. . . . . AN AMERICAN JOURNAL OF CIVIL DEFENSE

SURVIVE

VOL. 2 NO. 3 MAY - JUNE 1969

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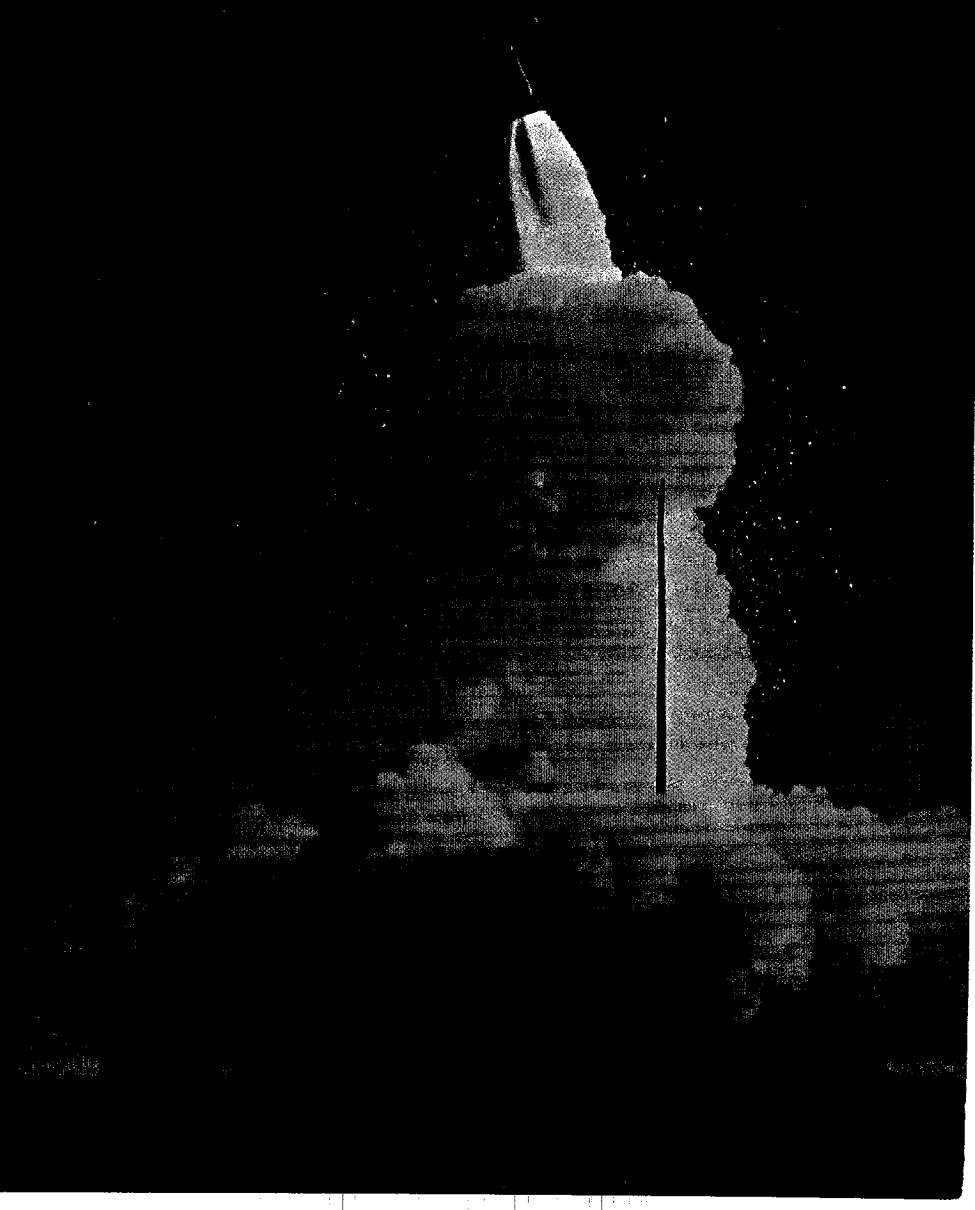
FIRST ANNIVERSARY ISSUE

In this issue:

Exotic Weapons,
by Edward Teller

In the Shadow of Ground Zero,
by Wm. Cornelius Hall
and Carsten M. Haaland



CIVIL DEFENSE FORUM

OAK RIDGE CIVIL DEFENSE SOCIETY

ASSOCIATION FOR COMMUNITY-WIDE PROTECTION FROM NUCLEAR ATTACK

"The need for an effective Civil Defense is surely beyond dispute . . . No City, no family nor any honorable man or woman can repudiate this duty . . ."

—Sir Winston Churchill

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Survive presents authentic information relating to civil defense – to the survival of free government, the United States, and its people in the nuclear age. Its aim is public education in this field and service as a forum.

Authors are encouraged to submit manuscripts for consideration by the editorial board for publication. Articles (preferably illustrated) should be 1,000 to 1,500 words in length, slanted to the non-technical reader, and oriented toward the civil defense field. Views expressed in contributions to *Survive* are those of the authors and do not necessarily reflect *Survive* policy.

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SURVIVE – First Anniversary! . . .

Assembled between the covers of this anniversary number are six articles which probe and expose several important aspects of civil defense: weapons possibilities, nuclear blackmail, protective shelter, blast area environment, and recovery. They are written for Survive *by foremost authorities in their respective fields.*

We hope you find these articles to your liking, informative and stimulating. We did. We hope, too, that you may want to discuss some of them with others or comment on them.

On page 24 appears an index of back issue feature articles. Opposite, on page 25, are offers by Survive *circulation manager, Randine Chism, (1) for the purchase of a back-issue packet, and (2) for regular subscriptions.*

Our goal in the coming year is to produce the kind of journal that will deserve your continued interest and approbation. We aim to develop it further as a national forum where matters of civil defense import can be objectively and authoritatively presented.

We hope you will be with us. Thank you.

AMONG SURVIVE WRITERS

Francis S. Wagner

Prior to emigrating to the United States in 1949, Francis S. Wagner distinguished himself as a Hungarian scholar and diplomat. From 1946 to 1948 he was Hungarian Consul General in Czechoslovakia. Now a prolific writer, Wagner's fields of interest are modern history – especially nationality and racial problems; diplomatic history of World War II; foreign aspects of the American Civil War; U.S. foreign prestige; and dialectical materialism. Among his numerous publications are: *The First Period of Slovak Nationalism* (1940); *Cultural Revolution in East Europe* (1955); *Széchenyi and the Nationality Problem in the Hapsburg Empire* (1960); and *The Hungarian Revolution in Perspective* (1967). In addition to his many books Wagner also finds time to contribute generously to German, Hungarian, French, Slovak and English-language periodicals. At present he is working on a world guide to the problems of ethnic minorities. In his *Survive* article, "Budapest Shelter – World War II", Wagner describes vividly his life as an involuntary tenant of subsurface Hungarian shelters.

QUESTIONS AND ANSWERS

Q: I have been hearing much about the book "Who Speaks for Civil Defense" from time to time, but have not seen it for sale. Now I understand from a speech by U.S. Representative Chet Holifield that President Nixon has borrowed a concept from it. This was reviewed in *Survive* last year. How do I obtain a copy?

A: A copy may be ordered through your local bookstore, or you may order direct from the publisher, Charles Scribner's Sons, 597 Fifth Avenue, New York, New York 10017. The hardback sells for $3.95 and the paperback sells for $1.65.

READER COMMENT

ABM Fable

To: *Survive* Jacksonville, Florida

The First Little Pig built his house of straw and the Big Bad Wolf came, and huffed and puffed, and blew the house down, and ate the First Little Pig.

Sometime later, the Second Little Pig built his house of sticks; and again the Wolf came, and huffed and puffed, blew down the house and gobbled up the Second Little Pig.

The Third Little Pig had heard of the great misfortune of the first two pigs and was quite concerned. He must construct a house strong enough to offer protection from this existing danger. He researched and deliberated and concluded that it was vital that he build a house of bricks. He began to gather the bricks.

"Wait a minute! Just a minute, Pig," a group approached. "We are the leading politicians, scientists and intellectuals, and we hear that you are building a brick house."

"Yes, I am," replied the Pig.

"Don't you know that having a brick house is a provocative act? You are just daring the Wolf to attack! To try and blow it down! Besides, bricks are expensive. Build yourself a straw house and we can use the savings for, well, our social problems."

"Gee," said the Pig. "I know that you fellows are very, very brilliant, but couldn't I at least have a 'limited system' of protection? Perhaps, I could construct just one room of bricks; that's not so expensive, and it would offer some protection."

"Nonsense, Pig. That would still be provocative."

Another member of the committee told the Pig that there might not really be a Big Bad Wolf, anyway. These stories about the Wolf were probably fables made up by people who sell bricks. If there were, in fact, a real Wolf, he could be reasoned with. No Wolf is all bad.

So the Third Little Pig yielded to the views of this group whose motives seemed diverse and puzzling, and he constructed a cheap straw house.

Soon, the Big Bad Wolf came, and laughed, and huffed and puffed, and blew the house down and consumed the Third Little Pig. The Wolf then swallowed up the politicians, the scientists and the intellectuals.

It is, we are told by people purportedly wise, too expensive, too provocative, and too ineffective, to have an ABM system protecting our cities. In the wake of the barrage of propaganda emanating from Senator J. W. Fulbright and others, perhaps a response of just being pigheaded is not enough.

Horace E. Smith

Repression

To: *Survive* Falls Church, Virginia

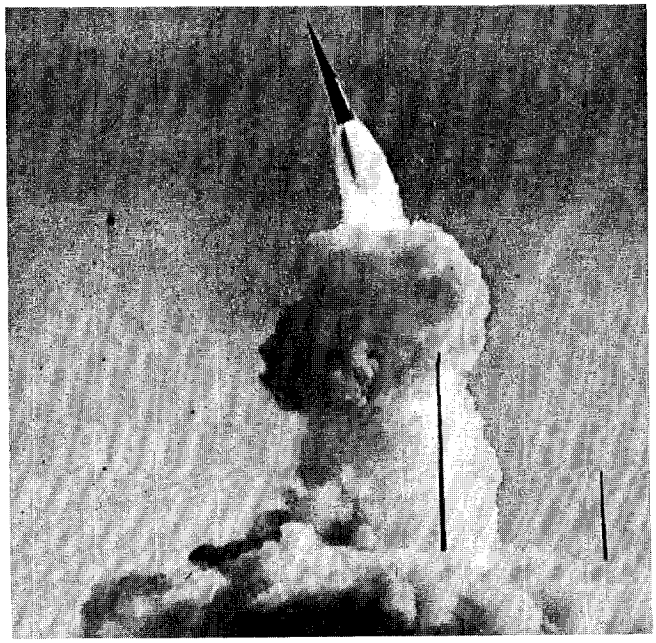
I must express how much I am disturbed by the editorial on the back page of the March-April 1969 issue of *Survive*. You have apparently been led to believe that career civil servants must lie or suppress the truth to protect their jobs. In 27 years of service in the Department of Defense, I have never been forced to do so nor have I ever observed the repression of which you speak. Whether intended or not, I'm sure you recognize that the implication in your editorial is most insulting.

The substance of your editorial is not at all well-founded. As any professional knows, fallout shelter is an integral part of any larger, more ambitious strategic defense posture. The current policy is not simplistic but rather a logical first step and has been represented as such. What is needed to go further is a resolution of the real issues, which involve the nature of deterrence and the role of assured destruction and damage limitation. A major part in this resolution of strategy is undertaken by the very people you attempt to discredit.

It is neither necessary nor useful to denigrate such progress as has been made in order to argue for a more effective civil defense. The constructive approach would emphasize an informed contribution to the discussion of the basic issues that underlie the policy constraints on the strategic defense posture.

Walmer E. Strope

COVER PICTURE



Shown here is a "Sprint" missile launch at White Sands Missile Range (New Mexico). "Sprint" is the short range interceptor in the Safeguard Ballistic Missile Defense System. It was developed at the Orlando Division of the Martin Marietta Corporation.

EXOTIC WEAPONS

- by Edward Teller

At Los Alamos in 1945 Edward Teller probed the secrets of the H-bomb before the A-bomb was developed. Later, in order to keep American weaponry in first place, he directed the work of the team of scientists which produced it. Here Dr. Teller looks behind the curtain of the future. What is possible in new weapons and defense against them? What is not possible?

When thermonuclear explosives followed the fission bomb, increasing a thousand fold the power of the A-bomb, an obvious question was asked: What will come next? The question remains unanswered. Nothing followed. Yet the suspicion remains that there may be no effective limit to man's ability of wreaking havoc. One can never evaluate what, as yet, has not been invented. But one can consider what types of developments appear to be possible.

First, we may consider a further increase of the power of an explosive. One might multiply the explosion again a thousand fold. Instead of kilotons or megatons, one may talk of gigatons.

There is, however, a simple reason why such an increase will not bring about a great change. Fissionable material was – and to a considerable extent still is – expensive. Fuel for fusion as used in the hydrogen bomb is cheap. This low price brought about a great increase in the explosive power one could buy. At present, however, the main expense – the limiting factor – is not connected with the explosive but with the delivery system. It is reasonable to assume, therefore, that larger bombs will have a greater weight and that it will cost more to deliver them unless one finds an essentially cheaper method of delivery. No one has succeeded in this, and there are no ideas on the horizon which are likely to change the situation.

Neither has any effect been discovered which would make a very big bomb appear as a desirable military item.

Many modifications of nuclear explosives make them much more appropriate for use on the battlefield or make them preferable tools for missile defense. But for the strategic attack we seem to have approached the limit.

In the race between the delivery of massive explosives and the protection against blast effects, defense is in a reasonably strong position, provided we make the needed effort. The most *obvious* effect of a nuclear explosion is the blast. Blast damage can be catastrophically augmented by a conflagration or a firestorm. But well-planned shelters can save most of the people in spite of these dangers. A really good blast shelter will also withstand fire.

The most *insidious* effect of a nuclear explosion is connected with radioactivities generated by the explosion. The fission products from a big explosion are extremely dangerous. In a thermonuclear explosion radioactivity may play a much lesser or a much greater role. On the one hand the radioactivity may be greatly reduced by the employment of clean explosives which are also useful for the peaceful project we call Plowshare. On the other hand substances may be placed into the explosive which, when irradiated, produce the greatest possible harmful effect. As always, man's knowledge and power may be used for good or for evil. In this case both good and evil are great.

This is the orgin of the cobalt bomb concept, used by many to prove that the destructive power of nuclear weapons is, indeed, unlimited. Cobalt, when activated, has a half-life of five years. It emits radiation of great penetrating power. It could produce terrible contamination.

The whole question of radioactive warfare is a difficult one. In some situations cobalt may be most dangerous. Other radioactive substances can certainly not be ruled out. Five years may not be the appropriate half-life to cause the most damage in a nuclear conflict. A shorter time with more intense radiation may be the strongest weapon. A two to three month period may turn out to be the most effective.

It will not be easy, however, greatly to surpass the radiation effects produced by the weapons which are now available. Fission, which is the main source of radioactivity even in the so-called hydrogen bombs, may not give optimal periods. However, for each neutron absorbed to produce fission, several – six or seven – radioactive nuclei are produced. If the neutron is absorbed by cobalt, or some

similar "salting" material, only one radioactive nucleus results. The radiation of this nucleus may be more dangerous than that of any of the six or seven fission products, but in quantity it will not exceed the total of the six or seven fission products by a great margin; it is more likely to be below it.

Furthermore, the contamination may be spread in a form against which it is difficult to develop countermeasures. There is a great difference between the fallout pattern of a ground burst which gives local effects and a high-altitude burst which gives rise to a world-wide distribution of radioactivity. It might be possible by ingenious means to produce some radioactive nucleus which is difficult to eliminate by any known clean-up procedure.

The methods of cleaning up radioactivity have received some attention but certainly not sufficient financial support for development. To judge which will prevail, a poorly specified attack or an undeveloped defense, is, indeed, impossible.

What is possible is to make a few relevant statements.

First, it must be recognized that the radioactive danger, great as it is, will not mean the end of the human race. To produce a contamination which might result in such a catastrophe, a Hiroshima-sized explosion would be needed on each square mile of our planet. The required effort is so stupendous, that the danger can be dismissed.

The United States occupies, of course, only a very small fraction of the globe. Nevertheless, in order to contaminate this country alone with lethal radioactivity an aggregate of explosive power would be required which is of the same general magnitude as that required for a devastating attack utilizing blast. One must recognize that radioactive warfare is not cheaper than other modes of attack.

In the second place the immediate danger to life can be eliminated by a shelter program. Defense against radioactivity is less difficult than defense against blast.

What is difficult to counteract are the long-term consequences of radiation. After two weeks it will become necessary to begin leaving the shelters. The contamination may still be very severe after this period – it may remain dangerous for years. Therefore, the problem of how to clean up radioactivity becomes decisive.

It seems probable that methods can be developed to decontaminate limited areas within a short time. Defense has the advantage that a limited success suffices. The attacker has the difficulty that he must try to make the contamination high in practically all places.

Probably the only valid statement one can make is one that is not conclusive. Neither the attacker, nor the defender will attain full success. That the possibilities are grim can hardly be denied.

The last and perhaps most relevant observation I want to make is connected with the purpose of the attack. Most wars are fought for military victory, not for mass murder. Is it likely that sums of money comparable to our entire defense budget will be spent, not to win, but to kill? Radiological warfare is more frightful but is not an effective means toward military victory.

We cannot forget about a "Doomsday Bomb" (a bomb to destroy the whole world). One of my friends after listening to all my arguments remarked, "But you cannot prove that it is impossible." He is right.

This brings me to the question of the arms race in the scientific age. At the beginning of the twentieth century, "arms race" meant an accumulation of familiar arms. At the time the race was massive. Its results were not completely unpredictable.

We have learned that there is something more dangerous than steel and TNT. We have learned that the greatest danger lies in human inventiveness.

Such inventiveness may, of course, take a direction other than development of ever more terrible nuclear explosives. Chemical and biological weapons are by no means excluded. The former are probably heavier and hence harder to deliver than nuclear bombs. Furthermore, good shelters which of necessity must be air-tight will provide adequate protection.

Perhaps the most ominous possibility is the production of biological agents. What makes the situation difficult to handle is the fact that the same type of research, immunology and biochemistry, gives the highest hopes to rid us from suffering and also brings with it the most dangerous potentialities of destruction. The specific danger of biological warfare is the fact that the poison can propagate itself and is not subject to strictly calculable limitations.

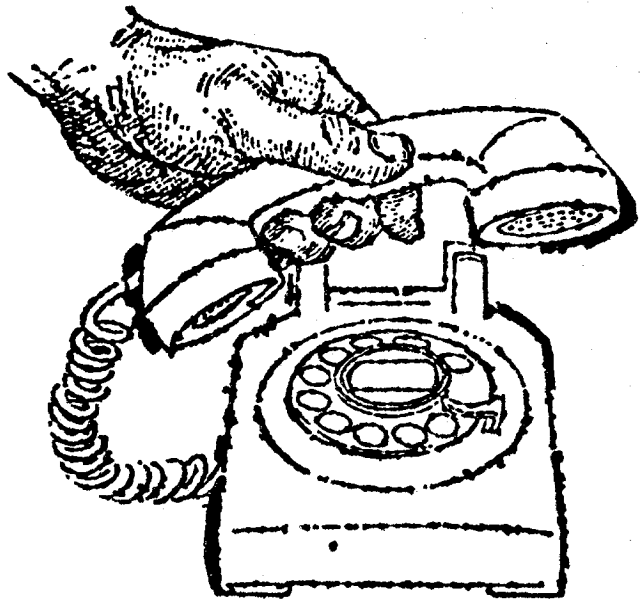
It would be a mistake to stop at this point. The real danger is not inventiveness in itself but rather the *uncontrolled use* of inventiveness. There is no defense that will insure us against all future attacks. There is also no weapon of aggression that can overcome all possible future defenses. Ingenuity and determination may well win the battle for survival by defense.

With those who say it would be better to make peace than to develop any defense, one must agree. However, we must develop a defense in order to gain time in which to make peace.

It seems to me that there is only one relatively simple conclusion which is probably correct: The questions connected with weapons, with survival, with new technical ideas and with human values never have simple answers. We cannot ask for a guaranteed future. We can only seek a chance to work toward a better and perhaps a safer way of life. ■

WHY WORRY?

- by A. A. Broyles



The time is May, 1973. The place – the President's conference room in the White House where the National Security Council has been in session for several hours. The cause of this meeting – tension in the Middle East. Well-armed Arab forces have crossed the Israeli border. Tel-Aviv, Cairo, Damascus, and Amman have all been bombed. Early successes of the Arab armies suggest that years of preparation may have finally paid off. An urgent message from the Israelis requesting military assistance has been received. Within the past hour, messages have indicated that a naval engagement between ships of the U.S. Sixth Fleet and Soviet naval vessels has occurred. Although no ships were sunk, one of our destroyers was heavily damaged by Soviet shells. Indications are that the Soviet officers may have mistakenly believed the American ships were on the verge of bombarding Arab coastal positions just behind the current battle lines, but this is only a surmise. The tension is further heightened by the recent changes in Kremlin leadership and by doubts that these new leaders may have concerning the resolve of the American President.

An aid enters the room and addresses the President: "Mr. President, the Russian Prime Minister wishes to speak to you on the 'Hot Line'." The President turns his chair and picks up the telephone receiver. A hurried and tense conversation follows. After a few minutes he drops the receiver in to place and slowly turns toward his advisors. His face is noticeably whiter. "Gentlemen", he says, "The Prime Minister has informed me that unless we assure him within the next thirty minutes that we are withdrawing the American fleet from the Mediterranean, he will order an H-bomb exploded over New York City."

A moment of shocked silence follows. Then the Secretary of State fairly shouts, "The man has gone insane. Our retaliation will destroy his country."

"This is not necessarily so", replies the Secretary of Defense. "You will recall that the Russians have been evacuating their cities for a number of hours now. They have shelters waiting for these people in the outlying areas. In addition, their ABM system may *greatly reduce the chances of our bombs reaching their military installations and their cities. Our latest estimates of their population losses under these conditions range from 10 million to 30 million people. If they had not evacuated their cities, their losses would be much greater. We believe the 30 million loss is more likely than the 10 million, but they may have more confidence in their ABM system than we do."*

"But surely the loss of 10 million people together with factories and buildings is unacceptable to them," is the reply.

"You must recall that they accepted a loss of 10 million people in order to collectivize their farms against peasant resistance and well over 10 million people to defend their country from the Germans in World War II. Still I agree with you that these losses look too great for them to accept. They are evidently gambling that we will not strike back."

"But how can we afford not to strike back?"

"You forget that if we enter this kind of war, we may well lose over two thirds of our population. Every person in a city of appreciable size has chances of less than a third of surviving. We will be dead as a nation while they will only be hurt."

"But what about our civil defense and ABM systems?"

"They will save millions of lives, especially in the rural areas where fallout shelters are available, but our ABM's are concentrated around military installations. Evacuations would take days and would be relatively useless since we do not have the shelters to take care of the people when they are outside the cities. Our fallout shelters will greatly reduce fallout fatalities in rural areas, but we lack the blast shelters to save the people in the cities. Even so, I cannot understand why they consider this risk worth taking just to remove our fleet from the Mediterranean."

"I can explain that," answers the Secretary of State. "Our failure to protect Israel will wreck our alliance system all around the globe. The Russians will have proved their nuclear superiority and no nation will trust us to defend them from now on. They will all turn to Russia."

*

This hypothetical incident shows how essential civil defense is to national defense. The President might decide to hold out and threaten the Russians with all-out retaliation as President Kennedy did in the Cuban crisis some years ago. But after the bomb had destroyed New York City, it is hard to believe that the President could sacrifice our exposed and vulnerable population in order to avenge the people of New York. If, on the other hand, we had an adequate ABM and shelter system, no nation would dare to attack us because it would know that we could and would fight the war that followed our counter strike. To *prevent* nuclear war, we must be able to *survive* it.

If anyone should doubt the reality of Soviet civil defense preparations, he should read Joanne Levey's article in the March-April issue of this journal.

*

The first objective of civil defense, then, is to make an attack on this country less likely. An additional advantage is that civil defense can assure the survival of the vast majority of our population if our efforts to prevent nuclear war fail. Past history has taught us that these efforts often fail when we least expect them to fail. The attack at Pearl Harbor showed that an enemy nation can underestimate our strength and can attack when we are convinced that such an attack is most unlikely. The occupation of Czechoslovakia showed up our inability to predict the time and place of enemy aggression. Our navy admirals stated recently that they had considered the North Korean seizure of the Pueblo to be almost beyond the realm of possibility. These incidents show how poorly we have predicted enemy action in the past. Can we be sure that such incidents will not some day lead to nuclear war?

The increasing number of nations with the capability of launching nuclear attacks also adds to the chances of war. At first only the U.S. and Britain had nuclear capability. Then the Soviet Union learned to make these weapons. Later France and China developed them. Several other nations also have enough scientific know-how to learn the nuclear secrets for themselves. Nuclear weapons may some day be sold on the world munitions market. The danger exists that some nation may launch a missile attack at us from submarines with the hope that we might strike some other nation in the mistaken belief that it was guilty.

It is beyond question that, if a nuclear attack comes, an anti-ballistic missile (ABM) system and shelter system will save human lives. An ABM system can destroy incoming attack missiles. The only question is: "How many ABM's are required to destroy one incoming ICBM? It is certain, however, that every missile destroyed means lives saved on the ground. It is a physical fact that people can be protected from blast waves by placing them behind strong walls or underground. Bunkers and trenches have long been used to protect soldiers from the blast of conventional high explosives. Similarly, as every civil defense worker knows, massive shields have been used to protect people from radiation of the type emitted by fallout particles. The lead shields used by x-ray technicians are examples of such protection.

It is true that, no matter how good our civil and ABM defense is, many lives would be lost if an attack comes, but this number would be many millions smaller than without defenses. The evidence for this has accumulated as the result of a number of studies. In 1963, the House Committee on Armed Services under Congressman Hébert conducted extensive hearings on the Administration's proposed fallout shelter program. In these hearings some 108 witnesses, technically competent in a variety of fields, testified. The summary of the hearing states, "At the beginning of the hearing on May 28, 1963, most, perhaps all, of the committee members were, for one reason or another, opposed to a fallout shelter program. . .As these witnesses presented their testimony, a slow but easily perceptible change was evident in the attitude of the committee members. Opposition to the program melted and then hardened into an attitude of firm belief in and support of the fallout shelter program. . .The result is an estimate, based on conservative assumptions, that 25 to 65 million lives would be saved by providing reasonable protection against fallout radiation." The bill providing for this fallout shelter program passed the House without difficulty but never reached the Senate floor.

The most select scientific body in the United States is the Naional Academy of Sciences. It is completely independent of the Federal Government. During the winter of 1962-63, the Academy was asked by the Assistant Secretary of Defense to conduct a study on the feasibility of civilian protection by means of civil defense. This study was carried out under the directorship of Dr. Eugene Wigner, a Nobel Prize Laureate and Professor of Physics at Princeton University. The conclusions were updated by a further study conducted in 1967. The updated report states, ". . . the general features of a civil defense system designed to protect against nuclear attack should remain useful in spite of any changes in weaponry in the next 15 years . . . The cost of a Class I (100 p.s.i.) shelter, which according to the (1963) Harbor Summary would assure the survival of 80% of the population in case of a 3000-MT. attack, was based in the Harbor Summary on a cost of $267 per shelter space." The 1967 figure for this cost was $300/space for 1000 people per shelter.

It is clear from both the report from the House Committee and the report from the National Academy of Sciences that tens of millions of lives will be saved by civil defense. We conclude, then, that civil defense plays an important role in deterring nuclear war and in assuring the survival of a large fraction of our population if nuclear war should come.■

CONGRESSMAN CHET HOLIFIELD SPEAKS OUT

Last March 11th in Washington, D.C. Representative Chet Holifield of California cut incisively into the national civil defense dilemma. The occasion was the mid-year conference banquet of the United States Civil Defense Council. Said Holifield (in part):

". . .The problem and the challenge of civil defense is to reduce the dimensions of nuclear destruction.

"We pray nuclear war will never come. Our Government leaders constantly strive to prevent its coming. And yet there is nothing in the habits or wisdom of men and nations that can give us assurance on that score.

"We as a nation want peace, not war. We want to help people, not hurt them.

"We want to see people of all nations educate their children and grow crops and produce goods in that measure of abundance which will bring them up from poverty and despair, give them a chance for the good life. We want to see people, if not united in brotherhood, at least living in peace, hopefully according each other a decent respect.

"We want these things but we cannot wish them into being. Even though our yearning for peace be great, and our quest for peace be strong, we cannot be sure of the intentions or designs of others. Too many nations or their leaders are dominated by ideologies of hate or by necessities – real or fancied – which move them to hostile ways.

"Events are not wholly within our control, nor – for that matter – within the control of our adversaries. Who knows when a small spark may cause a great fire, when a local flare-up may lead to a great power confrontation? Events that involve small nations may sooner or later involve the large.

". . .In civil defense I see no obsolescence, because in the final analysis we are talking about shelter – shielding from deadly radiation or other weapon effects. And shielding from radiation, for example, is no great mystery. You have to have a thick enough cover or intervening substance to ward off the penetrating gamma rays. Earth, metal, brick, and stone are not likely to be outmoded by weapon technology.

"By the year 2000, when a crowded metropolitan society, such as ours is rapidly coming to be, learns the need and the efficacy of underground construction, whether for freeways, factories, schools, or even homes, perhaps the argument in civil defense circles about blast shelters will become moot. The dual-purpose millennium will have arrived.

". . .I have been around Washington too long to be an optimist. I do not expect sudden changes or great advances in policy or program in a field which lacks political appeal, which is low on the defense priority list, which calls upon individual citizens to do things that are not comfortable or convenient, and which is subject to misinterpretation and vocal criticism at home and abroad.

"On the other hand, crises do not always advertise their coming, events do not always yield to peaceful persuasion. The citizenry which is apathetic today can be asking tomorrow: 'Who is responsible for the defense of this country and why have you let us down?'"

BUDAPEST SHELTER – WORLD WAR II

- by Francis S. Wagner

In the frenzied and tragic days that shook the whole of Europe during the final twelve months of World War II Hungary took its full share of allied air and ground attacks. Here a man who lived under the bombardments of Budapest and its environs outlines the intense drama that engulfed him at that time and the measures he and his compatriots took to try to stay alive.

Fortress of Buda

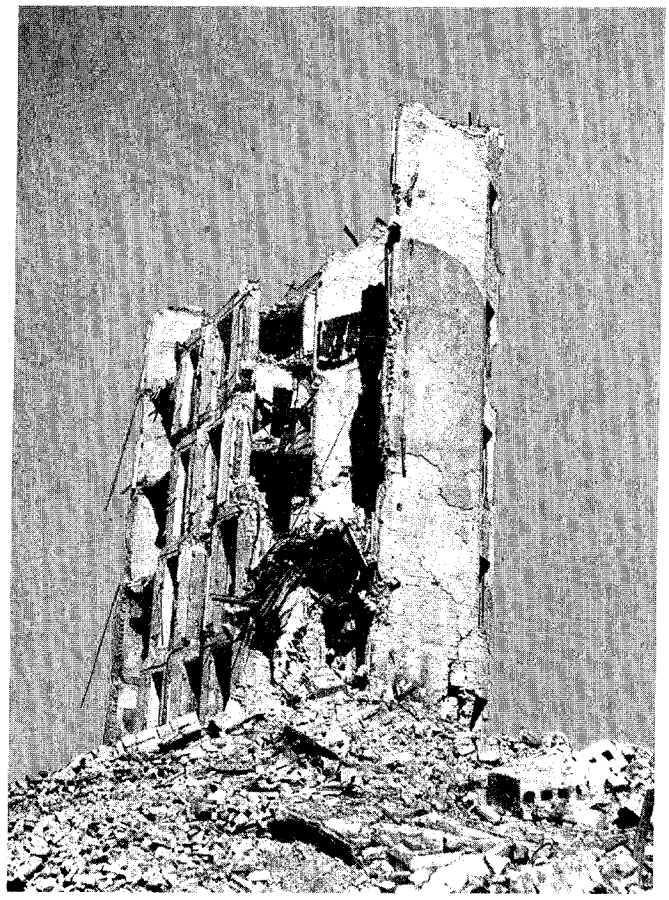
Since my early childhood I have had an aversion toward subterranean spaces, an attitude which I think might well be shared by people anywhere in the world. So you can easily understand my antipathy toward anything connected with shelters. Due to this very negative feeling I did not display any interest in reading pamphlets issued by the Hungarian government and civil authorities on air raid topics when we were on the threshold of World War II. The general public acted much in the same way. Indeed, only amazingly few people had the ability to foresee the gathering clouds and the usefulness of such literature. Later on we all regretted that our life-saving knowledge was almost exclusively based on the principle of "on the spot" training. Prior to relating some of my experiences I think it necessary to describe a few essential features of air raid shelters – our home in the most hectic weeks of the war.

The Hungarian government, like others in Central Europe, made it compulsory to build air raid shelters. Building proprietors were required by law to protect their families, tenants, and employees to the upmost. Apartment houses which represented the major part of dwellings in Budapest, office buildings, and industrial (factory) buildings were all equipped with shelters. In old buildings cellars had to be renovated into shelters of modern design. The shelters were situated almost without exception below street level and were equipped for blackout and reinforced to be gasproof and splinterproof as well as to render full protection against debris. The ceiling of each shelter, in accordance with specifications, was reinforced to withstand the weight of falling rubble and even the collapse of the whole building. Special steel doors and (window) shutters were installed and fitted with rubber gaskets rendering them completely airtight. Shelters located on the same block of the street were interconnected by holes of about 4 feet by 4 feet dug at the base of the partition walls between cellars. It was also compulsory to store first-aid kits and fire-extinguishing equipment, including water, sand, various digging implements, and chemicals. Noteworthy is the fact that German-type public (communal) shelters designed to afford full protection for tens of thousands and to safeguard against direct hits were virtually non-existent outside Germany.

The persistent bombing of Budapest where I lived started early in April, 1944, and ended on February 12, 1945. During this period I experienced a series of bombardments amounting to well over 100. The longest air raid was the last one which commenced Christmas Eve, 1944, and ended February 12, 1945. During April and May of 1944, aerial bombings by the Allied forces were concentrated almost without exception on large-scale industrial plants.

At this time many of us preferred to take refuge in the trenches, provided there were any, in our neighborhood. I myself spent several air raids in trenches on the outskirts of Budapest near O-Buda. These open or covered narrow ditches proved to be very primitive shelters indeed. They were roughly funnel-shaped, about 2 meters in depth with an approximate width of 1 meter at their base which gradually broadened upward. These trenches offered some protection as well as some feeling or illusion of protection which was psychologically of utmost significance. But they were very uncomfortable. Furthermore they offered no protection against the sound of blasts which was terrifying to hear. I am still unable to forget the frightful sounds of the bombings of the O-Buda Gasworks and of a railroad train in the vicinity of Szob, a railway center, in July 1944, when I was compelled to take refuge in the nearby trenches. Despite such shortcomings the trenches proved to be very useful, especially for commuters when the trenches happened to be situated between home and work. Out of my several experiences it happened only twice that low-flying aircraft spotted and machine-gunned our trenches, thus inflicting light casualties.

The safest shelters I ever made use of were those in the Fortress of Buda located in the city's central district. Many of them extended as deep as 100 feet or more beneath street level. Steel doors were at the entrances to these shelters and, in many instances, the shelters were built in natural caves. These caves were mostly interconnected,



Underground: Safe Shelter

thereby comprising a huge network of shelters. Each of them was really a fortress in itself consisting of two or more floors under the cellar. A few were modernized and equipped with electricity, kitchens, etc. But their ventilating systems, if any, failed to supply enough fresh air. The lack of windows produced a hot, stifling, humid atmosphere which made a prolonged stay unendurable. This is why I preferred to use other shelters although they were located a little more than half a mile from my residence in Buda. Although the Fortress shelters offered exceptional protection I also felt depressed by the depth which made me feel completely severed from the outside world, but especially by the dank, fetid surroundings. Seeing the water trickling down the walls and soaking our mattresses, blankets, and luggage, all of which we had laid on a few bricks for protection, lowered our spirits considerably.

In March 1945, when I visited the Fortress again after the siege, I saw that these shelters, constructed in rock well beneath the surface, generally withstood even the direct hits of the bombs. When hit directly, the one or two-story buildings collapsed. The bombs exploded in their cellars, killing and injuring people there. But in the first and second levels underneath the cellars few occupants were ever injured. A few were entombed by debris but escaped death. Shelter dwellers living below the cellars enjoyed almost complete physical safety except in the cases where a few suffered shock caused by the series of crashes. When I exchanged experiences with one group of my friends who had sought refuge in the Fortress they related their experiences to me very dramatically: extremely heavy outside bombing caused their refuge, which was some 60-70 feet underground, to shake. Everything went dark. It was a direct hit. In the cellar above, [1] where the bomb had exploded, several persons had been killed and buried in the rubble, but deeper down in the cave shelter where my friends were they sustained only the secondary effects of the explosion: eyes, ears and mouths full of dust and dirt, their exit was temporarily blocked, but they survived.

In the last phase of the war I sought refuge against aerial attacks in a total of about 35-40 shelters located in Budapest, the Hungarian countryside and in Slovakia. On October 15, 1944, the day of the Nazi takeover, I deserted from the Army. Somewhat later I moved from Buda to Pest. [2] Our 3-story building was one of the most exposed spots of the siege. Here we experienced one of the most destructive sieges ever recorded in military history. Budapest, with a population of about one million, was defended by German and Hungarian troops. At least 20 Russian divisions attacked the well-fortified city. The aerial attacks and house-to-house fighting completely demolished 13,588 dwelling units (flats), made 18,755 uninhabitable and nearly 48,000 were partially damaged and unfit to live in. Our house belonged to the latter category. Living conditions were severly affected and 300,000 persons were left homeless. More than 12,000 civilians lost their lives as a direct result of war injuries; 15,700 died from consequences of the unsanitary conditions up to June 1945. [3]

Our cellar shelter in Pest was a typical one as described previously. We were a total of 67 persons representing a cross section of society, including 6 Army deserters and 9 Jews in hiding. Due to the men's military obligations our shelter commander, as in many places elsewhere was a woman. A middle-aged lady with a staff of 7 or 8, she was well-trained in civil defense and kept our life well under control by maintaining a fairly good discipline. Our commander frequently reiterated such useful slogans as "Maintain your composure,"; "Do not ignite an open flame,"; "Never start or spread disquieting rumors."

Recalling our daily way of life, I still clearly remember the frequent "news conferences" she held to keep her community busy and informed about most recent developments. These news conferences truly lifted our spirits. During the siege each group of shelter communities lived in absolute seclusion and displayed a marked disinterest in any affairs not linked with their only common purpose: survival. Her announcements were geared accordingly – safety conditions around the shelter, and our physical and mental well-being, including distribution of meals. We had beans, peas and very rarely bread – never meat or fish, no luxury items whatsoever. Budapest was saved from starvation by beans. On the occasions of her announcements she also stated some compulsory rules of public hygiene to prevent typhoid. Washing oneself daily as well as shaving for men were consistently mentioned.

Once in one of our neighboring shelters debris blocked the single storage place where all digging implements were stored. Our management in turn drew a lesson from this incident and ordered that our digging implements and first-aid kits be evenly distributed at 3 or 4 places.

Our main (steel door) entrance time and again was obstructed by falling rubble. But this never posed an insurmountable problem since we had 2 emergency doors and 5 or 6 reinforced windows through which we were able to escape and clear away the debris barricading the main door.

One of my contributions to our safety procedures, which was added to the suggestions of others, dates back to the summer of 1944 when I took refuge at the shelter of the Ferencvares Railroad Yard. During the 30-40-minute

[1] *My general observations led to my opinion that the thinness of roofs on the buildings contributed to disaster. Because these roofs did not offer proper resistance, bombs ripped through them to explode in the populated cellars.*

[2] *During the siege of Budapest I lived in the shelter under 4 Podmaniczky Street, near the Western Railroad Terminal.*

[3] *For further details see Francis S. Wagner's chapter "Human Behavior in Disaster: The Siege of Budapest" in a forthcoming book edited by Eugene P. Wigner under the title* Civil Defense: The Problem of Survival in the Nuclear Age *to be published by the Indiana University Press.*

bombardment we were talking quietly to each other. My neighbor happened to be a railroad official. He was sitting comfortably, reclining his head against the stone wall. Several explosions were heard and the lights went out. Suddenly, my neighbor stopped answering my questions. When the bombs hit the Yard area the blasts shook the walls of our shelter, causing my neighbor to die instantaneously of a brain concussion. This experience of mine was immediately incorporated into our emergency procedures, and we were warned to avoid contact with the walls. Our chairs and beds were placed at a distance of at least 1 foot from the shelter walls, and though more than 20 bombs hit our house and its immediate area, no further deaths of this kind occurred.

We were lucky that our emergency home was quite dry, but we suffered increasingly from the ever-mounting, deafening clamor of the war because our shelter was far from being soundproof. Under these circumstances the nervous systems of a few were affected and the lack of sleep caused their temporary mental and physical exhaustion.

Viewing the Battle of Budapest from a distance of over two and a half decades, I find that many details have blurred in my memory. But the memories which remain intact have convinced me that expertly designed, constructed, and equipped shelters significantly reduced the loss in human lives. And the well-trained shelter leadership likewise contributed to decreasing the fatalities by creating and maintaining a panic-free atmosphere. ■

After the Bombs – Reconstruction

IS RUSSIAN CIVIL DEFENSE LAGGING?

Any claim that Russian Civil Defense is behind ours is false, as was shown years ago by the definitive studies of Cannel and Foster (Stanford Research Institute, 1960) and Gouré (University of California Press, 1962). These studies showed Russia's vast superiority in:

1. Dispersion. From adherence to a pre-World-War-II decree that no new industry would be established in existing cities, 600 new industrial centers have been created.

2. Shelter. The Soviets are constructing shelters for protection from chemical and biological weapons and nuclear radiation, blast, and fire. We merely mark spaces in existing buildings which afford radiation protection.

3. Training and personnel. Besides compulsory training courses (not feasible in our democracy) taken by most of the population, Russia has a large professional paramilitary civil defense corps.

That this civil defense gap between Russia and the U.S. has further widened since 1962 is shown by Joanne Levey (of the Oak Ridge National Laboratory) in her article in the March-April 1969 issue of *Survive*: "Civil Defense in the Soviet Union."

Thus, the great present "threat to peace" is not our superiority in offense, which is disappearing; rather it is the increasing superiority in civil defense of an opportunistic autocracy. Our danger is that the very loss of 100 million which makes war unthinkable to us may make war attractive to a country which can limit its losses to less than ten million through strong civil defense. (H.A.S.) ■

BLAST SHELTER EFFECTIVENESS AND COST

- by Eugene P. Wigner

Winner of the scientific world's highest accolades, including the Nobel Prize, Eugene P. Wigner, scientist and engineer, directs much of his endless store of interest and energy toward alerting his fellow Americans to the need for a strong civil defense as a basic survival means in the nuclear age. Here he reviews the elements of the blast shelter question and comes to grips with the cold-blooded equation of offensive-defensive cost ratios.

The present program of the Office of Civil Defense has two principal objectives:

1. To bring to the public, and especially to those in certain occupations, a better understanding of the effects of nuclear weapons and of the modes of protection against them.

2. To provide protection for the population at large against fallout radiation.

Fallout is caused by nuclear explosions if they take place close to the ground; explosions at high altitudes, such as those of ABM missiles, do not create significant fallout. The fallout radiation emanates from particles of earth and other debris to which the radioactive atoms produced in the explosion have attached themselves. This material first rises in the mushroom cloud accompanying the explosion, then falls, bringing the radioactivity down to the earth. Fallout shelters are designed to protect against radioactivity from these particles.

Protection against the other effects of nuclear explosions is discussed in this article. The most dangerous of such effects are the blast wave and the heat pulse. The present very economical program of the Office of Civil Defense does not include protection against these effects. This protection would be much more costly than the present program, and the effects in question extend over a much smaller area than that covered by the fallout. Nevertheless, blast and heat can destroy countless lives in cities where many people are concentrated in a relatively small area.

The best protection against blast and heat – and the only one which we now envisage – is provided by blast shelters, which also protect against heat and radioactivity. The rather high cost of blast shelters gave rise to the objection that such shelters are purposeless: the enemy can overcome their effect by increasing his arsenal and the size of its explosions. Furthermore, it is said that the enemy can do this at a cost which is lower than the cost of the protection. We shall see that, under the most widely prevailing conditions, this objection is erroneous.

The blast wave itself is described in the article of Hall and Haaland[1]. It is a sudden increase of the air pressure, followed by an intense gust of hot wind. This can hurl a man against a wall or other solid object. It can throw solid objects at him. These are the principal dangers to avoid. In addition, the air pressure itself, if it exceeds 40 psi (pounds per square inch), may result in lung damage; the eardrums will burst at a much lower pressure. However, if a shelter has a 100 psi blast resistance, the area in which those in the shelter are endangered is reduced to about 1 square mile in the case of a 1 MT (megaton) explosion, to about 4 square miles for a 10 MT explosion, to about 9 square miles for a 25 MT explosion. These figures apply if the weapon is an air-burst, in which case the effect of fallout – the most widespread effect – becomes negligible. The area of blast damage for ground burst weapons is considerably smaller. Needless to say, a good blast shelter also protects against the heat radiation and all other effects of the explosion.

Many types of blast shelters have been designed and proposed. Some of these serve only as shelters to be used solely, or at least principally, to protect the people against nuclear weapons. A particular example is the tunnel-grid system, the design of which has been developed in some detail by the Oak Ridge National Laboratory. It consists of two parallel sets of tunnels, situated as the avenues and streets of a typical city are. The advantage of such an arrangement is that one can enter the shelter system anywhere and proceed within it to any other part of the system. The husband and father in the business section can walk toward his home and join his wife and children there. Other designs are for multipurpose shelters. These may serve as garages or conduits for utilities in peace and assume the role of shelter only in an emergency. The proper type of shelter will depend on various circumstances, such as the density of population, the need for utility tunnels or garages, etc.

A comparison of the cost of a blast shelter with the cost of a weapon to overcome its protection was given recently in the *Little Harbor Report.* This report presents the conclusions of a committee of the National Academy of Sciences which was convened to study the effectiveness of various civil defense measures. It estimates the cost of a blast shelter with a 100 psi blast resistance as $300 per shelter space. It also estimates how much our government spends for missiles with various explosive powers. Since it has been variously claimed that the Soviets can produce their most powerful missiles, the so-called SS-9, at a lower

[1] *In the Shadow of Ground Zero, by Wm. Cornelius Hall and Carsten M. Haaland, page 15.*

price than the U.S. spends for its missiles, we shall use for the cost of the USSR missiles less than half of what our own costs would indicate. We assume that an SS-9 exploded over our country costs $35 to $40 million to the USSR (we pay about $50 million for a weapon of half the explosive power). This will render our conclusions most conservative.

An SS-9, if an air burst, may cover an area of 7 to 9 square miles with a 100 psi overpressure. In case of a ground burst (to produce fallout also), the area becomes 5 to 6½ square miles. For $35 to $40 million, one can build 100 psi shelters for 115,000 to 135,000 people. If the 5 to 9 square miles in question contain more than about 125,000 people, the defense is more expensive than the offensive power necessary to overcome it; otherwise, it is cheaper. Only about 15 million of our people live in areas with a population density exceeding this. Thus, even if one uses our adverse cost estimates, one must conclude that only for a small part of our urban population (of about 75 million) does the cost of protection exceed the cost of overcoming the protection. Of course, if humanitarian rather than cost-effectiveness considerations control the decisions, one will try to save lives at almost any cost.

What are, then, the principal limitations of, and valid objections to, blast shelters? The principal limitation is that they protect only the lives of people, not their houses and property. This is a serious limitation – ballistic missile defense is more effective in this regard. In addition, ballistic missile defense can be always on the alert, ready to shoot at incoming missiles. People need time to reach shelter. This last point is particularly serious if the attack comes from submarines: the warning time may be no more than a few minutes. On the other hand, shelters are less subject to obsolescence than the highly sophisticated antiballistic missiles, and technical innovations of the offense are less likely to endanger their effectiveness. They also would support the morale of the people better than the physically more distant, and emotionally and intellectually more remote, active defense. The two could, of course, be combined to give the most effective protection that is possible. ■

NUCLEAR NOTES

Architecture and Construction Notice No. 68-12 (California) states that it is "the policy of the Office of Architecture and Construction" to slant shelter into building design according to OCD and California Disaster office recommendations. It further states: "The primary responsibility for compliance with this directive is that of the design architect because the success or failure of the program in time of emergency will be determined by his efforts... Supervising architects, in their initial direction and in their review of design solutions will make certain that full consideration has been given to use of slanting techniques without jeopardizing the financial limitations, functional requirements or aesthetic values of the project."

*

Search and Rescue in the State of Washington is serious business – *civil defense* business. The state-wide organization is composed of trained and registered volunteers who receive compensation for time spent on rescue missions. In 1968 Washington conducted 226 search and rescue missions with a total of over 26,000 volunteer man hours. A large hardcore group of specialists is in this way maintained for immediate use in any civil defense emergency.

*

Head of the four-man Russian delegation to former President Dwight D. Eisenhower's funeral was Marshal Vasily I. Chuikov, Soviet Director of Civil Defense. Chuikov in World War II was commander of the 64th Army which defended Stalingrad against the Nazi invaders. He also played a prominent role in the capture of Berlin.

In Alabama within the past few weeks 22 severe weather observation and reporting classes trained a total of 1,198 state and local government employees. According to Alabama Director of Civil Defense J. Frank Manderson this provides a nucleus of specialists in every Alabama county ready to function day or night.

*

The Board of County Commissioners of Levy County, Florida has just passed a resolution *requiring* fallout shelter in all new construction where it can be accomplished without exceeding an additional 5% tacked on to building cost without it.

*

The International Civil Defense Organization (Switzerland) announces the first "International Course for Civil Defense Instructors" for August 4-30, 1969. Held at the Bernex Civil Defense Training Center near Geneva the course will be divided into two sections, one in which English will be used, and the other in which French will be used. Instruction will test theory with field exercises and will be programmed so as to give intensive coverage to:

Civil Defense Organization and mission (1st week)
Light and heavy rescue techniques (2nd week)
Fire fighting (3rd week)
First aid and treatment of casualties (4th week)

Further information may be obtained by writing:

Secretariat
International Civil Defense Organization
P. O. Box 124
1211 Geneva 6
Switzerland

CD SPOTLIGHT

OAK RIDGE REPORTS ON CIVIL DEFENSE RESEARCH

Over 150 scientists, industrialists, educators and civil defense officials from Hawaii to the East Coast and Canada to the Gulf of Mexico met April 8th and 9th at Oak Ridge, Tennessee. The occasion was the 3rd Annual Information Meeting conducted by the Oak Ridge National Laboratory's Civil Defense Research Project. Among the fourteen research reviews given by staff members were the following:

Utility Tunneling Technology. Experiments being made at Oak Ridge with high speed water for drilling through rock indicate that this method holds great promise for increasing the rate of tunneling in this medium. 2, 4 and 6 mm diameter water jets were used at a pressure of 6,000 psi. Experiments at higher pressures were also reviewed. The Oak Ridge experiments are to be broadened to include higher pressures and different types of rock.

Washington, D.C. Subway as a Dual-Use Shelter. The proposed Washington subway, if designed to permit proper closing, would afford blast shelter for about 1/3 of the peak daytime population on a 15-minute warning basis. The cost of adapting the subway to shelter is now being studied.

Civil Defense in the Soviet Union. Mrs. Joanne S. Levey, whose article by the same title appeared in the last issue of *Survive,* covered the recent upsurge in civil defense activities in the Soviet Union. She cited the following six points to illustrate the "unmistakable earnestness" of the new civil defense effort:

(1) The total reorganization of the administration of the program;
(2) Compulsory instruction in the schools;
(3) High quality training for teachers;
(4) Detailed and concrete evacuation plans;
(5) Realism and practicality in exercises; and
(6) Extended radio, television, and newspaper coverage.

Simulator Studies of EMP Effects. The mysteries of electro-magnetic pulse (EMP) phenomena are being probed through the use of a miniature EMP "simulator" at the Oak Ridge Laboratory. So far, tests have been run on EMP effects on above-ground wires, AM and FM broadcast receivers, and radiation monitoring equipment. It is anticipated that further research with the simulator will bring about a better knowledge of EMP effects.

U.S. Food Supply, Distribution, and Reserves. Food stocks have increased in the last twelve months. Many areas outside the midwestern food basket, however, would in a war emergency be severely handicapped by local shortages and a transportation situation that would make distribution from the surplus areas exceedingly difficult.

Other subjects reported on were: Urban Use of Reactor Heat; Advanced Solid Waste Treatment; Crisis Behavior; The 1961 Berlin Confrontation; Sources of U.S. Public Attitudes Toward ABM and Civil Defense; National Hardened Civil Defense System; Schlieren Studies of Shock Reflection from Angles; Flash Sterilization of Biological Aerosols, Livestock Vulnerability and Salvage; and The German Recovery: Lessons for Postattack Recovery Planning.

"LITTLE HARBOR REPORT" NOW AVAILABLE

The manuscript of the *Little Harbor Report,* an analysis of the American Civil Defense posture, was reviewed in the September-October issue of *Survive.* The booklet has now been published by the U.S. Atomic Energy Commission and is "available without charge as TID-24690" from:

Division of Technical Information Extension
U. S. Atomic Energy Commission
P. O. Box 62
Oak Ridge, Tennessee 37830

"Little Harbor" is described on its cover as "A Report to the Atomic Energy Commission by a Committee of the National Academy of Sciences." The committee was composed of the following individuals:

Harold L. Brode, Physics Division, The RAND Corporation
Lee Christie, Systems Development Corporation
L. J. Deal, U.S. Atomic Energy Commission
William J. Hall, Dept. of Civil Engineering, University of Illinois
Harold A. Knapp, Institute for Defense Analyses
William Osburn, U.S. Atomic Energy Commission
Richard Park, National Academy of Sciences
John H. Rust, Department of Pharmacology, University of Chicago
Sidney G. Winter, The RAND Corporation
Eugene P. Wigner, Oak Ridge National Laboratory
John P. Witherspoon, Oak Ridge National Laboratory
Stephen B. Withey, University of Michigan

The mission of the committee was to "review and update the Project Harbor Study on Civil Defense." This study was made in 1963 during a six-weeks period under the auspices of the National Academy of Sciences; 63 scientists and engineers participated in the study and 88 consultants, observers and briefers also took part.

The result of the reviewing and updating is *The Little Harbor Report.*

IN THE SHADOW OF GROUND ZERO

- by Wm. Cornelius Hall and Carsten M. Haaland

Is survival within the heavy blast area of a nuclear weapon possible? The picture usually given is one of hopelessness. Here two scientists, specialists in the nuclear field, show that measures to contend with this brutal environment are practical and if conscientiously implemented will result in survival odds worth fighting for.

The Soviet Union has over a thousand missiles[1] and several hundred aircraft which can deliver nuclear weapons to the U.S. In a few years China will also be able to deliver them. The development of the ultracentrifuge for enriching uranium and the possibility of a laser trigger for thermonuclear weapons[2] may make nuclear weapons available to the secondary nations of the world in 10 to 20 years. If a general war should break out, chances are very great that these nuclear arsenals will be used, and that many nuclear weapons will be used in an attempt to destroy our cities.

Nuclear war is horrible to contemplate, but it *is* possible to reduce the fatalities and injuries – even within target areas – by as much as tenfold and to ensure the recovery of the nation afterwards by implementing basic civil defense measures.

The Destructive Effects of Nuclear Weapons

A nuclear weapon is so devastating because it releases an enormous quantity of energy into a small volume in a very short time. A nuclear weapon rated at a yield of one megaton occupies less space than an automobile, yet it releases upon detonation the same amount of energy as one million *tons* of TNT (enough to fill 100 freight *trains*, each train with 100 *gondolas*, and each gondola carrying 100 *tons* of TNT). Both the U.S. and USSR have now the capability of delivering this tremendous quantity of energy *or more* in any *one* of their strategic missiles. Furthermore this energy can be delivered over a range of 5000 to 7000 miles in 25 to 35 minutes.

The sudden release of the energy of a one megaton nuclear weapon begins the sequence of events listed below (for more technical details the reader is advised to read *The Effects of Nuclear Weapons*)[3]:

Prompt nuclear radiation: At a distance of one mile, a person would need the protection of about one foot of steel, four feet of concrete or five feet of earth in order to suffer no ill effects. At this range he would also require protection by a specially designed structure rated to withstand an overpressure of about 60 pounds per square inch.

Flash: On a fairly clear day, thermal radiation would be of sufficient intensity to cause moderately severe burns of exposed skin as far away as twelve miles. The warmth may be felt at a distance of 75 miles. Newspapers would be ignited at a distance of about nine miles. Heavy dark cotton draperies would be ignited through living room windows at a distance of about six miles, and various items of exterior clothing in dark colors would be ignited at five to six miles.

Shock Wave: At a distance of four to five miles, wood frame houses would be torn apart and the frames shattered by the shock and blast. At three to four miles, multistory brick apartment houses would be shattered.

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[1] *C. M. Haaland, "U.S. vs Soviet Union Strategic Offensive Force," in* Survive, *Jan-Feb 1969.*

[2] *Neville Brown, "Blows to Non-proliferation," in* New Scientist, *Feb. 6, 1969, p. 295.*

[3] The Effects of Nuclear Weapons, *prepared by the U.S. Dept. of Defense, edited by Samuel Glasstone, is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., for the price of $3.00 and can be obtained by mail, postfree. It consists of 730 pages and includes a Nuclear Bomb Effects Computer, a circular plastic "slide rule" for making rapid calculations of bomb effects.*

Blast Wind: At a distance of four miles the peak velocity in the gust of wind which follows the shock wave would be 180 mph. A man standing up would be hurled through the air about fifteen or twenty feet. Slivers of glass from shattered windows would fly through the air with speeds of 100 to 130 mph.

Fallout: The harmful effects of fallout from an *airburst* would be virtually negligible. However, a *surface burst* fireball picks up thousands of tons of dirt and debris and the radioactive materials from the bomb attach to it. When this debris settles to earth again, it is radioactive. In this case, several hundred square miles would be contaminated to the extent that people remaining in the area without taking shelter would die of radiation sickness. Fig. 1 (opposite) shows a possible fallout pattern resulting from an attack of 3600 megatons on the U.S., of which 1600 megatons is directed at cities. About half the people remaining for the first four days in the 300 to 1000–total–roentgens areas without protection would die, and all those remaining for the first four days in the areas of 1000 total roentgens or greater without protection would die.

Practical measures for protection against nuclear weapons effects – including blast and heat – are well established. Two hypothetical and extreme cases are:

1. The highest degree of protection is available, and people are warned in advance so they can use it.

2. No pre-planned protection is available, and people are caught in the streets without warning.

Hardened Shelters Can Provide Almost Complete Protection

Prompt nuclear radiation is reduced in intensity by passage through matter. At a distance of only 1500 feet from the origin of a one megaton nuclear detonation, a person would be perfectly safe from the prompt nuclear radiation if he were surrounded by a wall of earth of about 10 feet thickness, or of concrete of about seven feet thickness. The overpressure in the shock wave at this close range would be about 1000 pounds per square inch.

This shock wave would be transmitted through the ground to a buried structure with its top several feet underground. Even if the structure were sufficiently strong not to crack under the impact of this shock, the entire structure and the soil around it would be suddenly knocked back and forth several feet by the action of the shock wave. People inside would be injured or killed by being thrown about unless the structure were designed and built to isolate the inhabitants from the effects of the shock wave.

Shock isolation can be accomplished by building the structure in two shells, one inside the other, with springs separating the shells. The outer shell is designed to shield from prompt nuclear radiation, and is sufficiently strong to withstand the impact of the shock wave and ensuing motion. When the outer shell is suddenly displaced, the inner shell initially remains virtually fixed in place by compressing the mounting springs on one side and expanding them on another. Shelters of this type actually exist.

It is not practical to build protective structures which will protect people at higher overpressures than 1000 pounds per square inch, because the region where these higher overpressures occur is within or too close to the crater formed by the explosion. However, shelters protecting against lower pressures are feasible.[4]

Protection against prompt nuclear radiation and blast in the high pressure region is also protection against the effects of thermal radiation, blast wind, and delayed nuclear radiation. Heavy fallout may cause lethal radiation in the first few hours after the detonation, but the radioactivity would decay to a level that would permit the safe evacuation of people by automobile after two days (the streets would have to be cleared by bulldozers having special shielding to protect their crews against the radioactivity). In two weeks one could walk in the area for several hours without protection and without any harmful effects, i.e. without bringing on radiation sickness.

The area of heaviest fallout would be suitable for habitation in about two years. Rainfall would shorten this period, but monitoring the initially heavily contaminated areas in order to assess the residual radioactivity would remain almost imperative in any case.

So, almost complete protection *can* be provided by a special and very costly structure very close to the nuclear inferno. The task is much simpler farther away from the explosion.

Survival Without Protective Structures

At a distance of two miles or more from a surface burst of one megaton yield it is even possible, with luck and alacrity, to survive *without* the benefit of a special structure.

Suppose *you* are walking on the street of a city and suddenly, noiselessly, the air is filled with stark, dazzling light. Looking directly toward its source would instantly cause permanent blindness. Even the reflected light can cause temporary flash blindness which may last from a few seconds to several days. Duck *immediately* into the shadow of something, anything – a car, a building, or even a utility pole. Cover your face and as much exposed skin as possible with your clothing to prevent serious burns. If you are close enough to the detonation to receive a lethal dose of prompt radiation, you are likely to be killed by the all-shattering blast wave anyway. At two miles distance you have a chance. The blast wave arrives in 5 seconds.

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[4] *See "Blast Shelter Effectiveness and Cost", by Eugene P. Wigner, Page 12.*

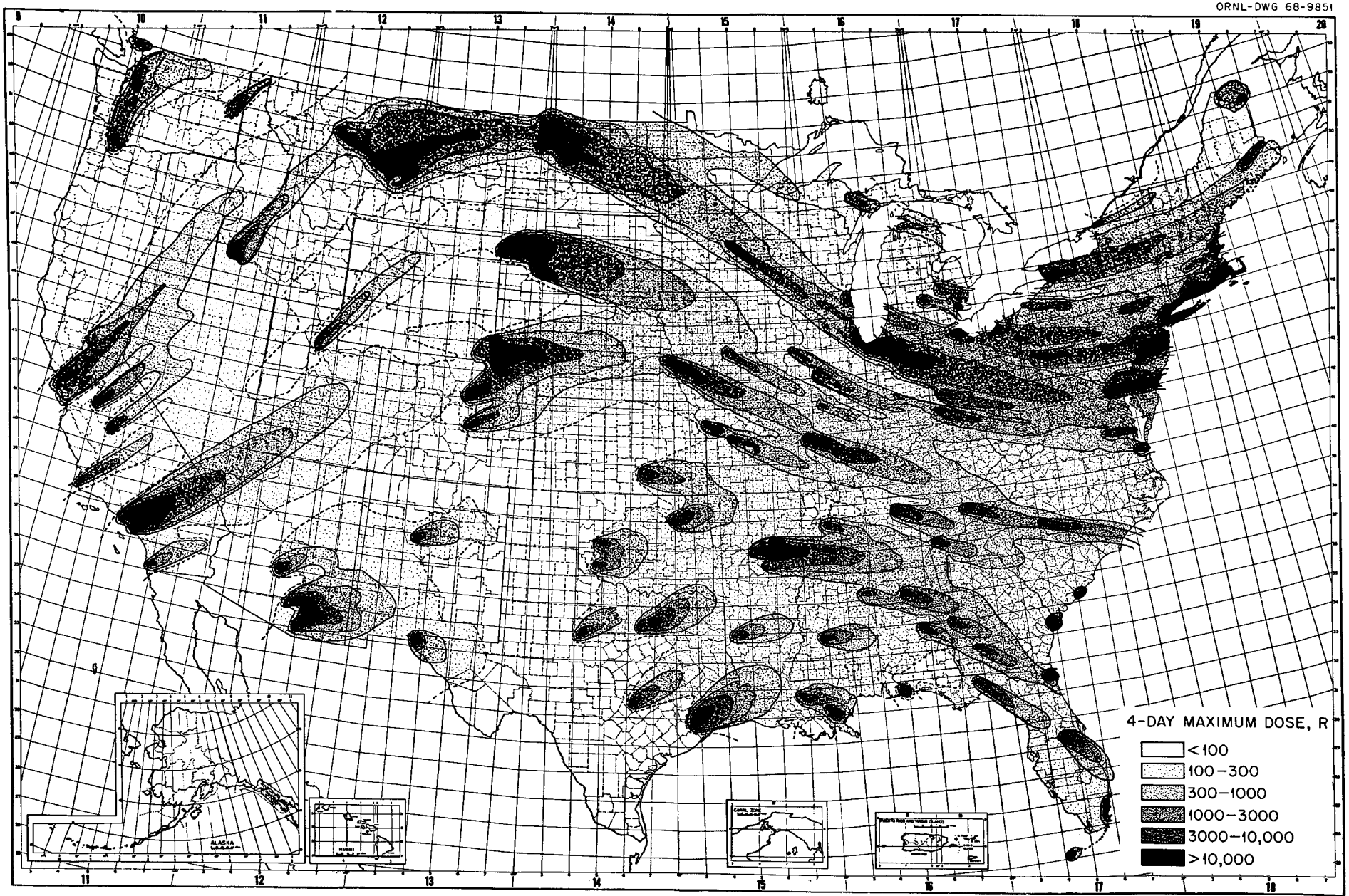


Figure 1: Fallout radiation patterns from a simulated 3600 MT nuclear attack on the United States based on only one particular set of attack conditions and on meteorological conditions pertaining to one four-day period. (Inasmuch as these sets of conditions will vary widely it is evident that fallout patterns will also vary widely. Selected localities would therefore receive greater or lesser amounts of fallout depending upon the combined effects of these conditions. It would be totally unrealistic to assume that any particular locality is not subject to lethal quantities of fallout radiation.) The above study was developed by A. F. Shinn from a map supplied by NRAC, OEP.

Here the greatest hazard from the blast will be from falling walls, flying bricks and glass, and also from the possibility of being picked up (if you are standing in the open) by the wind and mixed with flying debris. The inside of a culvert or of a storm drain offers good protection and a deep ditch is fairly good. A deep gutter by the sidewalk is better than the sidewalk itself or the middle of the street. Wherever you are, get down on your stomach and hug the ground. An automobile (not convertible) will provide fair protection if you get down on its floor. Stay away from windowpanes. If you are inside a building, get under a solid table, desk or bed, preferably near the sturdiest wall, and away from glass. Cover yourself with layers of blankets or cloth or any kind of padding, if available.

Suppose you were not concerned with survival, and were on a high hill from which you could see the city extending below you, you would see a bulging, rolling line of buildings being smashed followed by a wall of dust and debris rapidly advancing towards you. You would hear no sound because the shock wave would be moving towards you faster than the speed of sound, faster than 1100 feet per second.

The sudden increase in pressure from the shock wave may pop your eardrums, knock your breath out, and give you a nosebleed and sore lungs even though you have protected yourself from missiles and falling walls. Furthermore, the blast wind, which will drive air and dust with a peak gust velocity of 240 mph and a temperature of around 150°F, can produce severe burns on exposed flesh. The situation is, of course, better farther from the explosion.

Assuming you still are in business, you now have two more hazards to face: fire and fallout.

The flash which initiated the chain of events will have ignited many flash fires throughout the city. Many of these will be blown out by the blast wind, but those which are not may now burn faster because of the piling up of rubble. Additional fires might start due to shorted power lines and broken gas lines. The important thing is this: the fires must be conquered within ten to fifteen minutes after the blast wave has passed. Otherwise they may grow beyond control. The area covered by flash fires will probably be too large to get out of.

If there are only a few people fighting many (initially small) fires, there may be little chance for controlling them. However, if there are enough people fighting them, say one or two for each unit of area equivalent to that of an ordinary house, there is a very good chance of extinguishing them.

Last: Fallout Radiation

The final and most uncertain hazard of the nuclear detonation (assuming it was a surface burst) is fallout. If the fireball did not touch the ground, there will be no danger from fallout. But unless the burst was very high up, it would not be easy to determine from the flash whether the burst was an air burst or a ground burst.

After the major part of the light flash is over, even a sneak look at the fireball would still severely damage your eyes, and probably would not confirm it as either a surface or an air burst. The fireball will be rising at the rate of several hundred feet per second. But if large chunks of pavement, bricks, or rocks fall out of the sky while you are out fighting fires, you may be certain that the detonation was a surface burst, and you will know you must be concerned about radioactivity.

Also, while you are fighting fires, you may notice that the shadows of some objects, such as a fire hydrant, have been lightly sketched onto pavement or concrete, or outlined on grass by the heat of the flash. If the length of this shadow is less than twice the height of the object, then you are free of the direct hazards of this nuclear detonation. Fallout will not be a hazard to you.

If you cannot determine whether the detonation was a surface burst or an air burst, or if you learn that it *was* a surface burst, then you must find or prepare protection against radioactive fallout as soon as possible.

In an area where nearly all buildings are shattered and strewn about, look first, without spending too much time, for a building which may have had food stored in it. If you see an official "Fallout Shelter" marking, go to that location. Even though the building may be severely damaged, the food and water stocks in it are planned for use through the fallout hazard. Look for a basement area where the beams form a lean-to, i.e., the ends of the beams on one end are propped up on the top of the basement wall. You may have to improvise. Construct a lean-to, if you can't find one. Don't choose a low area where rain might wash radioactive debris into your shelter. Watch out for leaking gas lines and fallen power lines. If you have time, quickly pile additional beams on top of your lean-to, then pile layers of loose bricks and chunks of concrete on top of these beams, as thick as you can, and fill in the voids between the chunks with loose dirt. If you are able to get about 12-18 inches cover over the beams, your shelter may reduce the effects of fallout by a factor of 100 or more, and you can survive this final hazard. However, you may have no more than a half hour's time.

The hazards we have described would be less severe at greater distances from the nuclear detonation. At greater distances, more time can also be spent on the preparation of an emergency fallout shelter.

Without good shelter achieved through prior planning, in order to survive in a target area you will need lots of luck, and lots of organized emergency know-how. ■

APNA SOUNDS OUT SENATE ABM SENTIMENT

On March 31st APNA (Association for Community-Wide Protection from Nuclear Attack) sent telegrams to all United States Senators worded as follows:

PLEASE SUPPORT ABM TO PROVIDE AS MUCH PROTECTION FOR AMERICANS AS RUSSIA PROVIDES FOR RUSSIANS.

Although no answers were requested twenty-one senators have so far provided APNA with their views on the limited ABM program proposed by President Nixon. Results:

Pro-ABM-		
Wallace F. Bennett	Republican	Utah
Spessard L. Holland	Democrat	Florida
B. Everett Jordan	Democrat	N. C.
Jack Miller	Republican	Iowa
Bob Packwood	Republican	Oregon
John Sparkman	Democrat	Ala.
Herman E. Talmadge	Democrat	Georgia
Strom Thurmond	Republican	S. C.
Milton R. Young	Republican	N. D.
Anti-ABM-		
Birch Bayh	Democrat	Indiana
Frank Church	Democrat	Idaho
J. W. Fulbright	Democrat	Arkansas
Vance Hartke	Democrat	Indiana
Mark O. Hatfield	Republican	Oregon
Fred R. Harris	Democrat	Okla.
George S. McGovern	Democrat	S. D.
Edmund S. Muskie	Democrat	Maine
Joseph D. Tydings	Democrat	Maryland
Undecided-		
Edward W. Brooke	Repbulican	Mass.
Harry F. Byrd, Jr.	Democrat	Virginia
Charles E. Goodell	Republican	N. Y.
Edward J. Gurney	Republican	Florida
William B. Spong, Jr.	Democrat	Virginia

Among the "anti-ABM" group Senator Frank Church wrote:

"Though the cost may prove immense, I still believe the system should be built if, on the evidence, it appears that the ABM:

(1) *is workable;*
(2) *will protect American citizens;*
(3) *will lessen the chances of nuclear war.*

"With these tests in mind, I have listened closely to the testimony and examined the evidence. I have found the proposal, thus far, deficient in all three categories. Experts sharply disagree on whether the ABM would even work in a showdown. Since it won't be deployed around the cities, the system is not designed to save lives.

"As far as lessening the chances of nuclear war, the ABM is more likely to have the contrary effect. Its deployment will doubtlessly set off another round in the nuclear arms race – on both sides – thus increasing the general level of danger to all, without giving us one whit of added advantage over the Russians."

From the "pro-ABM" group we quote a "Position Statement on ABM" submitted by Senator B. Everett Jordan with his letter. It reads:

"There has been increasing controversey in recent weeks over the Sentinel anti-ballistic missile system.

"Serious questions have been raised about whether, or in what form, it should be deployed as a part of the nation's defense facilities.

"Because of the extreme importance of the issue, I have searched for every bit of information I could find on the matter as a basis for determining my own position. I have studied the record of hearings before Senate committees and evidence produced during the weeks of Pentagon and White House review. I have talked at length with men whose knowledge, sincerity and judgment I have come to trust.

"Having done so, my judgment dictates that I support the modified deployment plan outlined by President Nixon as being the most realistic, practical and prudent of the available alternatives.

"To me its advantages lie in the placement of the protective devices where they can be expected to be most effective in defending our retaliatory power against attack from any source, and in the flexibility which the plan allows for changing procedures to meet changing conditions.

"I still strongly favor discussions with Russia which hopefully may produce firm agreement for limitation of missiles, both defensive and offensive. I do not think our decision to deploy ABM facilities on the proposed basis will inhibit this possibility but rather might enhance chances for success, since we cannot negotiate convincingly if we have no ABM capacity to match that Russia is known to possess.

"And, finally, in the absence of such firm agreement, I do not think we can afford to risk remaining defenseless against possible nuclear attack.

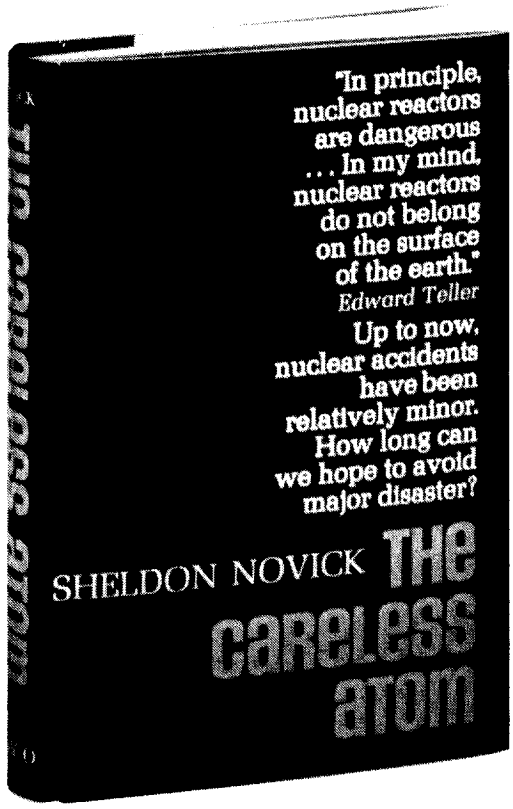
"If we prejudice our security in order to put more money into domestic programs, it could be a poor gamble in which both freedom and those programs would be lost.

"Having concluded that, I feel I must back the plan for a deployment start and implementation until circumstances clearly dictate a change of course."

Note: In the July-August issue of *Survive* a special technical analysis of ABM will be featured: *Anatomy of ABM.* This analysis is written by Donald C. Latham, co-author of the authoritative and widely-read *Strategy for Survival.*

BOOK REVIEW

The Careless Atom



The Careless Atom, by Sheldon Novick (Houghton Mifflin, $5.95). The subject of *The Careless Atom* is nuclear reactor safety, an alarmist's view of the dangers of possible reactor explosions. The book is long on criticism and short on solutions.

Unfortunately, a statement by Edward Teller to the effect that nuclear reactors should be constructed underground is chopped up and parts of it patched together on the book's jacket to make it appear that Dr. Teller is opposed to the construction of nuclear reactors.

In a letter to Oliver Townsend of the New York State Atomic and Space Authority (January 10, 1967) Dr. Teller gives a simple and clear account of nuclear reactor safety which serves to clear up this distortion as well as to set the record straight. We quote it in its entirety:

Lawrence Radiation Laboratory
Livermore, California

Dear Mr. Townsend:

Nuclear reactor safety has been carefully considered and very successfully regulated by the appropriate agencies of the Atomic Energy Commission. At the same time, there has been widespread discussion of this issue which was not always based on a complete understanding of the technical aspects of the matter. The following letter contains a statement concerning the status of these safety considerations, together with a projection of recent and expected changes in the situation.

It has been recognized throughout the history of nuclear engineering that no possible accident involving a nuclear reactor can be more violent than the detonation of a quantity of chemical explosive comparable in mass to that of the active part of the reactor. Nevertheless, reactors have to be controlled much more carefully than more conventional industrial operations, due to the large quantities of radioactivity contained in reactors which have operated at high power levels for considerable lengths of time. Dispersion of these reactivities in consequence of a major accident could result in widespread and completely intolerable casualties.

All of this has been fully recognized by the Atomic Energy Commission, by its various agencies, and by the private companies which construct and operate nuclear reactors. Basic differences between nuclear reactors on the one hand, and the more conventional industrial operations on the other hand, have been firmly established for years. In conventional operations, accident prevention has been based on some experience concerning the accidents themselves. In the case of nuclear reactor accidents, no major release of radioactivity to the environment can be tolerated and, due to the establishment of and adherence to proper procedures, no such major release has ever occurred. The stringent criteria applied, and the continued meticulous care exercised are both necessary and satisfactory.

In the last year there has been an unprecedented expansion in orders for very large nuclear power reactors. It is probable that within the next decade a major part of our power industry will utilize nuclear energy. The great increase in number and size of such reactors will make it necessary to insist on at least the same levels of safety measures as have been required in the past. These safety measures must eliminate even the remotest possibility of the liberations of massive amounts of radioactivity.[1]

(continued on page 23)

[1] *Relatively small amounts of radioactivity have been liberated in past accidents. While of course, all accidents should be avoided as far as possible, it should be noted that the liberation of small amounts of radioactivity does not constitute a great danger. Radioactivity in sufficient dilution has not been clearly established as harmful, and in very great dilution has effects which are the same as found everywhere in our natural environment.*

ECONOMIC ORGANIZATION FOR RECOVERY FROM NUCLEAR ATTACK

– THE ROLE OF GOVERNMENT CONTROLS

- by D. A. Patterson

A University of Tennessee professor of economics takes frank issue with current recovery planning and fields his solutions for bringing the American economy back to a condition of effectiveness in a difficult post-attack environment. This research was sponsored by the U.S. Atomic Energy Commission under contract with the Union Carbide Corporation and was undertaken at the Oak Ridge National Laboratory.

The concept of recovery from a nuclear attack on the United States depends on an assumption that sufficient material and human resources will remain to provide the necessary resources to resume the production of needed goods and services. (Guaranteeing that this assumption is valid is the responsibility of pre-attack defense planning, and is the necessary first step for recovery.) Given that this assumption is valid, the recovery problem then is to organize the inputs so that output can be resumed. During the early post-attack period such output may well be less than consumption, with the difference coming from pre-attack stocks. But if recovery is to take place at all, this output must expand to equal, and finally to surpass, mere survival levels of consumption.

If recovery is to be assured and speeded, recovery inputs, men and materials, the food and medical supplies for survival and the equipment for processing materials, must all be allocated to their most efficient recovery use. If an attack is relatively heavy, careful husbanding of these resources will be all the more important because, in this case, a meaningful recovery will be most difficult to attain.* Thus it may be necessary to severely limit all non-essential consumption of goods that are in short supply and are needed for the recovery effort. It is apparent, then, that government authority will be required to supervise the allocative process in some way.

Whether the allocative controls should be loose or tight, broad or narrow, is a matter of some debate. The official government solution to the problem of post-attack resource mobilization (See reference No. 8) seems to be one that relies on slightly more sophisticated versions of the methods used during World War II. They provide for a general price freeze, detailed commodity rationing, and materials control according to recovery needs. Provisions are made for local authorities to implement the first steps of rationing and price control in case the Federal authorities are unable to function. Materials allocation will certainly be improved over the World War II system because the availability of computers will provide a means of processing a greater volume of information and a means for checking the internal consistency of plans before they are implemented. The balance of the controls make no apparent use of modern technology.

In conjunction with the plans for direct controls over materials, provisions also exist for indirect controls. These are the more or less traditional controls over the supply of money and over the use and cost of credit exercised in our economy primarily by the Federal Reserve System. If a restrictive monetary policy is accompanied by fiscal policy measures, in the form of tax increases and reduced "nonessential" spending by government, both consumers and business will see reductions in their disposable incomes and in their ability to supplement current income with credit. Ideally this will reduce total demand and help to bring supply and demand into equilibrium without inflation, thus easing the problems of the price controllers and the rationing authority.

These monetary and fiscal measures might even be sufficient to justify reliance on the market processes, without rationing and price control, under special conditions. Thus if post-attack incomes were more or less equal, and there were no means of access to prior savings or other sources of cash, then each person's command over essential goods and services would be approximately equal to consumer rationing. Price control would then be

Recovery in my context will have occurred when current output equals or exceeds current consumption. At this point economic growth becomes possible and survival is no longer in question. In terms of pre-attack preparations this is a cost-minimizing goal in that it does not require pre-attack efforts to preserve every aspect of our current standard of living.

unnecessary in all but the most severe cases where, to select a "worst case" as an example, food resources were insufficient to maintain life for all survivors. However the conditions hypothesized, equal incomes and no savings, are unlikely in the first place and probably also undesirable in the second. A nuclear attack will doubtless destroy a great deal of wealth but the accompanying scarcities will also create windfall gains for some. Additionally, the need for wage incentives of various sorts is not to be ignored, especially at a time when maximum human effort is to be called for. Thus some individuals will necessarily have more money than others and consumer goods rationing is one well tried means of assuring that differential income or wealth position does not lead to excess consumption or accumulation of critically scarce consumer items.

These official plans have been subject to some criticism. It has been argued that any plan of control administered by the central government is bound to fail because government administration is too bureaucratic and unimaginative. These critics would rely on "free" market forces to do the recovery job. However, the free market systems for the allocation of *essential* goods and services can do a better job than government only when the supply of such goods is, or may quickly become, equal to the demand *at* prices sufficiently low to be within the means of the very lowest income groups. When this condition does not hold, those in the lowest income groups are forced to choose between privation and extra-legal means for meeting their needs. This problem is recognized within all modern economic systems today—hence our own use of social security, aid to dependent children and medicare programs.

There are other problems associated with the official plans. One is the failure to publicly recognize the probable need for a currency "reform" as a first step in the recovery process. After an attack the existing money supply will be excessive relative to the volume of goods and services likely to be available. Allowing this money to remain in the hands of the public, while attempting to maintain equitable levels of consumption through rationing and price control, is an invitation to develop black markets. Thus a delay in effecting a currency reform has been cited as one reason for the delay in the recovery of Germany after World War II. But if currency reform is so obviously necessary and even unavoidable, why is it not a part of the official plans? One reason of course is the obvious distaste with which many influential Americans would view such a plan. For a currency reform is an attempt to reduce excessive and disproportionately distributed purchasing power—i. e., it is a form of wealth redistribution where wealth is thought of as potential command over resources. Another reason for avoiding public consideration of this issue is the effect an anticipated currency reform might have on behavior during a pre-attack crisis, as people with high cash balances tried to convert them to goods suitable for hoarding. I believe both of these excuses are too weak to justify the exclusion of currency reform plans from the official position. The public needs to be aware of the nature and basis for emergency planning if it is to have confidence in the outcome.

One final criticism of the official plans might be mentioned. Economists have for some time recognized that the problem of emergency resource allocation might be better approached from the income side. Thus if currency reform were instituted and the resulting *funds* available for the purchase of scarce consumer items were rationed, it might be possible to eliminate most stamp-type rationing schemes. High tax rates and/or wages and profits frozen at very low levels are two means of accomplishing this "income rationing" but both of these methods are thought to have severe incentive-depressing effects and would therefore be inappropriate at the very time when society needs to call forth the best in individual effort and ingenuity. However, if it were possible to segregate the income of each spending unit into two accounts, one available for the essentials or goods that would otherwise be rationed, and the other account limited to use for non-critical items, for emergency use, and for saving, then the traditional forms of rationing could be replaced. The quantity of funds in the "disposable" account would be predetermined according to the size and composition of the family unit. The quantity of funds in the "blocked" account would be determined by the family income minus the allocation to the disposable account. Thus incentive wage and profit systems could still be permitted, without endangering the equitable distribution of essential goods and services, and without leading to the development of black markets to soak up excess purchasing power. Much of the bureaucratic red tape inevitably associated with traditional rationing systems would be eliminated.

Until relatively recently such income control schemes were impossible to consider carrying out. However the United States is well on the way to becoming a cashless society. If the money supply is defined in the traditional way, as currency plus demand deposits, then currency represents less than one fourth of the total. If defined as some economists have recently been insisting, to include time deposits as well, then currency accounts for just slightly more than ten per cent of the money supply. Thus present banking technology and the ubiquitous credit card would permit the elimination of currency with no inconvenience of the vast majority of consumers. Such a system would yield a further advantage in that record keeping and auditing procedures would be simplified as all transactions would flow through the banking system. The major disadvantage of such a system is that it is as yet untried.

As noted at the beginning of this article, recovery is only partly a function of what takes place post-attack. Pre-attack preparedness is necessary. It is here that I disagree most sharply with the apparent official philosophy. The current thrust of recovery research seems to be that a proper goal is the maximization of Gross National Product (GNP) per capita. With this goal the planner is necessarily concerned

with pre-attack means of saving entire factories and with stock piling machinery and other implements of the pre-attack "good life," and there may be less concern with saving people and more with saving material goods.

To put it bluntly, with this goal in mind, the planner is put in a position of trading people for GNP when he considers the alternative yields of various pre-attack investments, *in terms of their potential contribution to the objective,* GNP per capita. All would agree that it would be criminal to invest in a shelter system that would save people from the direct effects of nuclear attack so that they could starve. (Such an eventuality seems extremely remote in view of our current two-year stock of food and the greater vulnerability of people than food.) But it seems even more criminal to avoid investing in a shelter system *and* in an adequately distributed food and medical supplies stockpile merely because we cannot at the same time afford to stockpile a sufficient number of other goods to insure a swift and easy resumption of the pre-attack level of living for all survivors. The most important resource we have is people—what economists have come to call human capital. This human capital is certainly the necessary condition for recovery. Given food and medical care, human capital will also provide the sufficient condition to insure recovery. The fear that some have expressed, that we would somehow regress into a primitive technology—a horse and buggy or ox-cart society—is very unlikely. The technical skills and the orientation toward technology will survive in the minds and libraries of the survivors. ■

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BOOK REVIEW: The Careless Atom

(continued from page 20)

In assessing the various methods by which continued safety could be insured, consideration should be given to the subterranean or submarine deployment of nuclear power reactors. It should be noted that underground construction and operation of reactors has been practiced to some degree abroad. Fortunately, considerable experience with the sustained underground containment of large amounts of radioactivity exists, and this knowledge could be utilized for a further increase in power reactor safety. While underground and underwater construction will probably increase costs, it should be noted that such construction may well permit the location of reactors at points closer to the consumers, which, in turn, would result in more reliable operation of power systems and significant decreases in construction and operating costs.

It should be emphasized that location of reactors underground or underwater, or both, may be only one of the methods by which one can plan to meet the problems associated with the greatly increased use of nuclear power producers. It should be further emphasized that use of nuclear energy is necessary, not only on account of economic considerations and irreplaceable resource depletion, but also because this source of energy will not contribute to the pollution of the environment.

In conclusion, it should be stated that the present methods of reactor construction and control are satisfactory, that there is no need to modify existing plans for the construction of new reactors, but every avenue should be explored for increasing reactor safety, in view of the greatly increasing use of nuclear energy and the requirement that no major accident must ever occur. This requirement has been fulfilled in the past, and it can and must be fulfilled in the future, in spite of an increase in the number of reactors and in the number of circumstances under which human error, or unforeseen circumstances might occur. For this reason, the practice of multiple safeguards, by which the spread of massive radioactivity into the environment is prevented by several independent means, has to be continued and, wherever practicable, must be improved.

Sincerely,
Edward Teller

The subterranean construction of nuclear reactors recommended by Dr. Teller also has a big civil defense advantage: it would greatly decrease the danger of reactor damages in a nuclear attack and would therefore make post-attack recovery much easier.

Author Sheldon Novick is one of the St. Louis group of scientists and citizens – the Committee for Environmental Information – which examines the effects of scientific and industrial development on world environment. He is Associate Editor of the group's 11 year-old publication, now called *Environment.*

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Why does the American military protect its missiles with hardened sites? Why does the American military house its defense headquarters under a mountain of solid rock, on massive coil springs, behind hugh steel blast doors? Why does a major part of American industry insist on pushing ahead with realistic survival planning, the American Telephone and Telegraph Company for instance, investing over $800,000,000 in blast-protected cross-country communications?...

Why is this same policy not applied to the American public?

– Editorial, Vol. 1, No. 3

Although fears have been expressed that people (in a fire storm) would die from such things as the creation of a vacuum or the lack of oxygen, the evidence indicates clearly that no such danger occurs. There is, however, a real possibility of carbon monoxide poisoning. Since most of the burning in a given location is over in an hour or two in large mass fires, it would be wise to plan to close off the air supply of a shelter for approximately two hours.

– Arthur A. Broyles, Vol. 2, No. 2

The fact that so far we have invested in civil defense a negligible part of our effort is most disturbing in a situation which appears darker with each passing year. Civil defense may still save our country and may still prevent a nuclear conflict. But time to get prepared for the difficult period that lies ahead is running out fast.

– Edward Teller, Vol. 1, No. 2

Civil defense in the Soviet Union encompasses – at least in some degree – all aspects of protecting the population from the consequences of enemy attack and involves every citizen from top party officials to the man-in-the-street. The program is endorsed by both the Central Committee of the Communist Party and the Ministry of Defense and is implemented through an enormous organization which reaches down into every region, city, village, collective, farm, and industrial establishment.

– Joanne Levey, Vol. 2, No. 2

In a very real sense, I believe, it will be a test of the democratic ideal whether our people can resist burying their heads in sand or not, whether or not they can muster the foresight and maturity to carry out the unpleasant and unpopular task of protecting themselves, their country, and their freedom against dangers which seem far away. Nothing but illusory comfort can be gained by closing our eyes to these dangers.

– Eugene P. Wigner, Vol. 1, No. 1

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ABM EFFECTIVENESS AND IMPACT

National Educational Television in March featured a debate on ABM. Among the participants were Eugene P. Wigner. Following are the opening remarks of Dr. Wigner:

In the emotional debate concerning the deployment of the ABM, it is unfortunate that so much inaccurate technical information has been disseminated. Some of this is only misunderstanding, some is plain distortion.

The first question concerns the effectiveness of the ABM. Some oppose it because they claim it to be of no military importance; others maintain it would escalate the arms race and cause the Russians to greatly increase the size of their bombs. Both cannot be true. Neither is.

Concerning the effectiveness of ABM, the following can be said. As the Deputy Secretary of Defense admitted in his congressional testimony, the deployment of ABM by the Russians has diminished the explosive power of each of our 10-megaton missiles to 1/20 of its former value. Each missile contains partly explosive material, partly shielding to protect the missile from completely burning up as it passes through the atmosphere. In addition, in order to diminish the effectiveness of the Russian ABM, the missiles carry decoys which also take up some of the carrying capacity. As a result, when the U.S. is replacing the single warhead by an equal weight of multiple warheads, in order to protect each of the multiple warheads from the atmosphere, the amount of explosive material in the aggregate is being decreased to 1/20 of its former value. There are ten small warheads in the aggregate, and each has the effectiveness of 1/200 of the former single warhead. So *even if* decoys and the multiple warheads render the Russian ABM *completely ineffective,* and all ten of these reach their target, the installation of the ABM has reduced the explosive effect of our warhead to 1/20 of its former value. This is as far as fallout is concerned, but even the blast effect is reduced to less than 29 per cent of the original value. The Russians have mostly large warheads, of the 10 MT class, and it would be a great accomplishment to reduce the destructive power of these, by our own ABM, to a similar extent.

As for the danger to the surrounding area by the installation of an ABM, this is chiefly a danger to real estate values. There is no fallout from an exploding ABM. No death has been caused in this country by an accidental explosion of nuclear material. The accidental deaths in this nuclear age have been caused by exploding gas mains, automobiles, and drugs, and similar factors.

Let me now come to the second point, that our ABM will induce the USSR to multiply its forces of attack.

Since the last ABM debate in 1962, when the U.S. decided *against* deployment, the Russians have been almost feverishly building missiles and increasing the effectiveness not only of their military installations but also of their civil defense. Our restraint at that time did not inspire similar restraint on their part. One may suspect that it had the opposite effect. However, I do shudder when contemplating what some opponents of the ABM would say had we done anything to protect our people in 1962. They would blame the Russian buildup of the last few years on our having tried to protect our people in 1962.

Let me make two more points. When Ernest Bevin, British Labor Party Foreign Minister, was to negotiate with the USSR, he said that he did not intend to go naked into such a negotiation. Do we intend to do that by conceding ahead of time what our counterparts desire?

The second point I want to make concerns the instability when the offensive forces are so much stronger than the defensive ones. This gives a tremendous advantage to the one who shoots first, and hence provides a temptation to shoot first. Surely, the situation in which neither party can annihilate the other is better, is more conducive to peace than the one in which both parties can "annihilate" each other.

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