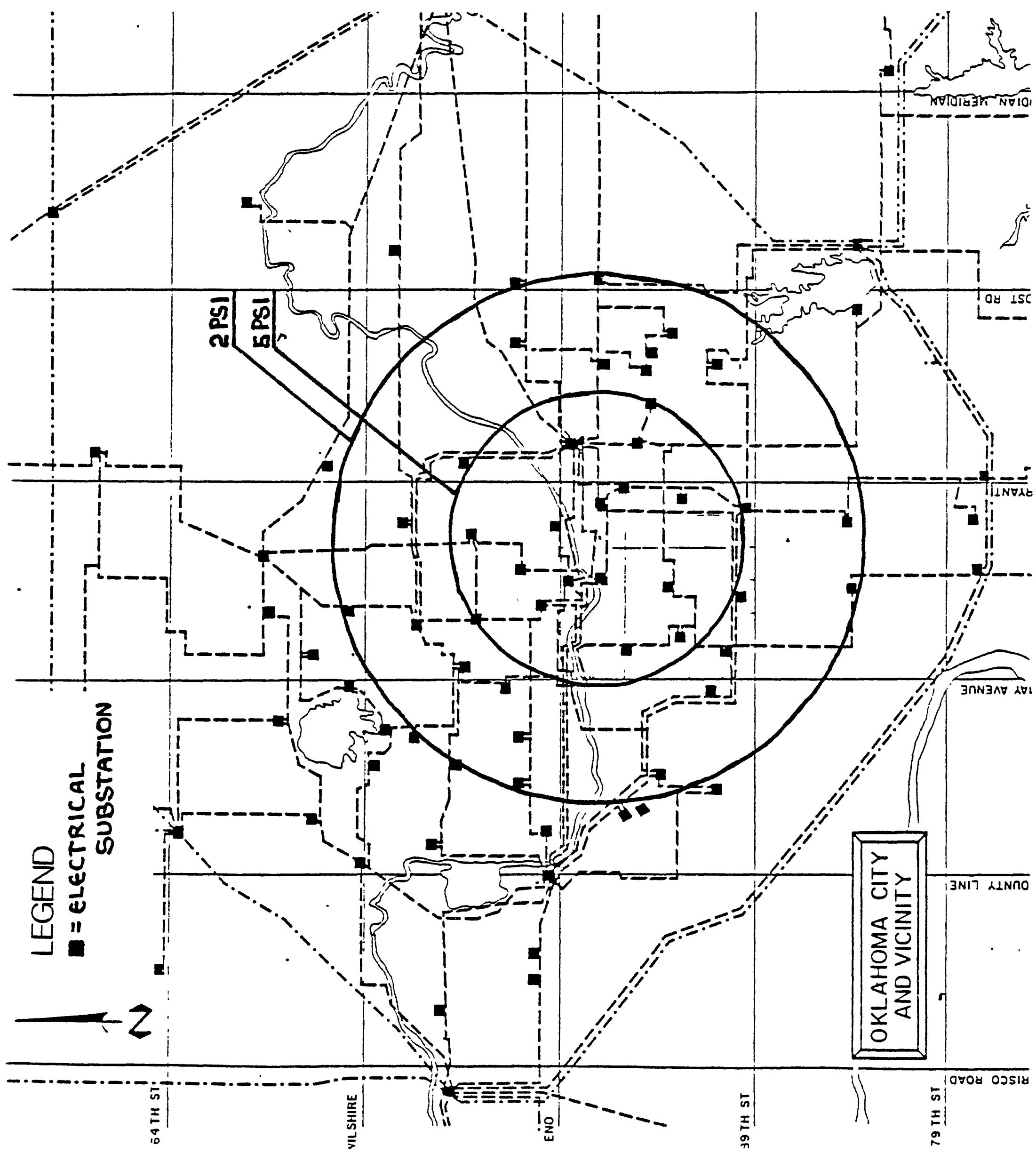
Electricity

Regarding the electrical distribution system, the substations are the critical link in the chain providing electrical supply. Electrical power flows from generating plants at very high voltages along transmission lines to substations where it is reduced to a voltage usable by the consumer. If substations are destroyed, then generating plants are useless. Within the Oklahoma City area there are 71 substations. Their locations among the overpressure rings is shown in Figure 22. As noted in Chapter 4, these structures are highly resistant to blast damage. Of the 71 substations, 16 are located in the 5 psi and above overpressure range. It is safely assumed that they sustained minor structural damage requiring some repair before they would again be operational. An additional 22 substations are located in the 5-2 psi overpressure range and are probably structurally sound. The remaining 33 substations are beyond the 2 psi overpressure range and thus were surely safe from blast effects. Thus, the majority, if not all, of the substations, were operational with only minor repairs, unless they were damaged by falling debris. Power lines are excellent collectors of electromagnetic pulse and

> surge voltages on overhead power lines may be sufficiently large to cause arcing in substations and at branches or changes in direction along the lines. Insulators can be damaged and circuit breakers locked out (DCPA, 1973:11).

The DCPA (1973:11) further states that ". . .the cumulative

Figure 22. Location of Electrical Substations Within the Overpressure Rings of A Hypothetical One-Megaton Detonation


LEGEND
■ = ELECTRICAL SUBSTATION
N
2 PSI
5 PSI
OKLAHOMA CITY AND VICINITY
64TH ST
79TH ST

weight of EMP effects thus makes likely widespread power failure on a national scale . . . ."

Unlike substations, transmission and distribution lines are vulnerable to overpressure. Power lines are above ground in Oklahoma City. As noted in Chapter 4, 5 psi of overpressure was sufficient to severely damage power lines in tests conducted by the Department of Defense. One may thus conclude that extensive damage to the electrical system would exist within the 5 psi overpressure ring.

This may not be of consequence since all buildings within this area were severely damaged. Outside the 5 psi ring, damage was less extensive. However, as mentioned above, there likely would be power outages not only for the Oklahoma City area but for the nation as a whole (assuming a nationwide attack combined with high altitude bursts). The re-establishment of electrical power to less-damaged and undamaged areas would depend upon survival of repair equipment and materials and trained personnel organized to perform such work.

Existence of electrical power would be much more problematic if the electrical generating stations themselves were destroyed. There are only eight such generating stations in the state of Oklahoma. It would not be difficult to target them to receive small warheads.

Natural Gas

Natural gas would be available to all structures so equipped that did not suffer severe structural damage (Glasstone and Dolan, 1977:195). However, most housing suffered severe damage.

Petroleum Products

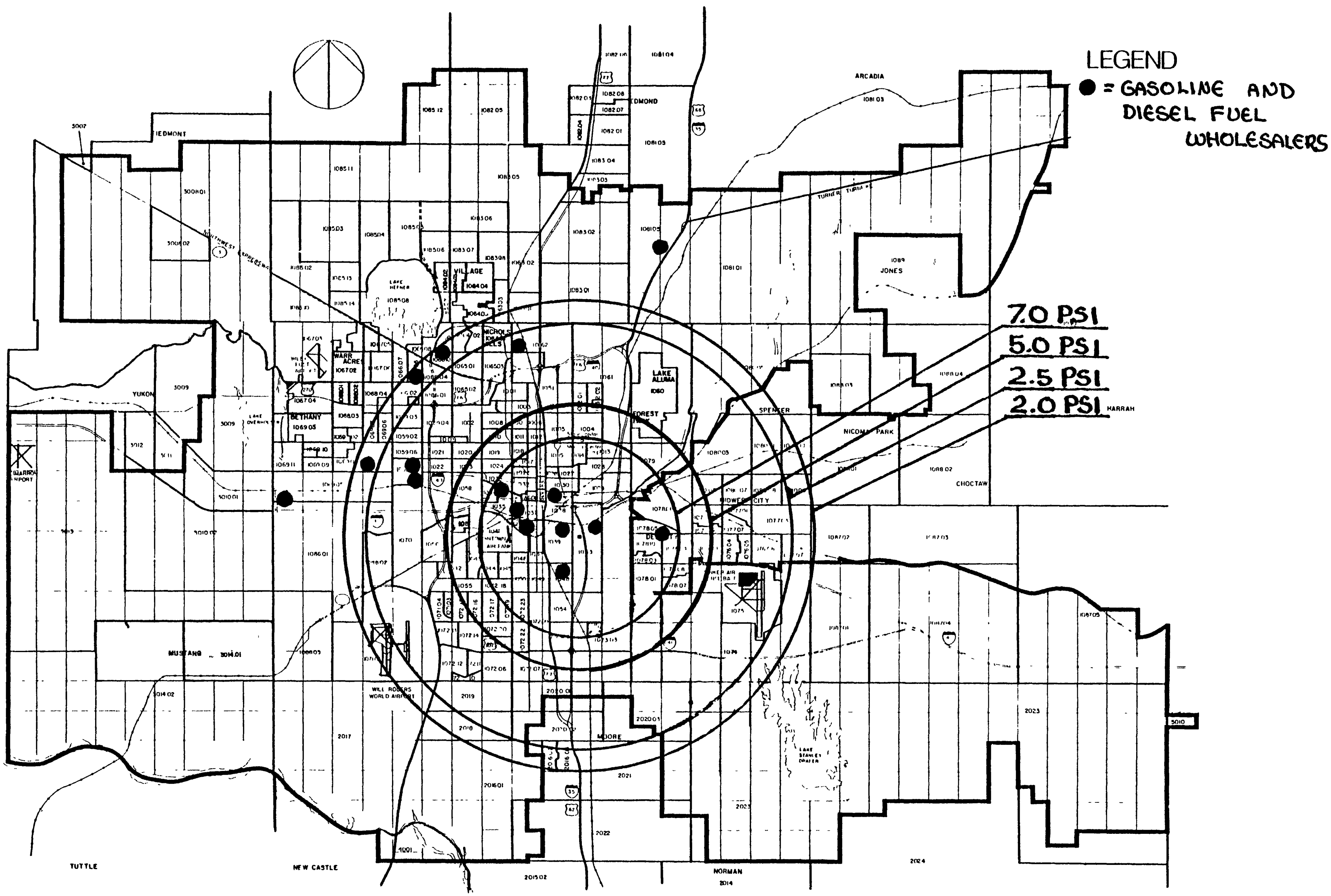
Wholesale gasoline and diesel distributors were used to gauge the availability of petroleum products in the Oklahoma City area following nuclear attack. There were 18 such wholesale installations in Oklahoma City. But, as a glance at Table XV indicates, 50 percent were destroyed, 38 percent damaged beyond use, and 13 percent survived. Their locations within overpressure rings are shown in Figure 23. It is evident that petroleum products in the form of fuel would be severely limited in supply. Furthermore, as discussed in Chapter 2, a small number of warheads in a nationwide strike could easily be so targeted as to virtually eliminate fossil fuels as a viable energy source.

The Governmental Institution

Water

The government provides the population with one biological necessity - water. The water system of Oklahoma City comprises nine major pumping stations which move water from Lakes Overholser, Hefner, and Draper. In addition, there is available storage for 22.5 million gallons of water. Continued functioning of the water system is

Figure 23. Location of Gasoline and Diesel Wholesalers Within the Overpressure Rings of A Hypothetical One-Megaton Detonation


LEGEND
● = GASOLINE AND DIESEL FUEL WHOLESALERS
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
ARCADIA
EDMOND
JONES
HARRAH
SPENCER
NICOMA PARK
CHOCTAW
LAKE ALUMA
FOREST PARK
MIDWEST CITY
DEL CITY
NICHOLS HILLS
VILLAGE
LAKE HEFNER
WARR ACRES
BETHANY
LAKE OVERHOLSER
YUKON
MUSTANG
MOORE
NORMAN
TUTTLE
NEW CASTLE
WILL ROGERS WORLD AIRPORT
LAKE STANLEY DRAPER
TURNER TURNPIKE
SOUTHWEST EXPRESSWAY

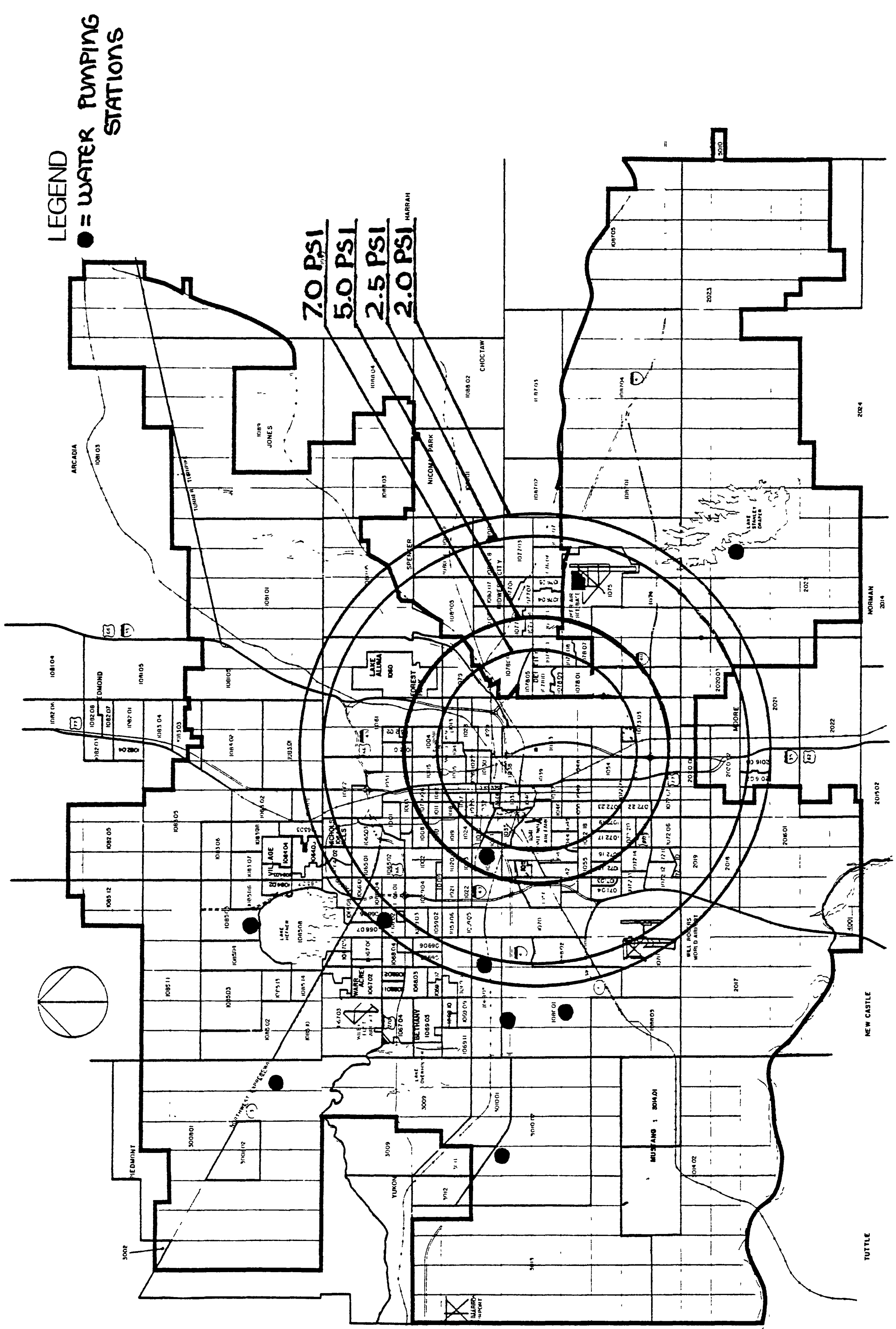
important. The average daily consumption of water in Oklahoma City is 90 million gallons.

A study of Figure 24 shows that one pump station in the +5 psi range was destroyed and two others in the 5-2 psi range were damaged. The remaining pump stations were still operable as long as fuel was available. Fuel availability, as the above discussion on energy indicates, would be problematic no matter what type of fuel is used.

In addition, even with the majority of pumping stations surviving, water service would be unavailable, since broken pipes and water mains in the high overpressure regions would result in a loss of water pressure overall. Closing off the damaged sections of the distribution system would re-establish water pressure as long as the pump stations remained operable.

The water system is important not only because it furnishes water, but also because it treats water and filters it to prevent diseases such as dysentery and typhoid fever and other health problems such as lead and other metallic poisonings. If the water system was unable to maintain an operational status, survivors of the nuclear attack could acquire water from the same lakes the water system does. However, they would have to boil it to prevent diseases, and they would be subject to the other health problems mentioned if they were without knowledge to build apparatuses to filter out various types of impurity.

Figure 24. Location of Water Pumping Stations Within the Overpressure Rings of A Hypothetical One-Megaton Detonation



LEGEND
● = WATER PUMPING STATIONS
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
HARRAH
CHOCTAW
JONES
ARCADIA
NICOMA PARK
SPENCER
EDMOND
LAKE ALUMA
FOREST PARK
VILLAGE
LAKE HEFNER
WARR ACRES
BETHANY
LAKE OVERHOLSER
YUKON
PIEDMONT
MUSTANG
MOORE
NORMAN
NEW CASTLE
TUTTLE
LAKE STANLEY DRAPER
WILL ROGERS WORLD AIRPORT

It is highly probable that treated water pumped to houses was unavailable immediately following the attack. This water would continue to be unavailable if repair work to the distribution system was not instituted and fuel was not acquired.

Governmental Agencies of A Control And Protection Nature

Regarding governmental agencies of a control and protection nature, a study of Table XVI indicates the extent of damage.

Civil Defense

Figure 25 shows the location of civil defense agencies within the overpressure rings. The Oklahoma City civil defense agency would be ineffectual in any efforts it might make at recovery or protection of the population as their broadcasting antennae was damaged. The facility itself, being located underground, would survive. The state and county civil defense agencies were both located within the +7 psi overpressure range, an area characterized by devastation. The remaining two civil defense facilities are located in Midwest City and Yukon. They probably would be more concerned about problems faced by those two areas.

Law Enforcement

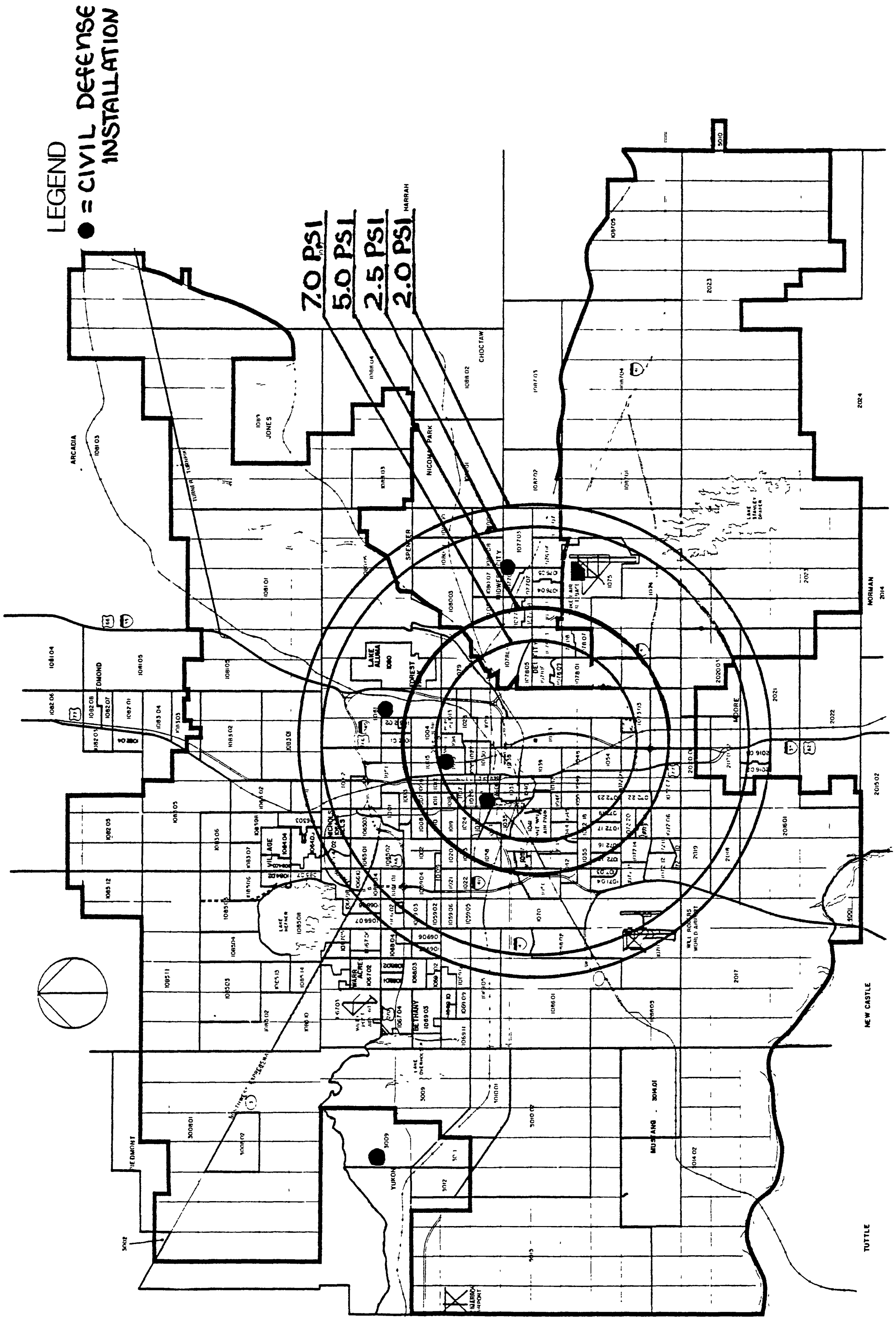
Oklahoma City has three city police facilities. One

TABLE XVI

DAMAGE TO GOVERNMENTAL AGENCIES OF A CONTROL AND PROTECTIVE NATURE

Type of Installation	Total Number of Installations	Destroyed		Damaged		Safe	
		#	%	#	%	#	%
Civil Defense	5	2	40	2	40	1	20
Law Enforcement (Federal, State, City, County)	17	6	35	8	47	3	18
Fire Stations	40	13	33	14	35	13	33
Military (Federal and State)	10	4	40	5	50	1	10

Figure 25. Location of Civil Defense Units Within the Overpressure Rings of A Hypothetical One-Megaton Detonation


LEGEND
● = CIVIL DEFENSE INSTALLATION
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
HARRAH
CHOCTAW
ARCADIA
JONES
NICOMA PARK
SPENCER
LAKE ALUMA
EDMOND
MOORE
NORMAN
NEW CASTLE
TUTTLE
MUSTANG
YUKON
BETHANY
PIEDMONT
VILLAGE
WARR ACRES

of these was destroyed and the remaining two substantially damaged. Of the remaining police installatitons, nine are city police for areas other than Oklahoma City. They could offer no assistance even if able. The one in Del City was destroyed, and the Midwest City, Forest Park, Nichols Hills, Moore, and Spencer police departments were damaged, leaving only The Village, Yukon, and Bethany police facilities structurally sound. In addition, the state highway patrol, Oklahoma State Bureau of Investigation, U.S. Marshall's facilities and the County Sheriff's offices were destroyed. Those police facilities surviving would function at much less than peak efficiency due to lack of radio transmission capability. Figure 26 shows the location of law enforcement installations within the overpressure rings.

Fire Departments

Fire stations are fairly evenly distributed throughout the developed areas of Oklahoma City and give fire protection to all areas of the city. This is indicated in Figure 27. As a result, as Table XVI indicates, a large portion of the fire stations survived, with 35 percent damaged and 33 percent safe. However, it is doubtful that even these relatively large numbers of surviving installations could cope with the level of damage and destruction caused by the nuclear detonation. This would be especially true, given the unavailability of water and a shortage of fuel.

Figure 26. Location of Law Enforcement Agencies Within the Overpressure Rings of A Hypothetical One-Megaton Detonation

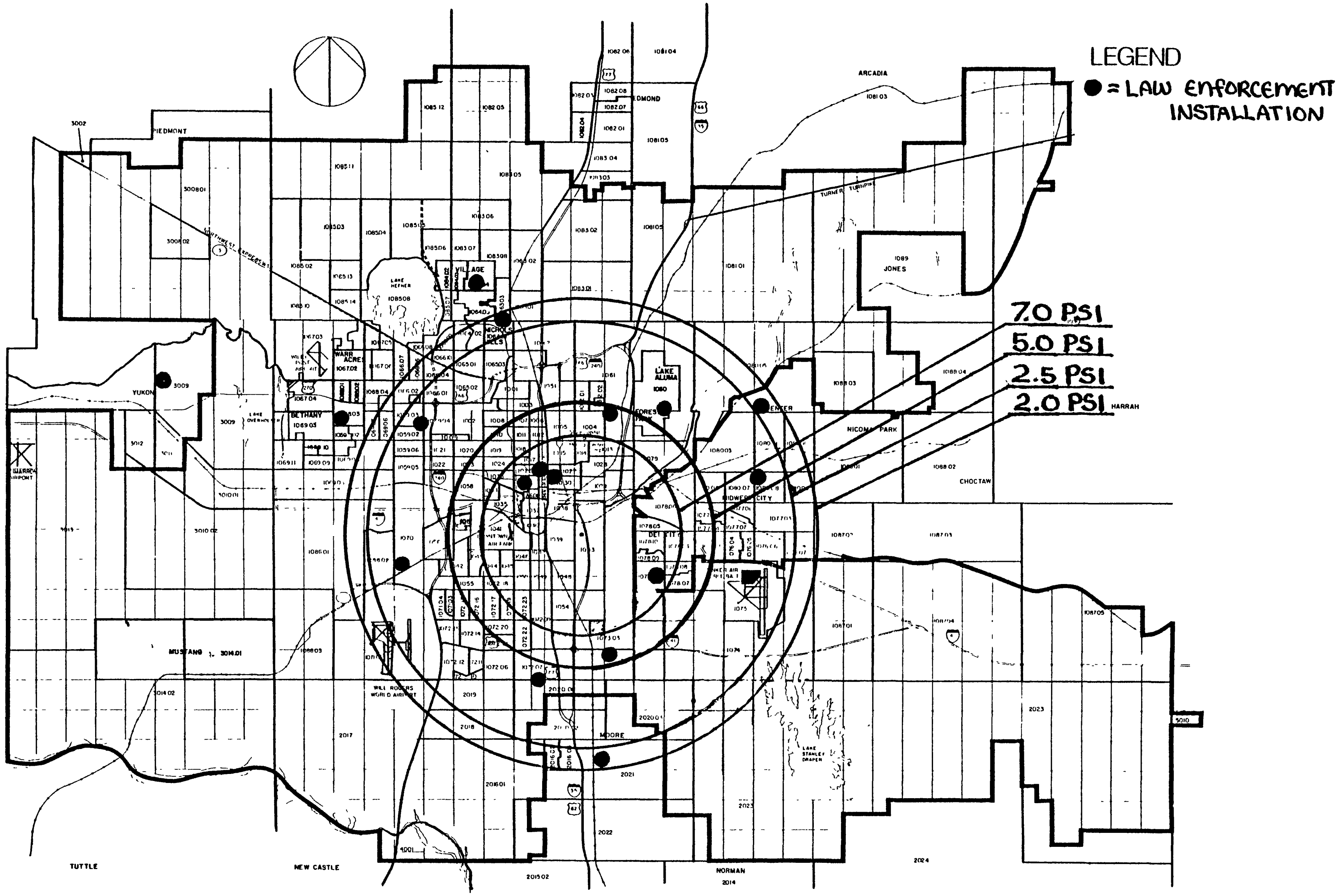
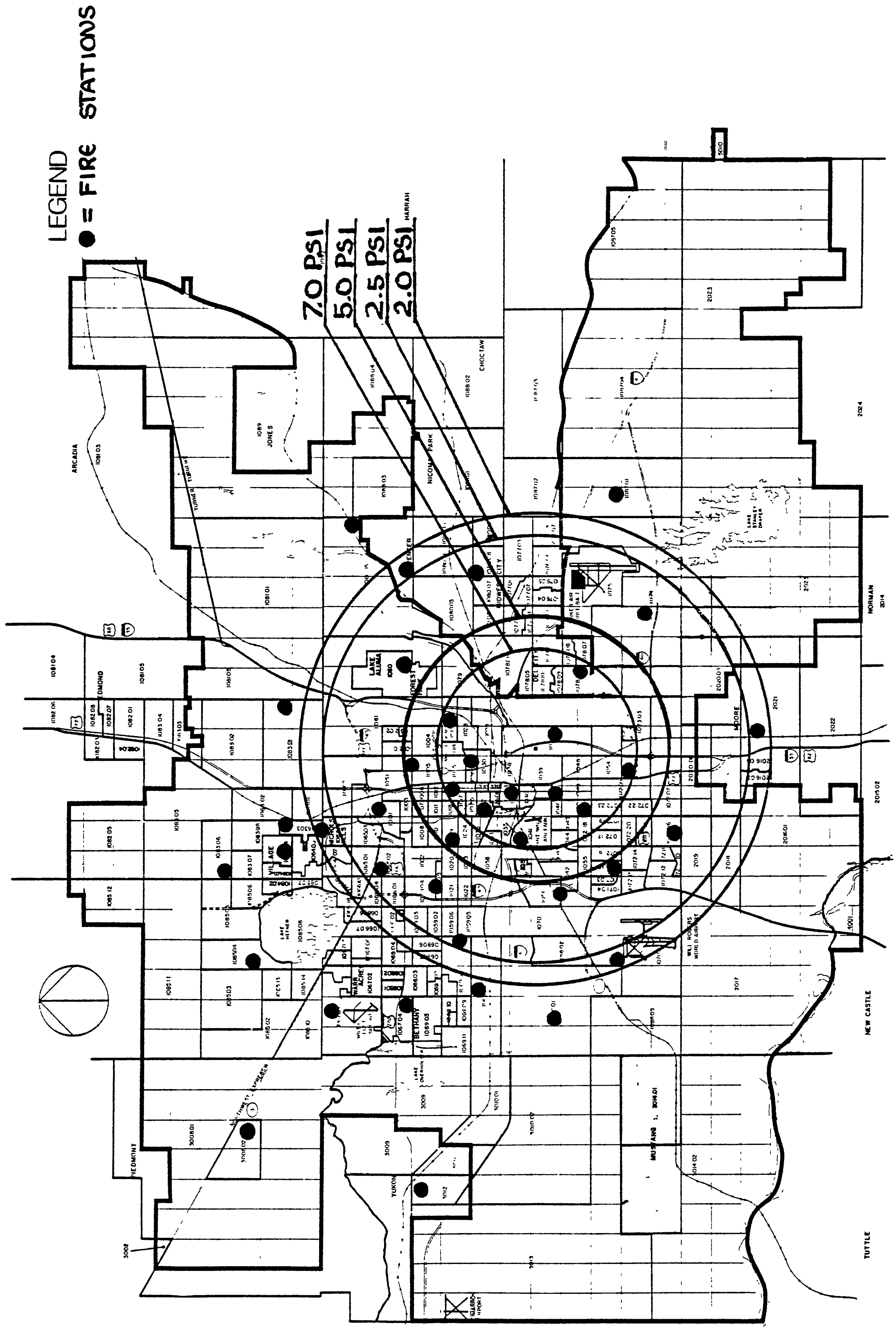

LEGEND
● = LAW ENFORCEMENT INSTALLATION
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
ARCADIA
EDMOND
PIEDMONT
JONES
HARRAH
NICOMA PARK
CHOCTAW
MIDWEST CITY
LAKE ALUMA
VILLAGE
NICHOLS HILLS
WARR ACRES
BETHANY
YUKON
LAKE HEFNER
LAKE OVERHOLSER
MUSTANG
WILL ROGERS WORLD AIRPORT
MOORE
LAKE STANLEY DRAPER
TUTTLE
NEW CASTLE
NORMAN

Figure 27. Location of Fire Stations Within the Overpressure Rings of A Hypothetical One-Megaton Detonation


LEGEND
● = FIRE STATIONS
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
HARRAH
ARCADIA
JONES
CHOCTAW
NICOMA PARK
EDMOND
LAKE ALUMA
MOORE
NORMAN
VILLAGE
BETHANY
YUKON
MUSTANG
PIEDMONT
NEW CASTLE
TUTTLE

Military

With regard to military facilities , 9 (90 percent) were destroyed or damaged leaving 1 installation structurally sound. Figure 28 shows the location of military installations within the overpressure rings.

General Governmental Levels

Governmental levels are of four types. They are: Federal, State, County, and City levels. Table XVII shows damage to these various levels and Figures 29, 30, 31, and 32 show their locations within overpressure rings. These levels do not include those agencies already discussed including: civil defense, law enforcement, and military facilities.

As evident from a study of Table XVII, the impact of a nuclear detonation upon various levels of government was extensive. This is because most governmental agencies are centrally located in the downtown area of Oklahoma City, especially the city government, close to ground zero.

Summary of Findings

The social system of Oklahoma City, in short, was severely crippled. The 75 percent of the population that survived would find itself with extreme shortages of housing, food, and water. There would be a lack of energy of all types, severely inadequate or non-existent medical

Figure 28. Location of Military Installations Within the Overpressure Rings of A Hypothetical One-Megaton Detonation

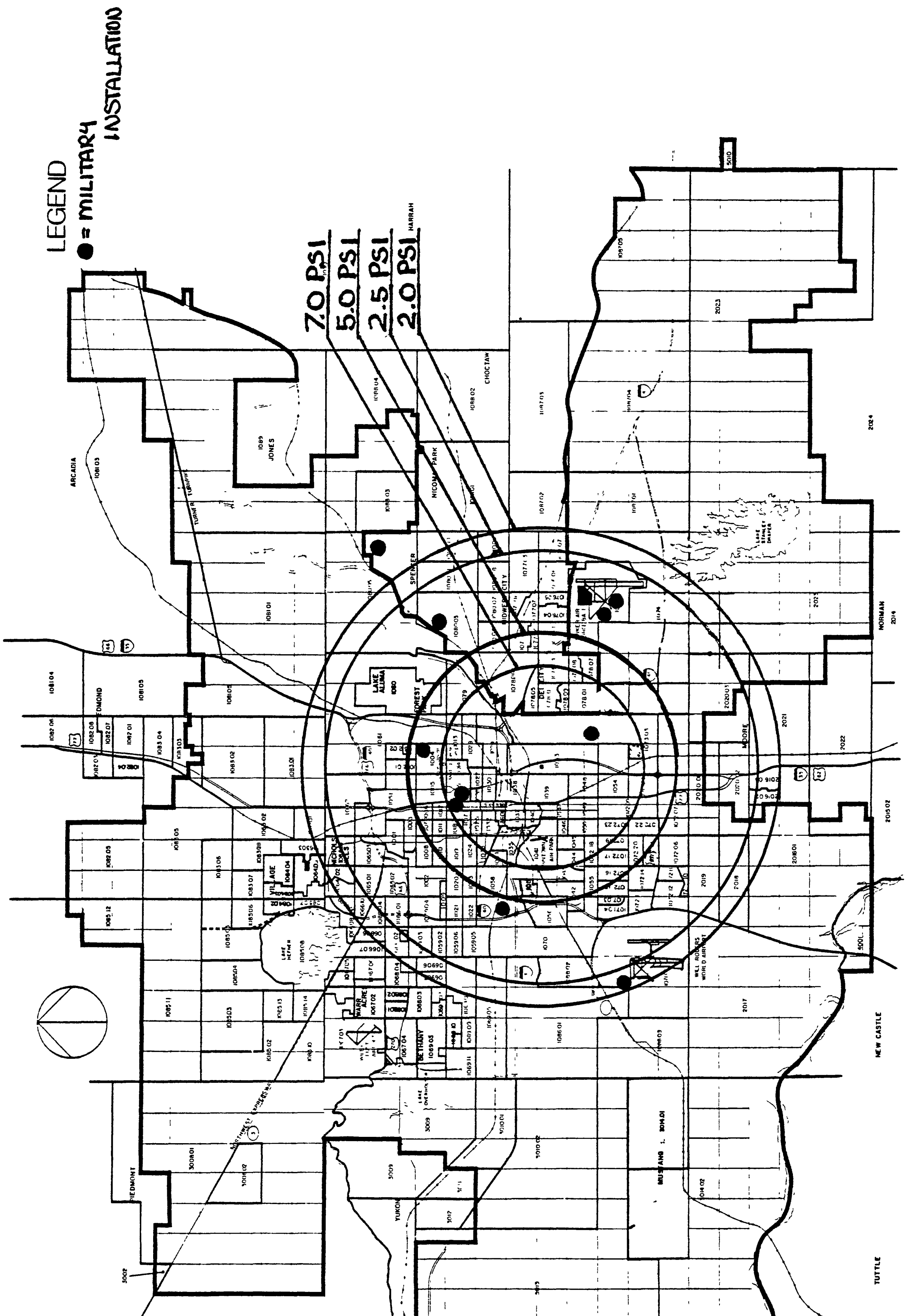

LEGEND
● = MILITARY INSTALLATION
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
HARRAH
CHOCTAW
ARCADIA
JONES
NICOMA PARK
SPENCER
MIDWEST CITY
DEL CITY
LAKE ALUMA
VILLAGE
LAKE HEFNER
WARR ACRES
BETHANY
YUKON
MUSTANG
PIEDMONT
MOORE
NORMAN
NEW CASTLE
TUTTLE
WILL ROGERS WORLD AIRPORT

TABLE XVII

DAMAGE TO GENERAL GOVERNMENTAL LEVELS

Level	Total Number of Installations	Destroyed		Damaged		Safe	
		#	%	#	%	#	%
Federal	4	3	75	1	25	0	0
State	6	5	83	1	17	0	0
County	1	1	100	0	0	0	0
City	10	9	90	0	0	1	10

Figure 29. Location of Federal Government Installations Within the Overpressure Rings of A Hypothetical One-Megaton Detonation

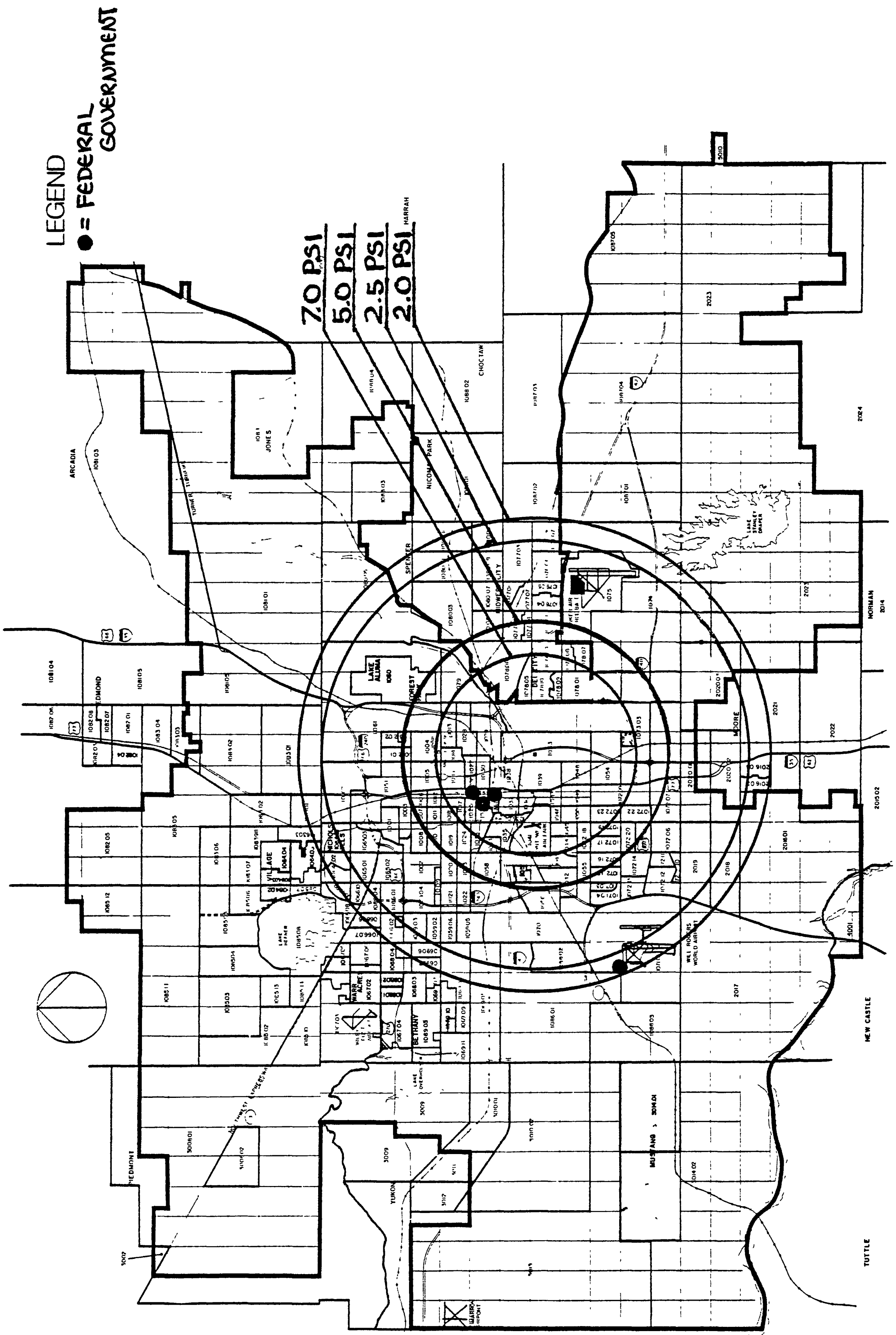

LEGEND
● = FEDERAL GOVERNMENT
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
HARRAH
CHOCTAW
ARCADIA
JONES
NICOMA PARK
SPENCER
EDMOND
LAKE ALUMA
MOORE
NORMAN
NEW CASTLE
TUTTLE
YUKON
BETHANY
VILLAGE
MUSTANG
PIEDMONT

Figure 30. Location of State Government Agencies Within the Overpressure Rings of A Hypothetical One-Megaton Detonation

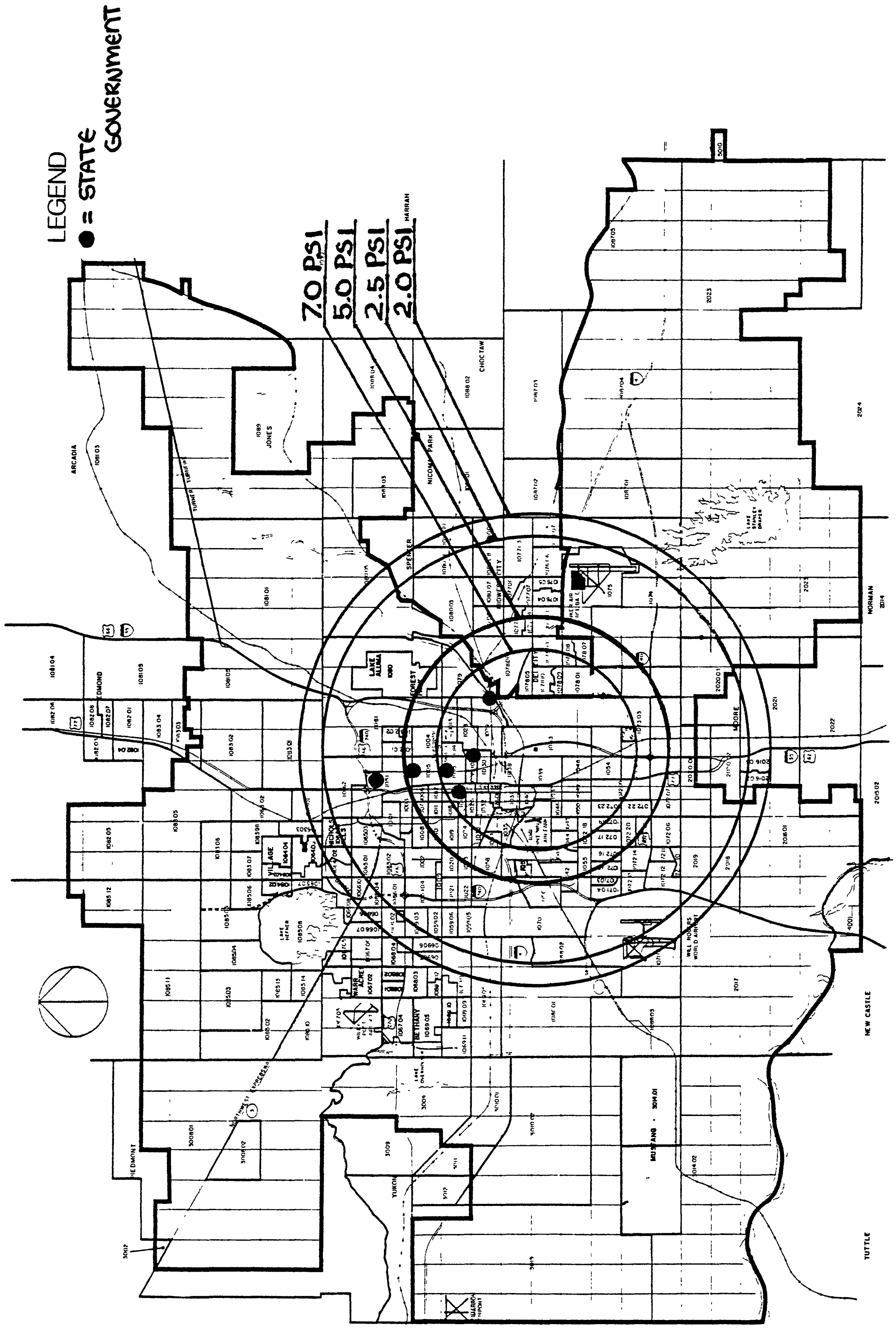

LEGEND
● = STATE GOVERNMENT
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
ARCADIA
EDMOND
JONES
CHOCTAW
NICOMA PARK
SPENCER
MIDWEST CITY
DEL CITY
MOORE
NORMAN
NEW CASTLE
TUTTLE
MUSTANG
YUKON
PIEDMONT
BETHANY
VILLAGE
LAKE HEFNER
WILL ROGERS WORLD AIRPORT

Figure 31. Location of County Government Agencies Within the Overpressure Rings of A Hypothetical One-Megaton Detonation

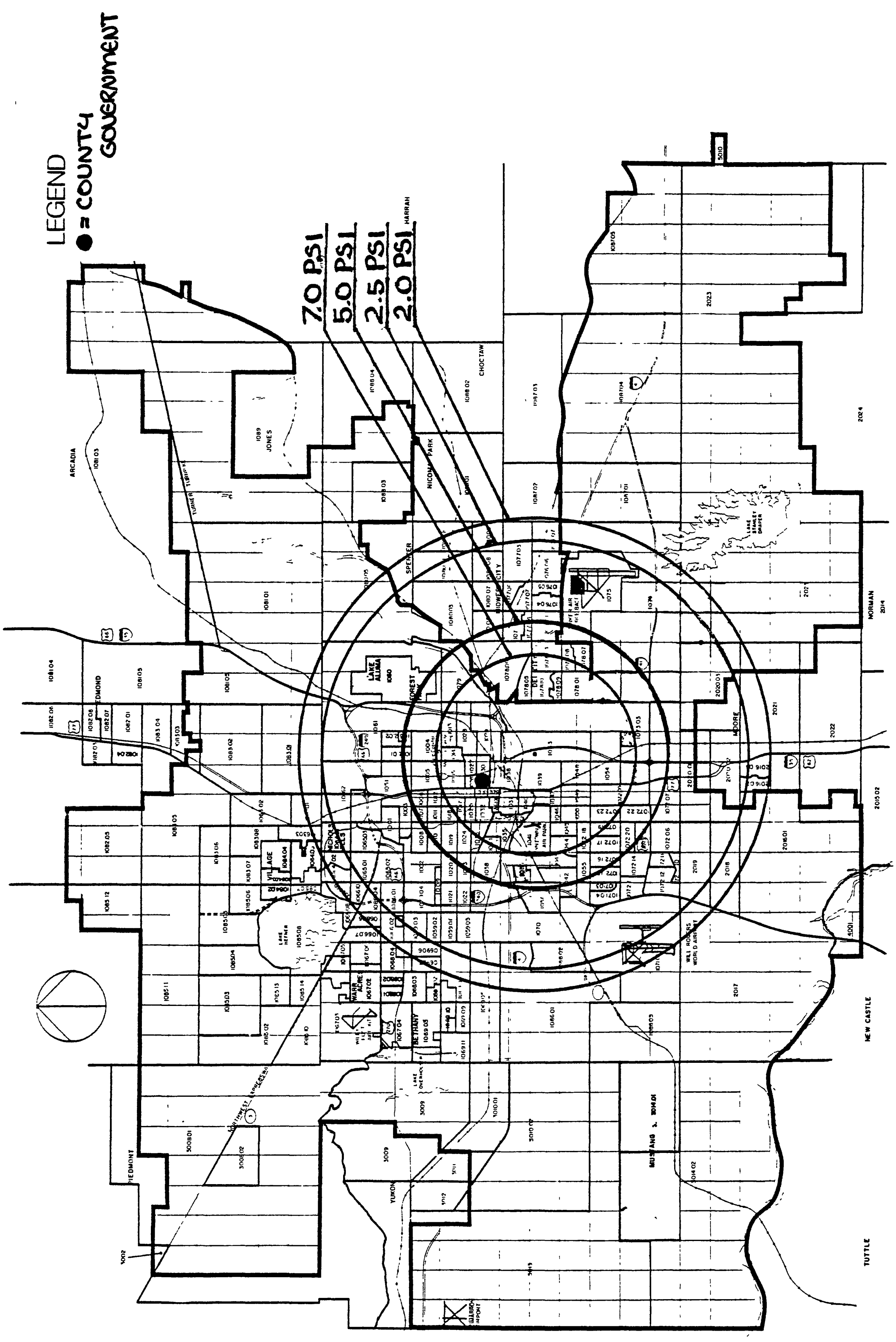
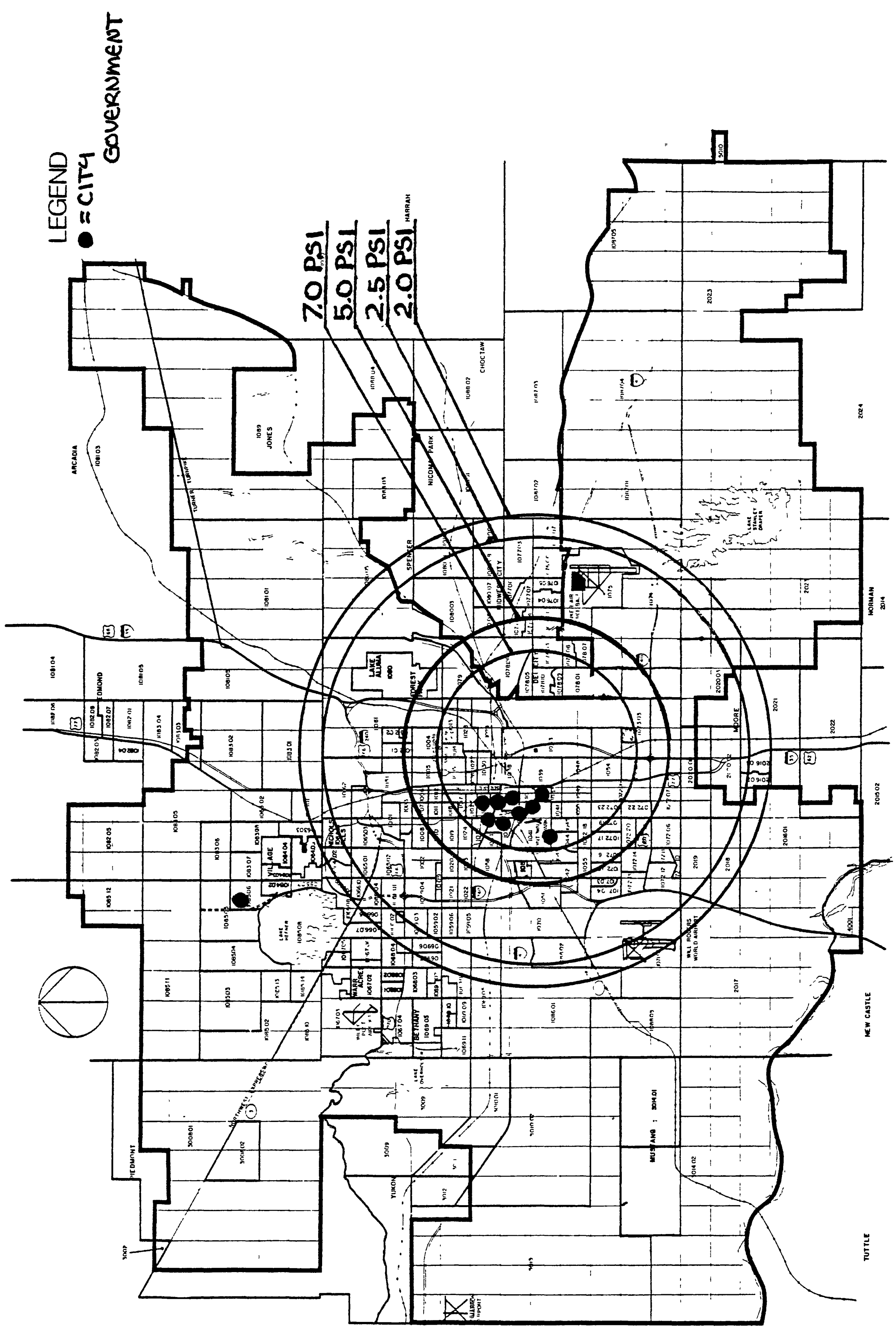

LEGEND
● = COUNTY GOVERNMENT
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
HARRAH
ARCADIA
JONES
CHOCTAW
NICOMA PARK
SPENCER
EDMOND
LAKE ALUMA
MIDWEST CITY
DEL CITY
MOORE
NORMAN
LAKE STANLEY DRAPER
LAKE HEFNER
VILLAGE
BETHANY
LAKE OVERHOLSER
WILL ROGERS WORLD AIRPORT
NEW CASTLE
MUSTANG
YUKON
PIEDMONT
TUTTLE

Figure 32. Location of City Government Agencies Within the Overpressure Rings of A Hypothetical One-Megaton Detonation


LEGEND
● = CITY GOVERNMENT
7.0 PSI
5.0 PSI
2.5 PSI
2.0 PSI
HARRAH
CHOCTAW
JONES
ARCADIA
EDMOND
NICOMA PARK
SPENCER
LAKE ALUMA
MOORE
NORMAN
NEW CASTLE
MUSTANG
YUKON
BETHANY
PIEDMONT
TUTTLE
VILLAGE
WARR ACRES
WILL ROGERS WORLD AIRPORT

care, a lack of communications and operational governmental agencies to give any guidance as to what to do.

In short, survivors would be taken, in the blink of an eye, from a functioning social system meeting all of their needs to a situation in which their survival depends upon their own abilities. The following Chapter will describe the likely human reaction to such a situation.

CHAPTER VI

POSTATTACK SOCIAL DYNAMICS

Assuming that the Oklahoma City social system has sustained damage to the extent discussed in Chapter 5, it is questionable that a preattack form of social organization could be maintained. Recovery efforts would face insurmountable obstacles to success at local and national levels. To begin, financial costs of such rebuilding would be staggering.

For example, Catton (1982) states it took more than 70 million dollars to restore just one small portion of Williamsburg, Virginia, to its original colonial stage of development. Hirshleifer (1956) suggests that nuclear attack on the United States' 100 largest urban centers would destroy property worth hundreds of billions of dollars (as measured in 1956 dollars). Thus, the process of physically rebuilding the infrastructure of the United States in general, and Oklahoma City in particular, would be extremely costly, if at all possible.

Such recovery efforts would be additionally hampered by damage to the economic institution such as that discussed by Hirschleifer (1956) who states that no one could prove title to property and that banking records would be destroyed. Also, money probably would be worthless. Tiryakian (1959:302) agrees with the likelihood of this scenario as he states that ". . . there will be major difficulties in finding sources of credit necessary to rebuild industry, on even a very modest scale." Thus, the state of the economic institution that survives could be characterized as chaotic at best. Furthermore, as indicated in Chapter 2, given the interdependent nature of the economic system, it may be considered destroyed if certain key components, such as the petroleum industry, are heavily damaged or destroyed.

> For a people, the economy -- any kind of economy, whether primitive or modern, is the means of survival from day to day. So if you ruin the economy -- if you suspend its functioning, even for a few months -- you take away the means of survival (Schell, 1982:69).

This would certainly be the case for the Oklahoma City area, if as Chapter 5 indicates, it is left without energy supplies, communications, water service, housing, medical care and food.

Those needs satisfied by the economic institution which allow for survival of individuals on a biological level, such as food and water, are the most critical functional requisites. These needs must be met if socal organization on a societal scale is to be preserved. Sorokin (1975:158) states that when members of a society are starving they have five ways in which they can react to meet their nutritional requirements. (The same five methods also could apply to water.) They are:

1. The development of new, or improvement of, existing sources of food.

2. Acquiring food supplies from other groups by peaceful methods.

3. Migration from the famine area to an area with food supplies.

4. The taking of food by forceful means from those that possess it by the starving.

5. Death from starvation.

That the postattack population of the Oklahoma City area would have to choose from among these alternatives is without question, given that economic collapse is unavoidable. Schell sums up the situation facing the population as follows:

> Innumerable things that we now take for granted would abruptly be lacking. In addition to food and clothing, they would include: heating, electric lights, running water, telephones, mail, transportaion of all kinds, all household appliances powered by electricity or gas, information other than word of mouth, medical facilities, sanitary facilities, and basic social services, such as fire departments and police. Hunger, illness, and possibly cold would press in on the dazed, bewildered, disorganized, injured remnant of population on the very day of the attack. They would have to start foraging immediately for their next meal (1982:70).

Schell thus points out two qualities of the postattack situation. Food as being a higher priority need compared to the multitude of necessities denied the postattack population and the critically short time within which the need must be met. Thus, the importance of Sorokin's five alternatives is evident.

By the development of new, or the improvement of, existing sources of food, Sorokin means increasing the food supply through innovation such as new farming techniques and/or scientific investigation. Plainly, this would not be possible after a large-scale nuclear attack. Turco et al. (1984) suggest that due to the threat of nuclear winter it is posible that temperatues may be reduced to -25 degrees centigrade after nuclear attack for a significant period. Plainly such a development would preclude the growth of crops even if the postattack population possessed the resources to attempt to do so.

Acquiring food supplies from other groups by peaceful methods such as commerical trade has always been necessary for large urban areas. Importation and exportation on an intranational and international scale to gain possession of commodities which would otherwise be unavailable became more important as societies entered the industrial period. The modern urban area cannot survive without the constant infusion of necessary resources. For example, food is not produced commonly within urban areas but must be brought into the city. However, this would not be possible in a postnuclear attack environment, either on an intranational or international scale. It would not be possible on an intranational scale, as Chapter 5 indicates, due to breakdown in the nation's ability to process and transport food. It would be impossible on an international scale as it is highly probable that other developed countries would have been targeted in a large-scale nuclear conflict and are thus unavailable for assistance.

Migration from the destroyed area would be a highly probable event as the urban social system would no longer be able to provide for itself due to breakdown in the supportive infrastructure. Previous studies, Hirschleifer (1956), Heer (1965) and Katz (1982), suggest such a response, by survivors, to nuclear attack on urban areas. According to Heer (1965), the motivations for migration would be many (see Chapter 2) including the need to find available food supplies. However, the ". . . exodus of survivors into surrounding areas will generate a host of major difficulties" (Tiryakian, 1959:301). The most important of these possible difficulties involves violence between migrants and the would-be hosts inhabiting the surrounding area. This possibility, as noted in Chapter 2, also is considered highly probable by Heer (1965). Hirschleifer (1956) suggests that those portions of the population living in rural areas will still have a way of life to protect from the demands of the migrating urban survivors who would be desperate for food and shelter. According to Hirschleifer,

> The urban survivors essentially will have the choice of placing themselves in a position of dependence upon the population and authorities of the small towns and rural areas in order to obtain food, shelter, and other necessities of life -- or some or all of them may attempt to take what they need or want by force (1956:210).

This view of conflict having an urban-rural distinction is viewed as flawed for two reasons. First, it may be true that, initially, rural residents may have some semblence of a postattack life-style to protect, given a lack of direct damage from the nuclear detonations themselves. But it is important to remember that rural areas themselves are just as dependent upon the proper functioning of the economic institution as are the urbanized areas. Thus, a lack of certain manufactured products such as fossil fuels will lead to a more gradual but just as inevitable degeneration in their quality of life. For example, food supplies eventually will become less than adequate in these areas, given the numbers of people to be fed, especially if they grant aid to those survivors from urban areas. Second, the potential source of violence is viewed as being caused by a conflict in self-interests of urban and rural residents that may be prevented, if those migrating to rural areas are confronted by the superior power of local authorities.

> It is true that the national and even most state administrative mechanisms may be paralyzed by the destruction of Washington and state capitols, and the disruption of essential links of the communication networks located in the target cities. Nevertheless, local authorities can generally be expected to act on their own initiative with the forces at their disposal . . . (Hirshleifer, 1956:211).

As noted in Chapter 5, damage to Oklahoma City definitely would eliminate urban and state governmental agencies as a source of population guidance and control.

Functioning without support, it is highly improbable that local (smaller community) governmental sources of protection and control would be able to deal effectively with the numbers of migrants from destroyed urban areas. Also, as mentioned above, stability of the social organization in rural areas would decline quickly as food and other resources become increasingly scarce. Conflict is thus inevitable and would not long be characterized by strife between unorganized urban migrants and organized rural groups. Although it may begin in such a manner, it eventually would lose this distinction.

The Effects of Industrial Collapse

This situation is so because of several simple socio-ecological principles which have been ignored by past nuclear war research. Catton (1982) indicates that world population (and one would assume the population of individual nation-states such as the United States) were able to grow through technological innovation. This, as noted, was also suggested as a method allowing for population growth or maintanence by Sorokin (1975). Table XVIII indicates this relationship. Table XVIII reveals that methods which traditionally have been defined as more efficient, in that they produce more food, have allowed for increases in the carrying capacity of land. Carrying capacity is defined as the maximum number of people a given amount of land will support on a permanent basis. Until about 1800 A.D., the

TABLE XVIII

HISTORY OF MAJOR TECHNOLOGICAL BREAKTHROUGHS AND ENSUING POPULATION INCREASES

Date	World population in millions	Most advanced economic type	Limit-raising technology	Population increase	Generations elapsed	Increase per generation
2 million B.C.		hunting and gathering	use of fire, tool-making		78,600	
35,000 B.C.	3		spear-thrower, bow and arrow	167%	1,080	0.09%
8000 B.C.	8	horticultural	cultivation of plants	975%	160	1.50%
4000 B.C.	86		metallurgy (bronze)			
3000 B.C.	?	agrarian	plow	249%	160	0.78%
1000 B.C.	?		iron tools			
1 A.D.	300			12%	55.9	0.20%
1398 A.D.	336		hand firearms	188.4%	16.1	6.80%
1800 A.D.	969	industrial	fossil fueled machinery	41.5%	2.6	14.28%
1865 A.D.	1371		antiseptic surgery, etc.	191.8%	4.4	27.55%
1975 A.D.	4000					

Source: Overshoot, Catton (1982:18)

carrying capacity was maintained and allowed to grow through a process known as 'takeover' or the use of resources previously used by other organisms to support life. Around 1800 A.D., carrying capacity was increased greatly with the advent of industrialization which relies not upon the takeover of renewable or reusable resources but upon drawdown or the reliance upon non-renewable fossil fuels.

The use of fossil fuels was so 'efficient', it increased carrying capacity prodigiously

> After mechanized agriculture began to be the dominant mode of sustenance production, the web of life was altered more extensively and more swiftly than ever before. If somehow, man's agricultural modification of the web of life (with steel plows, mechanical harvesters, fossil fuel-burning tractors, and synthetic fertilizers and pesticides) were to falter, and the web were to revert to something like the structure it had only six generations ago, then (because of these two most recent doublings) four earths would be needed to support the present human population of this one earth (Catton, 1982:108).

Of particular importance for industrial societies in the event of a technological breakdown and lack of fossil fuels would be the reintroduction of influence of Leibig's 'law of the minimum.' Leibig's Law suggests the carrying capacity of an environemnt is determined by whatever necessity is least available. Modern industrial societies such as the United States, and cities such as Oklahoma City, have been able to overcome the limiting factor of the locally least abundantly available necessity by the introduction of commercial trade. In other words, communities and nation-states are able to increase greatly carrying capacity through the importation of scarce commodities and thus increase the scope of application of Leibig's Law from local resources to world resources. This practice is what allows industrial societies and population concentration to be productive, but it also makes them extremely dependent and vulnerable. Damage caused by a nuclear war which would require a reduction in the scope of application of Leibig's Law to local resources through

> . . . trade dislocation would convert existing loads of human-resource consumers, previously supportable by composite carrying capacity, into overloads no longer fully supportable by fragmented carrying capacities (Catton, 1982:160).

Thus, it is obvious that, without the availability of large supplies of petroleum products, the earth in general, and the United States in particular, are overpopulated. Just how overpopulated the United States would be is dependent upon the technological level that the infrastructure would be reduced to in the aftermath of a nuclear attack. For example, Pimentel (1984:101) suggests the earth's resources are adequate to support fewer than ten million people if food production techniques were limited to hunting and gathering methods which require extremely low population densities to be effective.

Past research suggests that technological collapse would be great. The supportive infrastructure of society, as noted above, no longer would be functional according to Schell:

> . . . all sectors of the economy would be devastated at once. The task facing the survivors, therefore, would be not to restore the old economy but to invent a new one, on a far more primitive level. But the invention of a primitive economy would not be a simple matter. Even economies we think of as primitive depend on considerable knowledge accumulated through long experience, and in modern times this knowledge has been largely lost (1982:69).

The survivors of nuclear attack then will exist in an environment where, as noted in Chapter 5, their continued survival will depend upon their own individual abilities. Those abilities (functional in the preattack society), which revolve around a special skill or knowledge which are obsolete in the postattack environment will be useless. The individual now will need to know how to acquire food, potable water, shelter, and how to build a fire without matches, to name but a few things. The only economy that does not require possession of a great many skills and knowledge would be a hunting and gathering type. All people are able to forage. However, this type of economy, has a very low carrying capacity. A carrying capacity able to support far fewer than the number of people surviving nuclear attack.

According to Sumner (1913:31), "the most important limiting condition on the status of human societies is the ratio of the number of their members to the amount of land at their disposal."

> In the struggle for existence a man is wrestling with nature to extort from her the means of subsistence. It is when two men are striving side by side in the struggle for existence,

> to extort from nature the supplies they need, that they come into rivalry and a collision of interest with each other takes place. This collision may be light and unimportant, if the supplies are large and the number of men small, or it may be harsh and violent, if there are many men striving for a small supply (Sumner, 1911:9).

Durkheim (1933) likewise suggests that war and violence are highly probable reactions to overpopulation. In a similar vein, Catton suggests that

> . . . the ability to practice brotherly love, self-restraint, and a decent respect for the opinions of mankind depend on such environmental prerequisites as low population pressure . . . . (1982:103).

Thus, scarcity of necessities leads to increases in the intensity of competition to gain possession of these resources. This type of development can pose a serious threat to all 'civilized' social institutions which stress cooperation or subordinating individual freedom to the good of the group.

A scarcity of food can have a severely debilitating effect upon social stability. Hunger can cause a weakening in the percieved importance of the group to the individual because requirements on the individual which allow for group preservation may be antagonistic to the needs of the individual for his or her own preservation.

> We find everywhere cases in which satisfaction of hunger requires acts that inflict injury to preservation of the life, unity, and well-being of the 'intimates', and vice versa, in which the determinant of group self-preservation requires acts which interfere with the satisfaction of hunger. Observation also indicates that hunger often is the victor in this confrontation, i.e., it suppresses . . . the

> reflexes of group self-preservation, including those which are most deeply rooted among human beings (Sorokin, 1975:18).

Among the many behaviors of the starving which threaten group stability is endocannibalism or the eating of other members of the group due to a lack of food of other orgin. Reports of cannibalism are quite common in relatively recent times such as in Russia during the turn of the century and World War II. Instances of such behavior have also been reported among groups stranded due to plane crashes or ship wrecks.

In addition to cannibalism, murder of parents, spouses and other close relatives, not so that they may serve as food, but so that the 'useless' will not compete for food with the 'useful', can also result from a scarcity of food. Death can be caused either directly through physical violence or indirectly through neglect of the helpless.

Other milder responses of a group threatening nature are also produced in reaction to hunger such as the renouncement of allegiance to the group. As examples of this behavior Sorokin cites instances of people joining enemy armies to be fed, spying for the enemy for payment in food, and taking away food from children.

> In all those cases, starvation has depressed and weakened the conscious reflexes of group self-preservation, and has forced a person . . . to cause harm to his own state, class, family, corporation, party, etc. (Sorokin, 1975:116).

In addition, Turnbull (in a study of a tribe of Ugandan natives known as the Ik) provides further evidence that human society is not impervious to the effects of scarcity with regard to food. As a result of living with the constant threat of starvation the Ik

> . . . have successfully abandoned useless appendages. . . those 'basic' qualities such as family, cooperative sociality, belief, love, hope and so forth, for the very good reason that in their context, these militated against survival (Turnbull, 1972:289).

In short, in order to survive, their behavior has to be so designed as to function to their individual benefit. Turnbull cites as an example, an instance in which the strongest members of the tribe traveling to a government food distribution center deliberately prolonged the return trip in order to eat as much of the food as possible which they were supposedly bringing back for their parents, spouses, and children.

Breakdowns in socialness are quite common on the part of animals, such as monkeys and rats, in response to over-population. And 20th-century man has acted similarly when presented with situations of scarcity which are far milder than that of a postnuclear war.

> Man has imagined himself to be more unlike other mammals than he really is, so when human behavior has shown these same characteristics, various other explanations have been put forth which have obscured the significance of population pressure itself. In the twentieth century, with human numbers enlarged and resource drawdown becoming significant, man went to war. He rioted in the streets. He committed more and more crimes of violence. His political attitudes polarized and he created totalitarian governments, some of which gave rise to sadistic tendencies. A generation gap widened and deepened. In spite of earnest efforts by humane activists to

> inhibit racism and to rectify economic inequality, disparities between people remained and animosities became more virulent. Standards of decency in behavior toward others and expectations of considerate self-resraint were eroded and degraded in many places (Catton, 1982:103).

Indeed one need look no farther than the oil crisis of the 1970s in the United States, in which motorists actually engaged in occasional violence at gasoline stations, to find evidence of behavioral degeneration in response to population pressure and scarcity of a valued commodity. With such behavior occurring in an otherwise normal, orderly, stable society, one wonders at the possibilities in a totally disorganized, nonfunctioning society after nuclear attack.

A Structural-Functional Explanation of Social Breakdown

From a structural-functional perspective, social breakdown is a completely logical consequence of the destruction of the structural components of the social system. As mentioned in Chapter 3, Parsons viewed human behavior as goal oriented. Furthermore, as Maslow (1954) noted, humans have a hierarchy of needs or goals. The social environment or the characteristics of the social system determine what are considered the appropriate means through which those goals can be achieved.

The destruction of the structural components, such as the economy and government, would lead to a breakdown in the system's ability to meet the most basic needs of the people. In addition, it would also result in the loss of effective direction as to definitions of appropriate means through which, in a postattack situation, survival could be achieved.

Under normal conditions

> each of us is in the 'sphere of influence' of hundreds and thousands of different stimuli, in which the central place is occupied by other men and women and the product of their activities, as well as those of preceding generations (a complex of conductors, or all material culture including buildings, roads, domestic implements, instruments, books, etc.). From the day of birth to the time of death all these determinants impinge upon use, and require us to make corresponding adaptations (Sorokin, 1975:132).

Thus, the character of these adaptations, or, in Parsons' unit act which means are deemed appropriate, to achieve desired goals are dependent upon the character of the social and cultural environment. Alterations in the social and cultural environments then would lead to alterations in definitions as to the appropriateness of various means to achieve goals. In Sorokin's terms, these definitions, made manifest through adaptations, are a social costume.

> It is possible to dress a man in one costume of social-conditional reflexes, and it is possible to remove them (sometimes with difficulties) and to replace them with other 'costumes.' The tailor who decides the style of these costumes of conditioned reflexes for all of us is the tolality of these conditioned determinants, in whose spheres of influence we happen to be (Sorokin, 1975:132).

When these determining influences are removed or radically altered so as to make the most basic of human needs, survival, problematic and, at the same time, nullify or greatly weaken constraining influences, we can expect a behavioral and corresponding societal breakdown at least in comparison to the preattack situation. The individual, following attack will find himself subjected to various pressures, pulls and pushes to engage in socially destructive behavior. Pressures to do so will arise from the postattack situation itself which due to an overload in the postattack carrying capacity will be characterized by an extreme food shortage resulting in famine. The individual's preattack knowledge and skills will be useless as means to achieve the necessities of life. This is so given the fact that few people have the knowledge to produce food through their individual efforts. The overwhelming majority of the population has displaced and distanced itself from types of environments and knowledge which would allow them to do this by becoming members of the urban population relying on nonfood producing occupations. Whereas a primarily rural population such as the farm family of the 1920's and 1930's could maintain self-sufficiency, the urbanite cannot and will have to forage for food. As Catton indicates, during the turn of the century, there was still truth in the saying that the farm family can always eat. Thus, during the depression, many farm families with local resources were much better able to weather the effects of the Depression than were their urban counterparts.

In addition, the pulls of available food stocks in possession of others will tempt the individual or group to view them as potential sources of food. And others will be viewed, in many instances, as competitors to be overcome by whatever means are most efficient to overcome in the 'competition of life.' Also, the individual will be subjected to pushes or inner tensions in the form of fear of death from starvation and the hunger drive. These encouragements to deviant behavior will be especially forceful, given breakdown of the social system. In short, the forces of social control will be weakened. Given the chaotic nature of the social system due to its destruction the individual will be denied a stable system of norms which guide behavior along lines which assure social tranquility. Without the functional examples provided by authoritative punishment of deviant behavior, preattack definitions of deviance will easily change.

Sorokin (1975:138) indicates that conditions of extreme stress establish the "criminal-legal institution of extreme necessity." In other words, human history shows us that, in times of starvation, the legal institution relaxes its punishment for various crimes. This is important. Homans (1950) suggests that norms without reinforcement lose meaning and thus their effectiveness. This type of reaction by the criminal justice system in a situation in which it is intact indicates that its reactions would be much less effective after nuclear attack. Thus, mechanisms of social control would be seriously weakened allowing for a weakening of inner control or the internalized set of morals against such acts as murder.

> Most people do not kill others when they have enough to eat. Murder is impossible -- such is their conviction. During starvation this reflex often loses force and sometimes it is incapable of preventing starving people from killing to obtain food (Sorokin, 1975:139-140).

Sorokin thus indicates that external pressures may weaken inner control. Thus as ". . . the frequency of violations increases. . . convictions become weaker" (Sorokin, 1975: 148). It is difficult to kill or steal for the first time ". . . but when one has stolen and killed tenfold, nothing is left of the convictions 'do not steal' and 'do not kill' (Sorokin, 1975:148).

This is not to say that the inevitable result will be a Hobbesian war of all against all.

> If we know anything, we know that men will follow leaders. The more interesting threat to social life as we know it, therefore, is not atomistic chaos but, rather, extreme lawlessness -- in the form, perhaps, of a society consisting largely of robber bands engaged in mutual struggle for surviving economic resources (Hirshleifer, 1956:208).

If there is strength in numbers then groups will be more effective at gaining and maintaining possession of scarce food in a competitive, potentially violent atmosphere.

> Every individual excludes every other in the competition of life unless they can by combining together win more out of nature by joint effort

> than the sum of what they could win separately" (Sumner, 1911:8).

Thus, it is probable that small nomially cooperative, regional groups will develop in the aftermath of nuclear attack as a method of coping with survival problems with the size of the groups being regulated by the land's carrying capacity.

According to Tiryakian,

> The United States in the aftermath of a nuclear disaster may well be characterized by either of two polar forms of social organization. On the one hand, there may be a national anomie consisting of an aggregate of regional, community or kinship groups, loosely if at all related to one another economically and politically, each autonomous surviving social group lving more or less at the subsistence level. On the other hand, a semblence of predisaster national functional interdependence may be achieved -- but only at the cost of replacing democratic controls by rigid authoritarian structures (1959:302).

Tiryakian suggests then that whatever the outcome of nuclear attack upon the United States social organization will undergo a dramatic change. The alternatives given, however, are quite distinct and which exemplifies post-attack social organization depends upon the extent of damage from nuclear attack. Sorokin (1975), in agreement with Tiryakian, suggests that social organization undergoes changes in response to stress. In particular, Sorokin indicates that in response to food shortages social organization may evolve in a manner he terms "compulsory statism" which is totalitarian in nature ". . . in which the power and its agents regulate absolutely the entire behavior of the citizen." However, this type of development would require strong governmental control which, in turn, would require effective organization on a national scale if Tiryakian's prediction of national survival were to come to pass.

As noted in Chapters 2 and 4, national social unity and recovery demand the survival of the federal government as a viable political entity because, without existence of an effective centralized governing structure to minimize the effects of a reduction in the scope of application of Leibig's Law, the United States could dissolve into smaller groupings and the organizational scale of these coping elements would be determined by carrying capacity. Various governmental agencies, however, are highly concentrated geographically at the national, state, and local levels. Thus, it is highly probable that damage will preclude effective response from government at any level. In addition, as noted above, it is extremely improbable that surviving governmental elements will be capable of dealing with the surviving population's needs, due to the destruction of the economy, making survival of the remaining population problematic. Thus, the first of Tiryakian's postattack scenarios is the most likely postattack social development for individual areas such a Oklahoma City and the nation as a whole.

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