RESEARCH REPORT No. 16

THE CASE FOR CIVIL DEFENSE

(As Developed Through Systems Analysis)

by Jack C. Greene

Revised 1972

OFFICE OF CIVIL DEFENSE
OFFICE OF THE SECRETARY OF THE ARMY
DEPARTMENT OF THE ARMY

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The views and conclusions expressed in this report do not necessarily reflect the official views or policies of the Defense Civil Preparedness Agency or the Department of Defense. This report is based on a thesis submitted to George Washington University.

Postattack Research Division
Research Directorate
DEFENSE CIVIL PREPAREDNESS AGENCY
DEPARTMENT OF DEFENSE

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INTRODUCTION

Civil Defense and the Systems Concept

Most Americans are aware that the United States has a civil defense program. To many, "civil defense" brings to mind familiar yellow-and-black fallout shelter signs denoting shelter space in large public and private buildings. These Americans are aware that these shelters are intended to provide protection against the H-bombs they expect would be used in a nuclear war, but they have no clear understanding of how the protection would be accomplished or how effective it would be. Most Americans, however, have little active interest in civil defense. They spend very little time thinking about nuclear war. The likelihood seems remote and the consequences are not pleasant to think about.

Dr. Jiri Nehnevajsa and his group in the Sociology Department at the University of Pittsburgh, in studies of public attitudes on civil defense, have conducted several sample surveys, national in scope. The most recent was completed in 1968. During a 1970 symposium on research findings, Dr. Nehnevajsa summed up the results of these studies:

> Under most circumstances of normalcy, we cannot envisage conditions under which the American public would rise to demand a viable civil defense system. We cannot foresee a situation under which civil defense planning and operations would become major political issues on which significant numbers of votes could be won or lost either at the Federal, or the state levels. As a consequence, civil defense is of low saliency to congressional leaders as well, to Governors and state legislatures, and to the President. [Ref. 50, p 5.]

There is a much-less-silent minority among whom the term "civil defense" evokes strong emotional and highly negative reactions. This group appears to feel that (a) having little or no civil defense protection makes a war less likely, and (b) attempts to protect people against the effects of nuclear weapons would be futile or even dangerous, since this could engender a false sense of security and might tend to promote reckless behavior on the part of U.S. political leaders.

A third and even smaller group, also quite vocal, wants civil defense to be greatly expanded. Its members are inclined to favor the construction of sophisticated blast-resistant shelter systems (mostly underground), the dispersal of critical industry, and vast stockpiles of important recovery material. This group appears convinced that nuclear war is almost inevitable and is more concerned about when it will occur than whether it will occur.

Attitudes of the professional groups most directly concerned, the full-time civil defense people and the military, bear examination. The "civil

defenders," as would be expected, favor an expanded civil defense program, but underneath the natural layer of self-interest, these people probably are typical of the U.S. public. Although the full spectrum of attitudes is to be found among them, the percentage at either extreme is small. Most believe in the current program as far as it goes, but also would like to see some provision for protecting people in cities and near military targets not only against fallout but also against the blast and heat effects of nuclear weapons.

The U.S. military, in general, (as well as Veterans groups[1]) favor civil defense in a non-specific sort of way. Most military officers in positions of authority probably would say, if asked, that civil defense is important and should be taken seriously. But if asked whether money should be put into civil defense at the expense of ABM, Minuteman, Polaris, or a new bomber, most of them probably would answer, "No." A good illustration is an incident that occurred during the hearings on civil defense of a subcommittee of the Committee on Government Operations, U.S. House of Representatives in the spring of 1960. These hearings became known as the Holifield hearings, since Representative Chet Holifield of California was Chairman of the Subcommittee. He has held an active and positive interest in civil defense for many years.

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[1]The VFW adopted a strong resolution in support of civil defense during its August 1969 National Convention, and the American Legion, through the years, has provided strong support to civil defense. The current Director of the Office of Civil Defense, John E. Davis, was a National Commander of the American Legion.

General Curtis LeMay, then Vice Chief of Staff of the Air Force, appearing as a witness, presented a prepared statement in which he expressed general support of civil defense. He went so far as to say, "Civil defense is a vital element of our National defense posture." [Ref. 73, p 137.] Later, when asked by Mr. Holifield about the desirability of adding to the total defense budget $20 billion over a five-year period to build civil defense shelters, $5 billion a year over and above, not as a part of the then $40 billion a year military budget, General LeMay said:

> ". . . I don't think I would put that much money into holes in the ground to crowd into; that I would rather spend more of it on offensive weapon systems to deter war in the first place. In other words, I see any great expenditure for this sort of thing to be what I call a Maginot-Line concept, and I think it is doomed to failure." [Ref. 73, p 157.]

To both military and civilian segments of the U.S. population, civil defense does not have the importance or the immediate relevance of Vietnam, the population explosion, civil rights, or environmental pollution, as a major issue of national concern. There is very little public dialogue on it, either pro or con; and there is neither strong support nor strong opposition in the Congress. (Representative Holifield is one of the few members of Congress actively favoring a strong civil defense.) This fact is not surprising, especially in view of the many other national issues crying for attention and competing for funds.

There is another important reason for the lack of active interest and support of civil defense by the U.S. public and its political and military leaders: The nation's strategic analysts, both in and out of Government, have not performed the exhaustive analyses of the civil defense function justified by its potential importance to the nation; and also, they have not provided the nation's leaders with clear-cut, understandable information on which to base civil defense decisions, activities, and communication with the public. Failure of these analysts to adequately present the case for civil defense in today's strategic environment is due in some measure to their own misconceptions about nuclear weapons effects and the means of protecting against them. It also is due, in part, to failure of the analysts to view civil defense in the systems context.

Just what is meant by the terms "systems context" or "systems approach" or "systems analysis," as applied to civil defense?

A statement by E.S. Quade of the Rand Corporation in the introduction to the 1966 book Analysis for Military Decisions, helps to answer this question:

> . . . systems analysis might be defined as inquiry to aid a decision-maker choose a course of action by systematically investigating his proper objectives, comparing quantitatively where possible the costs, effectiveness, and risks associated with the alternative policies or strategies for achieving them, and formulating additional alternatives if those examined are found wanting. Systems analysis represents an approach to, or way of looking at complex problems of choice under uncertainty, such as those associated with national security.

> In such problems, objectives are usually multiple and possibly conflicting, and analysis to assist the decision maker must necessarily involve a large element of judgment. [Ref. 58, p 4. (Emphasis supplied.)

Civil defense is an issue involving national security. Few undertakings appear more complex than the attempt to understand possible physical, socio-psychological, and ecological environments resulting from a massive nuclear attack.

What are the realistic and appropriate objectives of a U.S. civil defense system? On what basis can the cost and effectiveness of such a system be evaluated? Whose judgment on various aspects of the problem can be trusted, and how far?

It is the purpose of this paper to identify the elements of a comprehensive, integrated, and realistic system for protecting the U.S. population and its resources from the effects of enemy attack; for sustaining the survivors in the hostile environment that would follow an attack; and for organizing the U.S. society and economy to assure national survival and recovery.

No experience base exists that is really relevant to this problem because no nation has ever been subjected to massive nuclear attack. The rationale and objectives of a system are easy to state in vague generalities (everybody deserves protection, the after effects of the attack should be minimized, recovery should be speeded, the economy should be restored,

the continuity of government should be assured, etc.) But these goals are difficult to state in meaningful terms--terms sufficiently concrete and quantifiable to permit the application of cost-effectiveness criteria and the identification and examination of possible trade-offs among various alternatives.

Examples of such trade-offs are: How much curtailment of civil liberties, for how long, might be desirable or acceptable if this brought about acceleration toward an improved standard of living? Or, even more difficult, how much increased probability of bone cancer from strontium-90 contamination of food might be acceptable to the public against the costs in money and percentage of the national effort devoted to decontamination efforts that would be needed to achieve some given reduction?

Perhaps the hardest question of all involves the intrinsic value of human life. With a given budget, should the primary emphasis be on saving the most people, or should certain measures be taken to improve the position of perhaps a smaller number of survivors? Such questions are discussed in an interesting way in a section entitled "The Devil's Deal" in a recent Rand report. [Ref. 8, p 61.]

Further, the goals and objectives of the various elements within today's pluralistic society are by no means homogeneous. The far left, the far right, the hippies, the black militants, appear sometimes to have little more in common than their agreement on how strongly they disagree.

This paper does not attempt to answer such specific questions. It does formulate four "basic questions" on civil defense and employ techniques of systems analysis to provide answers to them.

The Four Basic Questions on Civil Defense

The essence of the civil defense issue can be expressed in the following questions:

1. Is the probability of nuclear war so low that it does not justify any serious civil defense attention?

More specifically, is the probability of nuclear war so remote that it falls into the category of other possible but highly improbable catastrophes such as the collision of the earth with a huge comet? If this is true, then civil defense against nuclear war would warrant no more attention than, say, plans to cope with a new Ice Age. (Someday this may become important, but not yet.)

2. Does civil defense preparedness increase the probability of nuclear war?

That is, does civil defense by its very nature make the event for which it is designed more likely, in the manner of a self-fulfilling prophesy? If this is true, serious doubt as to the value would be justified.

3. Is recovery from a nuclear attack possible?

Would the world or even part of it (such as the northern half of the Western Hemisphere) inevitably become uninhabitable after a nuclear

exchange? This question may sound facetious or absurd to many people who have studied the problem, but it sounds real to many others. In the lead story of the March 23, 1970, New Yorker is this statement:

> Since the development of nuclear weapons, everyone has known that an international crisis could lead to the extinction of the human species . . .

If it is true that there is some basic unchangeable factor that would prevent the recovery of society after a nuclear war, then any efforts to mitigate the effects of such a war would be futile.

4. Is civil defense feasible?

Can this country develop an effective civil defense system at a cost it can afford to pay? In the event of a nuclear attack, could practicable civil defense measures result in a substantially greater number of survivors and contribute materially to their chances of continued survival, well-being, and ultimate recovery? If so, how would the costs of such measures compare with the cost of strategic offensive systems and other defensive systems, and would there be a better way (an expanded anti-ballistic missile system, for example) to achieve the same goals?

In this discussion, various techniques of systems analysis and operations research are used to address these four questions. In particular, the paper will draw heavily on two "models," a "Nuclear Conflict Model" and a "Flow Diagram Model of the U.S. Society In and After Nuclear Attack."

This Nuclear Conflict Model is developed as a basis for examining Questions 1 and 2 above. It is used in Appendix C to examine a number of other questions related, but less crucial, to the central civil defense issue. The Flow Diagram Model is developed as a basis for examining Questions 3 and 4.

Appendix A, which gives a brief history of U.S. civil defense and a brief status report of the civil defense program in the U.S. and selected other countries, is intended for those readers who have not been involved in these programs, or otherwise have not had an opportunity to become familiar with them. Appendix B, which discusses the probability of nuclear war, examines the literature available on the subject and compares the perceived likelihood of the nuclear war catastrophe with more familiar hazards such as automobile accidents. Appendix D elaborates the discussion of post-nuclear-attack economic recovery beyond that provided on page 47 in the body of the thesis.

USE OF MODELS IN CIVIL DEFENSE PLANNING

What Is a "Model"?

When people conceptualize some entity of the real world, and especially when they want to describe it to others, they select from the almost limitless number of properties and attributes of the entity those relatively few they consider essential for the description. In effect, they create a simplified mental picture of the entity and use it as a basis for the description. This picture or "model" of a particular entity may be very different, depending on which characteristic is being considered. An X-ray machine in many ways is a good model for the radiological properties of fallout; while fine sand or dust is a useful model for the physical properties. On the other hand, an X-ray machine would be misleading as a model for the physical properties of fallout, and sand would be misleading for the radiological properties.

A model may be very subjective, depending on how much its creator knows about a particular entity and how distorted or biased his perception of it may be. Before the usefulness of any model can be established it must be carefully described so that it can be examined and objectively determined to be valid and acceptable to those concerned. Otherwise, two people who

think they are communicating, may actually be talking about two entirely different things. A physical representation, such as a model airplane, is useful for illustrating the components of the model and for clarifying their interrelationships. But, ideally, the model should be completely described by a set of mathematical equations. Discussants then only have to agree on outside factors such as inputs or constraints. For example, if two persons accept the DELFIC fallout model of the Department of Defense (which is just a set of equations to be solved on an electronic computer), [Ref. 70, pp 291-297] they have only to agree on some attack pattern and specified weather conditions to have agreed on the fallout conditions that would result.

Models are important tools for the systems analyst, since most systems of interest are highly complicated and consist of a multitude of components. These components, for example, could range from a certain part in the guidance system of a Minuteman Missile, all the way to the social and psychological pressures being exerted on some military decision-maker. The building of models for strategic analysis has become an art (perhaps almost a science) in itself. There is considerable literature on the subject. The book Analysis of Military Decisions, comprising the series of Rand Corporation lectures on systems analysis, presents a good summary of the processes involved in model building, as well as the means of verifying the validity of models. A full chapter is devoted to the "Why and How of Model Building." [Ref. 58, pp 66-80.]

Most of the models to be considered in this thesis have not been, and perhaps could not be, fully represented by a set of equations. Other words that might be used to describe them include: concepts, images, analogs, and paradigms. The term "model" is used, however, in this paper for uniformity, and because the meaning of the term "model" is clearly understood by the systems analyst.

Three Models that Currently Are Operative

There are three models that, although mainly dysfunctional, continue to exert a major influence on the question of civil defense. These are:

Model No. 1: The History-Repeats-Itself Model;

Model No. 2: The Armageddon Model;

Model No. 3: The Diabolical Adversary Model.

Model No. 1: The History-Repeats-Itself Model

Those who use the History-Repeats-Itself Model base their beliefs, in large part, on the slogan: "Those who ignore history are doomed to repeat it." The lesson of history that they seemingly fail to grasp is the rapidity of obsolescense. World War II differed in many respects from World War I, probably much more than the Second Punic War differed from the First. Most analysts who have studied the problem think that a thermonuclear war would differ more from World War II (time span at least 25 years), than World War II differed from either of the Punic Wars (time span more than 2,000 years).

Two clear-cut examples may be used to show how World War II thinking and precedent are not applicable to present-day civil defense planning: plans for postattack resource management, and plans for utilization of fallout shelters.

The National Plan for Emergency Preparedness [Ref. 54], the official document of the United States Government on postattack planning, seems to be oriented toward controlling the U.S. economy in a World War II or Korean War type of situation, where the principal goal was the production of war materials and concomitant control of inflation. This National Plan calls for strong Government action to regulate wages and rents, to allocate raw materials, and to specify the kinds of goods to be produced. Many economists do not consider such a focus appropriate to a post-nuclear-attack situation. Dr. Sidney Winter of the Rand Corporation, in a paper presented at a 1967 symposium on postattack recovery from nuclear war, suggested that the four major post-nuclear-attack tasks for the Federal Government should be:

1. Reestablish private property rights.
2. Reestablish use of money to avoid a barter system.
3. Stabilize price expectations possibly by operating a futures market, and limited price control.
4. Reestablish government operations with provisions for important goods and services. [Ref. 51, p 415.]

This subject is discussed further in Appendix D, starting on page 130.

The other example of where the World War II model probably is dysfunctional is in the planned use of shelters in a time of nuclear attack. During World War II, especially in England, Germany, and Russia, shelters were designed and used to protect people from the blast effects of conventional high-explosive bombs delivered by many aircraft and a few rockets. Today, the 100-million public shelters that have been identified and marked in the U.S. are intended primarily to protect people against the effects of fallout. Yet much of the shelter-utilization planning in the U.S. seems to be based on the World War II model, i.e., Government advice is that people should, if possible, be in shelters before the attack begins. Many fallout shelters provide little protection against blast and fire effects, and some probably increase occupants' vulnerability to these effects.

This thesis does not specifically present a case either for or against the continued use of these World War II-based models. However, it points out that major U.S. policies now based on this model should be critically and thoroughly examined using more up-to-date models.

Model No. 2: The Armageddon Model

The Armageddon Model is based mainly on the view that nuclear war would destroy mankind, or at least destroy civilization as we know it. [1]

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[1] There seems little question that U.S. political leadership in the 1960's held this view. In his account of the Cuban crisis, "Thirteen Days - The Story About How the World Almost Ended," the title used in McCalls, [Ref. 41,

Since the earliest days of the atom bomb project of World War II, people have conjectured many bizarre and catastropic after-effects of nuclear explosions. Some were to result from the enormous power of the blast itself; some from the initial ionizing radiation and fallout. It was because of this kind of concern that Dr. Hans Bethe appeared before a special committee of the U.S. Senate in 1945 to testify that no temperature would "ignite" the earth's atmosphere or cause nuclear chain-reactions in either the atmosphere or the ocean. [Ref. 75, p 224.]

Another persistent and widely held public conjecture was that nuclear explosions affected the weather. During the 1950's while atmospheric nuclear tests were being conducted, it was not uncommon to see speculation in the U.S. and foreign press relating unusual wet or dry spells, hurricanes or tornados, to various Nevada and Pacific tests. Still another public notion was that a nuclear war would trigger a new Ice Age resulting from the deposition of vast quantities of fallout debris in the stratosphere for times

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p 6] or, Thirteen Days: A Memoir of the Cuban Missile Crisis, the title of the same material published in book form [Ref. 40, p 14], Robert F. Kennedy said, "Each one of us was being asked to make a recommendation which, if wrong and if accepted, could mean the destruction of the human race." Elsewhere in the book is the statement, "This was the beginning of the Cuban Missile Crisis - a confrontation between two great atomic nations, the U.S. and the U.S.S.R., which brought the world to the abyss of nuclear destruction and the end of mankind." The terms destruction of the human race and end of mankind do not equivocate; they represent accurately the beliefs of at least some of the U.S. leaders involved in this historic confrontation. And they accurately reflect the atmosphere surrounding the meetings of ExCom, the group that President Kennedy formed to advise him during the Cuban crisis.

long enough to affect the temperature of the earth. These particles, some people felt, would cause solar energy normally reaching the earth's surface to be reflected back to space.[1]

From the beginning of the nuclear age, however, strontium-90 has been perceived by many to pose the greatest threat to continued survival following a nuclear attack. In his book On Thermonuclear War, Herman Kahn (then of the Rand Corporation, now of the Hudson Institute) in a section entitled, "Will the Survivors Envy the Dead?" presented the first widely publicized analysis of the post-nuclear-war strontium-90 problem. [Ref. 37, pp 63-72.] Mr. Kahn realistically refuted the widely held (but erroneous) opinion that most survivors of a nuclear attack would sooner or later die from leukemia or bone cancer due to strontium-90.

Extensive research programs supported by the Atomic Energy Commission, the Department of Defense, and many others, have strengthened Mr. Kahn's conclusions that strontium-90 is not the serious threat it earlier was thought to be. This subject is treated more fully on pages 48-49 of this thesis.

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[1] In a 1964 Hudson Institute report by Dr. Robert U. Ayres, this phenomenon is discussed, as are other postulated nuclear-war produced ecological catastrophes--fire, erosion and flooding, pest outbreaks, epidemic diseases, weather, and balance-of-nature disturbances. His objective was to ". . . take seriously and examine in their own terms, all of the supposed mechanisms leading to catastrophe which have been subjects of speculation in recent years." Dr. Ayres summarized by saying, " . . . we have not found any of these mechanisms to be plausible in terms of any reasonable definition of catastrophe." [Ref. 3, p ix.]

Another persistent fear is that nuclear war would severely upset the "delicate balance of nature." One of the more commonly quoted statements of this fear was based on testimony by Dr. John N. Wolfe of the Atomic Energy Commission in hearings before the Joint Committee on Atomic Energy in 1959.[1] [Ref. 74, pp 840-842.] The statement issued by SANE (The National Committee for a Sane Nuclear Policy) based on Wolfe's testimony is:

> Fire . . . would spread over enormous areas of forests and grasslands . . . It is most likely, in my opinion, that these fires would go unchecked until quenched by the winter snows, spreading over hundreds of thousands of square miles . . . Along with fire, flood and erosion . . . would come intensification of disease, plant and animal, including man. Moreover, in the less irradiated areas, populations of deleterious animals, especially insects, would move in . . .

The unchecked fires would have two causes: first, fires started by the thermal flash at the instant of explosion; and second, fires occuring a few years later as a result of forests having been killed by fallout radiation. Forests full of dead trees would be highly flammable and vast fires would be produced by lightning and the other causes that lead to the forest fires of today.

Fallout has been indicted on another score. The "delicate balance of nature" would be upset through disturbances of prey-predator relationships. Because of differences in their sensitivity to radiation, the predators (the

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[1] Dr. Wolfe did not testify as an offical spokesman for the AEC. As an "expert witness" he was reflecting his personal point of view. Other AEC scientists, if called to testify, might well have presented a different picture.

birds) would be killed leaving their natural food supply (the insects) alive. Thus, without a natural controlling mechanism, insect explosions could occur.

A great deal of work has been done since Dr. Wolfe's statement of 1959, and as a consequence, many of the cause-and-effect relationships are now better understood and more definite estimations can be made of potential ecological consequences of nuclear war. To provide perspective, it is useful to keep in mind that nature may not be so delicately balanced after all. No logical weight of nuclear attack could induce gross changes in the balance of nature that approach in type or degree the ones which human civilization has already produced. This includes cutting most of the original forests, tilling the prairies, irrigating the deserts, damming and polluting the streams, eliminating certain species and introducing others, overgrazing hillsides, flooding valleys, and even preventing forest fires. Man has radically changed the face of the continent but should he leave the scene it seems overwhelmingly probable that there would be a gradual return to the original situation or a close facsimile thereof, rather than violent fluctuations or further change to a new equilibrium state of nature. [See Ref. 3.]

From the psychological point of view, it is not difficult to understand why so many theories have been advanced predicting the various kinds of cataclysms that inevitably would follow a nuclear war. If it could be established, widely publicized, and accepted that nuclear war, directly or

indirectly, could trigger some mechanism for annihilating the human species, the world could appear more secure. A nuclear war would seem much less likely since only a madman would initiate a course of action that inevitably would result in his own suicide. Further, the public would not tolerate the possibility that a madman could get control of a nuclear arsenal. Even the very remote chance that all the men in control of the arsenal "collectively might go mad" would appear too big a risk. Thus, public pressure would lead to arms reduction and arms control, making world peace seem inevitable.

More subtle, perhaps, is an underlying apprehension that, without the specter of some ultimate catastrophe, world leaders might be less restrained and nuclear war would become more likely. People holding this view, either consciously or subconsciously, may be motivated to generate new hypotheses for disaster as needed to fill in any breach.[1]

Model No. 3: The Diabolical Adversary Model

The implications of this model, in terms of the civil defense question, may be seen from the following scenario:

"It is a quiet and peaceful Sunday afternoon. Some people are at the ball park watching the Senators lose to Milwaukee; many others

[1] A view that nuclear war would be just like any past war, only a little bigger, is no less distorted than the mythological idea that nuclear war would annihilate mankind. Consequences of nuclear war in terms of the numbers of human lives lost (on both sides), the short time span (a day or so), the indirect social and psychological effects, and the magnitude of the damage to the productive capacity of the economy could be without precedent.

"are mowing the lawn, or on picnics, or fishing, or golfing, or engaged in some other of the myriad idyllic activities Americans associate with peace and tranquility. The world seems a little less hostile than usual. SALT is making some progress, and a new expanded cultural-exchange agreement has just been signed with the Russians. When SUDDENLY, out of the blue, Soviet SS-9's begin to rain down. Not only is the attack massive, but the missiles are in salvo. All parts of the Country are hit simultaneously, and no one has a chance to protect himself."

This scenario makes any kind of civil defense look almost hopeless. People would have no time to get to shelters, or to evacuate any high-priority target areas.

The fact that this scenario is only one of many ways in which a war could start, and that it is not considered by knowledgeable analysts to be one of the more plausible ways, is usually ignored.[1] The scenario represents the worst thing a completely malevolent enemy could do to you and, perforce, thereby it seems to be the most likely. There is evidence that this Diabolical Adversary Model is symmetrical, i.e., it is a model employed by the Soviets as well as Americans. During the '50's when American SAC bases were being built in countries surrounding the Soviet Union, the

[1] The Strategy and Tactics Panel of Project Harbor, a 1962 summer study group under the leadership of Dr. Eugene Wigner and under the auspices of the National Academy of Sciences, considered this question at some length. The results of the Panel's work are included in the Summary Report of the Study Group. [Ref. 12, pp 9-11.]

explanation that these activities were strictly defense-oriented no doubt was a little less credible to the Russians than it was to the Americans.

The so-called "Deterrence Concept" is another manifestation of the Diabolical Adversary Model. It, in effect, says that we (the good guys) have to deter them (the bad guys) from doing bad things to us that otherwise they surely would do. The model is open-ended--one would always like just a little more deterrence.

Some Limitations of the "Deterrence Concept"

To date, the Soviet Union has not attacked the United States with nuclear weapons. De facto, therefore, the U.S. strategic policy, which in its simplest sense is to deter such an attack, has worked. In addition, the Soviets have been deterred in a number of other cases that seriously involve the national security of the United States. Prominent examples are the eventual backdown of the Communists in the Berlin blockade of 1961, and removal of the missile sites from Cuba in 1962. It is fair to say, therefore, that our deterrent policy has done more than just deter an all-out, overt nuclear attack on this Country, provided one agrees that, in the absence of such a policy, the outcomes would have been different.

But our policy of deterrence has certainly not kept the Soviet Union from taking all actions inimical to U.S. security interests and to the objectives of U.S. foreign policy. The Soviet Union provided much of the arms,

training, and other support to the North Koreans in the 1950's, and to the North Vietnamese who are involved in direct face-to-face conflict with U.S. military forces. If such liberal Soviet (and Chinese) support had not been present, there is little question that the United States could have brought both the Korean and Vietnam wars to successful conclusions in short order, without the enormous costs to the U.S. taxpayer and high toll of American lives. In fact, it is doubtful that without Soviet backing (or in the face of express Soviet disapproval) either would have started.

The U.S. deterrence policy did not prevent construction of the Berlin Wall. It had little if any impact in alleviating the brutal repression by Soviet military forces of the Hungarian liberalization movement of 1954, or the Czech reform movement in 1968. Current Soviet military support of the Arab nations in the Middle East certainly is contrary to U.S. interests, and poses a threat to world peace.

Even if one argues that without a U.S. deterrent influence, each of the above conflicts would have been far more serious (which may well be the case), it is hard to describe the deterrence policy as an unqualified succes . It has not deterred the Soviets from actions that have been strongly contrary to U.S. vital interests.

An attempt to further define the basic ingredients of deterrence has brought the term "unacceptable damage" into the lexicon of strategic discussions. To illustrate use of the term: if the U.S., even after a first

strike by the U.S.S.R., clearly has the residual capacity to inflict "unacceptable damage" on the U.S.S.R., and if the Soviets are aware of the U.S. capacity, then the Soviets will be deterred from striking the U.S. The converse of this is, of course, equally applicable, at least theoretically.

Neither "unacceptable damage" nor "deterrence" can be defined in any general or specific terms. What clearly would be unacceptable damage in one case might be accepted in another, depending on the alternatives: what would deter attack in one situation would not in another. In an attempt to reduce the ambiguity, Herman Kahn in his book Thinking About the Unthinkable [Ref. 39, pp 101-25], and elsewhere, discussed three types of deterrence. Type I deters deliberate direct attack on the U.S. Type II deters extremely provocative actions short of an attack on the U.S. (such as an attack on a NATO nation or other U.S. ally). Type III deters provocations of a lower order, and encourages "acceptable" behavior.

Although Kahn's approach clarifies the meaning of deterrence to a degree, it fails to remove the subjectivity and ambiguity that are inherent attributes of the basic concept. A nation might be willing to accept the damage from a second strike if the only alternative were accepting the greater damage associated with a first strike; or the Soviets might attack one or more NATO countries rather than tolerate the defection of a major number of Warsaw-Pact countries; other examples could be given. But "deterrence," as it is commonly used, has the simplistic implication that

it applies under any circumstances without regard to what alternatives would exist.

It is not the purpose of this thesis to define the origin and trace the history of this "Diabolical Adversary" Model, or even to further elaborate on its validity. However, it is quite evident that both the U. S. and U. S. S. R. have interpreted activities of the other side as justification for acceptance of this model.

This deterrence concept has not helped create support for an effective civil defense in the United States, as attested by the extremely low percentage of the total defense funds expended for civil defense. Furthermore, this concept is not particularly functional as a basis for understanding and defining strategic policy. The deterrence concept is not functional at all for a strategic arms limitation agreement, or even for discussions aimed at curtailing the deployment of MIRV's or an ABM system.

A better model is needed, and it is the objective of the following section to suggest and define the characteristics of such a model. The model is not predicated on good-guy/bad-guy thinking, nor does it attempt to consider morality or the righteousness of the cause. The model is based on the simple assumption that people do not deliberately commit acts they perceive are likely to be contrary to their own best interests.

THE NUCLEAR CONFLICT MODEL

A nuclear war cannot occur unless someone starts it.[1] Some decision maker with the necessary authority, on one side or the other, deliberately (but perhaps very reluctantly) has to make a decision that starts the nuclear war. The objective of the material that follows is to "model" that time of decision.

Development of the Model

The setting is exemplified by the Cuban crisis of 1961. The decision maker may be exemplified by President John Kennedy or Premier Nikita Khrushchev. The model is applicable, however, to any other past or future nuclear-age period of crisis-level international tension, and to any other international leaders, Soviet or American. (It is applicable to the nuclear war case--not to conventional weapons wars such as World War I or II.)

The decision maker perceives a strong possibility that his country is about to become involved in a nuclear conflict, and that the other side may start it. He also is aware that his opposite number perceives the same

[1] The accidental detonation of a nuclear weapon on or over foreign soil does not constitute a nuclear war, although it might trigger such a war (see Appendix B for additional discussion). Also, the decision maker who starts the war may do so as a result of having misread some other event such as a clandestine nuclear explosion, and thereby think a war has already started. But, nevertheless, a nuclear war cannot occur unless someone starts it.

thing. The future path of well-being for the people for whom (and to whom) he is responsible is seen by this decision maker as likely to follow the solid curve from "a" to "e" of Figure 1.

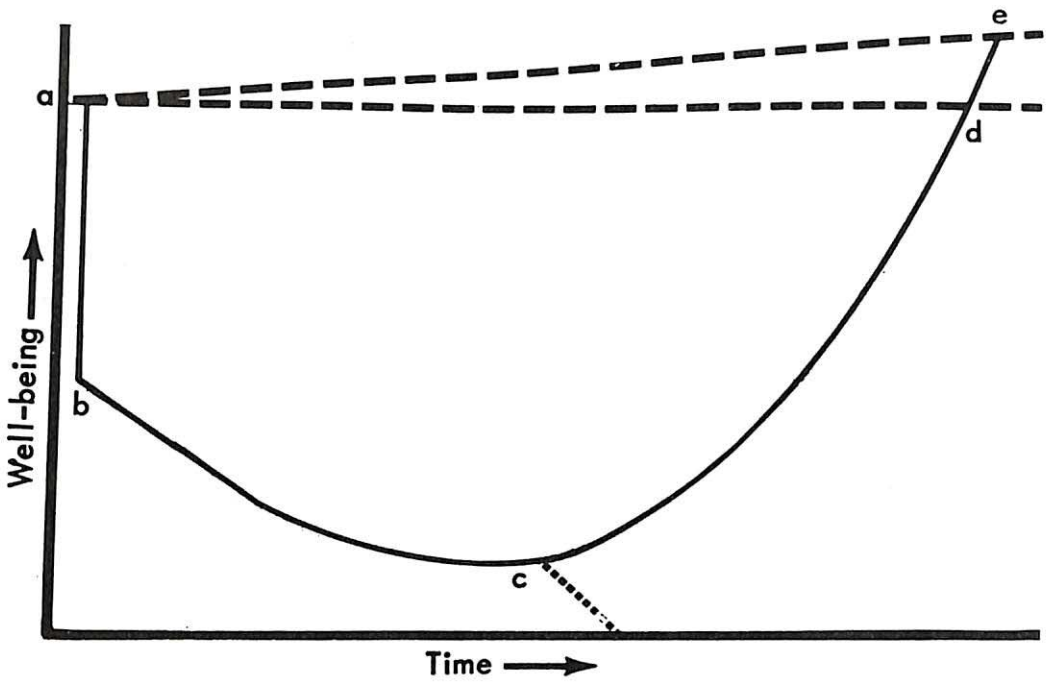

Figure 1. American Future.

National well-being may be considered as a composite of population, resources, and institutions--the constituents and characteristics of his country that the decision maker values. The decision maker sees that his nation's current state of well-being (level a) is about to take a precipitous drop (to level b) because of the effects of the expected enemy attack. He and his advisers know from the results of numerous war games and other strategic studies that this damage would be enormous--perhaps a third to a half of the population killed outright, with a commensurate loss of industrial and military resources.

The decision maker knows also that the initial sharp drop would be followed by a slower but inevitable decline due to later fallout-radiation effects and to general disruption and disorganization. He expects that, finally, a minimum or "bottoming out" should occur (level c) after which his nation would begin its upward path to recovery (level d), the preattack status, and finally, to where the well-being level would have been if war had not occurred (level e).[1]

There is a possible alternative route that the decision maker must consider, depicted by the path of the dotted line below level "c." This dotted line implies that damage was so severe, and/or management so inept or misdirected, that national recovery does not occur at all, and the society degenerates into chaos.

Faced with such an awesome prospect, the decision maker has three alternatives: he can back down; he can "wait it out" in hopes that the enemy will not strike; or he can order a preemptive strike. The pressure to preempt could be very severe, especially if the prospect of his country being attacked seems "almost inevitable," or the consequences of backing down seem "almost unacceptable." The decision maker's perception of his nation's future well-being if he preempts is represented by the upper

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[1]This depiction of the "well-being path" is patterned loosely after an illustration suggested by Dr. Sidney Winter of the Rand Corporation [Ref. 57, p 30]. Estimates of the time needed to recover have varied depending on the size of attack and the researcher. In one attack case studied [Ref. 38, p 28], it was estimated that the time for the postattack society to achieve recovery (level d) might be on the order of 10 years. (Population, of course, would not be expected to return to the pre-war level in a ten-year period.)

curve in Figure 2. (The lower curve represents, as in Figure 1, an enemy's first strike.)

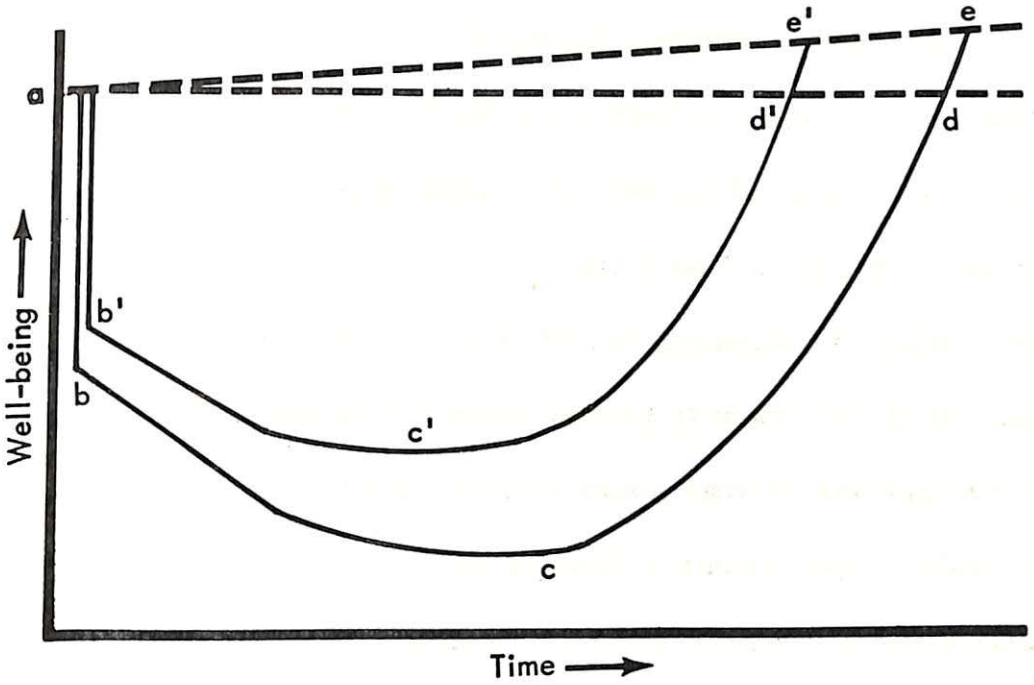

Figure 2. Alternative American Futures.

Even if a preemptive strike initiated by this decision maker is highly successful, he cannot hope to completely destroy the second-strike capability of the other side. The U.S. and the U.S.S.R. both have missiles in hardened silos, in Polaris-type submarines at sea, and they both have widely dispersed tactical and strategic aircraft. Some of these weapons are likely to survive a first strike and to penetrate the other's defense. A preemptive first strike almost certainly would trigger a retaliatory second strike by the opponent's residual forces, and this retaliatory blow would probably be aimed at population and industrial targets because most of the missile silos would by then be empty.

Thus, the preemptive first strike would almost surely result in retaliation, producing a similar precipitous drop due to the direct weapon effects (a to b'), and again a further decline (b' to c'). But these expected declines would not be as deep as they would be if the enemy first strike had been absorbed, since some of the enemy's military strength would have been destroyed by the preemptive first strike.

Since there was less damage, recovery should begin sooner and progress more rapidly. (It is important to keep in mind that neither of the curves of Figure 2 are predictions of what would happen; they represent a decision maker's reasonable expectations.) Even if this decision maker had not thought through these alternative futures, he probably would develop quickly a similar perspective. Further, to a decision maker faced with the option of absorbing a first strike or preempting, the non-recovery of his country (the short dotted line in Figure 1) would seem more likely for the lower path than for the upper one.

With the current and probable future balance of nuclear power between the United States and the Soviet Union, including the second-strike capability of both sides, it is almost inconceivable that either side could perceive itself being better off after a nuclear war or during the following years (or perhaps decades) than it was before the war. This conclusion requires no sophisticated analysis or access to classified data. Further, it is true no matter what value system is used, be it size of population, per capita or

national income, political or military influence on other nations, standing as a world power, or whatever.

U. S. -U. S. S. R Symmetry

Assume that level "a," the current (or prewar) state of well-being, has the same value for the Soviet Union and the United States. This is not an unreasonable assumption although Russia has a somewhat larger population (235 million to 200 million) while the U. S. has a higher GNP (750 billion to 365 billion). [Reference 13.] Both countries place a high value on their institutions--the U. S. follows the capitalistic free-enterprise approach; the U. S. S. R. has a communistic system. Thus, whether Russia initiates a nuclear war and follows the upper path in Figure 2, and the U. S. follows the lower one; or the U. S. initiates a nuclear war and follows the upper path, and the Soviets the lower one, the two curves are the boundaries of perceived state of future well-being for both countries.[1] The prospect of nuclear war then to either side is the prospect of the shaded path, Figure 3, no matter who strikes first, and this is apparent to the decision makers of both sides.

[1] If both sides initiated at about the same time, their status of future well-being would lie somewhere in between the two boundaries. For this reason, the area between the boundaries is filled in to illustrate a band rather than two separate curves.

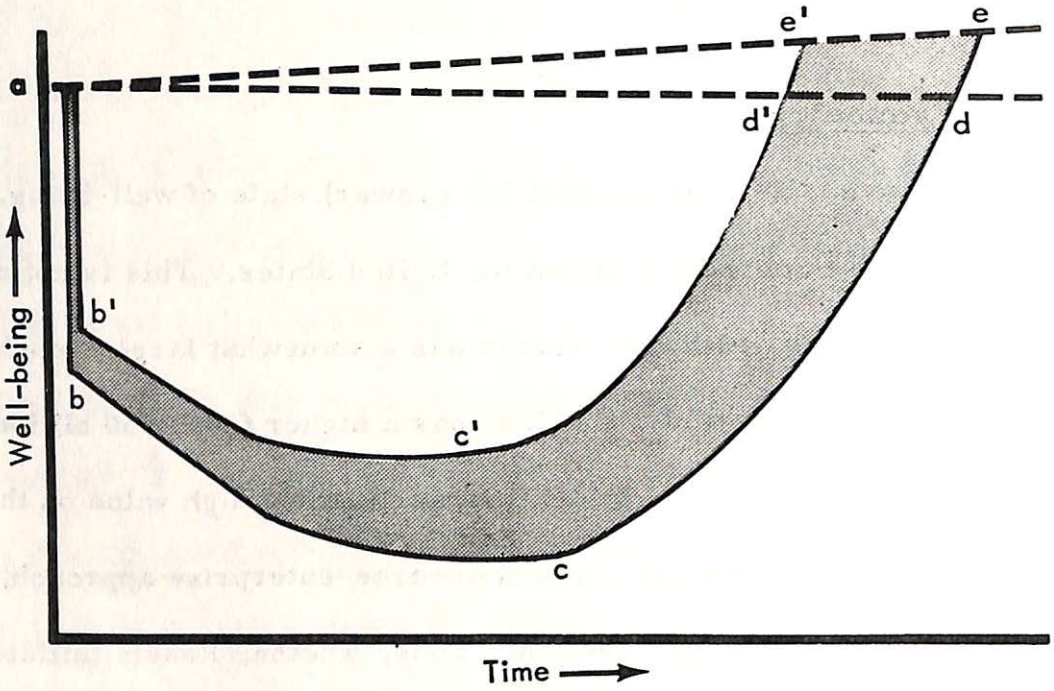

Figure 3. American or Soviet Futures

Nth Country Considerations

Now consider a path that would describe to either the U. S. or the Soviets, the expected future well-being of some third country, say Japan, following a U. S. -U. S. S. R. nuclear exchange. The model is as follows:

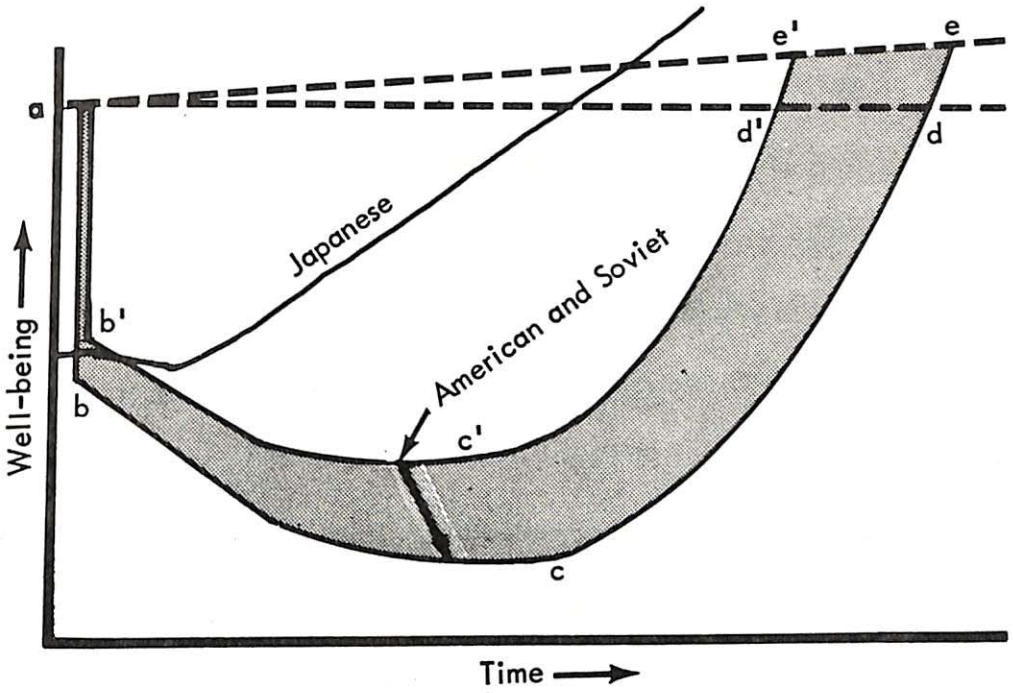

Figure 4. American, Soviet, and Japanese Futures.

The "a" level (preattack well-being) for Japan (i.e., the American or Soviet view of the current relative value of Japanese well-being) might reasonably be located at about one-half the normalized U.S. and U.S.S.R. preattack level. Japan's GNP for 1967 was about $153 billion and Japanese population, 100 million. [Ref. 13.] (Some Americans or Soviets might be inclined to set a higher "a" value for Japan because of her economic growth and future prospects.)

Now, according to the model (Figure 4), what would happen to Japan if the U.S. and U.S.S.R. become embroiled in a nuclear conflict (assuming Japan remains neutral)?

Japan's well-being path at first would be unaffected; then it probably would take a slight initial drop due to the secondary effects of attack (world-wide fallout, for example), and the loss of markets in the Soviet Union and the United States. Shortly thereafter, however, the path could begin to rise sharply due to the reduction of competition from the Russians and Americans. Both these nations would be concentrating on efforts to assure their own survival and recovery.

The crucial point, however--and one that would be obvious to American and Soviet decision makers--is that no matter how the war starts, and thus, whether it is the Americans or Russians who would follow the upper path on the chart, both nations would fall far below Japan. Both countries reasonably could expect to remain in this inferior status, not only to Japan but to other nations as well, for years to come. Whether the U.S. or the U.S.S.R. could regain its former position as a superpower, or would be permitted to do so by the other nations of the world, is by no means certain. Thus, if either nation wished to assure a future state of well-being superior to the adversary, and to remain a prominent world power, the initiator of the Soviet-U.S. nuclear war would also somehow have to assure a major reduction in the well-being of the non-combatants. The military power to do this throughout the world probably does not exist, even if some nation were barbaric and callous enough to try. (Table I, derived from Reference 13, gives comparative GNP and population data for some of the world's most prosperous nations.)

TABLE I

COMPARATIVE POPULATION AND GROSS NATIONAL PRODUCT
(for 1967) (GNP in market prices 1966 U.S. dollars)

Country	Population (millions)	GNP (billions)	GNP/Capita ($/person)
U.S.	199.1	777	3,902
U.S.S.R.	235.1	365	1,552
Germany	76.9	174	2,262
West	59.7	142	2,377
East	17.1	32	1,871
Japan	100.0	153	1,530
France	49.7	114	2,293
Italy	52.6	78	1,482

The path for Germany (and there probably would be no East and West separation following an American-Soviet nuclear exchange), could be very similar to that shown for Japan. The combined population of East and West Germany was 77 million in 1967, and the GNP was $174 billion in that year.[1]

[1]The advantage that could accrue to Japan or Germany or Communist China if the two major nuclear powers should "knock each other off" might motivate them to try to start such a war. The Chinese, for example, might shoot off a missile at the U.S. in hopes the U.S. would think it was Russian and the war would be triggered. On the other hand, Russia and the U.S. being aware of just such a possibility, might compare notes and figure out what had happened and punish the culprit severely. Such a move by the third party most likely would seem to him to be very dangerous in terms of what he could expect to gain from it, even if he were Machiavellian enough to try.

One has only to reflect a few seconds to recall that it was just a little more than 25 years ago that the Soviet Union and the United States were fighting as allies in a desperate attempt to keep Germany and Japan from following just this projected path.

How A Nuclear War Might Start

Based on the above Nuclear Conflict Model, one is led to believe that the United States and Soviet Union both should be highly motivated to avoid nuclear conflict with each other; and, therefore, that the probability of nuclear war between them is very low. This being the case, why does either nation need civil defense?

There are at least four plausible (although highly unlikely) ways that a nuclear war could begin:

1. Things get out of hand (or escalation, or "Cuba plus"),
2. A major military accident occurs and triggers a war,
3. A third party succeeds in purposely starting it,

and 4. A "madman" (such as Hitler) gains control.

Of these four possibilities, number one appears to the writer to be the most dangerous. Although fears that the present Southeast Asia war might escalate into a nuclear conflict between the U.S. and the U.S.S.R. appear to have receded, there is concern over the possibility of the Arab-Israeli situation escalating into a direct confrontation between the two superpowers.

That there will continue to be high-tension situations somewhere in the world seems almost inevitable.

But in the final analysis, there is no model or any other analytical technique that can determine the likelihood of nuclear war occurring, or the numerical chance of civil defense being needed. (Appendix B discusses this question in some detail.) On the other hand, there is no way to prove that wars, including nuclear wars, are obsolete and that, therefore, civil defense will not be needed. Can the U.S. afford to play Russian Roulette? (The pun, if one chooses to call it that, seems appropriate.)

Does Civil Defense Affect the Probability of Nuclear War?

The symmetrical U.S.-U.S.S.R. Nuclear Conflict Model (Figure 3) may be used to examine the potential contribution of a civil defense program to a change in the probability of nuclear war.

Civil defense systems would limit the damage that would otherwise occur to the constituents of national well-being; therefore, an improved civil defense serves to raise the band defining perceived future well-being (Figure 5). Certain civil defense measures, a crisis city-evacuation program for example, under certain circumstances could cause the width of the band to increase; other measures would cause it to decrease, but not much. However, no feasible civil defense program, or other passive or active defense system, could assure damage limitation to the extent

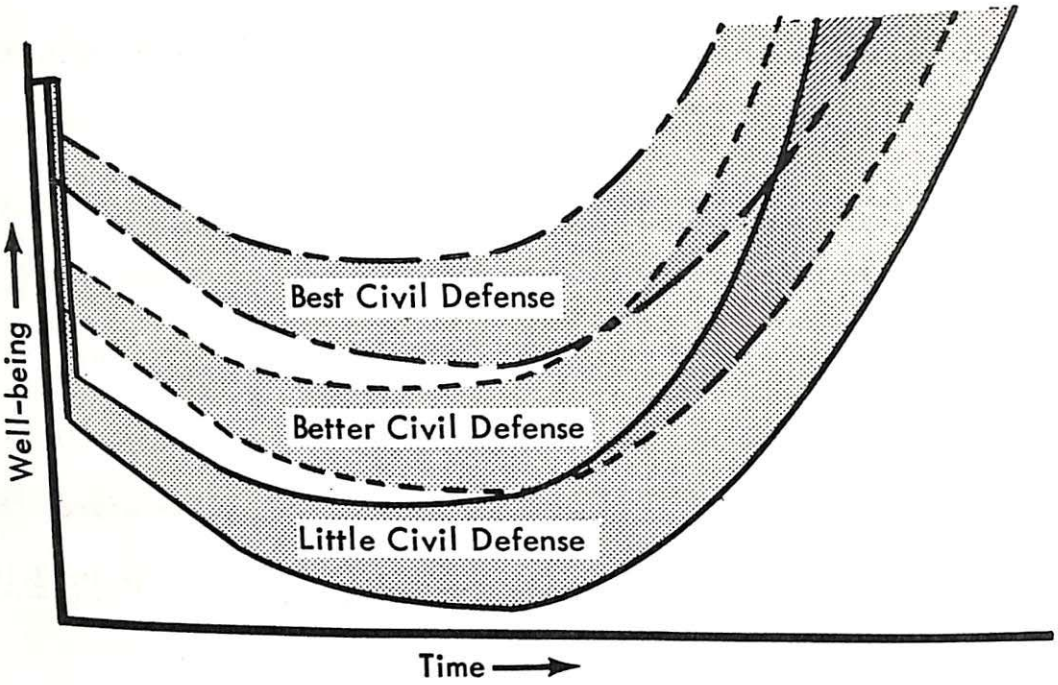

Figure 5. American Futures with Alternative Civil Defense Programs.

that the post-nuclear-exchange level of well-being would not be severely and dangerously degraded compared to the level of well-being existing beforehand. Under heavy attack even the most expensive civil defense system sould fall far short of protecting everyone and everything. Millions of people would perish and damage to industry would be severe and wide-spread (i.e., the path would dip well below the pre-war well-being level).

On the other hand, it might be argued (and has been in Reference 7) that civil defense could have a stabilizing effect. In the event of accidental misfiring of a nuclear missile, or of misreading some enemy action as being highly threatening, the decision maker whose country has a good civil defense system might be less "trigger-happy." The consequences of a

decision to wait, if wrong, would be somewhat less disastrous than it would be if the population were defenseless from a civil defense standpoint.

Even if either of the arguments (that civil defense would increase the probability of war, or that civil defense would decrease it) has validity, almost no one would argue that this influence would be strong. At best, it would be a second- or third-order effect.

Through use of the Nuclear Conflict Model, answers to the first two of the four essential questions about civil defense were found to be favorable for a civil defense program, i.e., the prospects of a nuclear war are not negligible, and, no practicable civil defense system would increase this probability. The remaining two questions: Could the U.S. survive and recover from a nuclear war?" and "Can the U.S. afford an effective civil defense program?" will now be addressed, with the aid of the following Flow Diagram Model of the U.S. Society In and After Nuclear Attack.

A FLOW DIAGRAM MODEL OF U.S. SOCIETY IN AND AFTER NUCLEAR ATTACK

The Nuclear Conflict Model of the previous section was used to depict how a decision maker reasonably would perceive his nation's alternative paths of future well-being when he is considering an action that would begin a nuclear war. The following material provides a more detailed description of possible postattack futures. For simplicity, however, it is restricted to only one of the three ingredients of well-being, namely, the number of survivors.

The amount of study and research to date on post-nuclear-attack problems would be judged meager by most standards, especially when compared with other government-sponsored defense research. Nevertheless, a major improvement has occurred in the past ten years in understanding the nature and seriousness of the potential postattack problems and what could be done to alleviate them. It is the objective of the following to apply this knowledge in the development of a flow-diagram model of the U.S. society in and after nuclear attack.

If P is the size of the U.S. population immediately prior to a nuclear war, the effects of the war on P may be examined in terms of the diagram of Figure 6.

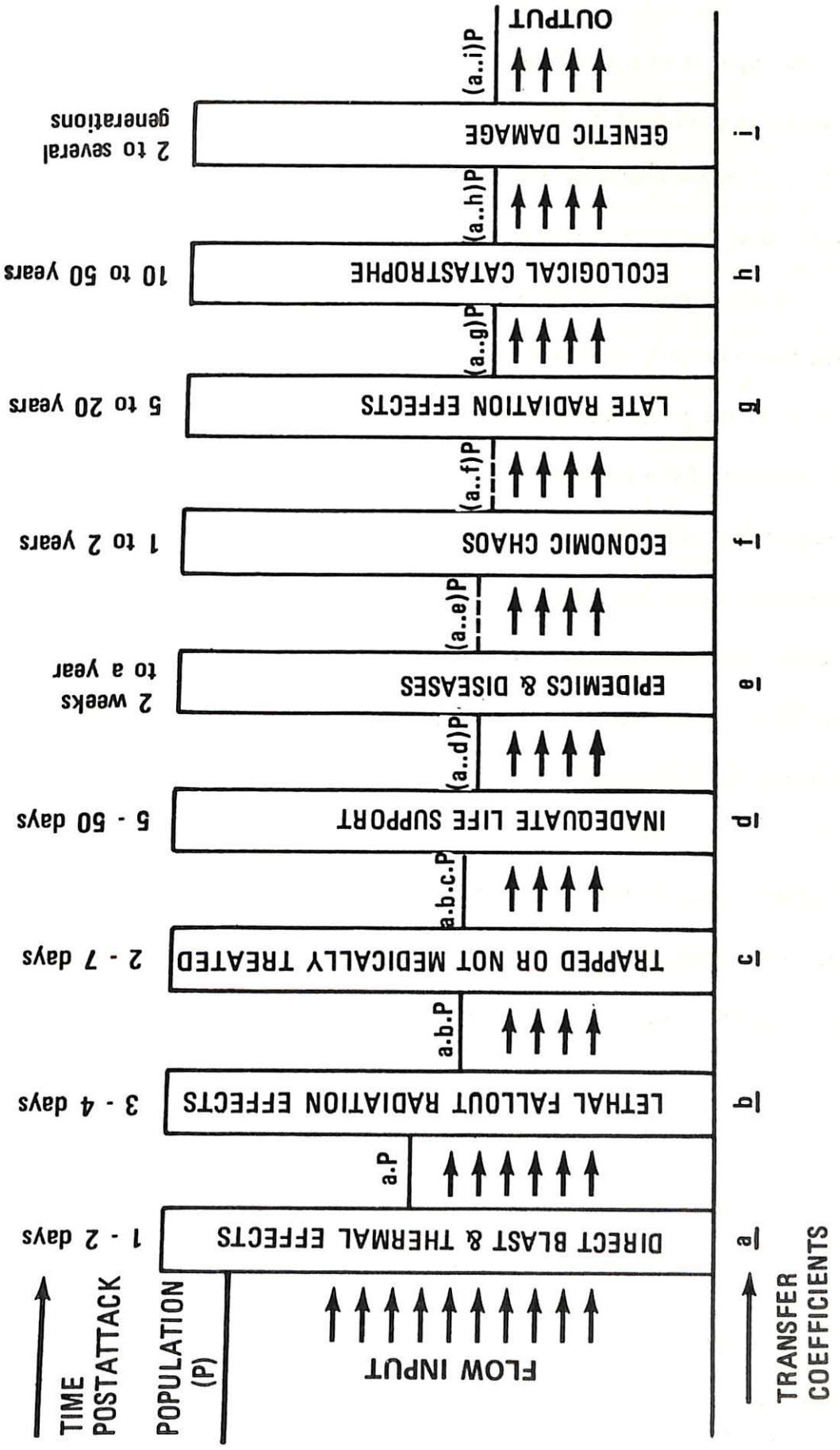

Figure 6. **FLOW DIAGRAM MODEL OF U.S. SOCIETY IN AND AFTER NUCLEAR ATTACK**

If the initial flow input is of magnitude P, and each of the attack effects is represented by an impediment or barrier-to-flow, then the value of each transfer coefficient represents the fraction of population that successfully passes the particular barrier to which a given coefficient applies. (It may be useful to think of each barrier as a sort of semi-permeable membrane, or as a screen that partially restricts flow.)

The fraction of the preattack population that survives all the attack effects is the product of the transfer coefficients, $\underline{a} \cdot \underline{b} \cdot \underline{c} \cdot \underline{d} \cdot \underline{e} \cdot \underline{f} \cdot \underline{g} \cdot \underline{h} \cdot \underline{i}$. Clearly the objective of a civil defense, or any other military offensive or defense system, is to make this product as large as possible. It is equally clear that if any single one of the transfer coefficients is critically small (or zero, representing the Armageddon model), there is no point in attempting to raise the others unless the critical one also is raised.

Each of these transfer coefficients will now be discussed in terms of its probable range of values and also in terms of what action is needed to either lessen the uncertainties about the coefficient or to increase its value. [1]

[1] The number of research reports and other studies relating to the various transfer coefficients is quite large; therefore, only one or two that the writer considers representative of the best available are identified as each coefficient is discussed.

Direct Weapons Effects

a is the transfer coefficient for direct weapon effects, i.e., the fraction of the preattack U.S. population surviving the blast and initial thermal and nuclear radiation. With today's civil defense system, a probably would be in the range of 0.5 to 0.8, depending on the type and weight of attack. ABM, blast shelters, or preattack evacuation would increase a.

Fallout

b is the transfer coefficient for lethal fallout effects, i.e., the fraction of the population surviving the direct effects that also would not receive a lethal dose of fallout radiation. Typically, b is in the range 0.4 to 0.8. b can be increased cheaply (at least on the margin), i.e., expenditures to save lives with a fallout shelter program are highly cost-effective, as are expenditures to educate the public on the nature of the fallout threat and means of protecting against it. It is mainly for these reasons that the emphasis of the current civil defense program is on fallout protection.

At this point, the flow diagram may be used to illustrate the importance of viewing civil defense as a system. A certain tactic intended to raise b might appear highly attractive if a narrow perspective is applied

(sub-optimization). But if this tactic at the same time reduces some other transfer coefficient, say a, so that the product ab becomes less than it was before, the tactic obviously would not be desirable. For example, a policy of sending people to the upper stories of high-rise buildings to increase fallout protection in target areas, may increase b. But the accompanying increase in a (deaths due to initial weapon effects) may result in a net decrease in the number of people surviving both effects.

Table II, which applies to transfer coefficients a and b, was derived from Figure 11 of Reference 60.

TABLE II

TRANSFER COEFFICIENTS a AND b AND THEIR PRODUCT FOR VARIOUS WEIGHTS OF ATTACK[a]

Note: Units of attack weight are in megatons equivalent of TNT, abbreviated MT.

Transfer Coefficient	1,000 MT	3,000 MT	5,000 MT	7,000 MT	9,000 MT
a	0.78	0.64	0.57	0.54	0.49
b	0.81	0.70	0.58	0.48	0.39
a • b	0.63	0.45	0.33	0.26	0.19

[a]Data are based on a composite of damage assessment studies by the Department of Defense. The attacks were assumed to be against Military-Urban-Industrial targets, and people were assumed to use the best protection available in the normal place of residence.

Rescue and Medical Care

c is the transfer coefficient that relates to early postattack life support requirements. It depends on the effectiveness of emergency operations services such as the rescue and medical teams. Thus, c is the fraction of the population surviving blast, thermal, and fallout effects, not already foredoomed to die, that could be saved by rescue services and emergency medical care. Contrary to much prevalent intuition, c probably is a fraction near 1. This is not because rescue and medical care are expected to be highly effective; it is because the percentage of people that could be rescued in time or could be saved by medical care is very small. [Reference 32.] Therefore, expenditures to increase c do not appear to be very cost effective. The value for c is probably greater than 0.95.

Life Support Requirements

d is the transfer coefficient that represents survival during the very early postattack period when people in shelters or other isolated locations could be running out of food or water, or the shelters (because of inadequate ventilation or other reasons) might become intolerable. The value of d depends

on how rapidly food, water, and power-distribution systems can be reestablished, and how rapidly an effective emergency management system evolves in each community or area. In some localities, and under some conditions, the problems could be severe. Extremely hot or cold weather, radiological contamination, and disrupted transportation and communications systems could have a serious impact. This area requires more study and the development of individual plans tailored to the needs of individual localities and situations. On a national average, however, d is not likely to fall very much below 1.0.

Epidemics and Diseases

e is the transfer coefficient for epidemics and diseases. Post-attack health problems in many cases could be exacerbated because of disrupted water and sewerage systems, malnutrition, and radiation exposures. [Ref. 32.] The range of e might be wide, but with reasonable precautions and attention, it probably could be kept high. The national average value for e should be above 0.95. Additional study and development of contingency plans for specific health problems that might occur are needed (and are being undertaken). [Ref. 32.]

The Economy

f is the transfer coefficient that accounts for the requirement that the economy become functional and produce commodities essential to sustain the attack survivors before surviving inventories are consumed. In this respect it is particularly fortunate that the U.S. possesses food surpluses. There are enough surplus "calories" at any given time (either in storage or in the pipeline) to sustain the population for at least one and probably for two years, even if all agricultural production ceased abruptly at the time of an attack. Another significant advantage is that U.S. agriculture is the most efficient in the world. About six percent of the U.S. population produces enough food not only to feed America, but also produces vast quantities of food for export. [Ref. 62, pp 23-41.]

Numerous studies show that the "agricultural wherewithal" (transportation, fertilizer and petroleum products, essential industry, etc.) to provide food for the survivors of a nuclear attack would also survive. Even a badly damaged economy could provide, without undue strain, an adequate diet for surviving Americans in addition to other items essential to

survival, leaving a surplus of labor and capital and raw materials with which to rebuild. It is not enough, however, to consider only the nation's physical capacity to sustain survivors. There was no serious physical incapacity of the Nation's economy during the Great Depression; the problem was a lack of knowledge on how the economic machine could be reactivated and operated. To expect efficient (or even adequate) operation of an economy damaged by a massive nuclear attack, with the attendant social and psychological trauma, may be highly optimistic. [Ref. 51, pp 207-273.]

If there is an Achilles' heel in the postattack recovery postulate, it probably lies in f, the transfer coefficient relating to economic chaos. But if economic chaos should occur, it most probably would result from inadequate planning and management rather than from limitations on the physical capacity to produce. (This subject is discussed further in Appendix D.)

Late Radiation Effects

g is the transfer coefficient that accounts for the people who would die in the years following an attack from bone cancer,

leukemia, thyroid damage, and other radiation-induced effects. Although these consequences might well be detectable (and might have a more important psychological than physiological impact), such late radiation effects would pose little threat to the survival of the total society. $\underline{g}$ probably is a number greater than 0.99. Research in this area is being done largely under Atomic Energy Commission (AEC) and U.S. Public Health Service (PHS) sponsorship. Dr. Charles L. Dunham (former Director of the AEC's Division of Biology and Medicine, and currently the Chairman of the National Academy of Sciences' Division of Medical Sciences) recently summarized such long-term biological effects of nuclear attack by stating:

> 20,000 additional cases per year of leukemia during the first 15 to 20 years postattack followed by an equal number of cases of miscellaneous cancers, added to the normal incidence in the next 30 to 50 years, would constitute the upper limiting case. They would be an unimportant social, economic, and psychological burden on the surviving population.[1] [Ref. 16, p 406.]

According to the American Cancer Association, 20,000 new cases of leukemia is about the yearly rate appearing today for the 200-million U.S. population. There are now about 15,000 deaths per year attributed to this disease.

[1]The Dunham statements quoted were in reference to two specific hypothetical attacks. CIVLOG was a 455 weapon-2,000 megaton attack; and UNCLEX was an 800 weapon-3,500 megaton attack: The current status of civil defense was assumed.

The Ecology

h is the transfer coefficient that accounts for the damage to the ecology that could occur from the nuclear attack. There is still uncertainty concerning the probable ecological consequences of nuclear war. Some fairly extensive research programs are underway, and progress is being made. The most comprehensive program, at least in the Western World, is that of the Radioecology Section of the Oak Ridge National Laboratory--research that the U. S. Office of Civil Defense has helped to support during the last several years. [Ref. 17, pp 105-79.]

The "doom and gloom" predictions prevalent in the 1950's and 60's are not supported by this research. In the summary report of Project Harbor [Ref. 12, p 23], a 1963 study of civil defense by a committee of the National Academy of Sciences under the leadership of Dr. Eugene Wigner, is this statement: "Large-scale primary fires, totally destructive insect plagues, and ecological imbalances that would make normal life impossible are not to be expected." In a 1969 study intended to update the Project Harbor work, again under the leadership of Dr. Wigner, is the following: "A reasonable conclusion, therefore, is that the long-term

> ecological effects would not be severe enough to prohibit or seriously delay recovery." [Ref. 11, p 28.]
>
> Some perspective on possible ecological effects of a nuclear attack can be gained by considering the gross results that man is now, in peacetime, inflicting upon the ecology. The eventual ecological results of water and air pollution, widespread application of herbicides and insecticides are beyond our knowledge to predict; but whether or not there is a nuclear war, these problems have to be faced and solved.

At this point in the flow diagram, it would not be meaningful to give a numerical value to the transfer coefficients. By the time ecological consequences would manifest themselves, limiting the growth of population might have again become a socially desirable goal. But the idea that the ecological damage from a nuclear war would be so severe as to limit flow in the concept of the diagram is not supported by the facts.[1]

Genetic Effects

i is the transfer coefficient for genetic damage, and is included primarily for completeness. In common with late-radiation and ecological effects, the genetic effects

[1] It should be noted that a nuclear war would alleviate some of the factors that are leading to today's ecological disturbances which are due to current high-population concentrations and heavy industrial production.

are widely misunderstood and consequently feared, and they probably have aroused more emotional attitudes than the others. Statements quoted from Robert Kennedy on page 16, and from the New Yorker on page 9, probably could be partially attributed to such misunderstandings. The genetic effects of radiation exposure have received a great deal of study both in the laboratory and in the field. The latter includes study of humans given radiation for therapeutic and diagnostic purposes, people involved in nuclear accidents, and the survivors of Hiroshima and Nagasaki. The Atomic Bomb Casualty Commission, a joint U.S.-Japanese study, has had an extensive program underway in Japan since the early days following World War II.

Dr. Dunham, in the same summary referred to above [Ref. 16, p 406] said, "The genetic effects would be lost as at Hiroshima and Nagasaki, in all the other 'background noise.'"

Obviously, the single objective of maximizing survival coefficients, i.e., the number of people alive at any given time in the flow diagram, is insufficient. Many individual attributes of human and national welfare could be affected by the attack. Injury and disease status, the character of

elementary life-support systems, and economic productivity are but three of the welfare attributes that could be critically important. There is no doubt, however, that people are our most important national resource. And, if no survival coefficient approaches a very low value, other requirements probably can be met.

The third critical question about the civil defense issue, "Is recovery from a nuclear attack possible?" has been examined with the aid of a Flow Diagram Model of U.S. Society In and After Nuclear Attack. No insuperable physical or biological obstacles to recovery were found. Whether or not society would recover from a nuclear attack is of course impossible to answer unless an actual attack occurs, and unless agreement is reached on just what constitutes recovery. On the other hand, it is equally impossible to prove a priori, by a model or any logical reasoning process, that recovery would not occur.

It is clear, however, that the chances for efficient recovery will be influenced greatly by how well those doing the research succeed in identifying the postattack problems and determining what can be done about them. But research alone is not sufficient. The pre-attack decision makers have to become convinced that recovery is not impossible; that effective civil defense is essential to recovery; and that the cost of an effective civil defense system is reasonable, justifiable, and within the nation's financial capability.

The last of the four critical questions on civil defense, which relates to cost, is examined in the following section.

THE COST OF AN EFFECTIVE CIVIL DEFENSE PROGRAM

The Flow Diagram Model of U.S. Society In and After Nuclear Attack provides a convenient means of identifying and examining the kinds of civil defense measures needed and the magnitude of their potential contributions. The model indicates two kinds of needs: first, to decrease the expected drops in flow, i.e., to raise the transfer coefficients that fall significantly below 1; and second, to reduce uncertainty (e.g., change to solid lines the dotted lines following the Disease and Epidemic barrier, and the Economic Chaos barrier). The five opportunities for such corrective action are marked by the numbered arrows of Figure 7. They will be discussed in turn.

Blast Protection

Opportunity No. 1. Decrease the Number of Deaths to be Expected from the Direct Blast and Thermal Effects

The greatest drop in level of flow is attributable to transfer coefficient "a"; that is to say, more people would be expected to perish from direct blast and thermal effects of the nuclear detonations than from other effects. There are three methods that almost certainly would reduce this expected loss. They are: (1) provide blast shelters to protect people where they

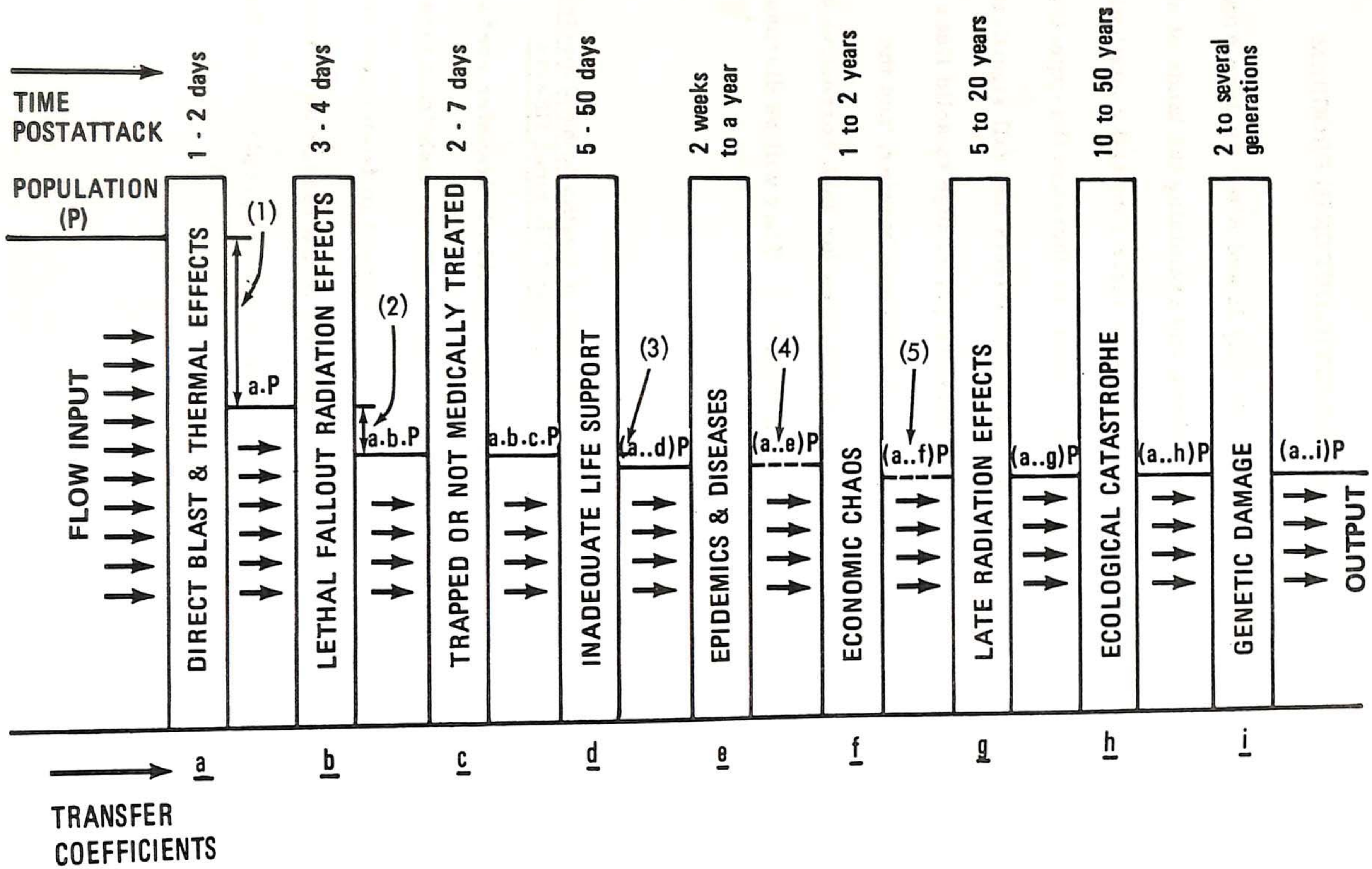

Figure 7. **FLOW DIAGRAM MODEL OF U.S. SOCIETY IN AND AFTER NUCLEAR ATTACK**

are at the time of attack; (2) move people to a safer place (pre-attack evacuation); and (3) ballistic missile defenses to intercept incoming enemy weapons.

Blast shelters vary in cost and complexity from relatively simple designs to be incorporated into most buildings at little cost, particularly if included when the buildings are constructed, to deep underground shelters providing self-sufficiency to occupants for months, and costing thousands of dollars per space. The know-how for both of these extremes, and for intermediate designs has existed for many years.[1] (This know-how is being improved through the OCD Shelter Research Program.)

The cost of increasing blast protection through the provision of shelters at the margin (i.e., going from essentially no blast protection--the situation existing today--to some blast protection) would be relatively small. Protection against about 15 psi (pounds per square inch of blast over-pressure--about one atmosphere) could be provided in buildings constructed for other purposes (a residence or new office building, as examples) for about $ 60.00 per shelter space, assuming about 10 square feet per space. [Ref. 48.] Thus, the costs to protect the people in our 40 largest cities, with a projected 1975 population of about 95 million (see chart, page 123) would be about $5 billion. This cost, of course, could be spread over a

[1] In a 1958 report, a Committee of the National Academy of Sciences stated, "there is adequate technical knowledge to permit a program of construction of effective shelters to be undertaken immediately." [Ref. 1, p 1.]

period of years and could be shared between the government and private enterprise as it currently is in Switzerland, Norway, and Sweden.

The inherent natural protection of people in the best-protected areas of their homes and work places is usually less than about 5 psi. The incremental change in expected deaths (and thus the increase in the transfer coefficient a) for the population in the larger cities and near military targets with 15-psi protection, as compared to less than 5 psi, would be as many as 20 to 30 millions of added survivors, depending on the type and weight of attack.[1] The expected number of deaths due to fallout also would decrease since it would be easy (almost necessary) to include additional fallout protection along with the blast protection. A recent study estimated that, if a program to provide blast protection against 15 psi in new building construction were initiated, space to protect the entire population would be available within 10 years if new construction proceeds at the rate currently estimated. [Ref. 67.]

Under some circumstances, preattack evacuation would greatly reduce the loss of life from the blast and thermal effects of nuclear detonations. Planned large-scale evacuation, however, requires time, and in attack scenarios postulating only tactical (short) warning, the available time is inadequate. In other scenarios, however, strategic or long-term warning is postulated, and time would not be a critical constraint. But mass evacuation would have a collateral and significant effect on other transfer

[1] Based on information supplied by Mr. Sherman A. Baker, Operations Analyst, Operations Analysis Division, Office of Civil Defense, 1970.

coefficients. Most important, large numbers of people would be subjected to the fallout hazard, so the transfer coefficient b would decrease, unless fallout protection for the evacuees at relocation sites is provided. The requirements for life support at the relocation sites might also be more severe, resulting in a decrease in d. (There is evidence that preattack evacuation is a primary civil defense protective tactic that would be used by the Soviet Union. See Appendix A, page 79.)

Antiballistic missile systems, by destroying incoming enemy missiles or even by influencing an enemy's target plans, can reduce the expected number of deaths due to blast and thermal effects. The deployment plan for an ABM system in general is not based on the simple objective of saving the most people if a heavy attack occurs. Rather, more frequently it is stated that the purpose of ABM is to deter an attack by making the country, and especially its land-based missile sites and its military command and control system, less vulnerable to enemy weapons. Nevertheless, ABM could be used as a means of raising a, and it should be evaluated in terms of that potential.

To summarize: each of the available tactics for raising a-- blast shelter, evacuation, and ABM--would work. The effectiveness of each measure over what range of circumstances and at what cost, needs to be carefully evaluated. Optimum combinations covering the most probable

contingencies need to be fully defined, costed, and presented to appropriate decision makers.[1]

Fallout Protection

Opportunity No. 2. Decrease the Number of Deaths to be Expected from the Lethal Fallout

The second opportunity for increasing flow is by reducing the number of expected deaths due to lethal fallout (increase transfer coefficient b). The know-how exists; little additional research is needed. The requirement, simply stated, is to increase the number of spaces in fallout shelter deficient areas. The estimated cost is about $ 60 per space for single-purpose shelters, but only $ 10 per space for dual use shelters (when shelter space is deliberately created over and above that shelter space which is inherent in new construction).[2] All that is needed to go ahead with such a program is the necessary authority and funding. However, the detailed requirements for fallout shelter location, protection factor, etc., depend on other parts of the system. For example, and as stated above (page 59), provision of fallout shelters in non-urban relocation areas would be essential to effective implementation of a preattack evacuation procedure.

[1] Research to accomplish this task is underway. It is not, however, in the opinion of the author, adequately funded, considering its potential contribution to the future national security.

[2] Based on information supplied by Mr. George Sisson, Staff Director, Shelter Research Division, Office of Civil Defense, 1970.

Early Care for Attack Survivors

Opportunity No. 3. Decrease the Number of Deaths to be Expected from Inadequate Life-Support Systems--Transfer Coefficient d

Greater saving of life also can be achieved through the development of contingency plans to handle the particular situations prevailing in various locations. Examples of such plans would include stockpiling or other procedures to obtain and distribute food in likely food-shortage areas; methods and equipment to ventilate shelters in high temperature/high humidity zones; and plans to quickly restore water supplies wherever these systems appear to be especially vulnerable. The main cost here would be for establishing and supporting a planning group. Hardware and preattack logistics costs are not likely to be high. The problems have been subjected to exhaustive scrutiny and research over the last decade, and are quite well understood (at least by those involved in the research).

Public Health and Medical Care

Opportunity No. 4. Improvement of Provisions for Postattack Public Health and Medical Care

The level of flow (i.e., relative size of population surviving) after the "Epidemics and Disease" barrier of the Flow Model (Figure 7) is indicated as a dotted line, which connotes uncertainty. Perhaps the greatest uncertainty lies in the synergistic influence of the following:

(a) Increased susceptibility to infection and enhanced disease transmission due to the varying radiation dose that will be received by virtually all survivors. Some persons will receive smaller doses than others, but the average exposure will be considerably higher than preattack. It is well known that radiation exposure supresses or inhibits the normal defense mechanisms of the body. How much impairment of these natural defense mechanisms might be produced by the radiation exposure in survivors of a nuclear attack cannot be determined with confidence prior to such an attack.

(b) Destroyed, damaged, and disrupted sanitation and water-works facilities due to attack effects.

(c) Lowering of public health practices and surveillance systems due to general disruption of public health organizations and loss of public health personnel; and

(d) Inadequate supply of preventive, prophylactic, and therapeutic chemicals (vaccines, anti-toxins, antibiotics, and other necessities for disease control) due to loss of production and due to distribution problems.

Research programs to identify the most likely postattack diseases and to determine the best ways of preventing and treating them in a postattack environment, are now underway (although the funding level is low).

Questions such as the following are being studied:

If a greatly expanded source of broad-spectrum antibiotics should be needed after an attack, could such a source be quickly created at that time, and how? For example, could the fermentation process of a commercial brewery be used; or could vats now being used to produce detergent enzyme additives, produce penicillin? (The brewery facilities probably could not since a different kind of fermentation process is employed; the enzyme vats probably could be used.)

At this stage of knowledge, the cost of keeping the epidemics and disease coefficient near 1, and of reducing the uncertainty signified by the dotted line, does not appear to be high. What is needed is a complete library of contingency plans available after an attack to health officials confronted with outbreaks of disease or epidemics. Further work may show that the stocking of certain medicines or other disease control materials might be highly desirable. This conclusion, however, can be verified only by additional study. (The writer's opinion at this time is that the costs will not be high.)

Assured Viable Postattack Economy

Opportunity No. 5. Assure that the Postattack Economy Will Support the Attack Survivors

In common with the level of the population, P, following the Epidemic and Disease barrier of Figures 6 and 7, the level of P following Economic

Chaos is indicated by a dotted line that denotes uncertainty. The respective transfer coefficients for these barriers, e and f, are not assigned values, and therefore, incremental costs for increasing these values cannot be quantified. The first priority should be eliminating or reducing the present uncertainties, and this must be done through study and research. The level of research needed cannot be estimated with confidence, but the current level (about $ 1 million per year) is clearly inadequate. Further, it is highly desirable that the agencies responsible for the functioning of various segments of the postattack economy be involved in the research, otherwise they may feel threatened by it and not gain all there is to learn from it, and will not apply the results in development of their plans.

This is probably the most important area for study and research of any area identified in the Flow Diagram Model (page 56). Appendix D contains a more elaborate and detailed discussion of this problem.

A Civil Defense Management System

One cannot derive from the Flow Diagram Model the estimated cost of developing a planning and operating civil defense management system; for training in special skills such as firefighting, auxiliary law enforcement or radiological monitoring; for educating the general public; for research; and for the other necessities of operating an efficient civil defense organization. Such cost considerations, however, have been analyzed by several study

groups, including Project Harbor [Ref. 56], and have been scrutinized during Congressional hearings such as the Hebert hearings of 1962. [Ref. 72.] They are quite well understood, and although they clearly cannot be provided under the current OCD budget ceiling of about $ 70 million per year, a great deal could be done if more funds were available. For example, a budget of $ 200 - $ 300 million (increasing OCD's share of the total defense budget from the present 0.1 percent to 0.3 or 0.4 percent) would permit highly significant and useful work on the organization and management component of an effective civil defense system.

SUMMARY AND CONCLUSIONS

Adequacy of the existing civil defense system in the United States is, at best, marginal. The reasons for this are largely attributable to the dysfunctional attributes of three models: "The History Repeats Itself Model," the "Armageddon Model," and the "Diabolical Adversary Model." For the past several years these models have been operative, not only among many segments of the population but also at various focal points for decision making in the administrative and legislative branches of the Federal Government.

Answers to the Four Basic Questions

Through the application of two models developed in this thesis--the "Nuclear Conflict Model" and the Flow Diagram Model of U.S. Society In and After Nuclear Attack"--the four basic questions on the civil defense issue have been examined. The following conclusions are warranted:

(1) The probability of nuclear war, although impossible to quantify with any acceptable degree of confidence, is sufficiently high--and is so perceived by defense officials and the general public--to justify increased efforts to reduce the consequences of a war should one occur.

(2) Even a greatly expanded civil defense system or program would have little or no influence, positive or negative, on the probability of nuclear war.

(3) There is no identifiable consequence of a nuclear war that, by its very nature, would preclude the survival and recovery of the U.S. society following such a war.

(4) An adequate civil defense system would save additional tens of millions of American lives (over the estimated 20 - 30 million lives that would be saved by the present inadequate system), if nuclear attack should occur, and would assure their continued survival and eventual recovery.

(5) The cost of an adequate civil defense system for the U.S., which would reduce the consequences of a nuclear war to appreciably lower levels, are not exorbitant; and from a cost/effectiveness standpoint, such a system competes with any other active or passive defense measures that could be taken.

APPENDIX A

CIVIL DEFENSE STATUS

Civil Defense in the United States (With Comments on How It Evolved)

Civil Defense responsibility in the United States is a joint responsibility of the Federal, State, and local governments. [Ref. 79] The Federal role is primarily to provide leadership. It includes research, development of planning and operational guidance, training, provision of certain specialized equipment (such as radiation instruments and shelter supplies), and some direct financial support. This role is carried out by the Office of Civil Defense (OCD) which is part of the Office of the Secretary of the Army.

OCD works closely with the Office of Emergency Preparedness (OEP), an agency in the Executive Office of the President. OEP has general responsibility for coordinating emergency-planning functions of all Federal departments and agencies that have emergency missions. OEP also has specific responsibility for planning postattack economic stabilization, resource management, and continuity of government. In addition, OEP administers the Federal Government's contributions to natural disaster relief. [Ref. 21.]

The State and local governments develop their own civil defense operating capabilities. The rationale is that only an in situ organization could, in an emergency, act quickly enough without outside help or direction. The rationale also is based on the notion that civil defense simply is government in an emergency, and that the people--the Governor - the Mayor - the City Manager - the Police Chief, etc.--who normally run things, should not have their authority usurped by some local civil defense director (or member of his staff) who has been waiting in the wings for just such a moment, or by some outsider who does not know the community and its unique features and problems. The people who perform specific emergency functions should, as closely as possible, be the people who perform the peacetime counterparts. The police should be responsible for law and order, the medical profession for emergency medical care, and the like. Augmentation no doubt would be necessary and desirable, but not substitution.

The route by which the current structure of civil defense and its operating philosophies have evolved is a somewhat tortuous one. The historical details need not be repeated here since they are well documented in various publications. [Ref. 45, 10, 80, 47.] A summary will suffice.

Figure A-1, a synopsis of civil defense organizational changes, is adapted from material appearing in a report of the Institute for Defense Analyses. [Ref. 23.] Thus, post-World War II U.S. civil defense, appearing first as a gleam in the eye of the War Department, was conceived

Independent Agency	Executive Office of the President	Cabinet	Relevant Events	
	NSRB		Civil Defense Board established in War Department	Nov 1946
			*Effective date of National Security Act	Sept 1947
			Office of Civil Defense Planning established in National Military Establishment	Mar 1948
			Berlin Crisis and Airlift	June 1948
			Truman transferred Civil Defense to National Security Resources Board	Mar 1949
			Truman announced first Soviet A Bomb	Sept 1949
FCDA	ODM		South Korea invaded by North Korean Forces	June 1950
			Defense Production Act signed by Truman	Sept 1950
			*Truman established Office of Defense Mobilization by Executive Order	Dec 1950
			*Truman signed Federal Civil Defense Act establishing the Federal Civil Defense Administration	Jan 1951
			U.S. first thermonuclear explosion	Oct 1952
			*Eisenhower transferred functions of National Security Resources Board to Office of Defense Mobilization	June 1953
			Cease fire in Korea	July 1953
			Soviet Union's first thermonuclear device	Aug 1953
			Dulles announced policy of massive retaliation	Jan 1954
			Atomic Energy Commission described fallout threat	Feb 1955
			Soviets launched Sputnik I	Oct 1957
	OCDM		*Eisenhower merged Federal Civil Defense Administration and Office of Defense Mobilization by Executive Order	July 1958
			Castro entered Havana	Jan 1959
			U-2 shot down over Russia	May 1960
			Bay of Pigs	Apr 1961
	OEP	Sec Def OCD	Kennedy-Khrushchev Vienna Conference	June 1961
			Berlin Crisis and Berlin Wall	June 1961
			*Kennedy, by Executive Order assigned Civil Defense to Department of Defense and reorganized remainder of Office of Civil and Defense Mobilization into Office of Emergency Planning (now Preparedness)	July 1961
			Cuban Missile Crisis	Oct 1962
		Sec Army OCD	*Civil Defense responsibility redelegated by Secretary of Defense to Secretary of Army	Mar 1964
			Communist China exploded first nuclear device	Oct 1964
			U.S. Commander authorized to use American troops in Vietnam conflict	June 1965
			Communist China exploded thermonuclear bomb	June 1967
			Six-day Israeli-Arab War	June 1967
			Strategic Arms Limitation Talks (SALT) between U.S and USSR (Helsinki, Finland)	May 1969
			U.S. Astronauts returned from successful moon landing (This may seem a little far-fetched; and it is. But no man has ever been fetched so far before.)	July 1969
			Nixon announced plans to withdraw American ground combat troops from Vietnam (timetable secret)	Nov 1969
			Communist China orbits first satellite	Apr 1970
			U.S. troops entered Cambodia for two-month effort to clean out Communist Vietcong strongholds	May 1970
			U.S. initiated deployment of multi-warhead missiles (MIRV)	June 1970

*Appears by those events directly resulting in organizational changes.

Figure A-1. Organizational Evolution of Modern Civil Defense

by the National Security Resources Board (NSRB), and born as the Federal Civil Defense Administration (FCDA). Successively, it then became the Office of Civil and Defense Mobilization (OCDM), and finally (at least as of this date), the Office of Civil Defense (OCD), first in the Office of the Secretary of Defense, and then in the Office of the Secretary of the Army.

From its beginning under the Federal Civil Defense Act of 1950 (Public Law 920 - 81st Congress), U.S. civil defense has had as its stated purpose "study and develop civil defense measures designed to afford adequate protection of life and property. . ." "Adequate protection" was not further defined in Public Law 920, nor has it been defined in any explicit or legalistic sense by subsequent action of the Congress or the Administrative or Judicial branches of the Government. Implicit definitions of "adequate protection" at various stages of civil defense evolution may be inferred from the program emphasis at the time.

Initially, under FCDA, the basic civil defense program was primarily to help the individual help himself, rather than to assure survival of the national entity. "Providing adequate protection" in essence meant providing to each individual American the knowledge he would need to help him survive an atomic,[1] biological, or chemical warfare, or even conventional weapon

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[1]In the early days of modern U.S. civil defense, the term "atomic" was used rather than the current term "nuclear." The official U.S. Government handbook for civil defense use, issued in 1950, was titled "The Effects of Atomic Weapons." [Ref. 24.] The 1957, and subsequent versions, were titled "The Effects of Nuclear Weapons." [Ref. 25,26.] (If the Atomic Energy Commission (AEC) were being named today, it seems probable it would be the Nuclear Energy Commission.)

weapon attack. There was little thought that an atomic attack might threaten the survival of the society. The local civil defense organizations (groups of individuals comprised mostly of volunteers) were to provide rescue and fire-fighting services, medical aid and welfare relief, and the maintenance of law and order. Mutual-aid pacts were emphasized since only small isolated areas were expected to bear the brunt of direct hits, and help from unaffected areas presumably could be relied upon. Emphasis was on "duck and cover" to protect against the blast and heat waves from the atomic burst. Fallout was not recognized as an important hazard. Medical self-help training, and means of protecting against early effects of an atomic explosion by reducing fire hazards and the like were considered to be important. Rescue techniques taught by Federal civil defense training schools were patterned largely on British counterparts. "Adequate protection" then had the connotation of survival with the least amount of suffering for the relatively small percentage of the population likely to be affected. Some half-hearted proposals to construct blast shelters submitted to the Congress were not funded, although some monies to procure a medical stockpile and emergency hospitals were made available.

During this early period, the term "adequate protection" was not dimensioned. No authority stated that, "We must save X percent of the population, or Y amount of our production capacity, if the Nation is to survive. The possibility of there being a threshold above which casualty production

or industrial damage would have threatened survival or recovery of the American society was not taken seriously; at least no one identified it in quantitative units. The reasons were twofold:

(1) The magnitude of the threat did not seem that severe; and

(2) The analytical techniques and the necessary damage-assessment models and computer support to apply them were not available.

For the same reasons, there was no basis for, or felt-need to ascribe cost-effectiveness properties to various possible protective or ameliorative measures.

The early period of the newly formed Civil Defense Agency was by no means tranquil. Headlines were full of events throughout the world that posed threats to the future of the peace so dearly won in World War II. The bellicosity of the Soviets during the Berlin blockade, and the attempted take-over of South Korea by Communist North Korea, were dramatic manifestations of the growing Communist menace.

But, if there was a clear threat to the survival of the American society, it was not the fear of a direct Soviet atomic attack on the American homeland. The threat was more subtle. Unless the "monolithic Communist conspiracy" could be contained, first the non-aligned nations, then U.S. Allies, one by one, would fall to the Communists until ultimately the U.S. would be the sole surviving democratic nation in a hostile Communist world.

There were major reactions to this Communist threat. The military budgets increased markedly, and John Foster Dulles (Eisenhower's Secretary of State) negotiated treaties in many critical areas of the world to contain the Communists. There was over-reaction--McCarthyism--leading to abuses of civil liberties. Some rhetoric went so far as to proclaim "better dead than Red." But little, if any, of this reaction benefited the civil defense program. Neither the public nor its leaders strongly perceived that there was threat of a war that would directly involve the U.S. homeland.

As the Soviets built their arsenal of thermo-nuclear weapons (evidenced by numerous weapons tests) and perfected their delivery system (evidenced by the Sputnik successes), the nature of the threat changed. It now became obvious to the American public that, in the event of war with the Soviet Union, Americans personally would be directly involved. The Soviets had sufficient weapons and the means of delivering them to wreak vast damage on a virtually unprotected U.S. population. But again, there was little if any benefit to the civil defense program. Civil defense, in effect, passed quickly from the category of "superfluous" to "futile."

A war would be "mutual homicide," and in the words of Herman Kahn, then of the Rand Corporation, "The concept of certain 'mutual homicide' has been comforting to some. It makes plausible the widely held conviction that as soon as Governments are informed of the terrible consequences of a

nuclear war, their leaders will realize that there can be no victors, and therefore, no sense to such a war." [Ref. 35, p 2.]

Herman Kahn went on, however, to point out that ". . . one can conclude that with current technology there are plausible circumstances in which leaders might decide that war was their best alternative." [Ref. 35, p 4.], and he proceeded, in his book On Thermonuclear War, to develop the arguments. Mr. Kahn was a highly controversial figure. He was attacked by influential writers--Norman Thomas in the Saturday Review, [Ref. 69] and James Newman in the Scientific American, [Ref. 53] as examples. Many seemed to think that Mr. Kahn, somehow, was advocating nuclear war, although he repeatedly pointed out that "To recognize such possibilities is certainly not to endorse them."[Ref. 35, p 4.]

Full realization of the change in the nature of the threat came home to the American public during the Berlin blockade of 1961, and especially during the Cuban crisis of 1962. The Soviets were about to deploy nuclear missiles in Cuba where their presence would be a constant reminder that the U.S. homeland was within easy range of a "hostile" nuclear force. President Kennedy's television address to the Nation on the Cuban crisis evoked a significant response. Shelter builders were swamped with orders. Radiation instrument supplies were sold out in a few days, and civil defense offices throughout the Nation were inundated with requests for help. But the crisis was short-lived, and the interest in civil defense did not last. The shelter

builders went out of business. The radiation instrument makers who accelerated production were stuck with big inventories, and the civil defense telephones quieted down. The "adequacy" of the protection for the population was not put to test. There are few, however, who believed that such a test would have been well met.

The era of the balance of terror has not passed, nor does it seem likely to pass in the foreseeable future. But, somehow, the level of terror is not so high. Perhaps this is due mostly to the fact that the human animal is wonderfully adaptive and can learn to live with just about anything, including the "bomb." Also, time has given reassurance. There has been a decade during which either the Soviets or the Americans could have launched a devastating nuclear attack on the other, but did not. The China-Russia fracas has dispelled the specter of a monolithic communist society bent solely on world domination. The signing of the nuclear non-proliferation treaty by Russia and the U.S., and the scheduling of the SALT (Strategic Arms Limitation Treaty) talks are signs that the adversaries are at least interested in controlling the growth of nuclear armament. Also, the terror of the bomb, at least in part, has been replaced by the terror of an over-population threat, and of a pollution threat. Nuclear war represents a terror that will eventuate only if some world leaders behave stupidly, and if things go wrong. Pollution and overpopulation are threats the consequences of which are inevitable unless drastic and dramatic action is taken to curb them.

What, then, does "adequate" connote in the context of today's civil defense program, a program that involves about 700 people at the Federal, and 6,000 full- or part-time people paid with the help of Federal funds at the State and local levels; and a program with an annual budget of about 70 million dollars [Ref. 78.], about 0.1 percent of the current total national defense budget?

In reality, it appears that today's civil defense could only meet the full test of adequacy under one contingency: the contingency that nuclear war does not occur.[1] If nuclear war should occur:

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[1]NOTE: This thesis addresses civil defense only in the context of its contribution to protection against nuclear attack. All other roles are considered to be peripheral.

Many civil defense organizations at the State and local level also have natural disaster responsibilities. Alaska's civil defense played an important role during the recovery operations following the earthquake of 1964 that devastated Anchorage. In Mississippi, civil defense did an excellent job warning and caring for people in the path of Hurricane Camille.

The obvious advantages of combining natural disaster and nuclear war responsibilities under one agency are twofold: (1) the organization more likely will have an opportunity to exercise its plans and to test out its philosophy of operation and its management systems; and (2) in the present political climate it is easier to "sell" civil defense for natural disasters than for nuclear war. This particularly is true in the hurricane and tornado belts.

The principal disadvantages also are twofold, and in fact are the corollaries to the advantages: (1) by concentrating on plans and procedures for handling natural disasters, the more difficult tasks of understanding and planning for nuclear disaster are slighted; and (2) the organization and procedures which are appropriate during natural disasters may be highly inappropriate for the nuclear circumstance. Natural disasters in many respects are not good analogs for nuclear attack--no fallout radiation - different scale of damage - unavailability of outside help, for examples.

- Civil defense would save few, if any, from the direct effects of the attack--the blast and fire effects.
- Civil defense could save a high percentage of those who otherwise would die from fallout radiation (assuming the enemy chooses to detonate his weapons as ground bursts).
- Civil defense medical support and rescue services would make only a marginal contribution to the alleviation of suffering and the rescue of trapped personnel.
- Civil defense would contribute to the survival and recovery efforts following the attack, but much planning and preparatory effort is needed if this contribution is to be very effective.

Civil Defense in the Soviet Union

It is natural to wonder what one's principal adversary is doing about civil defense. His perception of your threat to him, by a mirror image sort of analog, gives some idea of what he intends to do to you. Also, one begins to feel a little uncomfortable if an adversary starts getting too far ahead in matters involving national security. Although this is particularly true in relation to offensive and, to a somewhat lesser degree, defensive weapons systems (ABM), it also applies to civil defense.

Dr. Leon Goure (formerly at the Rand Corporation, now at University of Miami, Florida), who was born in Russia and speaks the Russian language

fluently, has followed civil defense in the Soviet Union for many years. His report, "Soviet Civil Defense Revisited 1966-1969" is the best authoritative unclassified document on the subject. The following is quoted from Dr. Goure's summary:

> An examination of open Soviet sources indicates that the Soviet civil defense program, which was initiated in the 1950's and upgraded in 1961, has increased in scope and intensity since receiving unusual endorsement by General Secretary of the Central Committee of the CPSU, L.I. Brezhnev at the 23rd Congress of the CPSU in 1966.
>
> According to Soviet public statements, an effective civil defense program is regarded as a very important element of the Soviet defense capability and a requisite for the survival of the population and the Soviet state in a nuclear war. As essential for victory, great stress is placed on maintaining industrial production in wartime, on preserving a superior military-industrial capability, and on recovering more rapidly from attack than the enemy. Soviet civil defense spokesmen argue that neither the present active defense systems, including ABM, nor even successful Soviet preemptive counterforce strikes, although they may significantly blunt an attack, can insure Soviet cities and important industrial regions against attack. Hence the need for an effective civil defense program.
>
> The Soviet civil defense program combines measures for the protection of the population, the organization of a nationwide network of trained civil defense units, the compulsory training of the general population in civil defense, and plans for large-scale post-attack rescue and repair efforts in the disaster areas.
>
> The most significant development in Soviet civil defense in recent years has been the increased emphasis on preattack evacuation of the population from potential target cities and dispersal of essential workers and employees beyond the immediate danger zones to pre-selected locations. Evacuation and dispersal are now viewed as the main means of protecting the population. This appears to have resulted from a recognition of the high cost of building sufficient effective shelters for the entire population in the target areas. It was decided instead to

> build special shelters for only those essential workers and employees who will be required to remain at work in order to maintain critical production and services. The rest of the population will be provided with various types of fallout shelters, some of which would be built only when the emergency arises.
>
> Although no precise information is available on the actual state and cost of Soviet civil defense, published sources indicate that an active civil defense program is being carried out on a considerable scale, especially in the industrial sector. A large number of various types of civil defense units appear to have been trained and equipped; some shelters have been built and others may be under construction; and evacuation exercises have been held for some factories and collective farms, though apparently not for entire cities. In recent years civil defense measures have been increasingly publicized, and a 21-hour compulsory training course for the population (following 104 hours of courses given between 1954 and 1967) is nearing completion. Since 1967, school training has been expanded to 45 hours for students in the 5th through 7th grades. [Ref. 29, pp v-vi.]

The estimate of expenditure per capita on civil defense in the Soviet Union is about $2.00 per person, according to General George Lincoln, Director of the Office of Emergency Preparedness, in a speech before the National Association of Civil Defense Directors on April 7, 1970, " . . . the Soviets have, over the last few years, spent at least one-half billion dollars per year on civil defense." The population of Russia is about 240 million. [Ref. 83, p 559.]

Civil Defense in Europe

The level of effort and the amount of funding for civil defense among the various countries of Europe vary widely. On the one extreme are Sweden

and Switzerland, traditionally neutralist countries, who have the most sophisticated and comprehensive civil defense systems in the world. At the other extreme are Spain, Portugal, and Greece, who have done little to protect their populations against the possibility of nuclear attack. The United Kingdom, France, Western Germany, and Belgium, are intermediate. Civil defense in East Germany and other countries of the Eastern Bloc are thought to be patterned after that in the Soviet Union, but probably varies as it does in the Western World with respect to how much support it receives.

The programs of two countries, the United Kingdom and Switzerland, are further described for illustrative purposes:

Civil defense in the United Kingdom, the country after which much of U.S. civil defense planning has been patterned, is barely alive.* Expenditures which had been running at about 25 million British pounds ($60 million) per annum, were reduced to about £7.5 million ($18 million) in Fiscal Year 1968-69, and £4.5 million ($11 million) for Fiscal Year 1969-70. [Ref. 30.]

The objective in the United Kingdom is to continue emergency planning at the minimum level needed to enable more active preparations to be resumed if necessary without too much loss of ground. The warning and radiological monitoring organizations have been retained and one of three training schools has remained open to provide courses for senior officers of central and local governments. The objective is to keep a nucleus of instructors and to keep uptodate on changes in policy and new developments. There is no shelter

*The British call it a "care and maintenance" basis.

construction program and, if a fallout shelter survey is to be conducted, it will be done by local personnel, not as a federal program as it was in the U.S. The expenditure per capita for civil defense in the United Kingdom in 1969 was about 20 cents.

Switzerland has constructed about 300,000 blast shelters (protection for at least one-half the population), and in addition, has many World War II shelters which are not as good, but could be used if needed. All new construction has to provide protection for its occupants. Other opportunities to create protection are utilized; for example, two new highway tunnels going into Lucerne are to have heavy blast doors installed and will provide room for about 30,000 people. There are similar plans for Zurich. If any new installation has a civil defense application, the Government pays about 70 percent of the cost. Factories, schools, etc., have civil defense facilities and many private companies have their own civil defense organization. There is training in all civil defense fields, including radiological monitoring. Plans are to spend about 1 billion equivalent U.S. dollars on civil defense during the next ten years. [Ref. 68.] This is about $11 per person per year.

APPENDIX B

ON THE PROBABILITY OF NUCLEAR WAR

World War I was the "war to make the world safe for democracy" and "the war to end all wars." If these objectives had been met either by WW I or by WW II, there would have been no Korean or Indo-China wars, and there would have been no need for civil defense; and this thesis would have had to be on some other subject.

> For all sad words of tongue or pen,
> The saddest are these: "It might have been!"
> --John Greenleaf Whittier, Maude Muller

But World War I and World War II did not end wars, and today's prospects for a completely peaceful world do not seem much brighter than they did then.

There are now (and probably will continue to be) wars involving huge numbers of people that History will not classify as one of the World War series. Perhaps at this stage of history, almost by definition, any war that does not include a massive nuclear strike on the homeland of a major world power will not meet the criterion for designation as a World War. It is conceivable even that the nuclear threshold could be crossed through employment of tactical nuclear weapons on the battlefield without escalation to the category of a World War. (Many analysts, however, doubt that escalation

could be stopped once either side resorted to nuclear armaments of any type.)

In any case, the probability of nuclear war involving the United States, though perhaps very low, is finite and (unfortunately) seems likely to remain so for years to come. The basic causes for the wars that have occurred more or less continuously throughout history--religious fanaticism (and Communism might be considered under this heading) - aggressiveness - the territorial instinct - misunderstanding - fear - exploitation - liberation--still exist. Indo-China, the Arab-Israelis conflict, Nigeria-Biafra, the Chinese-Russian dispute, and Honduras-Nicaragua, are ready reminders of this fact.

It is not particularly reassuring that no one of these wars has reached the nuclear threshold. In most cases, nuclear armament was not available to the combatants. Would Biafra have resorted to "nukes" if it had the option before its final capitulation to Nigeria? Although wholly academic, this is not a question one can answer with a strong, "NO." Will Israel "milk" her reactors for enough plutonium to make a "bomb" if annihilation seems the only alternative? What change in circumstances would have led the U.S. to employ nuclear weapons in Korea or Vietnam?[1] There would have been those who advocated use of nuclear weapons, or at least the threat thereof, in

[1]General Curtis E. LeMay, former Air Force Chief of Staff, as Vice Presidential running mate on George Wallace's Independent Party ticket in a nationally televised campaign appearance on October 2, 1968, said he "would use anything we could dream up, including nuclear weapons, if it was necessary to win the Vietnam war." [Ref. 20.]

Vietnam, and it is widely accepted that President Eisenhower's threat of nuclear escalation helped bring about the end of the Korean War.[1]

Just what the numerical probability of nuclear war is now, or will be at any given time, is impossible to know (unless of course, we get into such a war). Arthur Schlesinger reports that during the Cuban crisis of 1962, President Kennedy said, "Of course, if you simply consider mathematical chances, the odds are even on an H-bomb war within 10 years." [Ref. 61, p 802.] Schlesinger suggested that the President probably added to himself, "or within ten days."

Many defense analysts would argue that no matter how close we came to nuclear war over Cuba, the danger of war has reduced appreciably since. If true, this reduction at least is partly due to the fact that "Cuba" was a very painful experience for both sides. This can be seen in the agonizing reflected in Khrushchev's personal letter to President Kennedy of October 26, 1962 [Ref. 40, pp 86-90], as well as in Robert Kennedy's account of what was going on in Washington. [Ref. 40.] One tangible result was establishment of the "hot line" between Washington and Moscow, aimed both physically and symbolically to help avoid such a confrontation in the future.

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[1] In his book, Mandate for Change, President Eisenhower said, "One possibility was to let the Communist authorities understand that, in the absence of satisfactory progress, we plan to move decisively without inhibition in our use of weapons and would no longer be responsible for confining hostilities to the Korean Peninsula. We would not be limited by any world-wide 'gentlemen's agreement.'" In India and in the Formosa Straits area, and at the truce negotiations at Panmunjon, we dropped the word, discreetly, of our intention. We felt quite sure it would reach Soviet and Chinese Communist ears." [Ref. 18, p 181.]

The Niskanen Hypothesis

In a paper written in 1966 [Ref. 52], Dr. William H. Niskanen of the Institute for Defense Analyses suggested some quantitative estimates of the probability of nuclear war (to be abbreviated as P_{nw}). He suggested that P_{nw} could be expressed in the form:

$$P_{nw} = (b + cM^{-d})$$

where:

b = the probability of a strategic attack during a 10-year period, with an indefinitely large U.S. missile force;

$(b + cM^{-d})$ = the probability of a strategic attack during a 10-year period, with a nominal U.S. missile force;

c = a parameter relating to the general strategic environment (his state of preparedness, for example, and our weapon yield);

M = the number of standard survivable U.S. missiles that could penetrate a Soviet missile defense;

and d = a missile effectiveness parameter.

Niskanen argued that the value of b, though small, is not zero--zero being inconsistent with an imperfect understanding of what constitutes deterrence; also, a non-zero value allows for some possibility of accidents and for the chance that someone in authority might get an overwhelming temptation to initiate a nuclear strike--the "mad-leader" scenario. Niskanen selected a value of 0.02 for his base case. The parameter, c, was given a

base-case value of 0.4. The parameter, d, is derived primarily from the population distribution (or some other value index) in the Soviet Union. A value of 0.5 was used in the base case, which is to say that potential damage is closely related to the square root of attack level.

To illustrate, assume the U.S. has 1,000 missiles that meet the requirements, then:

$$P_{nw} = (0.02 + 0.4 \times 1000^{-0.5})$$

$$= 0.03 \text{ (rounded to a single significant figure)},$$

i.e., the chances are 3 in 100 that the U.S. will be, or will have been, involved in a strategic nuclear war during the coming decade. (If M were 2,000, P_{nw} would still be 0.03 as rounded to one significant figure.)

The Richardson Data

Dr. Lewis F. Richardson, in his book Statistics of Deadly Quarrels [Ref. 59], presents a listing of over 300 wars during the period 1820 to 1949, with perceptive statements as to causes and conditions, and the approximate number of dead in each. He applied statistical methods to his body of data and produced important and plausible conclusions, among which were the following:

> 1. Wars seem to have been distributed in time by chance in respect to both beginning and end. There is no evidence that they have been becoming either more or less frequent, though there seems to have been a tendency, at least since 1820, for large wars to become more and small wars less frequent.

2. The increase in world population from 1820 to 1949 seems not to have been accompanied by a proportionate increase in the frequency of, and losses of life from, war, as would have been the expectation if belligerency had been constant. Thus, "there is a suggestion, but not conclusive proof," that mankind has become less warlike since AD 1820.

3. States have varied from one another in the frequency of their participation in wars during this period, but each has varied so much during its history that none can be properly characterized as inherently belligerent or inherently pacific. The problem of war does not arise from the diabolism of one or a few states.

4. Allies in one war may become enemies in the next, but alliances seem to have had some influence in preventing war between former allies. That influence, however, declines with the passage of time since the war alliance.

5. Similarity of religion seems not to have made for peace, except in the case of Confucianism, but differences of religion have apparently caused war, especially the differences of Christianity and Islam. The statistics suggest, but do not prove, that "Christianity incited war between its adherents."

6. The larger the number of belligerents in a war, the more neutrals have tended to be drawn in. Wars with many participants have tended to be longer and less frequent.

7. A trend for war to become indivisible, that is, for every war to become universal, has not been proved. Most wars have been localized. Neutrals have tended to become belligerents only if two or more world powers have been fighting each other. [Ref. 59.]

The data for the outbreak of wars of magnitudes 3.5 to 4.5 ($10^{3.5}$ to $10^{4.5}$ people killed) over the 110 calendar years from 1820 to 1929 were compared by Richardson with the Poisson distribution of improbable events. The following resulted:

x = war outbreaks in a single year	0	1	2	3	> 4	Total
f(x) = number of such years	65	35	6	4	0	110.0
$Ne^{-\lambda}\lambda^{x}/x\,!$	64.3	34.5	9.3	1.7	0.2	110.0

where:

N is the total number of years and λ is the mean number of war outbreaks per year, 59/110.

Richardson pointed out that there is a considerable resemblance between historical facts and the Poisson Law, and he went on to examine available data in an attempt to gain some idea of the probability of war as a function of number of people killed. A plot of Richardson's data extrapolated to include the range of casualties that might have resulted if a war the size of a plausible nuclear war had occurred during this period, appears as Figure B-1. (The extrapolated range is in the area falling below the dashed line.)

By extrapolating Richardson's data, implicitly it is assumed that nuclear armament of the amount possessed by the nuclear countries during the last ten years had been available to possible combatants during the period of the plot (1820 to 1945) and that, therefore, there could have been wars during that period producing the numbers of fatalities that would be expected in a nuclear war.

The range of fatalities to be expected in a nuclear war, the exact values of which were selected for mathematical simplicity, is from about 32 million to about 320 million ($10^{7.5}$ to $10^{8.5}$). These numbers are not inconsistent with the results of numerous hypothetical attack analyses. This range,

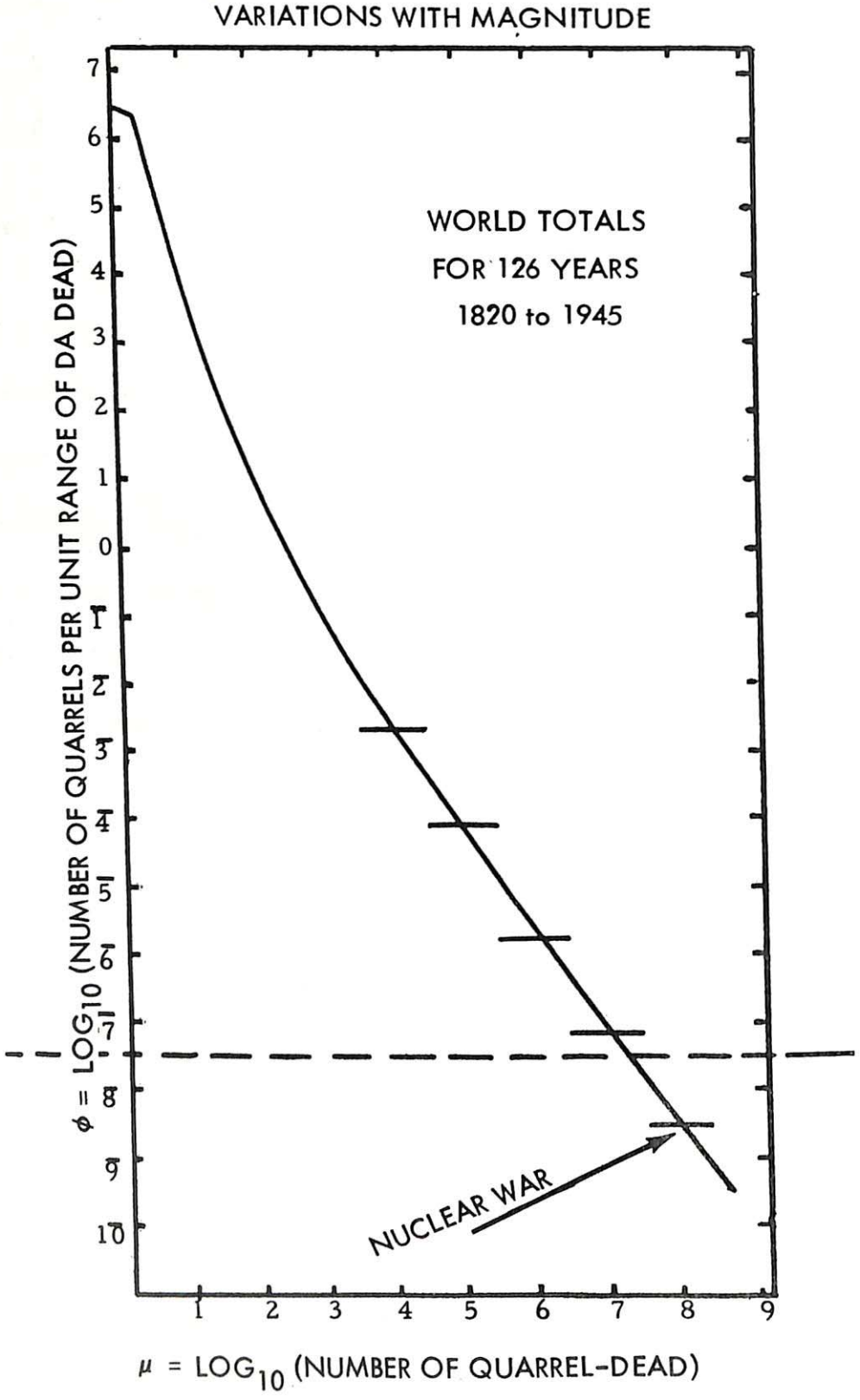

Figure B-1. The Whole Range of Fatal Quarrels (extrapolated to include nuclear war).

7.5 to 8.5, on the abscissa of Figure B-1 marked by the arrow, corresponds with the ordinate value of 8.5.

Therefore:

$8.5 = \text{LOG}_{10}$ (number of nuclear wars per unit range of dead).

(The range of dead is 320×10^6 less 32×10^6, or about 3×10^8.)

Therefore:

$8.5 = \text{LOG}_{10}$ (number of wars times 3×10^8),

or

Number of wars = $1/3 \times 10^{0.5} \cong 1$.

According to this reasoning and this model, the average number of nuclear wars per year would have been 1/126, or about 0.01, and if the future is like the past, the probability of nuclear wars per year is now about one in one hundred.

It is not suggested that the above analysis is in any sense rigid, or even that it should be taken seriously. Rather the analysis is included to illustrate kinds of data that are available, and how inadequate they are as a basis for predicting the future. It may be highly coincidental that the Richardson model gives a number that differs from Niskanen's number by only a factor of about 3 and is im the general range that many people inherently feel is appropriate (see page 93).

In any case, as the editors (Quincy Wright and C. C. Lienau) of Dr. Richardson's book (the book was published posthumously) stated in the introduction to it:

> The proof of the pudding is in the eating. The value of a system of classification and measurement depends upon the results obtained from it. Perhaps Richardson's very emancipation from the professional distortions of the social scientists, lawyers, and historians has enabled him to throw new light on the problem of war. No one should condemn his method without studying its application, the conclusions drawn from its application, and its potentialities for further development. [Ref. 59, p viii.]

There seems to be little hope for developing a satisfactory analytical basis for determining the probability of nuclear war. Even if some analyst could convince himself that his method had validity, he most likely would have trouble convincing others.

The primary reasons for being interested in the probability of war are twofold. First, being aware that the probability is not insignificant might motivate action to reduce it; and second, an estimate of war probability facilitates the comparison of the threat of death or damage by war with the threat of death or damage from other causes and should provide guidance as to where actions are needed to bring threats into balance, if such is found not to be the case.

The Stannard Analysis

Dr. Burke Stannard of the Defense Research Board of the Canadian Department of National Defence, in an article, "How You Risk Your Life--A

Study of Comparative Risks," [Ref. 66, p 30] compared the magnitude of a number of common and not-so-common hazards. Included was an estimate of the probability of death from fallout radiation in the event of nuclear war. (Note that this is a conditional probability, i.e., the probability of death from fallout radiation if the event, a nuclear attack, occurs.)

Dr. Stannard's chart, which is reproduced on the following page, provides a good perspective of the relative levels of various life-threatening hazards.

The University of Pittsburgh Public Survey

The Department of Sociology of the University of Pittsburgh for many years has been engaged in research to find out how the public evaluates and feels about civil defense issues. This research has depended heavily on national public opinion surveys. The following table contrasts the results of a 1964 and 1968 sample. It is taken from the report, American's Perceptions of the International and Civil Defense Environments: 1968. [Ref. 46, p 10.]

LIKELIHOOD OF WORLD WAR III

	1964	1968
Very likely and Fairly likely	39%	44%
Fairly unlikely and Very unlikely	57%	44%
Don't know	4%	12%

CHECK LIST OF COMMON RISKS

	Deaths per billion persons with one hour risk exposure
Being vaccinated or inoculated	1.3
Exposure to radiation in a two hour high altitude flight during solar flare	2.5
Living in area where snakes are present	3.8
Radiation exposure of world population in major nuclear war (areas away from conflict)	5.0
Railroad or bus travel (USA)	30.0
(Britain)	50.0
Child asleep in crib	140.0
Being struck by lightning	200.0
Coal mining (Br.)	400.0
Amateur boxing (Br.)	450.0
Climbing stairs	550.0
Coal mining (USA)	910.0
Hunting	950.0
Automobile travel	1200.0
Air travel	1450.0
Cigarette smoking	2600.0
Mountain climbing (USA)	2700.0
Boating (small boats)	3000.0
Motor scooter riding (Br.)	3000.0
Swimming	3650.0
Motor cycle riding (Canada)	4420.0
(USA)	6280.0
(Br.)	6600.0
Armed forces in Viet Nam	7935.0
Canoeing	10000.0
Motor cycle racing (Br.)	35000.0
Mountain climbing (Alpine)	40000.0
Professional boxing	70000.0
Being born	80000.0

It may be seen that the perceived level of tension in the international arena increased between 1964 and 1968, by which time nearly half the respondents thought World War III was not unlikely.

The University of Pittsburgh surveys consistently have shown that the general public is not opposed to civil defense (as many people who are themselves opposed to civil defense have claimed). There is a "clear pattern of support for civil defense--nearly nine in ten respondents in 1966 were favorably disposed to civil defense . . . (findings) suggest a high level of commitment and support for the goals of public protection as well as for certain means which the Office of Civil Defense has set forth as necessary." [Ref. 46, p 1]

The Greene Poll

Jack C. Greene, Director of the Postattack Research Division of the Office of Civil Defense (and author of this thesis) during the early part of 1970 conducted a poll primarily among officials of the Office of Civil Defense (but also including a few scientists who have been involved in strategic analyses) in an attempt to find out how likely they considered the event for which they were planning--nuclear war. The question asked was, "What do you think is the probability of a nuclear war between the United States and the Soviet Union in the next decade, that is, before 1980?" If the answer was not quantifiable, for example, "Not very." or "Inevitable." as sometimes it

was, the respondent was pressed to provide a numerical answer. Figure B-2 shows the results.

The sample was small (totaling only 34 people), and the data based on it are not claimed to have high statistical significance. It was interesting to note that there was some correlation between status of the respondent in the organizational hierarchy of civil defense and the magnitude of the perceived threat. The higher the responsibility level of the respondent, generally, the greater he perceived the threat to be. One might attribute this to the assumption that the higher the official, the better his information sources or the more realistic his analysis of the problem. On the other hand, one might ascribe it simply to functioning of Festinger's cognitive dissonance theory [Ref. 22], i.e., the higher the position, the more important the role and, consequently, the higher the perception of the threat.

About 35% of Greene's respondents thought the probability of nuclear war involving the United States is greater than one in ten during the next decade; about 62%, equal to or greater than 1 in 10; about 75%, greater than 1 in 100; and 79%, greater than 1 in 1000 (a level below which it was considered that the threat was negligible).

This basically heuristic exercise can be carried one step further by comparing the perceived nuclear hazard with other more familiar hazards. For illustration, assume this is being done for the 62% group of respondents who thought war probability was equal to or greater than 0.1 in the next decade.

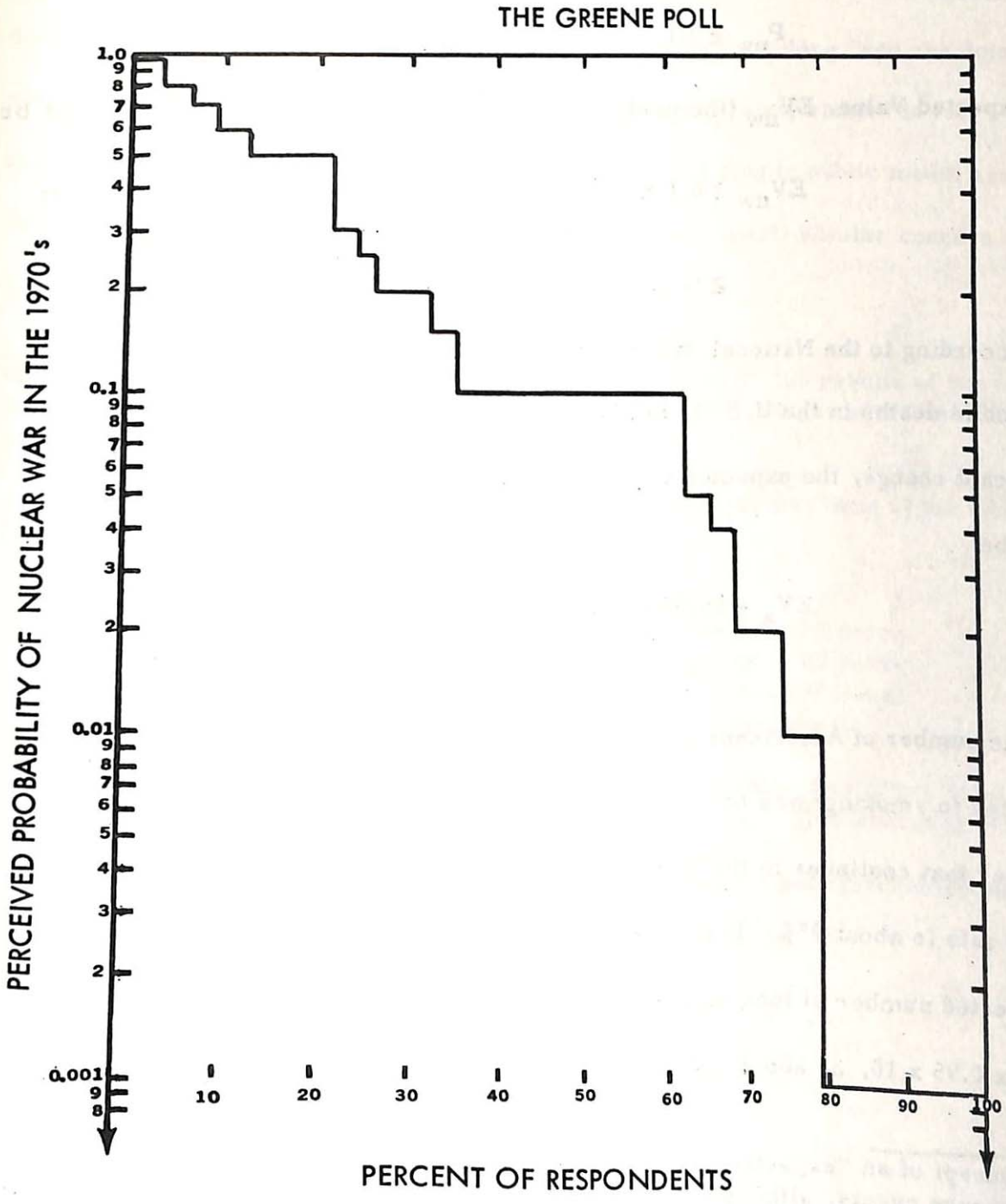

Figure B-2. Estimates of Civil Defense Officials on Nuclear War Probability.

Let P_{nw} again be the symbol, then:

$$P_{nw} \geq 0.1$$

and Expected Value, EV_{nw} (the probability times the consequences), might be

$$EV_{nw} \geq 0.1 \times 10^8$$ (100 million is a typical number for the deaths in a hypothetical war.)

$$\geq 10 \text{ million dead in the '70's.}$$ [1]

According to the National Safety Council, the current fatality rate from automobile deaths in the U.S. is about 56,000 per year. Assuming no significant change, the expected value for automobile deaths in the '70's would be:

$$EV_a = 56{,}000 \text{ per year} \times 10 \text{ years}$$

$$\cong 1/2 \text{ million.}$$

The number of Americans diagnosed to have lung cancer (primarily attributed to smoking) was 65,000 in 1968, and 68,000 in 1969; the only type of cancer that continues in the U.S. to increase each year. Currently, the fatality rate is about 95%. If the 1969 rate were to continue through 1980, the expected number of lung cancer deaths in the next decade qould be $68{,}000 \times 0.95 \times 10$, or about 650,000. [2]

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[1] The concept of an "expected value" for very low-probability/high-consequence events, although mathematically acceptable, is not philosophically acceptable to some people who prefer to think in terms of most probable value. For the case in question, according to the assumptions, the most probable value is zero--the only other possible value being 10^8 dead. The expected value, 10 million, could not occur during a single decade.

[2] Data are from the National Cancer Society obtained by the author (by telephone from the Washington, D.C. office) July 1970.

The general public and its leaders are concerned about the automobile death rate, and about the consequences of cigarette smoking, and are doing something about them. Federally imposed higher-safety standards for automobiles, and restrictions on cigarette advertising in public media are examples. The nuclear war threat would seem to merit similar concern.

NOTE: Subsequent to the first printing of this report, the results of two Delphic inquiries into the probability of nuclear war have become available to me.

The first (which I should have known about earlier) was done at the RAND Corportation in the early '60's. The statistics are:

100 participants

- lower quartile — 4% probability over 25 years
- median quartile — 20% probability over 25 years
- upper quartile — 30% probability over 25 years
- concensus — 1% probability per year

The second Delphi was conducted in 1970-71 in connection with a Joint Chiefs of Staff Post Nuclear Attack Study (PONAST II). The statistics are:

30 people (military - government officials - non-government scientists)

- 46% > 10% in next 20 years
- 80% ≥ 10% in next 20 years
- median ~1/2% per year
- mean ~ 1% per year.