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LIFE AFTER DOOMSDAY

A Survivalist Guide to Nuclear War and Other Major Disasters

Contents

Preface

I ORIGINALLY BEGAN to write this book because I was angry. While studying for my doctorate in ecology I had become interested in the effects that spilled radioactive materials could have on natural and man-made ecosystems. Since I was doing field research in an area liberally sprinkled with Minuteman missile silos, it was not long before my interests expanded to include the ecological consequences of a full scale thermonuclear war.

My concern about these effects naturally led me into contact with a group of disarmament activists, in whose company I visited a SAC bomber and missile base for a tour of the facilities. I also attended a series of meetings sponsored by the group in which they showed anti-nuclear weapons films and presented talks by prominent disarmament speakers. It was during those meetings that I first began to be really alarmed—but not the way you might think.

The basis for my concern was the bumbling incompetence of the disarmament activists. Their stated goal was to draw people into their meetings, educate them about the dangers of the arms race, and eventually initiate a public drive to have the weapons abolished. But the disarmament people I knew were absolutely incapable of motivating the public to follow their banner. The effect of their presentations was only to discredit themselves and encourage the audience to leave early.

How would you feel if you went to a "peace"meeting and were forced to watch films or slides of burned, mutilated, and dismembered human beings? What would be your reaction to a prominent expert who insisted that there was no way you could save yourself—that a nuclear war would utterly destroy mankind? The people I saw at those meetings were sickened, discouraged, and disgusted. They had come because they were mildly interested in "doing something" about nuclear weapons, but they departed with the impression that disarmament activists were masochistic deviates who enjoyed torturing themselves (and others) with images of pain and despair. The audience felt brutalized and repulsed, and reacted with condemnation not for the weapons but for the people who had run the meeting. I have since become convinced that this condition is characteristic of most disarmament groups. It's no wonder that their efforts never get anywhere.

This incompetence was disheartening to me, but I was more concerned by the lack of truthful information in the talks and films. Having read the original research on nuclear weapons effects, I was painfully aware of the distortions and outright lies which the films and speakers were passing off as "the truth about nuclear war." Let me give you some examples.

One speaker who had participated in the design and construction of the first atomic bomb was asked by a member of the audience, "Where can I go to avoid being caught in fallout after an atomic attack?" The speaker replied, "Oh, maybe the north coast of Alaska." From my studies I knew that there are many areas of the United States which stand very little chance of getting any fallout at all, even in the event of an all-out attack on our cities. The speaker was apparently not too interested in the facts.

On a different occasion a speaker was asked, "What would you do right now if the bombs started falling?" He made a gesture of resignation and replied, "What could I do? Nothing.'" This speaker was standing in a seminar room within a well-shielded steel and concrete building of considerable size, complete with two cafeterias, restrooms, a first aid station, a bowling alley, and a bookstore. What could he have done? He could have grabbed a bite to eat, selected a good book, and sat down in safety to wait it out. Somehow that wasn't the impression I got from his answer.

My objections were not entirely local, however. One evening I was listening to a National Public Radio broadcast about the dangers of nuclear war when I heard a supposedly knowledgeable "expert" remark that nuclear war was unthinkable because "the National Academy of Sciences has recently shown that a nuclear war would kill everyone in the northern hemisphere." This remark hit me particularly hard. I had just finished reading the NAS report in question and it had said nothing of the kind. In fact, the report had been harshly criticized because it had not made any such statement. The real NAS conclusion was that there is nothing about a nuclear war which can exterminate the human race.[1] The truth doesn't count in the disarmament debate.

There is no need to lie to people about the effects of a nuclear war. The truth is bad enough. The damage done by making the threat seem worse than it really is cannot be easily dispelled. The exaggerated tales of total annihilation convince people that survival is impossible. This is not true. For most Americans, survival of at least the first few weeks following a nuclear attack is not only possible, it is almost unavoidable. With careful preparation, any family or small group of people can insure its own survival under such conditions and also through the long period of recovery to follow.

I feel that the "survival" message is a much more useful approach to educating people about the dangers of nuclear war than the "disarm or die" approach because it is positive and hopeful. There will be no political solution to the nuclear arms race until the American people make a potent political issue of the matter, and there will be no such mobilization until they can be shown a way to discuss the subject without brutalizing themselves in the process. It is clear (at least to me) that an audience will be much more receptive to a speaker who tells them that they are going to live than they will be to someone who insists that they are all going to die.

There was something else that made me mad enough to write this book. I decided to check into the official disaster preparations provided for us by Uncle Sam. The simplest way to do this was to go down to the local courthouse and interview the county director of civil defense. The fellow was a retired policeman who worked half time covering the paperwork of an office where he officially had nothing to do except "be ready" all the time. In that office I heard a sincere tale of woe.

This man took his job seriously and was very frustrated by the condition of the civil defense system. He told me of "the good old days" when the fallout shelter boom was at its peak and the CD officers had located, labeled, and stocked enough shelters to house half the population of the country, if necessary. Since then, he sighed, funding for civil defense had dropped sharply in each succeeding year. The food and medications stockpiled in the 1960s had been cycled off the shelves and not replaced. Emergency field hospitals and generators had lapsed into disrepair and had been junked. Our city didn't even have any air raid sirens anymore.

Then he told me about the new "crisis relocation plans" which had replaced the shelter plans in most areas. Cities near high-priority targets now had detailed evacuation plans, intended to get the people out of the danger area and into a safe "host community" when international tensions became dangerous. I listened in amazement as he described the monumental task of uprooting hundreds of thousands of people and shipping them from one city to another. He pointed out that the 50,000 refugees destined for our area would find enough "extra" space in local homes and buildings to accommodate them. He was not very confident about being able to feed and medicate the extra people, however, nor was he very enthusiastic about how the locals would react to the imposition.

Then I asked him what he would be able to do for us (and the refugees) if the atomic attack actually took place, destroying the cities the refugees had left and possibly the bulk of civilization too? He thought that one over for a long time and then replied, "Nothing. All I could do would be to go home, get out my personal disaster supplies, take them down in my shelter, and shut the door after me."

I have looked into the national civil defense situation more closely since that time, and it is appalling. The people involved know what to do, but they have virtually no money with which to do it. In fact, a friend in the business recently informed me that President Carter has quietly ended what little civil defense research had been going on. I guess it's not "nice" to think that we might need the information.

The last step in deciding to write this book occurred when I read Mel Tappan's Survival Guns, an encyclopedic tour of the world of survival and combat firearms.[2] Tappan's orientation was toward the needs of "retreaters" and "survivalists." These are people who plan to survive any possible collapse of civilization by becoming self-sufficient for the duration of the disturbance. Many have formed "retreat groups" by banding together and buying rural property which they intend to occupy when life in the cities becomes too dangerous. I had never heard of retreaters or survivalists, but a little research uncovered the fact that there are many thousands of such people throughout the country, with their own newsletters, newspapers, literature, and celebrities. This appeared to me to be an audience which would be interested in how to survive a nuclear war, and who (to judge from survivalist literature) had some fundamental gaps in their knowledge of what they were up against.

I went out and made an effort to meet retreaters and discovered some interesting things. Some survivalists are crazy. Others are simply prudent and want to be sure that their families will be safe in the event of some widespread danger, such as an earthquake, hurricane, economic collapse, or nuclear attack. Survivalists don't have a strong political identity. I have met people from the right, left, and middle of the political road who were making virtually identical survival preparations. I was surprised to find whole factions of the movement motivated by religious reasons (Methodists and Mormons, largely). Some groups were very involved with guns and physical defense; others had no guns and were more in favor of a spiritual defense. Some people are prepared to survive for several years completely cut off from outside help. Most have prepared for one year of self-sufficiency. A few are satisfied with emergency preparations good only for a period of a few weeks. Most survivalists currently have their collective eye on the nation's economy, expecting a collapse any moment. Some are more concerned with racial tensions, or the possibility of famine. (Incidentally, I have used the terms "survivalist" and "retreater" interchangeably in this book, but the reader should be aware that many people don't like to be called "retreaters." They think it sounds cowardly.)

So I joined the retreat movement. I searched through lengthy shelves of government publications, interviewed experts, purchased equipment to test in the field, learned to shoot, hunt, garden, grind grain, bake bread, build fallout shelters, predict fallout patterns, recognize wild food plants, and even went so far as to learn how to be my own doctor (sometimes). When I finished, I called up the publisher of this book and told him what I had in mind. A year later, here it is.

Surviving a nuclear war, or any catastrophe, requires a little luck. That is inescapable. With effort, preparation, and foresight, the amount of luck required becomes small, however. There are no insurmountable obstacles. I know this for a fact. I have actively sought out the truth behind the rumors, questioned the experts, brought my own scientific training to bear on evaluating their conclusions, and I know that the nightmare of total annihilation is nothing more than a figure of speech. An overworked figure of speech.

Nuclear war will be the greatest social and biological catastrophe our world has ever known. It will be unprecedented, but it will not be difficult to survive it. All you have to do is make an effort to understand the problems it will pose for you, and then systematically eliminate them one at a time. It can be done. This book tells you how.

And if in the course of reading you should happen to learn a little bit more about the threat which nuclear weapons pose to us, and if you should happen to listen a little more critically to the words of our politicians, and if you eventually contribute in some way to eliminating the problem . . . that would be all right with me, too.

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Notes

1. "Long-term Worldwide Effects of Multiple Nuclear Weapons Detonations," a report of the National Academy of Sciences, 1975.
2. Mel Tappan, Survival Guns (Rogue River, Oregon: The Janus Press, 1976-77).

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If s a Disaster!

I HAVE DESIGNED Life after Doomsday as a comprehensive survival manual intended to give a family or small group of people the information necessary to prepare for and survive a major disaster with a minimum of discomfort. Although my main thrust is toward surviving a full-scale thermonuclear war, I have considered many other disasters, both natural and man-made, and have provided for them in the survival plans. Whether your main concern lies with famine, disease, natural catastrophes, political disruption, economic collapse, or the slow and inevitable depletion of our natural resources, you will find the survival information you need within these pages.

When discussing the subject of do-it-yourself civil defense preparation, I have often been asked questions like "But what are you afraid of?" or, "Isn't it a little paranoid to be stockpiling food and things?" I have never known quite how to answer these questions. It seems to me that there are people who see the world as a somewhat risky place, and then there are others who just can't see any risks at all. I tend to regard the latter group as color-blind to danger—perhaps "danger-blind" would be the best term to describe them. The risks we take simply by living in the United States during the twentieth century are real and ever-present, and I don't think it's paranoid to recognize them. My attitude is that there is a little danger in everything we do and it is reasonable to take precautions to minimize our risks. The alternative is to assume you are safe until circumstances prove you wrong. 1 just can't go along with that policy.

But paranoid or not, the question "What are you afraid of?" is one that really should be answered. If you are considering taking steps to see that you, your family, and perhaps a small circle of friends will be able to survive some kind of danger, it is reasonable to wonder just what kind of catastrophe concerns you. This chapter is a brief summary of the possible troubles which an American might have to face within the next few years. It is intended as a complete listing, a sort of whirlwind tour of the worst nightmares of mankind. Several of these disasters are virtually certain to happen, others are very unlikely, and a few might even be impossible. Most would be temporary problems which would force you to depend on your own resources for a few weeks at most. One or two of the others, however, could shatter Western civilization completely.

All of these crises are survivable in comfort and security. It takes time, effort, and the expenditure of some money, but the result is well worth the investment. The result is saving your life.

Famine

Starvation is an old companion of mankind. To those of us who have never been hungry except when dieting, the idea of wanting food and not being able to get any is hard to imagine. But it has happened, and under certain circumstances it could happen to us today in America. Simply because we do not fear hunger does not mean we will never be hungry.

There are numerous examples of crop failures in history; these are usually due to severe weather or fungal plant diseases. Before the 1880s there were no effective fungicide treatments, and the airborne spores of food-destroying blights sometimes laid waste to the crops of entire countries—even continents. Crop failures were common, and famine frequently followed.

The best known example of such a crop failure was the potato murrain of Ireland, which struck in the 1840s. The Irish peasants were dependent on the potato for food, with each family eating about thirty-two pounds of potatoes each day. The potatoes and a little pepper water made up their entire diet. Then, in 1846, a new disease struck without warning. A contemporary witness wrote:

> On July 27th ... I passed from Cork to Dublin, and this doomed plant bloomed with all the luxuriance of an abundant harvest. Returning on August 3rd, I beheld with sorrow one wide waste of putrifying vegetation. In many places the wretched people were seated on the fences of their decaying gardens, wringing their hands and wailing bitterly at the destruction which had left them foodless.[1]

The result was an exodus of people from Ireland, where those too poor or too weak to leave tried to sustain themselves on unfamiliar natural foods which were soon exhausted. Millions died.

When a new disease of wheat appeared in India during World War II, the wheat crop was so severely reduced that many Indian peasants starved. India's grain reserves would have been adequate to meet the demand, but a combination of government bungling and private greed raised the price of grain so high that the food was unavailable to the common person. Unable to grow food and unable to buy it, the peasants simply died.[2]

In the United States, crop failure due to infectious disease has not been common, but it has occurred. In 1946, for example, another new grain disease appeared. This one, called "crown rust," appeared in oat fields from Texas to New York and from Florida to Idaho, producing a severe reduction in the oat crop of that year. As recently as 1970, a totally new strain of fungus appeared and threatened to destroy the American corn crop. We were fairly lucky that time because it happened to be a dry year, unfavorable to a fungus, and only 15 percent of the crop was lost. The discovery that the entire corn crop, coast to coast, had no resistance to the new disease was very disturbing, however. Changes in corn genetics were quickly made, steps toward chemical control of the disease were taken, and the situation was rapidly brought under control.[3]

What would happen if a new disease should break out and destroy a major American crop in the next few years? It isn't likely that we will starve because we have a diverse economy based on a wide variety of grain and feed crops, not to mention table vegetables and fruits. That does not mean that we would not suffer in any way, however. If the corn crop had actually failed in 1970, the price of feed grain for poultry and livestock would have risen out of sight. Food prices would have followed. The impact on the economy would have been very serious, increasing inflation and upsetting the international balance of trade. Only if the new disease appeared in conjunction with poor weather would we be in actual danger of shortages.

What about bad weather as a cause of crop failures? You've probably heard that some people think the next ice age is coming, and all kinds of dire predictions have been made concerning this over the last few years. I think we can safely ignore ice ages, but there are other possibilities which leave me feeling a little uneasy. One of these was described in a CIA report issued recently which pointed out that our entire agricultural science is based on the kind of weather we have had over the past thirty years.[4] The report also pointed out that the last thirty years have been a very unusual period of good growing weather, the best since the Middle Ages. Therefore, all of our agricultural techniques are based on weather conditions which are not normal and which could revert to more typical weather at any time. I examined the evidence behind this conclusion and found it pretty disturbing.

The weather during 1976, the year following the CIA report, seemed to bear out investigators' predictions of poor farming weather and severe variations in rainfall.[5] California had been suffering from a drought during the preceding year, and there was some optimism in February when rain and snow storms arrived in the Los Angeles area. It turned out that the worst drought in seventy years was destined to go on a little longer, unfortunately. Later, Oklahoma received 1/3 inch of rain, and the governor called on the entire state to pray for more. They were having a drought of their own.

In March, the farmers of Wisconsin had a little too much rain, accompanied by high winds, storms, and flooding. At the same time, a government study showed that, due to prolonged drought, wind erosion in the Great Plains had spread over the largest area in twenty years.

June brought floods in Georgia, Texas, and South Dakota. Part of Georgia was declared a disaster area because of flooding, as were areas of South Dakota that suffered from flooding and mudslides. The Texas incident involved 7 1/2 to 12 inches of rain that fell in Houston in twenty-four hours; this was more than the city's storm drains could carry away.

In July, the Kansas-Missouri border area relived the Houston experience with a twelve-inch downpour overnight, after which the National Guard and Civil Defense authorities evacuated 1,000 residents of flooded farm counties. A week later, severe thunderstorms hit Buffalo and Rochester, New York, knocking out utilities and flooding homes. California's record-breaking drought continued to destroy crops and livestock.

In August, while heavy rains were flooding Miami, Florida, the governor of Nebraska declared over half of his state to be an official disaster area. It still hadn't had any rain. Neither had North Carolina, where the city of Raleigh banned all unnecessary use of water to conserve enough for drinking. A sudden September shower in Palm Desert, California, produced a flash flood that damaged 100 homes. October brought floods and a state of emergency to Pennsylvania, while Oregon was seeding clouds for rain. The overall picture is certainly not one of even, reliable agricultural weather.

Don't think that weather doesn't change. It does. Sunny southern California was a hurricane coast as recently as the early 1800s, for instance.[6] It looks like our world population, which has grown by 50 percent over the last thirty years, may soon have to subsist on food grown in droughty summers punctuated by abrupt downpours and unpredictably early snowfalls. When you hear people complain about poor crops, remember the CIA report.

Famine does not have to be only the result of crop failure, however. Food shipments could be halted very easily in our country if truck and rail transportation were interrupted for any reason. If the trucks don't arrive, the supermarkets don't have any food to sell. Floods, winter storms, prolonged labor strikes, and high inflation can produce starvation even When the fields (or warehouses) are full of food.

The Indian grain famine of the 1940s, when food was too expensive to buy, is one example of this kind of emergency. Another is provided by the 25 million Russians who starved to death in the 1920s, following the end of World War I and the Bolshevik Revolution. Although the country was suffering from years of war and revolution, there was still a little grain in the warehouses. Unfortunately, it was doled out to only a few. Workers received full rations, but formerly upper or middle class families received almost nothing. An eyewitness in 1919 wrote:

> I met a woman and child, ragged and thin as skeletons, the child crying constantly with an unchanging expression of terror. The mother said that the child was hungry, and asked for a piece of bread, as they had not eaten in twenty-four hours. I opened my purse, but the woman turned away saying, "No, not money, but bread."
>
> I have seen children, hardly clothed, hollow cheeked and with forms like shadows, on their knees in the street trying to pick from between the paving stones grains of wheat that had fallen from a torn sack. I have seen before bakeries men, women, and children stretched on the cold stones, awaiting through days and nights their turn to eat their meager ration of bread and then often falling exhausted and dying at the doorstep before they receive it.[7]

As the famine worsened, people fled from the cities to live with relatives in the country. Of those who stayed in Petrograd (because they had nowhere to go), over 40,000 died the following October when winter set in. Overall, the population of the city fell from 2.5 million to 300,000.

What would you do if the cupboards were bare, the stores were empty, and there was a long winter ahead?

Epidemic Disease

Disease is another old enemy of our species and has played a very large part in our history. As modern Americans, many of us have never seen a friend or relative die of an infectious disease, and we tend to think that modern medicine can cure anything. It isn't true, and of all the biological threats to civilization, the danger of pestilence is one of the most real and frightening.[8]

There are many diseases to which humans are vulnerable. Cholera and smallpox have been two of the worst in the history of our country, but for the sake of discussion plague and Lassa fever will be described. Plague is one of the oldest diseases of man, and Lassa fever is one of the newest. Each tells us something about our vulnerability.

Plague is a disease of mammals, usually wild and domestic rodents, but includes humans in some circumstances. It has been known and feared since the third century, and three major pandemics have occurred. The first took place in the sixth century and killed an estimated 100 million people in Europe and Asia. The second, which killed 75 million, happened in the fourteenth century and is remembered as the "Black Death" because of skin discoloration suffered by the victims. Fifty million people died in Europe alone, which was about one quarter of the entire population. (Imagine the calamity if every family of four in your neighborhood lost one member to a disease.) The third pandemic began in China in 1894 and spread to the United States by 1900. Casualties were not severe, but the disease is still with us—waiting quietly in the rodent population of the Southwest.

In the United States, plague is known to be present in California, Oregon, Washington, Utah, Idaho, Nevada, New Mexico, Texas, Louisiana, Florida, Michigan, Arizona, Colorado, Montana, Wyoming, Kansas, North Dakota, and Hawaii, as well as areas in Mexico and Canada. It is carried by wild rats, ground squirrels, mice, marmots, owls (which eat rodents), gophers, badgers, rabbits, prairie dogs, and chipmunks. Ticks, lice, and bedbugs occasionally serve as carriers from the animals to humans, but usually the disease is transmitted from a wild rodent to a domestic rat, from the rat to a flea, and from the flea to a human victim.

The victim feels fine for two to four days after being bitten and then quickly gets very sick with chills, fever, headache, vomiting, delirium and other unlovely symptoms. Untreated, the disease is 50 to 90 percent fatal, death occurring within a week of the first symptoms. The only good thing about it is that the person who has been bitten by the flea will probably not infect anyone else, unless all are sharing fleas and lice.

Unfortunately, about 5 percent of the sufferers develop lesions in their lungs, and soon they begin to cough plague germs into the air. Anyone who inhales these germs is virtually doomed. The new victim soon begins to cough, too, and the plague can then spread from person to person like wildfire. Without immediate treatment with antibiotics, a victim of airborne plague has only one to five days to live. It is always fatal.[9]

Could an epidemic of plague get started in the United States in this antiseptic age? It would not be surprising to hear that five people had died of this disease in far-away Madagascar in June, 1976. After all, those primitive tropical republics don't have the medical facilities we do, and their grasp of sanitation is almost nonexistent. It's more disturbing to realize that in the same month a twenty-two year old woman was diagnosed as a plague victim in Colorado, and a twelve year old boy developed the disease in New Mexico.[10] That spring saw our worst series of bubonic plague cases in recent years, with eleven victims and two deaths spread over six western states. In 1976, there were a total of sixteen plague cases in the United States, followed by fifteen cases in 1977. One episode involved the development of plague pneumonia (the contagious form) in three widely separated victims, in California, New Mexico, and Arizona. Only one of them recovered. Fortunately, these patients lived in areas of low population density where the spread of the disease could be halted easily. Under the circumstances, though, one can't help but wonder how long it will be before an illegal alien with a fleabite sneaks into the barrios of Los Angeles and then refuses to see a doctor when the coughing and fever set in. He'll cough, his friends will cough, their friends will cough.... It would not take much to start an epidemic, and even a few cases could cause a serious panic. The Black Death is more than a disease; it is a legend. People run from it in terror, and in so doing spread the disease wherever they go.

You have probably heard of plague, but what about Lassa fever? This was a completely new and unknown disease that first appeared in Nigeria in 1969 and which eventually killed over two-thirds of the people who caught it. The first known case was a missionary nurse who died within ten days of getting sick. The next case was a second nurse who had cared for the first one during her illness. Then another nurse died, then members of the hospital staff, then the doctors, then visitors. A victim was flown from Nigeria to New York so the disease could be studied and identified. Soon two scientists at the Yale arbovirus research laboratory were sick. One of these workers had not been exposed to the disease specimens at all. When he died, all work was stopped at once. The disease was too dangerous to study.

The one-third of the patients who survived did so only with the help of elaborate modern medical support devices. They recovered only slowly, suffering from nerve damage and extreme debilitation. The first survivor lost twenty-eight pounds in three weeks before her condition stabilized. Untreated victims all died.

It's frightening to think that new deadly diseases can arise for which medical science has no treatment, but to me the really chilling part of this story is that a patient sick with an unknown and extremely dangerous disease was casually put on board a jet flight full of tourists, who were all exposed and who subsequently scattered all over the country. During the outbreak of the disease in Nigeria, missionaries, Peace Corps personnel, and tourists were traveling in and out of the area constantly. Lassa fever didn't turn out to be routinely infectious, since the viral particles had to be passed from one person to another through body fluids such as blood or urine, but occasional patients who project virus-laden drops of mucus during coughing are not unknown. Except for the comparative rarity of these infectious cases, Lassa fever might have provided us with a lesson in epidemic disease which we would have remembered for a long time."

The danger has not passed, however. In March of 1976, another Lassa fever victim passed through Dulles airport in Washington, DC, exposing 300 fellow travelers who rode the same jumbo jet across the Atlantic.[12] Public health officials scattered to seventeen states to locate and examine these potential victims. All turned out to be well. In August, yet another case appeared, this time in Toronto, where health authorities closed the hospital and quarantined it until they could be sure that the patient was no longer contagious. Eleven people were found who had been in contact with this patient, and some of them were discovered just as they were beginning to get sick. The pattern was repeated in May of 1977, when an English air traveler came down with the disease shortly after returning to London from Africa. Again the search for fellow air travelers was undertaken, made more difficult this time by the fact that they had scattered to various countries, not just to different portions of one country. The dimension that modern air travel adds to epidemic disease is that a serious outbreak in one country can spread all over the world in days or weeks. It's a very alarming thought.

There is a serious danger of the United States suffering an epidemic of a more familiar disease sometime soon. Public health officials report that less than two-thirds of today's school children have been immunized against the common childhood diseases of polio, diphtheria, measles, pertussus, and mumps. Young parents, and to some extent young doctors, have never seen a polio epidemic and tend to think that such diseases are things of the past. Epidemics aren't things of the past. We only have to wait long enough to see all that suffering take place again.[13]

Would you know what to do if a life-threatening disease spread into your community?

Natural Catastrophes

Mother Nature occasionally produces phenomena which put us at a temporary disadvantage by interrupting utilities and medical services, and by hindering transportation. From time to time citizens of quiet, comfortable communities find themselves thrown on their own resources for a matter of days or weeks before life returns to normal patterns. These traumas do not normally threaten civilizations, but they do threaten lives. And they seem to happen all the time.

I had an experience recently which illustrates the power of winter storms and blizzards. As part of a business trip to Washington, DC, I had a brief layover in New York. I was sitting in Kennedy International Airport on a Thursday night waiting for my flight when it began to snow outside; in the space of an hour, about six inches of snow accumulated. Two hours later, when the plane was scheduled to leave, there was over a foot of snow on the ground and it was still coming down. Forty-mile-per-hour winds were preventing the ground service crews from clearing the runways and de-icing the planes. Naturally the airport had to be closed.

I spent two full days sitting in that terminal because the storm didn't let up. The snow became so deep that it was impossible to leave by any means. No buses or trains were running, and the few taxis willing to brave the six-foot drifts were charging hundreds of dollars for a ride into the city. Although the airline provided us with meal tickets to the cafeteria in the building, the three or four hundred of us trapped in the terminal had to shift for ourselves when it came to anything else. I talked the gate agents into raiding the parked airplanes for blankets and pillows after seeing too many cold children lying huddled together on plastic airport furniture or on ice-cold marble floors. The experience gave me a lot of time to think about survival preparation during large-scale emergencies. Fortunately the delay was only forty-eight hours, because I had developed two large, raw skin infections that almost covered my shins, and there was no way for me to get to a doctor until the snow had been cleared away. It made me wonder what I would have done if there had been no doctor to turn to at all.

Later, I went over the newspaper accounts of the storm and learned that the snowfall had been the heaviest in nine years and had caused the collapse of numerous roofs, including a supermarket and a 3,500-seat auditorium. Some neighborhoods were still snowbound the following Monday. One hospital ran out of supplies and food as early as Sunday morning, only three days after the trucks stopped running. Hospital staff members hiked through the drifts to purchase food for the patients. They said people gave them odd looks when they bought grocery baskets full of bread. I suppose they did.[14]

Summer storms, too, can threaten human life and property. The tornadoes of the Midwestern states kill an average of 100 people each year, striking with unbelievable frequency from Colorado to Carolina, and from the Gulf Coast well past the Canadian border. Throughout this region an average-sized county (about fifty miles square) receives a tornado every year or two, and in central Oklahoma this average rises as high as .3 to 4 twisters each year. (See figure 11 for an illustration of tornado frequency in the United States.) Occasionally, flurries of tornadoes strike the Midwest with devastating results. The estimated 100 tornadoes that swept through Georgia, Alabama, North Carolina, Tennessee, Virginia, West Virginia, Kentucky, Ohio, Indiana, Illinois, Michigan and Ontario during eight hours on the night of April 2, 1974, represent one of the worst of these disasters. These tornadoes killed 324 people and severely damaged scores of communities, leaving thousands of people homeless. Xenia, Ohio, a town of 25,000, was hit particularly hard, with half of its homes destroyed. Fortunately, there had been sufficient warning for the inhabitants to take shelter in basements, and only 30 were killed.

A similar rash of tornadoes occurred on April 11, 1965, when forty-seven funnels killed a total of 257 people in Indiana, Ohio, Michigan, Wisconsin, and Illinois. The greatest single disaster caused by a tornado was the result of a single twister that ravaged Missouri, Illinois, and Indiana in 1925. It took 689 lives. Since that time, there have been eleven tornadoes which have each taken over 100 lives; six killed more than 200. All caused massive destruction of homes, utilities, and communications.[15]

Hurricanes are another natural disaster to which millions of Americans are subject each year. The frequency of hurricanes varies, but on the average one passes over some section of the United States every year. Between 1900 and 1969, these storms killed a total of 12,000 Americans—about 174 per year. Hurricanes bring with them winds as high as 200 miles per hour, torrential rains, high tides and heavy seas, and can threaten life and property over areas hundreds of miles wide.

One of the worst hurricanes of recent years was hurricane Camille of 1969. Camille came in from the Carribean over the Mississippi coast towns of Gulf Port, Biloxi, Bay St. Louis, and Pass Christian; these towns were subjected to winds in excess of 205 miles per hour. Every house suffered damage, and in Bay St. Louis half the main business section of town simply disappeared into the sea. One hundred thousand people were evacuated from the coastal area of Mississippi and Louisiana, but the storm soon raged inland up the Mississippi valley into unprepared states. Within twenty-four hours, it had turned to the east. Three days after first crossing the coast, Camille passed over Virginia and out into the Atlantic. In its wake were hundreds of dead and hundreds of thousands left without homes. As a last gesture, Camille dumped ten inches of rain on Richmond, Virginia in one cloudburst, drowning at least 75 people (111 were missing).[16]

Flash floods, of course, do not require hurricanes in order to take place. Small flash floods are really quite common, so much so that we tend to ignore them. Larger floods occur more rarely, and we ignore them so successfully that many people living in the path of floodwaters don't even realize it.

For instance, there was a time during this century when most of the Los Angeles basin was under water. Between February 18 and 24, 1914, over nineteen inches of rain fell in the San Gabriel mountains north of Los Angeles, and since the ground was already saturated by previous rain storms, the entire deluge ran off into the Los Angeles and San Gabriel rivers. These rivers are dry most of the year, but that February they suddenly began to flow with a volume equivalent to the Colorado River at full flood. Other canyon streams contributed almost as much water. On the 19th, the streets of Los Angeles were beneath two feet of water and the city had been cut off from outside aid. On the 20th, hundreds of acres of Orange County were under water, and Long Beach had become an island. The entire area between the present civic center and San Pedro harbor was submerged. Telegraph lines were washed out, as well as bridges, roads, public utilities, and countless orange groves. Santa Barbara was cut off and isolated. Flood waters in the mountains destroyed so many bridges that passenger trains became trapped on mountain grades, unable to advance or retreat because of washed out tracks.[17]

The actual toll in lives after the waters receded was fairly small, due mainly to the fact that most of the inundated area was devoted to citrus farming. If such a flood were to take place today, the price would be much higher because those former orchards are now a megalopolis of suburban housing tracts. Virtually none of these people know about the 1914 flood. The fact that California's prolonged drought has at last ended in the equivalent of two years' worth of rain in the space of three months underlines the ever-present possibility of a recurrence. Even the best flood-control efforts sometime succumb to floods so bad they only occur once in a century.

Since we're discussing the perils of life in southern California, it's appropriate at this point to shift to the subject of wildfire. Forest fires and grass fires can be natural disasters anywhere in the country, but the explosive vegetation of the California foothills is particularly dangerous. The chaparral brushlands are plant communities that seem to actually encourage holocaust fires. Naturally, thousands of Californians have built expensive houses on chaparral-covered hills.

Having conducted field research on fire history in chaparral, I once made myself unpopular while visiting friends by saying that I wouldn't want to live where they did, in spite of the beautiful view from their brushy hillside lot. A few months later the Santa Barbara fire of June, 1977 destroyed their house along with 185 others. They had seen the fire coming but had barely had time to pack their most valued possessions into the car before the flames got too close. Then they couldn't find the car keys. There was no time to search. They got away with their lives and were pleased to have saved that much. They were fortunate that there was a road leading away from the fire; in many rural residential areas the roads lead up the canyons and stop in a dead end. When a fire comes up the canyon there is no place to go.[18]

The subject of wildfire leads naturally to a related topic—that of volcanic eruptions. You probably don't think you are in any danger from a volcano, and unless you live in Alaska, Washington, Oregon, California or Hawaii, you are right. Unfortunately, a large volcanic eruption can have effects on the weather that might one day make us all feel a little insecure. Major volcanic eruptions such as that of Krakatoa, Java in 1883, or Mt. Tambora, Indonesia in 1815 can inject incredible amounts of dust into the atmosphere, reducing the amount of sunlight reaching the earth's surface by as much as 20 percent. The effect lasts only one to three years, but in the meantime a world-wide drop in temperature can take place. The Mt. Tambora eruption pulverized six cubic miles of rock and injected the resulting dust high into the atmosphere. It produced actual famines in Europe and North America by causing repeated blizzards and hard frosts throughout the summer of 1816. Crops were very scarce that year. Four similar, but smaller, eruptions have taken place within the last century.[19]

Of course, if you do happen to live near an active volcano, you are certainly aware of the problems it is capable of presenting to you: molten lava, heavy rains, volcanic ash which can pile up and turn to thick mud when the rain hits it, the rock "bombs" which fall out of the air, the poisonous and sometimes superheated gases, and, lastly, the earthquakes which accompany volcanic activity. I visited Hawaiian Volcanoes National Park in 1971 a few days after an eruption and walked around on a still-hot lava flow that had cut off the island's main coastal highway, forming an absolutely impassable roadblock. It was very impressive. The barrier was too hot to bulldoze or blast, too insecure to build a road over, and too big to go around. Islanders were lucky they had another highway paralleling the coast a few miles inland. On another occasion, I visited the ruins of Pompeii, Italy, the town buried for centuries under millions of tons of volcanic ash until its excavation by modern archaeologists. The ruins were dominated by nearby Mt. Vesuvius. If you really want a survival nightmare, getting caught in a volcanic eruption is one of the worst.[20]

What about earthquakes? It is commonly thought that if you don't live on the west coast you are pretty safe from earthquakes. It is true that (as of March 17, 1976) the United States Geological Survey has officially notified the governor of California that a major earthquake equivalent to the San Francisco quake of 1906 is expected to hit southern California sometime within the next few years. Earthquake prediction has reached the point where geologists can predict a tremor, but cannot yet define the exact time when it will strike. Recently, an earthquake in China was successfully predicted to within twelve hours, but in the United States the ability to make such predictions is not that advanced.[21] (We aren't world leaders in everything.)

The fact remains that most of the United States is earthquake country, and only about 10 percent of us can rest easy that we are safe from this source of trouble. People outside of the areas of high seismic activity are really in the most danger, because their local building codes are not designed to produce quake-resistant housing. As an example of a Midwestern earthquake, consider the 1811 tremor near New Madrid, Missouri, which was so violent that it caused 200 square miles of forest to sink below the level of the Mississippi River, forming extensive lakes such as Reelfoot Lake in northwestern Tennessee. On the east coast there was the quake which destroyed Charleston, South Carolina in 1886. It was felt in every state east of the Mississippi.

Earthquakes in coastal areas sometimes generate tsunamis, the seismic sea waves mistakenly called "tidal waves." Unless you live on the coast of a large body of water, you don't need to worry about them. But if you do live in such an area, tsunamis are worth considering. The Hawaiian Islands, for instance, have been hit by the giant waves thirty times—since they were first discovered by Captain Cook in 1778. Following the Unimak, Alaska earthquake of 1946, seismic sea waves crossed 2,240 miles of ocean to Hawaii in just four and a half hours. The waves rose to crests as high as 54 feet when they reached Hawaiian beaches.[22] The largest tsunami known all but destroyed the Minoan civilization in the Mediterranean in 1470 BC, crashing into port cities as a wall of water 165 feet high. Archeologists have established the size of the wave from the distribution of buried wreckage on the old city sites.[23]

Natural catastrophes are a pervasive and continual worry to emergency planners because these crises can strike anywhere, at any time of the year, and can have results which vary from minor inconvenience to major disaster. Would your family be prepared to survive two or three weeks without utilities, food, medical help, or transportation? Would you be able to leave your home on a moment's notice to flee a fire, hurricane, flood, or tornado, and then live on your own resources for days or weeks, perhaps using only what you were able to take with you? These possibilities are not just bad dreams. They can happen to anyone, at any time, anywhere. They could happen to you.

Religious Catastrophe

A large number of survivalists, perhaps the majority, have become interested in emergency preparedness for religious reasons. The most obvious example is the Mormons, among whom many thousands of families now each have a year's supply of food stored away. Church leaders have adopted crisis preparation as an official policy, even to the extent of using church funds to build granaries large enough to feed one-third of the membership through a full year of famine. Their reason, as explained to me by a friend who is a Mormon bishop, is simply that there seems to be a time of hardship in every life and it is sensible to prepare for it. "We take care of our own," he explained.

A second group of survivalists with a religious motivation is Jim McKeever's branch of "born again" Christians. McKeever is one of the pillars of the retreat movement who has successfully combined a knowledge of economics with "the Word of God." If you want to see a carefully argued religious rationale for joining the survivalists, read McKeever's Christians Will Go through the Tribulation . . . And How to Prepare for It.[24] The basic theme is that the Scriptures warn of a catastrophic period of tribulation involving famine, earthquakes, economic collapse, and possibly nuclear war, and that this time is near. The book also stresses preparation and gives particularly good advice on monetary collapse and earthquake preparedness. Even if you aren't religious, the practical advice provided in this book is very worthwhile.

Actually the "religious catastrophe" I referred to in the heading for this section is not a supernatural event, but is rather a sociological one. Looking back on the fundamentalists' attempt to dominate the government (remember prohibition) and their attempt to subjugate the sciences (the Scopes monkey trial), I get very uncomfortable at the thought of an extreme religious group gaining political power. This could easily happen in the aftermath of a national disaster such as a nuclear war. Religious intolerance has been a leading feature of human history, and zealots have a tendency to be very casual with the lives, rights, and property of unbelievers.

Some people prepare for disaster because of the fears shared by their religious group. Others prepare because they fear religious groups. Do you fall into either category?

Depletion of Natural Resources

As an ecologist, I have a great respect for the role of natural resources—their conservation has been a concern of biologists for many years. The recent scare over the "energy crisis" has brought this subject into the open, and many people feel that we are on the threshold of imminent disaster. Others are convinced that the whole crisis is a con game staged by the oil companies to raise prices. Both could be right.

The underlying fact is that the depletion of natural resources is a proven civilization-killer. We tend to forget that ours is not the first major civilization to flourish on the earth; most people have never even heard of all the minor civilizations that have existed. These last were mainly agricultural civilizations which toppled to disaster when poor farming practices finally destroyed the fertile farm lands which fed the cities.

Take Iraq, for example, an area which today supports barely one-quarter of the population which it had 4,000 years ago. The area depended on an elaborate irrigation system which was continually being choked with silt, the product of runaway erosion in the nearby highlands. When foreign armies conquered the area and freed the slaves, who kept the canals clear, farming became impossible and the civilization collapsed. A similar process of resource depletion occurred in Syria, Lebanon, Israel, Tunisia, Algeria, Spain, Italy, Sicily, Yugoslavia, Greece, Crete, and Turkey, all of which now support less than half of the population they once had.[25]

The primary fear we entertain today is that our "slaves" (machines) may be about to run out of "food" (oil) and our intricate civilization will come sputtering to a stop. There are lots of arguments about this, with wide differences of opinion about when the oil will run out, how fast we are using it up, and how much unknown oil remains hidden in the earth's crust. It really doesn't matter. No one argues that the oil will not, in fact, run out sooner or later. It will. Certainly no one disputes that the Arabs, who have the largest reserves left in the world, are capable of rationing our supply or cutting it off if they like. They already have. And as for the United States' policy of developing the north slope of Alaska as quickly as possible in order to become energy "self-sufficient," that's like noticing that the gas tank is nearly empty and flooring the accelerator so you can get to a service station before you run out. It's not very smart.

Ours is not the first energy crisis. There was a previous one in Britain in the sixteenth century. At that time, wood was the main fuel for domestic and industrial uses as well as the primary source of building material. By the seventeenth century, the English forests had been depleted to the extent that a common joke was that Judas could never have found a tree to hang himself in Britain. Over the space of a century and a half, a shift from wood to coal gradually took place, an event which eventually led to the beginning of the industrial revolution. The transition was completed without any serious difficulties by a natural evolution of technology to meet the demands of society.[26]

The danger of our energy crisis is that during the period when we are in transition from oil to some other energy source, there could be some difficult times. Our agriculture requires not only gasoline to run the equipment, but oil-based fertilizers and insecticides as well. Without them, even for one year, we could not feed ourselves. Depending on how wisely the changeover to new energy sources is handled, the transformation could be either simple and painless or a series of emergencies. Time will tell.

Man-made Catastrophes

Human beings, in their impetuous need to build bigger and better things, have managed to create bigger and better kinds of disasters as time has gone by. We still can't match the sheer massiveness of a hurricane or earthquake, but in our own small way we have managed to utterly destroy a city or two and hundreds of small towns over the years. The greatest tragedy is that many of these occurrences could have been avoided or recognized in time for early evacuation. Too often they just happened, and days later, while searching through the wreckage, people asked one another how it was possible.

The San Francisco earthquake of 1906 is an example of a disaster that was at least partly man-made. For some time prior to the event, the local fire chief had insisted to the city council that San Francisco was inadequately protected against fire. For one thing, the water mains all crossed the San Andreas fault, and no provision had been made for the possibility that they would break in an earthquake and leave the city without water. His pleas fell on deaf ears, and in the hours following the quake the city burned to the ground. A large community of wooden houses without fire protection is just a time bomb. The homes in the chaparral of California fall into this category.

The problem of unsafe dams has also come to the public's attention several times over the last few years. The concern began on February 18, 1972, when a makeshift dam across Buffalo Creek, West Virginia overflowed and then failed, releasing a sixty-foot high wall of muddy water which partially (and in some cases, wholly) destroyed fourteen communities of coal miners. The dam failure killed 60 people and left 5,000 homeless. Just before the dam let go, a policeman tried to warn the residents in the valley below, but few of them listened. Those who left for high ground immediately were still alive the next day even though their houses and belongings were completely swept away. It turned out that the "dam" had really been an overgrown pile of coal mining waste that had just happened to block the stream and form a lake. The danger of flood was recognized by the locals, but no steps had been taken to prevent a disaster. They knew it had to be dangerous because the same dam had burst once before in 1966.

In June of the same year, a second dam gave way. This one was in Rapid City, North Dakota, where heavy rains and flooding were suddenly compounded by an earthen dam which failed and sent a raging torrent through the center of town. The flood left 155 dead, 500 missing, and 5,000 homeless, in spite of the fact that radio warnings had been given predicting that the dam would not hold for long.

The result of these two incidents was the enactment of the federal Dam Safety Act of 1972, which provided that the Corps of Engineers would begin a routine series of inspections of the nation's 28,000 unregulated dams to prevent a recurrence of the 1972 disasters. A few dams were specifically exempted from inspection, such as the 500 dams operated by the Bureau of Reclamation. The Bureau had its own inspection program, and there was no need to duplicate the effort.

It was about this time that plans were being made for the construction of a large Bureau of Reclamation dam in Rexburg, Idaho. In spite of opposition by environmentalists and hazard geologists, who said the dam was being built on a fault and would therefore be unsafe, construction went ahead and the Teton Dam was completed in early 1976. In June, as the dam was filling for the first time, a small leak developed under the base of the dam. Soon a section of the dam gave way, and the pent-up waters raced down the valley, eventually causing eleven deaths and forcing 30,000 people in the upper Snake River valley to run for their lives. The subsequent inquiry showed that the Bureau had not heeded the warnings of outside geologists in the selection of the dam site, and that there was "human error" involved in the construction of the dam itself. Of course, the dam had been inspected and declared safe—another error. As a Bureau project, the Teton Dam had not been covered by the Dam Safety Act, but following its failure, someone checked up on the 28,000 dams that were covered to see how many of them had been inspected since the law was passed in 1972. Zero.[27]

As this chapter was being written, a source of danger to the average American was brought to my attention which I had not seriously considered before. In February of 1978, three train wrecks in the southeast portion of the country centered public and Congressional attention on the transportation of hazardous chemicals by rail. One freight train derailed near Waverly, Tennessee because a handbrake had accidentally been left on. The train included two tank cars of liquid propane gas, a highly explosive fuel. While attempting to empty one of the damaged cars, eleven people were killed and scores injured when the volatile gases ignited and the tanker exploded. Shortly afterward, a second train derailed, this time near Youngstown, Florida. The derailment was caused by sabotage (somebody removed a rail) and resulted in the rupture of a tank car full of chlorine, the gas used in World War I as a chemical weapon. The cloud of green gas drifted over a nearby highway, where motorists driving into it discovered that not only was it impossible to breathe, but that their car motors stopped dead. Eight people died and 67 were hospitalized. The saboteur was one of the casualties. Within a week there was another derailment, this one purely by accident in Cades, Tennessee. This time it was a car full of sodium hydroxide which leaked, forcing the evacuation of 150 nearby residents.[28]

The rapid succession of these accidents brought them to national attention for a few days, after which they faded from the news again. Since there had been two similar incidents within a few miles of my home over the last few years, I became interested in just how often these train wrecks and chemical spills actually occur. The facts are enough to make anyone who lives near a railroad track nervous.

For starters, in 1977 there were 7,858 train derailments in the United States, an average of 157 per state. Relatively few of these involved dangerous chemicals, but the list of serious incidents is still pretty long. In January, 1,000 Dover, New Hampshire residents fled from an overturned propane car. Three hundred people were evacuated from their homes in Hanover, Ohio, following the derailment and explosion of a car full of vinyl chloride. In February, two square miles of Dallas, Texas were evacuated following the explosion of three propane tankers. Another propane car derailment and explosion happened in March, in Wenden, Arizona. A small area in Delphi, Indiana was cleared when a train carrying high explosives hit a truck at a crossing and derailed. At Inverness, Florida, a derailment spilled 10,000 gallons of acid. In June, a collision of two trains in Neelyville, Missouri forced 400 people to flee while the resulting fire neared an explosive vinyl chloride car. On June 27, a derailment in Metuchen, New Jersey damaged three cars laden with liquified chlorine gas, but there was no evacuation because nobody knew what was in the cars. In August, 2,000 people in Novi, Michigan were removed from the vicinity of a ruptured tank car carrying paradichlorobenzene, an insecticide. In September, part of Watseka, Illinois was evacuated after an automobile collided with two trains and caused the leakage of toxic and explosive chemicals. Bloomingdale, Indiana was the scene of a derailment in October which ruptured a propane car. In November, 5,000 people left their homes in Pensacola, Florida after a derailed tanker released ammonia gas. In Maryland, 400 people fled the vicinity of a train fire in which an ammonia car was threatened. Thirty-six were subsequently treated for chlorine poisoning from the same fire. In Nebraska, 771 residents of Battle Creek fled when a propane tanker derailed and began to leak. Two hundred people evacuated an area in West Philadelphia, Pennsylvania following a derailment. The last entry for the year, immediately preceding the famous February accidents of 1978, occurred in Goldonna, Louisiana, where a truck-train collision caused an explosion and fire that destroyed one-third of the town and involved several tank cars of propane and chlorine gas.[29]

I don't know about you, but after reading about these accidents (and hundreds of others that did not release chemicals) my confidence in the nation's railroads is shaken. The two accidents that happened near my home involved a derailed chlorine car and a boxcar full of highly toxic nuclear wastes which caught on fire. I think about them every time I see a train go by.

There are many other types of man-made disasters, but one of the most alarming possibilities is a kind of disaster that so far has happened only once. I refer to the accidental large-scale release of radioactive materials into the air. Many people fear this will happen one day following an accident or sabotage at a nuclear power plant. If you have been sitting back and comfortably assuming that such things cannot happen (as the power companies assure us), you are in for a rude shock. Several of them, in fact.

There is adequate evidence now to support the story that in 1958 a Soviet nuclear waste storage facility in the Ural mountains accidentally exploded "like a violent volcano." Tons of highly radioactive nuclear wastes were injected into the air and carried many miles across the Russian landscape, resulting in the deaths of several hundred farmers and the permanent evacuation of thousands of others. At least two Soviet scientists who later emigrated to the free world support this story, and there is ample evidence within Soviet scientific papers that the release was both massive and widespread. One of the scientists, who passed through the area in 1960, described it as "an empty land ... no villages, no towns, only chimneys of destroyed homes, no cultivated fields or pastures, no herds, no people—nothing."[30]

Could a nuclear reactor accident happen in the United States? The recent series of incidents at the Three Mile Island nuclear reactor plant in Harrisburg, Pennsylvania has shaken many people's confidence. And it is a little disturbing to reflect on the reactors that have already had accidents. There was the NRX reactor at Chalk River, Canada, which melted down, releasing radioactive steam into the air in 1952. Then there was the EBR-1 which melted and leaked radioactive material at Idaho Falls in 1955. In October of 1957, the Windscale reactor burst a fuel rod and developed a uranium fire, spewing radioactive gases and dust for more than 300 miles across the English countryside. Chalk River suffered another accident in May, 1958, when a fuel rod in the NRU reactor melted and caught fire. In 1961, another accident occurred at Idaho Falls when an SL-1 reactor exploded, killing three workers and releasing radioactive materials into the environment. Then there was the Fermi reactor near Detroit which suffered a partial meltdown in October of 1965, an accident which came under control just before officials were about to give the order to evacuate the city.[31]

No discussion of man-made disasters would be complete without mentioning the dioxin accident at Seveso, Italy, in July of 1976.[32] This town of 17,000 people contained a chemical plant where trichlorophenol (TCP) was manufactured. (TCP is used to make hexachlorophene for surgical soap.) The disaster began when a vat of TCP accidentally overheated and burst, releasing a huge cloud of chemicals which spread over the town. It seemed to be a minor inconvenience at first, because although TCP is irritating to the skin, it isn't really dangerous. Unfortunately, overheated TCP changes into dioxin, one of the most poisonous chemicals known. People soon became sick. Livestock, pets, and wildlife died in their tracks. Large sections of the town had to be evacuated, barricaded, and guarded by troops to keep people out of the danger zone. Over 1,500 people received continuing medical attention, and 50,000 animals within the danger zone were systematically killed to keep them from spreading the poison. The crowning blow came when it was discovered that there is no known way to decontaminate the town. Dioxin is not water soluble, so rain does not touch it. And no ordinary fire is hot enough to destroy it. Burning the buidings would just put the poison into the air again. Dioxin is so stable that it is not expected to degrade within a human lifetime. The inhabitants have been permanently relocated.

A major accident will probably never happen, they say—but the little ones seem to me to have happened all too often. The nuclear accidents, poisonous chemical spills from trains, dam disasters, and the general lack of foresight shown in hazardous human activities brings the potential for man-made calamity to a high place on the list of dangers which threaten the average person. Which of them are you subject to?

Political Disruption

As American citizens we tend to take for granted the idea that we have certain basic freedoms which cannot be taken from us, and that the government has certain basic obligations which it cannot refuse to carry out. In spite of a certain tendency toward retiring presidents early (by vote or by bullet), our government has been pretty stable, and we expect it to stay that way. So why is this section devoted to the dangers of political disruption?

I include all kinds of politically inspired attacks on our comfortable way of life (or on our lives) under the title of political disruption. This is a topic about which people tend to worry too much, in my opinion, but there are certain definite possibilities of danger to civilization and to ourselves inherent both in big governments and in small revolutionary groups.

A surprisingly large number of survivalists are concerned about a dictatorship taking control in this country. It seems impossible for such a thing to happen here, but on second glance, perhaps there is considerable food for thought in this idea. Historically, democracies have tended to degenerate into dictatorships in times of war or internal turmoil. The dictator does not rise to power in a bloody coup, but is elected to the office by popular acclaim. He holds out the promise of solving the nation's problems through firm policies and a restoration of "law and order." A democracy has no defense against a dictator who is placed in office by the people.

In this regard, the content of Executive Order 11490 (October 20, 1969) often comes under discussion. This order provides for the necessary emergency powers and continuity of government in the event of a nuclear attack. Such a provision is sensible and justifiable. The cause for concern lies in the fact that the order does not explicitly state that it is intended for a nuclear war. It says the President may invoke the emergency powers in "any national emergency type situation." Who decides what constitutes a national emergency? The President.

Executive Order 11490 contains provisions for the total control of the economy and the suppression of many individual freedoms. It could be liberally interpreted to allow all of the following policies to be implemented: registration and persecution of persons suspected of being enemy or subversive agents; control or confiscation of firearms; arrest of any person trying to enter or leave the country (remember the "iron curtain"); elimination of free enterprise through control of industrial "priorities," resource allotment and even outright confiscation and nationalization of private property; control of all communications systems, including radio, television, and telephone in the name of "national security"; control of all forms of travel, including air and highway travel; confiscation of privately owned radio equipment; censorship of internal mails; seizure of foreign ships in United States ports; control of the lending policies of financial institutions; freezing of stock and bond prices; and impressment of skilled labor into national service. Some of these provisions are spelled out exactly as I have indicated; others could be so interpreted by a President determined to undermine the Constitution. Before you conclude that such a thing could never happen, think back on the abuses of executive power which accompanied the Watergate cover-up. Then remember who signed Executive Order 11490. Nixon.

The most likely kind of civil or political disturbance that the average person might encounter is a large-scale riot such as those occurring in recent years in various cities and college campuses around the country. These have usually been associated with racial troubles or draft protest. The following titles are a collection of headlines generated by one such disturbance.

The Mob Increasing in Numbers
Encounters Between the Mob and the Military
Large Numbers of Rioters Killed
Streets Barricaded, Buildings Burned, Stores Sacked, and Private Dwellings Plundered
Another Day of Rioting
Continuation of Mob Rule
Several Soldiers Killed and Wounded
Resistance to the Draft—Rioting and Bloodshed
An Armory and a Hotel Destroyed
Colored People Assaulted
Orphan Asylum Ransacked and Burned
Mob Armed with Rifles—They Pick Off Soldiers from the Housetops
The Contagion Spreading . . .

Sounds familiar, doesn't it? Actually, these headlines were drawn from the New York Times, during the period of July 13 through 17, 1863, more than 115 years ago. The lesson to be learned is that the draft and race riots are nothing new, and the fact that they have died down for now does not mean that we have seen the last of them. Disorganized mob violence is a calamity which seems to lurk just beneath the surface in many of our cities, and a hot summer night or a slump in the economy can be all it takes to set it off.

Organized violence against the government is quite another matter. The ranks of political dissidents and terrorists in the United States, although small, are surprisingly well-armed and pose a significant possibility of danger to the average citizen. This is not just right-wing propaganda. The potential for large-scale revolution is not great, but it is there. When you consider that between 1971 and 1974 over 6,900 combat rifles and 1.1 million rounds of ammunition were stolen from our Army and National Guard armories, you begin to wonder just who has them. It is probable that these weapons were sold for profit to guerillas in other countries, but since they have never been located, the question remains open.

A specialist in terrorism from the Arms Control and Disarmament Agency recently told the New York Times that even a small well-trained paramilitary force could sabotage the power supply of any large metropolitan area and black out the city for extended periods of time. A five-day blackout in New York, he predicted, would have very serious consequences:

> Looters would run wild, fires starting at random, and jittery National Guardsmen shooting into crowds of panicked people.... Food and water would become scarce, the sanitation system would collapse, and the rats, which outnumber the people, would be close to achieving a permanent victory.[33]

Then there is the problem of home-made atomic bombs. For a long time, scientists were divided on the subject of whether or not it was possible to build an atom bomb with materials available to the public—until a Princeton physics student designed one as his senior thesis.[34] No one would officially admit that the design would work, but he got an A grade. The student didn't even have to use classified information. Everything he needed was in the library. The only actual material he could not have obtained legally was the plutonium.

Where would a terrorist get weapons-grade plutonium? Well, first of all there are "tens of tons" of the dangerous metal missing and unaccounted for in government processing plants. Most of this is almost certainly stuck inside pipes, but if thirteen pounds (enough for a Hiroshima-size bomb) were missing, no one would ever know.

Of course it wouldn't really be necessary to build a bomb when there are so many around to steal. At one point, the United States owned about 40,000 tactical nuclear weapons small enough to carry off in a car. These were scattered in warehouses and on board ships all over the world. Consider the inventory problem. If the military inventory is 99.9 percent efficient—an unheard of level of reliability—that still leaves forty bombs unaccounted for. Most of these are just misplaced, in the wrong room or on the wrong shelf, but we can't be certain that one or two aren't in irresponsible hands.

The CIA has been understandably concerned about terrorist weapons, and although officials admit that a terrorist atom bomb is possible, they think an attack using chemical, biological, or radiological weapons would be more likely.[35] A radiological weapon is a radioactive substance, such as plutonium, sprayed into the air as a mist. Anybody who breathes it dies of radiation sickness a few weeks later. There is no treatment.

I don't think that many of us are in any danger from these possible attacks. The question which bothers me is the over-reaction by the government which may follow such an incident. We have already seen signs of this in the over-reaction of United States intelligence agencies to the imagined "threat" of student dissidents in the Vietnam protests. A recent Senate investigation revealed that the FBI had created over 500,000 files on potential "security risks," and that the CIA had opened a third of a million first-class letters in tracking down these domestic demonstrators in spite of the fact that no communist link to the demonstrations was ever found. I was particularly interested in the FBI's list of 26,000 Americans who should be "rounded up" in case of national emergency because they might cause trouble.[36]

Terrorism is based on the idea that if the authorities can be forced to lose their nerve, they may take countermeasures that will be unacceptable to private citizens, who then join the ranks of the revolutionaries. This kind of reaction does take place, as I can personally testify. During the Vietnam college campus demonstrations in the spring of 1970, I was a struggling undergraduate at UCLA trying to pass some very difficult classes in calculus, physics, chemistry, and biology. Neither my friends nor I had any time for what we regarded as harmless fun-and-games on the lawn, where some scruffy liberal arts students assembled each day to march around and wave signs. Then one day I walked out of UCLA's 3.5 million volume research library into a scene right out of a nightmare. Police in body armor were chasing unarmed students and beating them to the ground with clubs when they caught them. A riot-control squad had been loosed on campus, and, in a punitive display of force, they simply broke every head they could reach. I quickly returned to the library and stayed there until the battle was over. After that, though, I had a lot of trouble controlling my attitude toward the police. It took several years before I began to regard policemen as people again. I am a basically conservative person, but the over-reaction and brutality I witnessed strongly shifted my approval toward the demonstrators. Imagine what happened with the more liberal elements on campus. The point is that the basic principle of terrorism works, and it could have effects on our lives which would go far beyond the bombing of a few buildings.

If it is the goal of terrorists to provoke excessive retaliation and police-state activities, then they are already beginning to succeed in the United States, in spite of the fact that next to nothing has happened here. A recent Harris poll showed that 60 percent of all Americans feel terrorism is a major problem in this country, and 55 percent would favor the formation of a special police unit with powers to investigate, capture and execute suspected terrorist leaders and all members of their groups without a trial.[37] With so little encouragement, half of us would be willing to create a modern American Gestapo unit.

If you are still thinking "That kind of thing could never happen here," think again. During World War II, over 100,000 innocent United States citizens were herded into concentration camps without trial on the suspicion that they might be enemy agents.[38] The basis for the suspicion was that these Americans had Oriental faces. The camps were in California. Their inalienable rights as American citizens were completely ignored. Your rights could be ignored just as easily if the political climate were right.

If the power in your city was shut off for several days, could you do without it? Could you survive the resulting riots? Would you vote for a proponent of "law and order?" How do you feel about imprisonment or execution without trial? How about Executive Order 11490? The potential for political disruption in the United States is real, and although we may hope it will not occur, we cannot ignore the possibility.

Economic Crisis

I think it is fair to say that if you were to make a list of the top ten leading survivalists, as many as seven would be former economists and investment counselors. The fear that the stock market will crash and the economy will collapse is strong among these men, and considering their credentials, the possibility of economic chaos should be considered carefully.

I ought to mention, however, that my personal attitude toward the field of economics is somewhat unenlightened. I regard economics as an occult religion complete with mystics, gurus, totems, taboos, and sacrifices to the gods. I ran a private survey of articles in the New York Times for the last two years and concluded that economic predictions are usually wrong. Forecasts of economic collapse in survivalist literature are common, and most are painfully overdue. The "crash of '79" used to be the "crash of '76," and before that it was the "crash of '73." Someday the economic doomsayers will be right, but few will know it in advance.

What could go wrong with the economy? The concern here lies with problems relating to inflation and banking. We'll examine inflation first. Inflation is the gradual loss of value which happens to a nation's currency when the government starts meeting its debts by printing paper money without having enough silver or gold to back it up. The new money does legally pay the debt, but it has no value. The effect is to dilute the value of money already in circulation. As the process goes on, prices begin to rise to compensate for the falling value of the money. This has been happening in our country for many years.

Isn't a dollar still worth a dollar? Well, let's see. A 1979 one dollar bill is supposed to have the same value as four 1979 quarters, which in turn ought to be equal to four 1960 quarters. But it doesn't work that way. If you suspend your faith in the figure "$1.00," you suddenly realize that a 1979 dollar bill is not redeemable for gold or silver. Its intrinsic value is about one-tenth of a cent. Even if you tried to redeem it for gold, you wouldn't get much. The United States has only a few cents worth of gold in Fort Knox for every dollar in circulation.

The 1979 quarters are big copper pennies plated except at the edge, where the copper shows through. They have a real value of about six cents each, in terms of their metal—or about sixty times as much as the bill. (The new 1979 "silver" dollars are the same size—and value—as these copper quarters.) A 1960 quarter, however, is made of silver and is now worth four times its face value. That makes a 1960 quarter worth (in terms of intrinsic value) twenty 1979 quarters or 1,250 dollars in 1979 bills. Is a dollar still worth a dollar?

Of course, if you go out to the store right now to spend your one dollar bill, your four new quarters, and your four old quarters, you will receive equal value for them. Why? Because we still live under the convenient fiction that "a dollar is a dollar." But as inflation continues, our money will begin to lose its value more and more quickly. There are many examples in history of currency like ours which became worthless in the space of a few months as people lost faith in it.

The classic example of hyper-inflation, cited in most economics textbooks, is that of Germany during 1923. Inflation was completely out of control due to the post-war government's attempts to spend all the paper money it could print. (There wasn't much in the treasury following the German defeat in World War I.) The German people were very alarmed about this inflation, which was forcing prices to double every month during the early part of the year. By the end of the year, prices were doubling every week, and finally they began to double every day. When the system finally collapsed, the cost of living had risen to a point 700 million times the pre-war level. Factories paid employees two or three times a day so workers could hurry out to spend their wages before the bills lost too much value. Some companies paid their workers by giving them the merchandise they produced. The workers would then spend the evening trying to barter their goods for food. People on fixed incomes or living on their savings were totally unable to obtain goods and services. Between October and December of 1923, there were over forty food riots in major German cities. This pattern has been repeated fifteen times in recorded history, and it has never been successfully opposed. Some economists suspect that there is no practical way to halt this inflationary spiral, and that the United States dollar may soon go the way of the mark. Time will tell.

The second area of weakness in the economy involves the nation's banks. Banks operate under another convenient fiction: the idea that depositors can withdraw their money at any time. When depositors lose faith in that idea, they rush to withdraw their money and the bank fails. How does this happen?

If you ignore the fancy economic terms and legal restrictions, the operation of a bank is absurdly simple. Imagine this situation: you deposit a dollar in your savings account. The bank then lends your dollar to another person, who opens an account and deposits the dollar back in the bank. Then the bank lends the dollar to another person, who probably will also deposit the dollar back in the bank. Under Federal Reserve Board rules, United States banks can lend four different people the same dollar. Now you and four other people each think you have a dollar in the bank, but there is only one dollar. What will the bank do if you all show up at the same time to withdrawn "your" dollar? One of you gets paid, and other others go without—and the bank fails.

It gets worse. In the preceding situation, the borrowers would eventually repay their loans, at least in theory, and you would be the only person with a claim on that much-used dollar you originally deposited. But what if one of those borrowers defaults on the loan? In that case, you and the other three borrowers have been robbed. The dollar isn't there any more. If you try to withdraw it, the bank may have to close its doors.

On a much grander scale, this is the position of our nation's largest banks. They have been lending billions of dollars to third world countries which have not paid back the money. This has put the banks in a shaky position. They have to make the loans look good, or their depositors will panic. To avoid the image of insolvency, therefore, the banks have lent additional money to the defaulting countries so they can at least pay the interest on the previous loans. That way the banks don't have to admit that the loans are bad. It looks good on paper, but it leaves the banks very vulnerable to a loss of faith among their depositors. If one of the nation's biggest banks should suffer a rumor of approaching failure, the rumor could actually cause the failure. Naturally, when one bank fails, rumors start immediately about other banks. The outcome of this cycle will be left as an exercise for the reader's imagination.

If one of these calamities develops in the next few years, as many people expect, we might find ourselves thrown on our own resources for a period of time ranging from a few weeks to several years. Maybe it won't get that bad. We could get lucky. Economic doomsayers are usually wrong in the short term, but in the long run they will probably be right. If you suddenly find one morning that your bank has failed, your business has closed, and your money is worthless, how will you feed your family?

Thermonuclear War

The last kind of disaster I am going to discuss is one that has never taken place at all: a full-scale thermonuclear war. Of all the potential disasters imaginable, nuclear war is both the greatest possible catastrophe our nation could ever face and the most immediate and continuous threat to each of our lives. I have saved nuclear war for the end of this chapter because such a war will produce its own version of every other kind of disaster. Nuclear war represents every danger to mankind rolled up into one event.

Most of the people with whom I have discussed nuclear war seem to think that they already understand everything about it. The general idea seems to be that one of these days some idiot will "push the button" and the whole world will go up in radioactive smoke. Actually, most people's ignorance of the reality of nuclear conflict is as great as their ignorance of the far side of the moon. They know it is there, and as far as they're concerned that's enough to know about it.

The only question which people routinely ask me is, exactly how likely is such a conflict? They seem to have convinced themselves that the opportunities for a nuclear war occur very rarely and can be safely ignored, but they still want to hear words of assurance from an "expert." Unfortunately, this is one of those paradoxical situations where the event is, oddly, both unlikely and certain to happen sooner or later.

How likely is a full-scale nuclear war? Attempts have been made in the past to assign a definite probability to it, but time has shown the prophets to have been embarrassingly wrong, and it is currently the unspoken policy of nuclear arms experts to avoid the question. Even so, if you can sit still for a little math, I would like to illustrate something that is very disturbing about the "probability" of nuclear war.

One facet of training to be a scientist is studying the art of statistical inference. Perhaps the most interesting thing this subject teaches one is what happens to very small, insignificant probabilities when they are compounded year after year. For instance, I once read an estimate by a knowledgeable man who "guessed" that the probability of having a nuclear war was one chance in fifty for any given year. One chance in fifty means a 98 percent chance of not having a war during the year. You have to admit that this estimate sounds pretty reassuring. Of course thereat probability of war is unknown; it changes every time a new world leader comes into power or a new weapon is developed. The estimate of one chance out of fifty, however, will be sufficient to illustrate my point.

Starting in any particular year, and knowing that there is a 98 percent chance of peace each year, what is the probability that peace will continue for five years?

To find out, you change the 98 percent figure to the form 0.98, and multiply it by itself five times. This gives you the probability that there will be peace in the first year, and the second year, and the third year, and the fourth year, and the fifth year. We write this as $(0.98)^5$, which equals 0.90, or a 90 percent chance that peace will continue for five years from the starting date. The probability of peace for any length of time can be computed in this manner.

Table 1 gives this probability for several warless periods of time. What this table shows is that even though the probability of peace in any one year is assumed to be very high, a person's chance of living to a ripe old age without seeing a war are very small. If there is only one chance in fifty of having a war during any year, there is still a 78 percent probability (four chances out of five) that there will be a war within the span of an average person's life.

TABLE 1
Probability of Consecutive Years of Peace

YEARS	PROBABILITY IN PERCENT
1	98
5	90
10	81
25	60
50	36
75	22

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1	98
5	90
10	81
25	60
50	36
75	22

The exercise assumes that the probability of peace is 0.98 in any particular year.

The false confidence inspired by a low probability of disaster simply encourages us to allow the risk to continue year after year. The end result of such a policy is inescapable. If we continue to give this calamity repeated opportunities to take place, eventually a war will come. Under these circumstances, the advent of nuclear war can be regarded as a certainty. Only the date is unpredictable.

The fact that the date is "unpredictable" doesn't mean that no one is trying to predict it, however. R. E. McMaster's Cycles of War: The Next Six Years is a recent review of various war prediction schemes which raises some interesting possibilities.[39] It is thought provoking to discover that several independent war prediction methods seem to point to a major war in the early 1980s. These methods are based on cyclic developments which precede important wars and are drawn from our nation's political, literary, and economic history. None of them are reliable enough to take seriously, but it gives one pause to find that predictors agree about the potential danger of the next few years.

One factor which obviously influences the probability of nuclear war is the attitude and posture of the "other side." We can assume that the Soviets do not want such a war, although they do seem to be well prepared to meet it. The fact that the USSR devotes an entire branch of its armed services to civil defense is only one indication. But the assumption that the Russians don't want a nuclear war does not rule out the possibility that they would sternly back a nuclear bluff if they thought they could get away with it. After all, we have humiliated them several times in the past in just such a manner. Revenge might be sweet for the Kremlin.

Could the Soviets win a showdown confrontation? Table 2 shows a partial summary of United States and Soviet military forces based on figures drawn from the popular press and government publications. The exact number and precise definition of each kind of weapon can be argued, of course, but the figures are essentially correct. In the last few years, the USSR has been building up its military might while we have been retiring ours. Through inaction, the United States has lost its superior position in the balance of power, and it is only a matter of time before we see how the Soviets will exploit their new advantage. We can rest assured, I think, that they will exploit it.

How would a nuclear war get started? The popular myth of the insane general with a finger on the button is pretty far from reality, but something like it did happen during the Nixon administration. The President, harried by the Watergate investigation, remarked to some members of Congress, "I can go into my office and pick up the telephone and in twenty-five minutes 70 million people will be dead." This remark sparked a great deal of concern and a special Congressional investigation into the mechanism of command and control over this country's nuclear weapons. Before the investigation could convene, Defense Secretary Schlesinger quietly told his staff that any unusual orders from the White House should not be honored until he had personally examined them. This was a prudent action under the circumstances, since the Secretary was worried about a possible military coup, but it was also quite illegal. The danger of an insane President (the person occupying the most stressful job in the world) cannot be dismissed.[40]

At the international level, there are several ways in which a nuclear war could start. Serious students of the subject can list over a dozen possibilities:[41]

1. We might one day get a false alarm from our early warning radar systems and launch a mistaken retaliation, forcing the Soviets to launch a real counter-attack.
2. There is the "crazy general" or "crazy President" possibility. Nuclear war might be ordered for no rational reason.
3. True mechanical or human error might launch one or more missiles.
4. A limited war might uncontrollably escalate. A NATO-Soviet armed conflict in Europe, for example, could spring up in which neutron weapons would be used, then small tactical nukes, then larger ones, then...
5. The rationality of irrationality might overwhelm logic. What if the Soviets put on a big show, saying that if we don't back down they'll blow us up? They might think that if they sound crazy enough, other

TABLE 2
US and Soviet Strategic Forces

WEAPON CATEGORY		US	USSR
Intercontinental ballistic missiles		1,054	1,450
Submarine-launched ballistic missiles		656	800+
Anti-missile missiles		0	65
Strategic bombers	Old equipment	350	8,000
	New equipment	65	200
Interceptors (Anti-bomber)		341	2,600
Surface-to-air missiles (Anti-bomber)		0	12,000
Tanks		10,000	50,000
Naval combat ships		170	250

SOURCE: Chiefly Bill Sweetman and Bill Gunston, Soviet Air Power (New York: Crescent Books, 1978).

countries would beg us to be reasonable and we'd back down. What if we didn't?

6. The Soviets have one of the most advanced civil defense systems in the world, with massive relocation plans and widely dispersed industry. No matter how well the system would really work, it's lots better than anything we have. What if someone decides that they can go through a nuclear war without suffering too much damage? Tens of millions of Russians were lost in the two world wars. The loss of the same number in World War III might not seem too high a price to pay.
7. One of the worst possibilities is that one side will fear that the other is about to attack and will try to shoot first. The advantages of a first strike are so great that in a crisis it could well seem the best thing to do if other prospects look poor.
8. We might launch the missiles at the Soviets as part of a pact to aid an ally under attack, or vice versa.
9. A variety of crises, such as the election of an extreme right-wing hawk to the Presidency might convince the Soviets to attack rather than wait for us to do so.
10. If one side gained a definite lead in the arms race, it might feel that it was time to launch a full-scale attack before the other side could catch up. Such a situation may develop between 1982 and 1986, when the Soviets will have the capability to destroy our land-based missiles in a single strike. Our new MX missile system will not yet be completed.
11. An ambitious dictator with nuclear weapons might start a war to further his own designs. (Remember Hitler?)
12. An ambitious third nation, such as China, might decide to launch simultaneous attacks on the United States and the USSR, hoping that the two powers would retaliate against each other. The third nation could then rule over the rubble.
13. A desperate third nation (as Israel could be if it were about to lose a final war with the Arabs) might fake a nuclear attack on itself in order to draw us more actively into the conflict.

Experts seem to agree that for the time being, the most likely form of nuclear war is a small one between two minor powers. As proliferation continues, smaller and smaller countries are developing their own atomic weapons, and before long the world will certainly have to deal with petty dictators lobbing radioactive materials at one another. It has even been suggested that such governments might try the ultimate in international affrontery—using their crude bombs on major powers.[42]

Most people could name the Cuban missile crisis of 1962 and the Arab-Israeli war of 1973 as two times when the United States threatened to use its nuclear strike force against the Soviet Union, but few are aware of the total extent to which the rival powers constantly threaten one another through the time-honored activity of "sabre-rattling." In the period between 1946 and 1975, the United States used its armed forces for "political purposes" (bluffing) a total of 215 times. The Soviet incidents during the same period numbered 115. This averages out to about one incident per month over thirty years. Of course, most of these events were fairly minor, such as the time a United States missile submarine paid a diplomatic visit to Turkey, incidentally demonstrating that there were United States subs within striking range of Moscow. Other incidents ranged in seriousness from Soviet overflights of the West German border to the Red Army's sealing off Berlin. United States and Soviet warships regularly harass one another at sea, with Soviet bombers circling over American aircraft carriers, the bombers themselves closely escorted by United States fighters. The game of "chicken" even extends to undersea operations, where it has led to nine collisions between United States submarines and Soviet naval vessels of various kinds.

In total, there have been nineteen incidents in which the United States has deployed strategic nuclear strike forces in order to underline some message to the Soviets. Any of them might have been interpreted by the Soviets as a hostile move. In addition, there are people who maintain that we have offered atomic weapons to allies from time to time when they seemed to need them. For instance, there are authoritative reports that we twice offered nuclear weapons to France during its struggle in Viet Nam for use against the Communist Chinese and the Viet Minh forces at Dienbienphu. Our fabled commitment never to use these weapons seems a little unconvincing sometimes.[43]

Well, let's get on to the unpleasant part. What will happen to us if a full scale nuclear war somehow does get started in the next few years?

During the initial bombing, our cities will be swept by shock waves and winds that dwarf even those produced by hurricanes and tornadoes. Fallout will confine people indoors much longer and more certainly than any blizzard. Fires will burn unopposed through cities, forests, and fields until nature extinguishes them. The erosion which will follow the fires, as well as that which will take place on temporarily abandoned farmlands, may permanently degrade much of our agricultural base and contribute to widespread flooding.

Famine will follow because the war will make gasoline, insecticide, and fertilizer unavailable to farmers. Many fields, some with ripening crops, will be heavily contaminated with fallout and will be unusable. The nuclear explosions will inject as much dust into the air as a major volcanic explosion, cooling the earth and shortening our growing seasons. Transportation facilities will be shattered, preventing what food is produced from reaching markets. Starving people will try to eat natural foods but will not know how to do so. Riots will follow.

Medical personnel, equipment, and supplies, which are found mainly in cities, will be in short supply after the cities are attacked. Sanitation will fail in many areas, contaminating the water and encouraging rats. Refugee camps will be perfect breeding grounds for dangerous diseases. Although many survivors will try to help one another, many will band together to prey on others. By far the easiest way to obtain food and supplies in the post-attack period will be to take them from the weak.

Then there are the nightmares brought about by nuclear war that exceed even nature's limits, such as the destruction of the ozone layer of the atmosphere, producing a drastic increase in ultraviolet light. Caucasians will have to cover up when they go outside or suffer a blistered sunburn in a few minutes. And then there are the problems of genetic damage, cancer, and radiation sickness.[44]

Pretty horrible, right? I tried to make it sound that way.

Believe it or not, even a nuclear war is survivable. With an eye toward realistic preparation, you can see to it that your family and a small group of friends will be able to live through the holocaust and the post-attack period with a minimum of unpleasantness. All you have to do is give it a determined try. This book tells you how.

Commentary

Since the time this chapter was written, many of the unpleasant forecasts 1 have made have come true. In the first six months of 1979, we had a truckers' strike which slowed down the transportation of food to many stores. There was an outbreak of polio in Pennsylvania, the largest in recent years. (As I write these words, a radio news program informs me of a small bubonic plague outbreak in southern California.) A pack of rats became bold enough to attack a woman on a New York street (less than two blocks from the City Hall). A blizzard in Colorado knocked out electrical service to 250,000 people in Colorado Springs, while another storm deposited ice over Michigan, breaking power lines, making highways impassable and isolating 230,000 people in cold homes. Then there were the spring floods, which forced 15,000 people from their homes in Alabama and Mississippi. Several flurries of tornadoes struck the Midwest, including one episode which left 44 dead and over 600 injured in Wichita Falls, Texas. A train derailment in Florida forced 5,000 people to flee from advancing clouds of yellow sulphur fumes. (That was after the acetone tank-cars stopped exploding.) On the political front, the Senate approved 2.1 billion dollars for development of the MX missile, a land-based mobile weapon designed to elude a Soviet surprise attack. I don't view this as a positive development, from either the military or the economic point of view.

Then there was the ominous incident at Middletown, Pennsylvania. The Three Mile Island nuclear power plant experienced the worst reactor accident yet, caused by an unbelievable combination of poor design and human error. Badly overworked technicians accidentally closed the valves which supplied the reactor with emergency cooling water. The main cooling system subsequently failed. When the emergency system didn't work, heat and pressure built up in the reactor core. The operators didn't know how hot the reactor had become because the computer which monitored the condition of the core was not calibrated for temperatures more than 100 degrees above normal. It just typed out "?????" instead of the temperature. A misleading gauge made reactor technicians think that the core was covered by cooling water when it was actually partially exposed. The company had known that the gauge could cause such a mistake but had not bothered to replace it. The pressure building up in the core should have been released by a special valve—which failed to open. It hadn't been replaced after a previous failure. Pressure backed up and forced radioactive water out on to the floor of the containment building. The water should have been safely confined within the building, but the building's sump pumps automatically started up and pumped the water outside to holding tanks. The pumps were supposed to be automatically disabled during an emergency. When the holding tanks filled up, the pumps kept right on pumping—spilling contaminated water on the ground.

For survivalists, there are two important lessons heie. The first is illustrated by the fact that one backup system after another failed in rapid succession following an initial emergency caused by human carelessness. This is characteristic of the way in which massive "fail-safe" systems finally do fail. I think this point applies directly to nuclear weapons as well as to nuclear power. The second lesson involves official response to the crisis. Virtually all of the information local residents could obtain came through the national news media. It took the power company thirty-six hours to get around to informing the Nuclear Regulatory Commission (NRC) that there had been a hydrogen explosion within the containment building, a key piece of evidence that the reactor core was badly damaged. The NRC members described themselves as operating "in the blind" during the crisis. They thought they should order an evacuation, but they didn't know if it was necessary—or already too late. The lesson to survivalists is clear: Don't wait for the official evacuation order. Such orders frequently don't come in time to save anyone. The Three Mile Island incident spurred a probe into emergency evacuation plans in general. Federal experts concluded that of the forty-three states which have nuclear power plants, only twenty-five of them have evacuation plans which would work. Of the twenty-five plans, only nine have been properly tested. Some of the others include embarrassing oversights such as using school buses to transport residents out of town—leaving children stranded at school.

Last but not least, let me remind you of the gas crunch. Subsequent to the political upheaval in Iran, United States crude oil supplies diminished, apparently giving the oil companies an excuse to press for price deregulation. In some parts of the country people began to have trouble getting gasoline, and two to six hour waits in line at the gas pump became common. Rationing schemes were proposed, and California went on an "odd-even" system, which required that service station attendants refuse to serve anyone whose license plate number was at variance with the date. The ominous part was the official effort to prevent private gasoline storage by making it illegal to fill a gas can larger than two gallons, and allowing only one can to a customer at that. When an emergency strikes, it really pays to be ready ahead of time.

This goal, to be ready for the emergency ahead of time, is the reason this book was written. Government agencies have a lamentable tendency to do too little, too late when danger threatens a community, making survival a do-it-yourself proposition.

It is my greatest wish that you will never need the information presented here. If you are forced to put this book to the test, however, I hope it will prove adequate. Never forget that every emergency ends eventually. If you hang on long enough, you will see the new dawn.

Even on the day after doomsday.

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2

Everything You Ever Wanted to Know about Nuclear War

I HAVE DESIGNED the survival information in this book to include material appropriate to a wide range of disasters, including political and economic ones, but the fact remains that my primary purpose is to address the topic of surviving a nuclear war. I am convinced that a group which is prepared to survive a nuclear war is fully capable of handling any other kind of crisis, too. But to withstand the stresses of nuclear weapons you first have to understand exactly what you will be up against. The purpose of this chapter is to provide factual information upon which to base your plans.

Please do not skip this section. It is vitally important that you understand this material for three reasons. The first is that much of what you have learned about nuclear war from disarmament spokesmen, science fiction novels, and Hollywood films is flatly untrue. This includes every so-called "scientific proof that survival is impossible. The second reason is that there are legitimate survival problems posed by nuclear weapons of which you may never have heard. Obviously, the third reason is that if your basic information is faulty, your precautions will be faulty too. You will have to survive the reality of nuclear war, not the legend.[1]

A note to the reader: In writing this chapter I have relied heavily on The Effects of Nuclear Weapons, edited by Samuel Glasstone, as well as several Defense Civil Preparedness Agency (DCPA) manuals and textbooks.[2] I found that there is very little agreement among them regarding the danger radii of nuclear weapons effects, including fallout patterns. Usually I have been able to trace the discrepancies to errors made by the DCPA writers, and therefore I have generally followed Glasstone. Be warned that the reference books you have been using in your planning could be seriously in error.

How Nuclear Weapons Work

The explosive effect of nuclear weapons comes from the instantaneous liberation of fantastic amounts of energy. The energy released is derived either from the process of fission or from a combination of fission and fusion processes. Without getting bogged down in too many details, these processes can be explained as follows.

Fission is the splitting of a large atom (of uranium or plutonium) that occurs when it is hit by a neutron. A neutron is a particle of matter which is usually found resting peacefully in an atom's central nucleus. On rare occasions, however, certain unstable heavy atoms in a block of plutonium or uranium will suddenly split up into various fragments, among which are two or three speeding neutrons. If the block of uranium or plutonium metal is large enough, these liberated neutrons will smack into other atoms, splitting them and releasing even more neutrons. Since each neutron liberates two or three others (and lots of energy) the process rapidly builds up to fantastic proportions. The result is an atomic bomb like the one used in Hiroshima in 1945.

Fusion is quite a different process. The basic idea of fusion is to take two extremely light atoms of hydrogen and smash them together hard enough to combine them into one heavier atom of helium. Once again, the process liberates neutrons and fantastic amounts of energy. On a pound-for-pound basis, the fusion of hydrogen produces about three times as much energy as the fission of plutonium. That is why most of our missiles today have hydrogen warheads (H-bombs).

The only practical way to get the hydrogen atoms to fuse is to heat them up to temperatures in the range of several million degrees, and the only way to do that is to use a uranium or plutonium fission bomb as a detonator. An H-bomb is constructed by enclosing a standard fission bomb in a mantle of hydrogen (in the form of "heavy" water). When the fission bomb explodes, it heats the hydrogen up to the point where fusion can occur.

There is usually an additional external jacket of uranium around the core of the H-bomb, too. This makes the explosion even bigger, because the neutrons from the fusion of hydrogen produce a second wave of fission when they strike the uranium jacket. This fission-fusion-fission arrangement is the standard design for a thermonuclear weapon. ("Thermo" refers to the heat required to set off the hydrogen fusion process.)

Now suppose you had a very small H-bomb (1 kiloton) all set and ready to go with a fission bomb inside, a layer of hydrogen around it, and an outer jacket of uranium enclosing the whole thing. What would you get if you stripped off the outer jacket?

In that case you would have a tiny thermonuclear warhead with some of its punch removed, obviously, but you would also have a bomb that releases a burst of high-energy neutrons. In a normal H-bomb, these neutrons would have been used to cause fission in the uranium jacket, but in this neutron bomb there is no jacket to contain them. This is important. The terrible and frightening neutron bomb is really just a regular H-bomb with a lot of its explosive power removed. It's not anything new, and it is certainly no more terrible than the weapon that gave it birth. In spite of this, there has been a loud outcry about building it for possible use in western Europe. For some reason people would rather have NATO use the much more destructive hydrogen warheads.

This isn't sensible, because the neutron weapons are tiny and very clean. One 1-kiloton neutron bomb can only stop ten Soviet tanks. The 2,000 neutron bombs necessary to stop all of the 20,000 Red Army tanks now stationed in East Germany would produce no fallout and very little blast damage to the defended territory. Normal nuclear weapons would ravage the continent.

Size and Type of Burst

Nuclear weapons can be detonated in all kinds of circumstances. They can be exploded in the air over a target, on the surface of the ground, under the ground (in a mine), under water, and at such high altitudes that the burst effectively occurs in space. Each of these locations alters the effects produced by the blast and other phenomena, making the location of the bomb at the moment of detonation one of the most important factors in predicting the problems it will cause for retreaters. We will be concerned with surface bursts, air bursts, and high-altitude bursts. Underground explosions and water bursts are not likely in an attack.

Nuclear weapons are described in terms of the amount of TNT it would take to produce an equivalent explosion. Usually, the nuclear weapon is equal to many thousands or millions of tons of TNT, and is referred to as a kiloton (thousand ton) or megaton (million ton) weapon. The bomb dropped on Hiroshima was approximately a 20-kiloton weapon. The largest ever built for an experimental explosion was a 57-megaton device. Nuclear weapons in present use range from 20-megaton "city busters" to kiloton and sub-kiloton tactical weapons.

The important thing to remember about variations in size of nuclear warheads is that the damage done does not increase in proportion to the size of the bomb. An increase in explosive power by a factor often produces, at most, a doubling of the radius of damage. This fact is not widely known; lack of awareness accounts for many of the wild-eyed estimates of the damage which could be caused by "super-bombs." The Guinness Book of World Records, for instance, reports that a 100-megaton bomb would make a crater 19 miles across.[3] This figure represents 100 times the 0.19 mile diameter of a 1-megaton blast in rock. The potential size of a 100-megaton crater in rock is really only 0.8 miles in diameter.

For our purposes, it will be sufficient to discuss the effects of a 1-megaton bomb and a 10-megaton bomb. These two sizes effectively span the range of weapons the Soviets may use on us, and even in the case of larger or smaller weapons, the differences will not be so great as to invalidate plans and precautions based on these estimates. Don't let anybody scare you with tall tales of 50,000-megaton "continent busters." Once you get over 50 megatons, the radius of damage expands very little with increases in bomb size. This is undoubtedly the reason that neither side has tried to build a world-shattering bomb. That, and the fact that we all have to share the same world.

Description of Air and Surface Bursts

When a nuclear weapon is exploded, the incredible amount of energy released instantaneously heats a large volume of air to a temperature of tens of millions of degrees. The white-hot air radiates heat intensely and gives off so much light that a 1-megaton fireball looks brighter than the sun even when viewed from a distance of 50 miles. The flash in the sky from a relatively small 100-kiloton burst is visible from as much as 400 miles away at night. (If the attack comes after dark, there won't be much question about which nearby cities have been hit.)

At the instant of detonation, the fireball of a 1-megaton bomb is about 400 feet in diameter. It then begins to expand rapidly until, ten seconds after the explosion, it is 5,700 feet across. Like a hot-air balloon, the fireball is buoyed up into the air at a rate of 300 feet per second. After about a minute, the fireball has risen to 25,000 feet and has cooled to the point that it is no longer giving off any light.

As the cloud of superheated gas rises, it experiences a certain amount of drag from the surrounding air. This slows down the outer edges of the cloud, allowing the inner part to rise a little faster than the outer part. The total effect is the formation of what amounts to a smoke ring as the lagging outer rim of the cloud is sucked into the space left by the rising center section. This rolling smoke ring is the fabled "mushroom," which sits on top of a "stem" formed by a column of windblown smoke and dirt carried up behind the rising fireball.

It has become fashionable to regard the mushroom cloud as a symbol of horror, but there was a brief time when the towering atomic cloud was regarded with awe and admiration. Admittedly, the time was a short one. Before the attacks on Hiroshima and Nagasaki, witnesses to the first atomic explosion described the mushroom cloud as the most awesome and beautiful thing they had ever seen. They talked about it as a rolling, glowing cloud giving off all the colors of the rainbow, with lightning bolts flickering all around it. We don't normally think of mushroom clouds as being dancing visions of loveliness, partly because the films we have seen of air bursts are not usually in color, and partly because we know now what the mushroom cloud means in terms of human suffering.

At first the gases of the mushroom cloud are red or reddish-brown because of a high concentration of oxides of nitrogen. These compounds are formed any time air is heated and are most familiar in automobile emissions which form smog. The yellow color of thick smog is a very pale version of the color of a newly formed mushroom cloud. (The production of such great quantities of oxides of nitrogen in the mushroom cloud represents a very significant threat to surivival planners, a fact which we will discuss in detail later in the chapter.) After a while the cloud cools down to normal air temperature and the water vapor in it condenses and forms droplets. At this point the reddish color disappears and the cloud turns white.

At a certain point, the cloud stops rising and begins to spread out into a flatter shape. When it finally stops growing, the nuclear cloud is very impressive in terms of size. A cloud from a 1-megaton burst is typically twelve miles high and twelve miles across. For a 10-megaton burst, the cloud is about twenty miles high and as much as fifty miles across.

Shock Wave Effects

Acting on the principle that retreaters aren't as interested in how the shock wave forms as they are in what happens to the surrounding countryside, I am going to skip the technical details of wave front formation and stick to the basic idea that a nuclear detonation produces a powerful shock wave in the air. This shock wave moves out in all directions from the fireball at a speed faster than sound. What are the pertinent details a retreater needs to understand about this effect?

Probably the most difficult thing to grasp about the blast wave is that it is actually composed of two effects which happen at once. The first effect is called overpressure, and consists of a drastic increase in air pressure above the normal level. This increase in air pressure tends to crush hollow objects (like houses or cars), producing an effect something like squeezing a beer can in your fist. The second effect is dynamic pressure, which produces a very strong wind blowing outward from the center of the explosion. This wind tends to knock things down, like slapping that beer can and sending it flying across the room. Together, the overpressure and the dynamic pressure are the effects which are loosely referred to as the blast wave.

The blast wave has many effects which are of interest to retreat planning. Obviously, one effect is direct injury to people. Others include damage to buildings, vehicles, shelters, and various objects that could block a retreater's escape route. Table 3 gives a summary of these blast effects.

This table calls for a few words of explanation. Parked private airplanes are very delicate and can be made unflyable by overpressures in the 0.5 to 1.0 pounds per square inch (psi) range occurring as far away as twenty-one miles from a 1-megaton explosion. If you plan to fly to safety after an attack, you had better pick an airport a long way from the nearest target as your starting point.

If you are anywhere near a target when the bomb goes off, the last thing you want to do is to stand next to a window and watch. At extreme ranges, the shock wave may not arrive for two or three minutes. Window glass is almost as sensitive to overpressure as the sheet metal in airplanes, and when glass shatters it forms thousands of razor-sharp missiles which shower into the room. Within 8.5 miles of a 1-megaton burst, some of these shards will have enough energy to penetrate through the body wall, causing serious injuries involving the abdominal organs.

An upright, absolutely unprotected human being out in the open may be picked up by the blast wave and hurled through the air, abruptly striking the ground or some stationary object. This refers only to people out in the open who don't have the sense to lie down on the ground before the blast wave arrives. At the ranges from a 1-megaton burst where this type of injury would be a primary problem (four to seven miles), a person would have fifteen to thirty seconds warning between the flash and the arrival of the blast wave. That is a lot of time in which to lie down flat or dive into a ditch. Actually, the delay between the explosion and the blast wave at these distances could be very dangerous. You might think the show was over before the wave front had time to arrive. If your guard were down, it could be a fatal surprise.

The dynamic pressure within six miles of a 1-megaton burst mimics the effects of a 90 to 120 mile per

TABLE 3
Arrival Time and Radius of Shock Wave Effects

SHOCK WAVE EFFECT	RADIUS AND ARRIVAL TIME			
	/ megaton		10 megaton	
	VIILES	TIME	MILES	TIME
Parked private airplanes damaged but livable; windows have light damage [0.5 psi]	21	1.5 min	45	3.0 min
Windows heavily damaged, wood frame houses lightly damaged. [1.0 psi]	14	1.0 min	28	2.3 min
Some glass shards capable of penetrating abdominal wall.	8.5	38 sec	15	1.0 min
Human body thrown hard enough to cause incapacitating injuries.	7.0	28 sec	18	1.2 min
Human body thrown hard enough to cause 1% fatalities.	5.8	25 sec	15	1.0 min
Forest roads impassable due to fallen trees.	5.7	24 sec	15	1.0 min
Wood frame houses collapse, 1% of eardrums rupture. [5 psi]	5.5	22 sec	9.5	35 sec
Brick apartment houses suffer severe damage.	4.2	16 sec	8.9	32 sec
Human body thrown hard enough to cause 99% fatalities.	3.8	14 sec	8.9	32 sec
Cars and trucks damaged too severely to drive.	3.6	14 sec	8.9	32 sec
Reinforced concrete houses lightly damaged. [7 psi]	3.5	13 sec	7.5	28 sec
Minor injury to lungs from overpressure. [15 psi]	2.2	7 sec	4.6	15 sec
Highway bridges of 250-400 foot span barely passable.	2.1	7 sec	5.7	20 sec
Highway bridges of 150-200 foot span barely passable, multi-story reinforced concrete office buildings severely damaged.	1.9	6 sec	4.7	15 sec
Multi-story steel frame office building (earthquake resistant) severely damaged.	1.7	5 sec	3.8	12 sec
Reinforced concrete houses collapse. [25 psi]	1.6	4.5 sec	3.4	10 sec
Lung injuries from overpressure cause 1% fatalities. [35 psi]	1.3	3.5 sec	2.8	7.5 sec
99% of eardrums rupture. [45 psi]	1.1	2.7 sec	2.4	6.0 sec
99% fatalities from lung damage. [65 psi]	0.9	2.1 sec	2.0	4.5 sec
Buried concrete arches collapse. [200 psi]	0.5	0.9 sec	1.1	1.8 sec

hour wind, one which is sufficient to knock down substantial numbers of trees and telephone poles. Keep this in mind when you plan your escape route. If a road is close to the target, it is likely to be blocked by debris; there may be no exit afforded.

Within about 5.5 miles of a 1-megaton explosion, the average tract house collapses completely. If you live in such a house, you don't want to build a shelter in the basement because the house will form a pile of debris on top of you—and maybe burn as well. This is also the point where the first minor blast injuries occur. A few elderly people at this range will suffer broken eardrums if not protected by blast-proof shelters.

At 3.6 miles most cars and trucks are damaged so badly by the blast that they require major repairs before becoming driveable again. The shock wave picks them up and bounces them end-over-end down the street. Within this radius, you could easily survive the blast in a properly built shelter, but don't expect to drive away afterward.

At 2.2 miles lung injuries may occur. At this range the effect is not too serious, but it is very uncomfortable.

A little closer to ground zero, there is a definite possibility of having highway bridges damaged too severely to use. This is actually good news in a way. It means that if you steer clear of target areas while driving to your retreat (a good policy in general), you shouldn't have any trouble with collapsed bridges. Steel or concrete bridges will be blown out only within the zone of massive destruction near ground zero.

At a range of 1.6 miles from a 1-megaton blast, most reinforced concrete houses can no longer stand the strain. They collapse. A little closer, and the people who have avoided the dynamic wind by hiding in basements begin to receive really serious lung injuries from overpressure. At one mile from the center of the explosion, direct injuries caused by high overpressures produce universal fatalities, except within exceptionally strong blast-proof shelters. At 0.5 miles from the center of the explosion (actually inside the fireball), even these special shelters collapse.

Notice that the same effects occur in generally the same sequence, but at greater ranges, in the case of the 10-megaton bomb. The exact range of each effect varies complexly when smaller weapons are compared to larger ones, but the 10-megaton radii are usually about twice the size of the 1-megaton radii. (For 20-megaton damage radii, multiply the 10-megaton figures by 1.3.)

Before closing this discussion of shock waves, I should caution you about a little-known phenomenon which could catch you napping. Nuclear blast shock waves can be refracted by the upper layers of the atmosphere to become refocused at the earth's surface many miles from the explosion. During the first atomic test at Alamagordo, New Mexico, the window-breaking power of the shock wave ought to have been limited to a four-mile radius around the explosion. (It was a small-kiloton range device.) Instead, the wave front passed into the upper atmosphere, where it was refracted and refocused. Several minutes after the explosion, the shock wave unexpectedly reappeared in Gallup, where it was strong enough to break windows. Gallup is about 250 miles from the test area. Similar phenomena were noticed in various Nevada tests, too.

The lesson is that the distribution of shock wave effects in the midst of a full-scale multi-megaton attack is a wide open question. No one has examined this effect in terms of megaton weapons, and, as for the possible interactive effects of setting off 400 1-megaton warheads all at once within the confines of a Minuteman missile field...

You could be hit by a structure-damaging shock wave even in the most remote parts of the country. Best to be ready for it.

Thermal Effects

I think it may be important to begin by telling you What the thermal flash is not. If you have read Robert Merle's nuclear war survival novel Malevil, you will recall a dramatic episode in which a single bomb detonated over Paris incinerated all of France in a gust of superheated air.[4] This is the "wall of fire" myth, and although it is very common in anti-bomb propaganda, it is patently ridiculous. When you hear someone talking about the expanding "wall of fire" from a nuclear explosion, you can be sure that he or she has not done any homework.

To envision the thermal flash of a nuclear explosion, think of very bright sunlight. When sunlight is concentrated by a magnifying glass, it is hot enough to start fires. The light from a nuclear bomb is so intense that it does not require the magnifying glass in order to be this hot. That is all there is to the thermal flash.

A point which is not well understood by the public is that the thermal flash from small (kiloton-class) weapons is actually more dangerous than that from megaton weapons. The 20-kiloton bomb dropped on Hiroshima caused horrible flash burns on the victims. This bomb released its thermal pulse in less than a third of a second; the victims were burned literally before they realized what was happening. A megaton weapon, on the other hand, releases its thermal pulse over a period of five to twenty seconds. This makes it less dangerous to people out in the open for two reasons. First, the skin can absorb a lot more heat without damage when there are even a few seconds for circulating blood to carry the heat away to other parts of the body. Second, the long duration of the pulse gives people a few moments in which to react by diving to the ground, running indoors, or taking other kinds of protective action.

The second subject of interest is the range of the flash damage. The ranges listed in table 4 are maximum ranges for clear weather conditions. The range of thermal effects in real life, however, can be very hard to predict.

Since the thermal pulse is composed of light, its intensity naturally decreases with distance from the center of the explosion. This is because the light rays spread out at increasing distances. There is also a shading effect caused by dust and dirt in the air (which ought to be considerable over some cities). But even this effect is complicated by the fact that the smoke particles can reflect the thermal radiation as well as absorb it, which means that they don't block out quite as much of the flash as they should. Instead, they scatter it, so even if you are protected from direct exposure to the fireball, you can still receive reflected heat from the surrounding sky.

Weather conditions can either decrease the thermal flash or accentuate it, depending on circumstances. If the target area is covered by a low overcast or fog, a bomb detonated above the cloud layer will have the same blast effects as always, but the thermal effects will be greatly diminished. This is because the cloud layer reflects and scatters most of the light from the flash, shading the earth below. On the other hand, if the bomb should detonate below a cloud layer, the thermal effects will be greatly increased; heat is reflected back downward by the clouds.

In table 4 I have listed retinal burns as an injury which may occur at distances of hundreds of miles from the explosion. This is true, but the occurrence also requires some special circumstances. The fireball is so bright that looking at it is like looking directly at the sun. Even at very great distances, anyone who has the fireball within field of vision at the exact instant of detonatior may suffer a retinal spot burn. The lens of the eye concentrates the light from the fireball into a small spot, and within that area the retina of the eye can be permanently scarred. Please note that the damage is confined to one very small spot, and the impairment of visual acuity is usually slight. Only people who have the incredible bad luck to be staring directly at the bomb when it explodes would suffer serious impairment of vision. Even these people would not be completely blinded, but would simply be unable to focus on an object by looking directly at it. The experts regard this kind of injury as extremely unlikely.

There is a second influence on the eye which is of more interest to us. The incredible brilliance of the flash is a little like having several people set off flashbulbs around you all at once. This scattered light can be so bright that it causes temporary bleaching of the retina, leaving you with "dazzled" vision. The effect clears up in a few minutes to a few days and has no permanent effect on the eye. (It could, however, bring your evacuation vehicle to an abrupt halt.) The sensitivity of the eye to

TABLE 4
Maximum Radii of Thermal Effects

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

this flash will vary with weather conditions (haze spreads the glare) and with the time of day. Night-adapted eyes are much more vulnerable because the pupil is dilated.

The rest of table 4 refers to the distances at which various common materials would be charred on the surface or would actually catch fire following the thermal pulse. The distances listed for human skin burns presume that the victim is just going to stand there and take it. Considering that the thermal pulse of a megaton bomb lasts several seconds, this assumption of passive immobility is pretty strained. You should interpret the figures as the extreme ranges at which you could possibly be burned.

The skin-burn figures in table 4 do not allow for variation in skin color. White-skinned people are likely to have much greater resistance to flash burns than darker races. This point was brought home to me while viewing films of a megaton test in the Pacific in which a flock of black terns and white terns was exposed to a thermal pulse. When the bomb exploded, the birds were startled and flew around in great confusion. A few seconds later, when the thermal pulse was peaking, the black birds suddenly began to trail streamers of smoke and literally "went down in flames." In seconds the flock was reduced to white birds only.

Notice the emphasis in table 4 on the word "dry" in several categories. The scraps of newspaper lying in the street, pine needles, or dead leaves are only going to ignite if they are bone dry. In most places that limits the incendiary effect of the thermal pulse to the driest summer months. If the leaves are wet and muddy or buried under a foot of snow, the thermal pulse won't set them on fire.

In spite of these factors, a nuclear explosion does produce fires. Flash ignitions account for some of the fires, but most are caused by blast damage which breaks electrical lines, ruptures gas pipes, and generally makes kindling out of wooden buildings. We tend to think of the pictures of Hiroshima in this connection; these show a city utterly leveled and burned to the ground. It is important to remember that Hiroshima was a city of buildings composed largely of wood, paper screens, and bamboo, in which cooking facilities and heating were provided by charcoal braziers. A modern American city isn't nearly as vulnerable to fire as was Hiroshima.

According to the experts, the kind of "fire storm" which destroyed Hiroshima is probably not possible in our cities. Only in wholesale distribution and slum areas is there enough loose combustible material to support the beginning of a fire storm. If one did get going, it would tend to be self-limiting, since the winds generated by a fire storm blow inward toward the center of the burning area and do not spread the flames.

If no fire storm forms, there is still the possibility that normal fires might spread downwind from the area of the explosion. Such fires could spread for many miles in some areas, but they would soon burn out of the devastated area and into neighborhoods with intact fire-fighting capability. In the case of an air burst with no significant local fallout, there is no reason why these fires could not be fought and contained in the normal manner. (Of course the fact that it could be done doesn't mean that it would be done.) Notice that even in this case the three-quarters of the city not lying downwind of the hypocenter would be relatively safe from fire.

A significant problem for survivalists is that of wildfires started by nuclear explosions. If the war begins during the driest summer months, it will be possible for unimaginably large areas of forest, chaparral, and grassland to burn. (Within this century there have been fires in the northern Rocky Mountains which have burned for weeks and covered many thousands of square miles.) These could be controlled in some areas, but in other locations they would burn until they ran out of forest. A wildfire can cover ground quickly, too, traveling as fast as ten miles an hour in some cases. Even if you select a retreat site that will escape all nuclear weapons effects, you will still have to give some thought to the delayed arrival of forest fires. (Natural forest fires occur all the time and will also threaten your remote retreat if the United States Department of Agriculture Forest Service is too busy to put them out.)

Electromagnetic Pulse

In addition to the intense light of the thermal pulse, a nuclear explosion also produces a burst of electromagnetic energy in the radio and radar portion of the spectrum. This is called the electromagnetic pulse, or EMP. Normal air and surface bursts do not produce a significant degree of EMP, but extremely high-altitude explosions (on the edge of space) produce an EMP that staggers the imagination.

A strong EMP can induce a current of electricity to flow in any large metal object, such as an automobile body, a power line, or a radio antenna. The longer the object, the more powerful is the surge of induced current. This current is capable of causing actual damage to radios, televisions, telephone networks, power networks, and computers.

The amazing thing about the EMP effect is the range of damage. High-altitude megaton tests in the Pacific knocked out emergency communications and city power in the Hawaiian Islands, over 750 miles away. Calculations show that it will be possible for the Soviets to explode one large bomb high over Omaha, Nebraska, and disrupt electrical equipment literally from coast to coast. If your retreat group intends to rely on CB radios, amateur radio equipment, microcomputers, telephones, or even electric blasting caps, you will need to consider the EMP question very carefully.[5]

Nuclear Radiation Units

When scientists start talking about radiation exposure, they use special terms to describe exactly what they mean. Three very common terms are the roentgen, the rad, and the rem. A roentgen is a measurement of how much gamma radiation is present. The rad is a measurement of how much radiation is absorbed by the body (or by a radiation meter). A rem is a measurement of how much damage the absorbed radiation does to the body. These terms are complex, and substantial "fudge factors" are involved in converting one unit to another, depending on the energy of the radiation, the type of living tissue exposed, and the species of animal involved. Fortunately, for humans exposed to gamma rays from fallout, the three units are approximately the same. In the civil defense context they are treated as essentially interchangeable.[6] I have simplified the matter by using the initial "R" in all instances where a more precise meaning is not necessary.

Initial Nuclear Radiation

The initial nuclear radiation is that produced within the first minute of the explosion. Virtually all of the radiation produced by the bomb appears within this time. (Fallout contains only 1 percent of the radiation produced by the explosion.) The important thing for retreaters to know about the initial nuclear radiation is that it is extremely limited in range. In order to receive a lethal dose of initial radiation, a person would have to be standing in a totally unprotected location less than two miles from the center of the fireball. If you think about that for a minute, you'll discover that anyone doomed by this kind of radiation exposure has only seconds to live anyway. The intense blast at that range will be lethal even if the thermal flash isn't. There is really no need to worry about initial nuclear radiation.

Fallout

Fallout is a simple word which represents a very complex phenomenon. Once again, though, the real danger it represents is much less than the legendary danger.

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

The amount of fallout formed and its distribution over the landscape depend on many interacting factors, such as the design of the weapon, the size of the particles, the height of the explosion above the ground, and the weather conditions at the time. In the case of an air burst, for example, the explosion occurs high enough in the air that no dirt is drawn up into the cloud. In this case the radioactive gases have no particles to condense upon, and instead they form very tiny droplets which are too small to settle out of the air. Therefore, in air bursts such as those at Hiroshima and Nagasaki, casualties due to fallout are completely absent.

This is a very important point to keep in mind for retreat planning, because the most efficient way to damage a city is by using an air burst. If we presume that the aggressors (regardless of their motives) are professional

MISLEADING FALLOUT MAPS

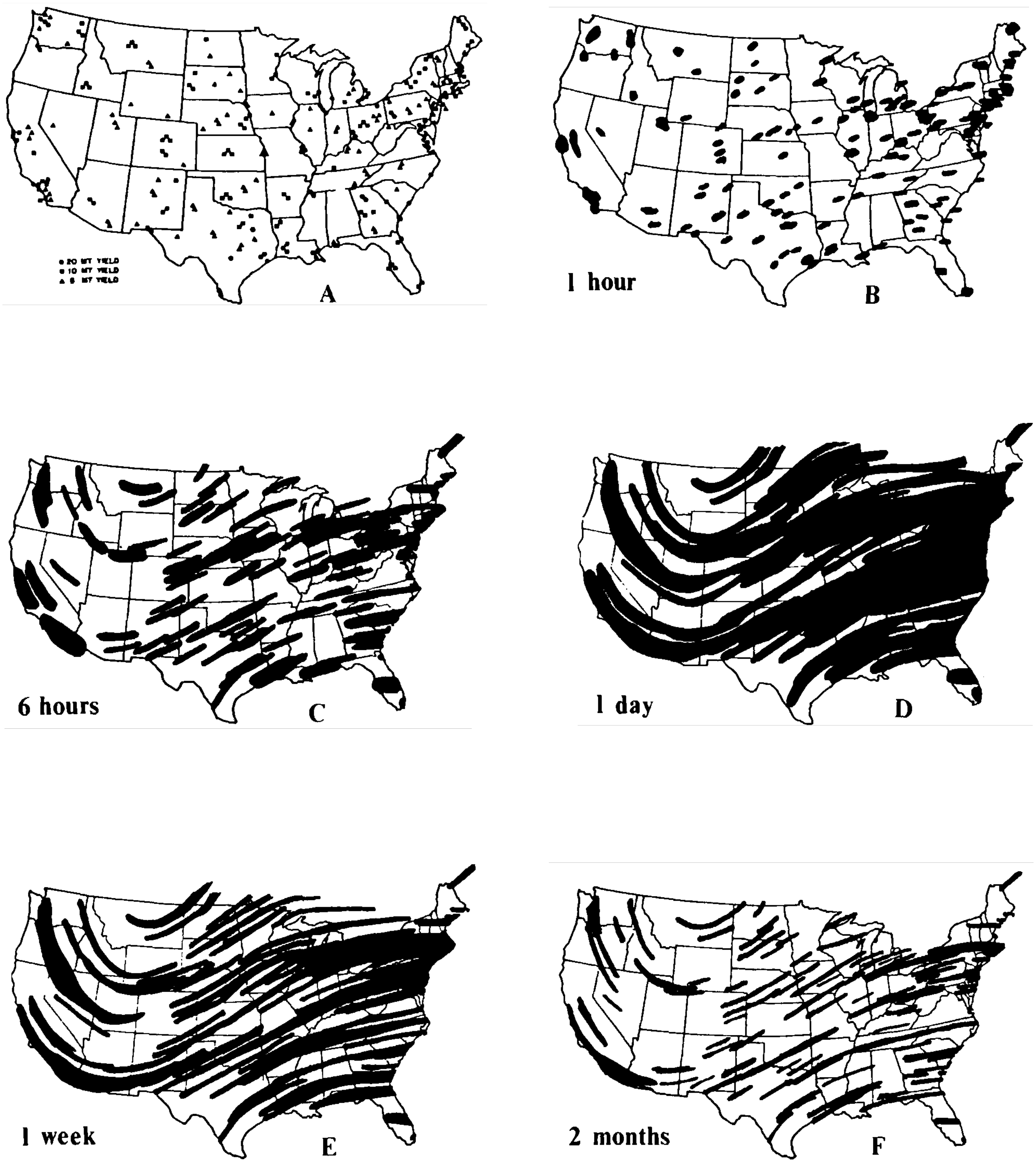


FIGURE 1: Misleading Civil Defense Fallout Maps. These maps show areas having more than 0.2 R per hour of fallout radiation at various times after a Soviet attack. The scenario assumes inappropriate targets, gigantic bombs, and universal ground-level detonations. No Soviet general would contemplate such an attack. (From the United States Congress; see Radiological Defense Textbook, Defense Civil Preparedness Agency, June 1974 SM-11.22-2.)

enough to use air bursts over our cities, then only the Minuteman missile fields and a few control centers are likely to be attacked with fallout-generating ground-level explosions. In that case, 90 percent of the nation will be fallout-free.

Figure 1 shows fallout patterns from a hypothetical attack on the United States, as derived from a Congressional study conducted in 1959. These maps are typical of those you see in many civil defense books, and they are almost entirely wrong. The targets selected are inappropriate, the weapons used are too big, and the fallout patterns presume universal ground level bursts. I have included figure 2 as a counter-example. In it the darkened areas represent local fallout after a realistic attack. Under realistic circumstances the fallout picture is much less alarming than the typical examples would indicate.

After a surface burst, the fallout gradually settles to the ground over a period of about twenty-four hours. This is the local fallout and consists of granules which are large enough to see with the naked eye, although the larger ones reach the ground fairly quickly, and by the end of the twenty-four hour period the dust is very fine. After the first day, the particles remaining in the air are so fine that they take weeks or months to finally reach the ground, usually carried by drops of rain or flakes of snow. This is the delayed fallout.

The design of the weapon determines both the amount of fission products available for fallout formation and the size and height of the mushroom cloud, which influences the fallout's distribution. In general, it is only the fission portion of the bomb that produces fallout. A 1-megaton 100 percent fission bomb will produce the same amount of fallout as a 2-megaton weapon using 50 percent fission and 50 percent fusion. Although the total amount of fallout is the same, the 2-megaton bomb may produce less severe exposures on the ground because the greater size of the cloud will spread the fallout more thinly over a larger area. This is a case where "bigger" isn't necessarily "badder."

The path of a fallout particle from the top of the mushroom cloud back down to the earth's surface can be very complicated. As a particle descends, it falls through many layers of the atmosphere, where winds may be blowing in different directions. Therefore, as the particle falls into each new layer, it may be temporarily carried off in a new direction relative to the ground. This makes it difficult to predict exactly where the fallout will land. Fortunately, within the United States the occurrence of radical differences in wind direction between atmospheric levels is not that common, and we can visualize the fallout as generally being carried off in one direction. This is a particularly good approximation for those areas within 50 to 100 miles of the target, where the

FIGURE 2: A Realistic Post-attack Fallout Map. This scenario assumes a counterforce strike against our ICBM fields which might or might not be accompanied by air bursts over bomber bases and cities. Air bursts produce no fallout. (Based on Analysis of Effects of Limited Nuclear Warfare, United States Senate Committee on Foreign Relations, September 1975.)

grains settle quickly and are only briefly influenced by the wind.

The speed of the wind which carries the dissipating mushroom cloud away from the target is very important to the distribution of the fallout. Since almost all of the grains reach the ground within twenty-four hours, the total distribution of fallout on the landscape will depend on how far the wind can carry the cloud during the first day following the explosion. Less obvious is the fact that the particles sift out of the cloud at a constant rate, and if a high wind carries the cloud across a large territory during the first day, the density of particles falling in any one area will be greatly reduced. High winds greatly increase the total size of the contaminated area, but greatly reduce the amount of fallout on the ground at any one spot.

Incidentally, the winds which move the cloud occur at an altitude of roughly 40,000 to 50,000 feet. The local wind direction you experience on the ground has nothing to do with winds at this height. In the United States the general rule is that these high-altitude winds travel from west to east. In the northern half of the country, the probability that fallout will be received from a target to the east is less than 1 percent. (That means you will get fallout from the east in roughly one nuclear war out of a hundred.) In the southern states the appearance of tropical summer storms makes the prediction of fallout patterns less certain. Even then, though, west to east winds predominate. The speed of the winds is commonly between 50 and 100 miles-per-hour and can sometimes reach 300 miles-per-hour. These speeds are high enough to help out the retreater by spreading the fallout very thinly in most of the contaminated areas.

Local weather does not normally affect the pattern of fallout deposition, but it can affect the rate of deposition. Fallout particles can be "scavenged" from the remains of the mushroom cloud by the strong downdrafts of thunderstorms, for instance. Also, when fallout particles drift down into a layer of moist air, the moisture may cause the particles to fall faster. Either mechanism can produce local "hot spots" where radioactivity on the ground is as much as ten to thirty times that of the surrounding area.

Figures 3 and 4 show idealized fallout distributions at various times after the ground-level detonation of a 1-megaton fission bomb. These examples assume that the downwind travel of the radioactive cloud proceeds at a rate of 15 miles per hour, and that winds at all altitudes are blowing in exactly the same direction.

To see how radioactivity builds up and decays at various distances from the explosion, first consider an area located twenty miles downwind of the target. At one hour after the explosion, the fallout has just started to arrive. The rate of radiation exposure is only 10 R per hour, and the total dosage for an unprotected person is 10 R. Fallout continues to arrive until it reaches a peak at about two hours, when the rate of exposure is over 1,000 R per hour. By six hours after the explosion, fallout has stopped arriving and decay has set in, bringing the rate of exposure rapidly back to 300 R per hour. The total dosage accumulated continues to increase and at six hours has just reached 3,000 R. By eighteen hours the rate has fallen to 80 R per hour, and the total dose has increased to 4,800 R. After one week, the figures will be 5 R per hour and 6,700 R total. At the end of the first month, the rate of exposure is down to 1 R per hour and the total accumulated dosage is 7,300 R.

What could people do to protect themselves at this location? A standard home fallout shelter will cut down radiation exposure to under 200 R for the whole month—a dose many people can tolerate without ill effects (see table 5). Unfortunately, the area would be radioactive enough to make it dangerous to re-occupy for two or three months. Unless retreaters are prepared to stay underground for ninety days or so, they should plan to evacuate.

TABLE 5
Radiation Dose/Time Relationships

ACUTE EFFECTS	1 WEEK	1 MONTH	4 MONTHS
Medical care not needed	150 R	200 R	300 R
Some need medical care [very few deaths]	250 R	350 R	500 R
Most need medical care [50% die]	450 R	600 R	*

For a fallout situation this category will be insignificant.

If an evacuation takes only thirty minutes, a retreater could leave as early as five hours after the explosion without acquiring a lethal dose of radiation. After twenty-four hours, a three-hour evacuation could be permitted. Two days after the explosion, an eighteen-hour evacuation could be managed. A full twenty-four hour exposure to the fallout could be tolerated by the fifth day. (Note that only one exposure is safe. Going out of the shelter for half an hour on the first day and three hours on the second day would be very dangerous.)

Now consider the situation 100 miles from the target. One hour after the blast, the fallout hasn't even reached this area—no one has been exposed to radiation. The fallout starts to arrive around the sixth hour, but at first the dosage is only I R per hour and the total exposure is negligible. After nine hours, the fallout has all arrived and the exposure rate is up to a peak of 12 R per hour. (This is obviously a far cry from the previous example.) By eighteen hours, the rate has decayed to 5 R per hour, and the total dose has risen to 80 R. At the end

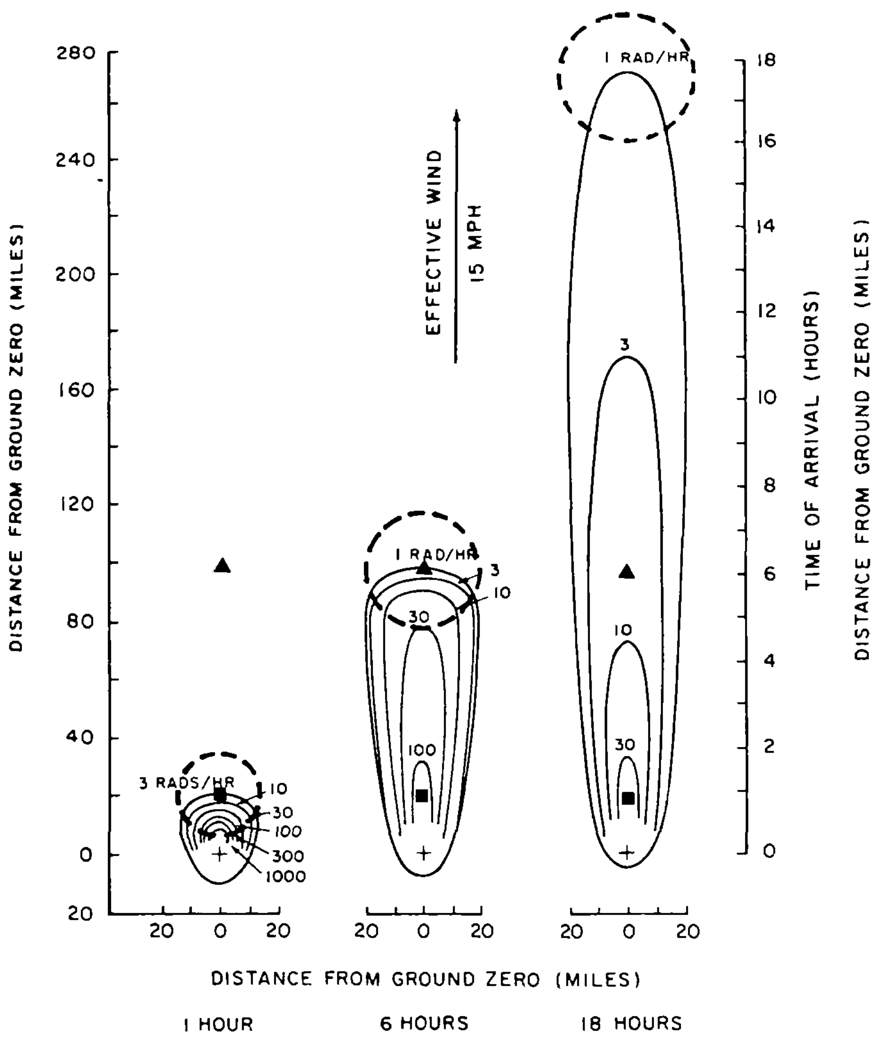


FIGURE 3: Dose Rate (R per hour) of Fallout Radiation. Figure indicates dose rate measured at three times following a 1-megaton fission ground burst.

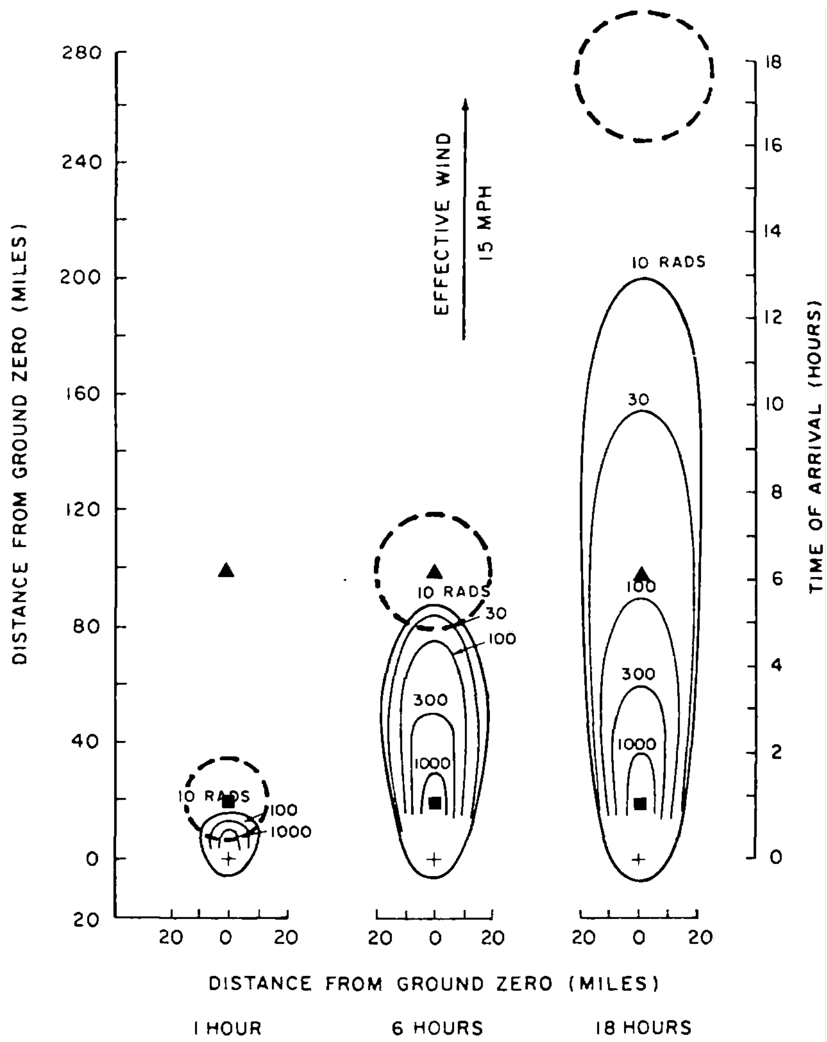


FIGURE 4: Total dose (R) of Fallout Radiation. Figure indicates total dose measured at three times following a 1-megaton fission ground burst.

of the first week, the rate is 0.3 R per hour, and the accumulated dose is 240 R. At the end of the month, the rate has fallen off to 0.07 R per hour, and the total dose is 300 R.

In this area you could live dangerously and ignore the fallout. A total dose of 300 R in one month is risky, but most people would not die from it or even become very sick. (Individual responses to radiation will differ, however.) If the people at this location were to stay inside normal wood frame houses for the whole month, their exposure would be cut in half, down to 150 R. To play it safe, however, it would be best to use home fallout shelters for at least the first twenty-four hours. This precaution alone would reduce the one-month total exposure to 100 R.

These examples aren't precisely representative of what will happen to us in the United States, however, because they presume four things that are not necessarily true. The first is that the wind is blowing at 15 miles per hour. This is too slow. Usually the winds we are interested in travel with a speed greater than 50 miles per hour. Since higher wind speeds spread the fallout particles more thinly over larger areas, this reduces the exposure to persons on the ground.

The second assumption is that the winds at various altitudes are all traveling in the same direction. This is not a totally inaccurate assumption, but it is not perfectly true, either. Slight differences in wind direction from one layer of the atmosphere to another also serve to spread out the fallout, again reducing the exposure of persons on the ground.

The third factor concerns the use of a 100 percent fission bomb. It is more usual to assume that a megaton-class weapon is 50 percent fission and 50 percent fusion. (The real value is actually closer to 30 percent fission.) Under this assumption all the radiation exposure rates and total dosages are cut in half.

Finally, it will be a rare location that receives fallout from the destruction of only one missile silo. The silos are distributed in groups which are just small enough to assure that their fallout patterns will overlap. As a rule of thumb, we might assume that anyone receiving fallout from one silo will also receive fallout from nine or ten others, too. Exposure rates and total dosages should be scaled up by a factor often to take this effect into account. Notice that multiple explosions will increase the concentration of fallout on the ground but will not greatly extend the total fallout areas in the downwind direction. Since the fallout reaches the ground within twenty-four hours, the distance it travels depends on the wind speed only, not on the number of bombs.

What does all this boil down to? It means that the example shown in figures 3 and 4 is roughly correct for areas near missile fields but greatly exaggerated for all other targets. Most fallout studies use "worst case" assumptions which make the problem look much more serious than it really is.

Ecological Effects of Local Fallout

What about the biological effect the fallout will have on animals and plants in the contaminated area? Effects on unprotected people are described in detail in Appendix D, but I assume that there will be very few people in the fallout areas who will be suicidal enough to expose themselves to the radiation by standing naked in the center of a flat field throughout the danger period. Wild animals and native plants will be subjected to just such exposure, however, and it is important to appreciate what the fallout will do to them.

For the most part, large-bodied mammals react to ionizing radiation exactly as humans do. A dose of 1,000 R will kill every deer, elk, mountain goat, and moose exposed to it. Smaller mammals which spend half or more of each day in burrows beneath the ground will receive some shielding from their burrows, but this effect will be canceled by their extremely close exposure to the fallout grains on the surface of the ground during their active periods. The effect on birds should be roughly similar to the effect on mammals. Ground-dwelling birds will be much harder hit than tree-dwellers or waterfowl.

From the levels of acute radiation dosages which will occur within fifty miles of the silos, there will be significant damage to terrestrial plants of almost every variety. Conifers are severely injured by radiation doses of 2,000 R or more, and grassland species become severely injured at doses exceeding 20,000 R. From these figures we can expect that pine forests will be defoliated and possibly destroyed for thirty miles or so downwind of the silos. Areas of grassland devastation will be much more restricted but will still extend for several miles downwind of each silo.

I want to underline the fact that as bad as all these effects will be, they are restricted to areas adjacent to the missile fields. The amount of actually unlivable area will be very limited. The myth that a nuclear war means a poisoned world for thousands if years is not true. Don't be taken in by it.

Internal Radiation Exposure

One of the most persuasive arguments of the "we're all going to die" crowd is that even if you manage to survive the immediate problems of direct weapons effects, local fallout, civil disruption, lack of medication, etc., you might as well give up because strontium-90 will get into your bones and kill you anyway. There is nowhere you can go, say the proponents of this notion, to escape the radioactive chemicals which will eventually find their way into your body. Well, there is some truth to this objection, but there is also a lot of nonsense implicit in it.

How does radioactive material get into the body? For the most part, such materials are inhaled, ingested, or enter the body through wounds. Inhalation and ingestion of fallout particles and chemicals are significant problems, and retreaters need to take steps to avoid these routes of contamination.

Internal radiation sources are dangerous out of proportion to their activity because even alpha particles (which cannot penetrate the skin) are capable of interacting with living cells when emitted inside the body. In the tissues immediately surrounding an internal radiation source, the exposure can be extremely high even if the particle does not contribute significantly to the total body dose. The potential for inducing cancer or killing nearby cells is relatively great.

Inhalation of fallout particles is not very likely under normal circumstances because during the period when the local fallout is arriving (and is suspended in the air) the particles are mostly too large to be taken in. The nose can filter out virtually all of the particles, and about 90 percent of what little does get in is soon coughed up.

Inhalation of radioactive gases is another matter. These gases, such as iodine-131, cannot be filtered out by normal means and are absorbed into the blood through the lungs. Radioactive iodine is also introduced into the body by drinking water or food contaminated with fallout particles. Since the iodine will dissolve in water, even strained or boiled drinking water is unsafe if it has been contaminated at one time. Once inside the body, the iodine naturally concentrates in the thyroid gland, where it can produce permanent damage. This effect is particularly noticeable in children, whose subsequent growth can be stunted by the lack of thyroid hormones. Fortunately, the half-life of radioiodine is about eight days, and a few weeks after the attack, most of it will have decayed. By simply avoiding contaminated food and water for a month or so after the attack, you can eliminate most of the risk.

Other radioactive elements which can be absorbed through the digestive system include the "bone seekers," strontium-90 and barium-140. These elements are similar to calcium in chemical behavior and tend to become incorporated into bones, where they remain permanently. Strontium-90 has been the focus of some pretty lurid tales from time to time, including predictions of "poisoned" agricultural products and universal leukemia. Fortunately, the natural systems through which strontium reaches the human body tend to operate very much in our favor.

Strontium-90 from fallout is deposited on top of the soil, and unless the ground is plowed, the strontium tends to remain near the surface. Plants with deep roots pick up very little of it. Even shallow-rooted plants absorb more calcium from the soil than strontium. When an animal eats the plants, the strontium is absorbed into its body and deposited mainly in the bones. The proportion of strontium deposited in the edible meat and milk is surprisingly low and acts as a barrier between humans and the radioactive chemical. Even within the human body the strontium from plant or animal food is mostly eliminated, although a small proportion does find its way to the bones.

Once inside the bone, the strontium-90 decays slowly, releasing low-energy beta radiation, which does little damage. Unfortunately, the decay product is yttrium-90, which decays again almost immediately, producing high-energy beta radiation. In areas subject to local fallout, enough strontium-90 may be deposited in the fields to produce a noticeable (but not necessarily large) increase in the incidence of bone cancer, anemia, and leukemia. Areas outside of local fallout patterns will not have sufficient strontium to produce any of these effects.

The distribution of strontium-90 from fallout corresponds closely to the contours of local fallout as described in Appendix B. The total extent of strontium-90 contamination exceeding current Energy Research and Development Administration (ERDA) standards for agriculture from a single ground burst is roughly equal to twice the 150 R exposure contour distance. This means that even in areas where the local fallout is not too severe, the strontium-90 contamination would still make the land unusable under current industrial standards. After a nuclear war, the standards may well be revised upward substantially. Current standards are intended to prevent any possibility of an increase in the cancer rate, however small, but in the post-attack period this will no longer be an important factor.-The fallout gamma exposure will already have boosted the cancer rate, and exceeding the ERDA strontium-90 limit will seem unimportant when the only alternative is starvation. There will be locations too heavily contaminated to use for agriculture, but they will be limited in extent. To put this in perspective, we have been talking about "acceptable" gamma ray exposures as high as 150 R in the civil defense context, but a dose of even I R would alarm an ERDA health physicist. Strontium-90 won't be that big a problem.

Cesium-137 is another internal emitter but it differs from strontium-90 in four significant ways. First of all, it tends to stay in the soil and not be taken up by plants. The primary way for it to enter an animal's body is through ingestion of surface-contaminated plant materials. The second important difference is that cesium imitates potassium (rather than calcium) and tends to concentrate in meat instead of bone. Therefore, the ingestion of meat from animals which have been feeding on contaminated plants can be hazardous. The third difference is that cesium-137 is a gamma ray emitter and contributes to the whole body radiation dose rather than concentrating in one organ. Lastly, cesium has a relatively short biological half-life and is 90 percent eliminated from the body within a year of being ingested.

There are other internal radiation sources, but iodine, strontium, and cesium are the three which are the most dangerous. The others either imitate the behavior of these three elements, or they are not retained by the body and are rapidly eliminated. For retreaters the lesson is that it would be better to avoid fallout areas when you select a location for your post-attack homestead. If you do have to raise your own food in a fallout contaminated area, remember that internal emitters won't kill you outright but will increase the possibility of dying from radiation-induced diseases. Much of what we know about internal radiation comes from studies of radium wristwatch-dial painters who used to lick their brushes to keep them pointed and unknowingly swallowed enormous doses of radium (a bone seeker). Many of these people were still around decades later when the Argonne National Laboratory scientists went looking for them. The workers had serious bone damage, but they had not been killed en masse. You won't be either.

Long-term Effects

In 1975, the National Academy of Sciences published "Long-term Worldwide Effects of Multiple Nuclear Weapons Detonations," a massive evaluation of the effects a full scale nuclear war will have on those parts of the world not within the influence of the direct weapons effects and local fallout.[7] The scientists attempted to evaluate and predict the results of a United States/ Soviet war involving roughly 1,000 explosions in the 10-megaton class and 5,000 explosions of about 1 megaton. (You have to admit that they were picturing a pretty respectable war.) Their report is the most up-to-date evaluation of this subject; I have used it heavily in preparing the material for this section.

The long-term effects of a nuclear explosion arise from three processes. The first is the injection of radioactive particles into the stratosphere, where they remain as a suspended aerosol for months before coming down. The second factor in creating long-term effects is the injection of non-radioactive dust into the stratosphere along with the delayed fallout. Like an immense volcanic eruption, the detonation of thousands of silo-destroying megaton weapons will put millions of tons of dust into the air, effectively changing the clarity of the atmosphere and shading the planet's surface. The scientists predicted a resulting drop in average temperature of about 1 degree centigrade. The dust is expected to settle out of the air completely in two years or so.

The third factor is the creation of enormous amounts of nitrogen oxides in the superheated air of the mushroom clouds. Oxides of nitrogen in the quantities expected from the detonation of 10,000 megatons will produce a significant reduction in atmospheric ozone. Since the ozone screens us from solar ultraviolet (UV) light, the amount of UV light will rise dramatically. The NAS scientists were very cautious about saying exactly how great an increase there will be, but their ballpark estimate was in the vicinity of six times the present UV level. This effect will return to near-normal levels in five or six years, although total recovery will take decades.

What effects will these developments actually have on us and our surroundings? Let's take plants first. Natural plant communities outside of local fallout areas will show no damage from delayed fallout, but the drop in world temperature and the UV light increase could have drastic effects in some areas. Not much is yet known about the UV threat except that some plants seem to be very sensitive to this type of light; a worldwide six-fold increase in U V light might mean extinction for many natural species, possibly including a few very important natural dominants. That one is left hanging.

We may assume that climatic cooling won't hurt native plants very much because we know from experience that plant communities can survive such periods without any damage. The volcanic eruption at Krakatoa, for example, did little to harm natural plant communities in the rest of the world. Crops will be more severely affected, however, because even a 1-degree drop in average temperature significantly shortens the number of frost-free days in a local growing season. Thedrop in temperature will eliminate wheat growing in Canada for a year or two and will move agricultural belts a few hundred miles southward all over the continent.

More serious is the fact that many agricultural crops show tremendous variation in UV sensitivity. Corn, soybeans, barley, wheat, and alfalfa are fairly resistant to UV damage and can be relied on to grow under high UV illumination, but tomatoes, peas, beans, onions, sugar beets, and lettuce will not do well at all. I think about that fact every time I see advertisements for "disaster" vegetable seed canisters. Corn is usually the only plant offered that would stand a chance of surviving the UV exposure (see table 5).[8]

Most wild animals will not suffer greatly from the long-term radioactivity produced by a nuclear war. The lifetime residual radiation dose for most wildlife will be about 2 rads (or 2 rem on the human scale). This is close enough to the natural background level to be unnoticeable. There may be some damage to wildlife in arctic and alpine ecosystems, where lichens and mosses are the chief form of plant food, because these plants tend to concentrate fallout. This biological magnification will increase the internal dosage of radiation received by herbivores such as caribou.

The UV light increase is likely to be a more serious danger to wildlife species than radiation. Many animal species are dependent upon particular plants which may die out under high UV exposure. This possibility is too uncertain to explore with any confidence, but as a hypothetical example, imagine the implications for a population of squirrels if suddenly their entire forest of oak trees were to die. Starvation would reach all the way up the food chain to animals which prey on squirrels, to still others which prey on the predators.

Direct effects of UV on wildlife are possible, but they shouldn't be serious for most animals. Experience has shown that animals which have accidentally become sensitive to sunlight (by eating certain toxic plants) simply find a shady place to spend the day and then forage at night. With the exception of birds, most of which are helpless in the dark, I suspect that most wildlife will adopt the nocturnal pattern for a few years. (Actually, many mammals are naturally nocturnal and are not in direct danger from U V anyway.) Larger mammals that typically spend the winter searching for food in snow-covered areas will not fare so well, however. The high UV concentration may mean severe snowblindness and starvation for them. After the first winter, big game could be very scarce in much of the temperate zone.

Effects on domestic animals will be almost identical to those for wildlife. If there are humans around to guide animals to food and water, however, livestock will not be seriously affected.

What about people? Many of the nuclear war horror stories we see on television or read about in science fiction novels involve sweeping long-term dangers, guaranteed to exterminate the human race if the hero of the story fails to clobber the bad guy in time. This is garbage. Of all the large animals on the planet, we have the least to fear. This is mainly due to the fact that people are capable of understanding what is happening and can take steps to protect themselves. That is what this book is about, after all.

The total residual radiation dose (both internal and external) for a human survivor not living in an area of local fallout will amount to less than 10 rem for a period extending up to thirty years after the war. Once again, this is next to nothing. Remember that the exposure has to be over 200 rem delivered within a week to cause acute, lethal reactions in even 1 percent of the population. We are talking about 1 / 3 rem per year or less. It doesn't seem very alarming, does it?

If you have read Nevil Shute's On the Beach, you will remember the terrifying and inevitable wait for the end, when the delayed fallout from the northern hemisphere finally spread to Australia, killing the last human survivors after just a few days of exposure.[9] The disarmament people have made great use of this myth, hinting that it really could happen. Could it?

A good-sized nuclear war will produce only 1/3 rem of exposure per year for residents of the northern hemisphere, and the evidence to date indicates that land areas in the southern hemisphere will get only one-third as much radiation as in the north. Let's make it easy and call it 1/10 rem per year for Australia. How many weapons would we have to detonate to increase the long-term fallout exposure level for Australia up to an average of 1,000 rem per week? The answer, rounded off a little, is 500,000 times the number of weapons which the NAS thought would be enough for a full scale war. Even with the insane competitiveness of the arms race, I suspect that it will be a while before we can match every available weapon with half a million others just like it.

What effect will a 10-rem exposure over thirty years have on the northern hemisphere survivors? For one thing, there will be an increase of about 2 percent in the spontaneous cancer death rate. (I suspect that there will be simultaneous increases in deaths from starvation, disease, and local riots which will make the cancer rate next to invisible in any case.) There will also be an increase in the numbers of radiation-induced deformities in unborn infants at the time of the war, but the increases will not be distinguishable from non-radiation defects.

The effect of inhaled plutonium particles in producing cancer of the lungs was not clearly defined by the Academy report; there is some controversy over that subject at this time. One interesting comment, recorded in the report, though, was that the average New Yorker in 1963 had about 1,000 plutonium particles in his lungs derived from weapons testing fallout. At last report, New York was nearly bankrupt but not experiencing any lack of population.

The increased U V dose to humans may produce a 3 to 30 percent increase in the levels of skin cancer when averaged for the forty years following the war. This means that while every 100 people who develop skin cancer now, between 103 and 130 may get the disease during the years after the war. This prediction assumes that everybody will spend a lot of time basking in the sun during the first three years, when the UV levels will be high. The cancer would be a delayed effect of this exposure. There is a serious objection to this assumption, however. If the U V levels get that high, a Caucasian will develop a blistered sunburn within ten minutes of exposure to the sun. Incapacitating snowblindness will occur equally quickly in snowy areas. Most people will probably try to avoid the sun for a while, which should cut down on the projected skin cancer rate. Remember that the UV problem only lasts a few years, not forever.

The final long-term effect on humans is the potential genetic damage which could be caused by radiation or UV light. Once again, many movies have been made which capitalize on rampaging mutants, deformed monsters, and other supposedly "genetic" changes in the human race. What are the facts?

The Academy scientists carefully took everything into consideration and decided that there will be an increase in birth defects of about 0.1 percent. This means that the spontaneous rate of defective children, which is 6 percent in our country, will increase to a high of perhaps 6.1 percent in the years after the war. Once again, the difference will be too small to notice, and the effect will be temporary.

For retreaters, the long-term effects of a nuclear war pose four direct difficulties. The first is the problem of being able to function in a high-UV environment. That ten-minute sunburn will be a serious nuisance. The second problem is the scalding of crops by UV light, which will mean that many of our most productive food plants will have to be shelved for several years until the UV levels return to normal. The two to three years of abnormally cool weather will mean that a crop which does well at your retreat site under normal conditions will be unable to succeed there when the agricultural belts shift to the south. Lastly, U V-induced blindness in big game animals (other than hibernating bears, perhaps), will make hunting a very unproductive activity in any areas subjected to winter snows. Retreaters will have to take all these phenomena into account in their survival plans.

Effect on Civilization

The long-term effect which a full scale nuclear war will have on Western civilization is fairly easy to define. Western civilization as we know it will cease to exist.[10]

There can be little doubt that a catastrophe which severely damages all the major cities of a civilization, which reduces the human population of those cities to a quarter of their original number, which destroys the factories, tools, and power sources upon which the economy is based, and which then causes ecological disturbances sufficiently great to make agriculture difficult for five or six years will deal a very severe blow to the stability of the civilization. When you consider that our civilization has been showing signs of running out of raw materials, that the easy seams of coal and veins of iron ore have all been used up long ago, that we have had to travel to the shore of the Arctic Sea for oil, you begin to suspect that economic recovery will not be possible.

Politically, it is difficult to imagine the United States government surviving the crisis. The halls of government are high-priority targets both at the national and state levels. Since the military forces will bear the brunt of the attack, it is doubtful that the nation will be able to muster a viable defense after the war. The great probability is that individual counties and associations of towns will band together into local alliances. The old line from the Declaration of Independence about our nation being composed of "free and independent states" may again become true for the first time in 200 years.

Within these recovering fragments of the nation, it is likely that local economies will soon be established with a fair amount of specialized labor. People will start using their old knowledge to put things back together. The people who say that we will become savages, or that at best we will be thrown back to the level of pre-industrial America, are not right. Imagine Civil War era Americans with a detailed knowledge of electronics, aerodynamics, medicine, and modern agricultural science who have the wreckage of 250 major cities to plunder for parts. It will not be a return to an old way of life, and it will not be a matter of living like savages. It will be another in a long string of difficult ages, when human beings will work hard to rebuild their world — as they have done so many times in the past.

What about Civil Defense?

For those of you who are wondering what the nation's civil defense program could do for you in the event of a nuclear attack, the answer is nothing. This is not just my opinion. In a recent interview, the director of the Defense Civil Preparedness Agency, Bardyl Tirana, candidly admitted that there is no real civil defense program in this country anymore." When asked what he would tell his family if he knew an attack was coming, Tirana replied, "I don't know. I guess I'd tell my wife to get in the car and start driving. To where, I don't know."

If the Tiranas had joined a retreat group they would know where to go in a crisis. How about you?

Commentary

Before closing this chapter, I think it is appropriate to discuss a few political subjects. The point of view of the survivalist is unique and provokes an unusual spectrum of political attitudes regarding military spending and arms control efforts.

Survivalists should vigorously oppose the following developments:

1. Strategic arms limitation treaties. The SALT talks were a noble idea, but in practice they have made a

nuclear war more likely in the near future by widening the Soviet lead in strategic weapons.

2. Any new land-based missile program, whether using silos, underground mobile launchers, or surface mobile launchers. More than 90 percent of the fallout we can expect from a Soviet attack will come from the destruction of our existing land-based missiles. Adding more gratuitous targets will just make our individual survival problems that much more difficult.
3. Deployment of strategic cruise missiles. Most of these mindless missiles will detonate over Soviet targets which have already been damaged by previous missile attacks. Multiple detonations over devastated areas will just add to the long-term ecological disturbance without aiding the military effort.
4. "Super-fallout" enhanced radiation weapons. There was once a lot of interest in "salting" nuclear weapons to produce very long-lived fallout. This would have been used to deny access to a region of special military or industrial value. Any future resurgence in this interest should be vigorously opposed. The long-term effects are severe enough as it is.

Survivalisls should support these developments:

1. Any form of civil defense activity, even the dubious crisis relocation plans in fashion at the moment. Government civil defense efforts generate research and surplus equipment of direct benefit to survivalists. Examples of these resources include both the surplus radiation meters discussed in chapter 8 and the government target list studies mentioned in Appendix A.
2. The B-l bomber, or any similar piloted delivery system. Any human-controlled vehicle is preferable to any computer-controlled vehicle from our point of view. A human pilot, unlike a cruise missile autopilot, can elect to abort the mission if the primary target has already been destroyed. It's the best way to avoid the ecological consequences of "pounding the rubble."
3. Improved missile guidance systems. The next generation of ICBM guidance systems is expected to drop a Minuteman warhead within thirty feet of a Soviet silo after a 2,000-mile flight. If guidance systems can really be made this accurate, megaton warheads will be unnecessary for silo destruction. Small sub-kiloton warheads, or even conventional explosives, might be substituted. This would virtually eliminate the possibility of serious ecological disruption.
4. Deployment of the neutron bomb. This weapon is the first positive achievement in forty years of nuclear weapons development. With about 2,000 1-kiloton neutron warheads, the NATO forces could easily stop a Soviet armored attack on western Europe and still have a territory worth defending afterward. The ability to achieve this military goal without destroying the defended territory is a tremendous step forward. The weapons NATO now stocks would stop the Soviet tanks easily enough, but they would also cause severe damage to the defended nations.
5. The Trident submarine program. To the extent that Trident submarines can be used to make Minuteman silos obsolete, they are a positive development. Even though the Trident system multiplies the total number of megatons poised in readiness for a "spasm" war, this is tolerable if it helps eliminate the land-based silos. As survivalisls, we can tolerate any development which removes the 2,600 American and Soviet missile silos from the first-strike target lists.

Unlike more conventional political groups, people concerned with surviving a nuclear war must occasionally support increased military spending (even if it undermines the dollar) and at other times oppose it (even if it weakens our defenses). Whether or not the war will be fought is not the question here. The question is how it will be fought. The goal of survivalist political activity in this area must be to alter the conduct of the war toward improved post-attack survival conditions. No one else is looking at the subject in quite this way.

Notes

1. A wealth of information is available to survivalists in the publications of various United States government agencies. When I have referred to such a document, I have included its depository call number to help you find it in a library. Your local library may not have a United States documents collection, but most universities do.
2. Samuel Glasstone, ed., The Effects of Nuclear Weapons, 3rd ed., a report of the United States Department of Defense and the United States Department of Energy, 1977 (D1 2:N 88/2).
3. Norris McWhirter and Ross McWhirter, Guinness Book of World Records (New York: Bantam Books, 1977), p. 393.
4. Robert Merle, Malevil (Anderson, Indiana: Warner Press, Inc., 1975).

5. See chapter 8 for additional discussion of the EMP question.
6. For further analysis, consult table 5 and the discussion of radiation injuries provided in Appendix D.
7. "Long-term Worldwide Effects of Multiple Nuclear Weapons Detonations," a report of the National Academy of Sciences, 1975.
8. See chapter 5 for a more complete discussion of survival gardens.
9. Nevil Shute, On the Beach (New York: Ballantine Books, Inc., 1974). Two fictionalized accounts of nuclear war that are particularly noteworthy are Pat Frank, Alas, Babylon (New York: Bantam Books, Inc., 1959), and Larry Niven and Jerry Pournelle, Lucifer's Hammer (New York: Fawcett Crest Books, 1977).
10. William M. Brown, The Nuclear Crisis of 1979, Defense Civil Preparedness Agency, September 1975. This discussion was heavily influenced by Brown's fictional account of the DCPA's handling of a nuclear war. I highly recommend it.
11. Michael Satchell, "Why the US Worries about Neglected Civil Defense," Parade 21 May 1978, p. 8.

3
To Flee or Not to Flee

WITH APOLOGIES to Shakespeare, the title I have used for this chapter directly poses the key question of all survival planning. To flee or not to flee? Run or stay? Retreat or dig in? To continue to paraphrase Hamlet, is it better to sit still and take it or to get out of the way? Well, it depends.

This chapter is intended to help guide you in selecting among several difficult alternatives in your personal survival planning. In the case of a nuclear war (or some other massive disaster you may have in mind) will you be better off staying at home or would it be better if you evacuate to another area? If you decide to stay, what will you need to do in order to secure your position at home? If your decision is to evacuate, where will you go? How will you get there? Should you drive, hike, sail, or fly? Would it be better to evacuate now, immediately, or wait until the last minute? How will you know when the last minute is at hand?

These are some of the difficult questions every group of retreat planners faces at first. The answers depend mainly on your personal situation. Where you live, how many people are in your group, and how much money you can spend will all affect the decisions. The only area which is completely up to you is how much effort and inconvenience you are willing to tolerate in the name of security. You could move to Bora-Bora and be completely safe from nuclear attack, but in exchange for that security you would have to give up frequent trips to the movies, the grocery store, and your doctor. Where do you draw the line? That's up to you.

Predicting Nuclear Danger Areas and Fallout Patterns

In Appendix A you will find a map and a list describing over 1,500 nuclear attack high-risk areas defined by the Defense Civil Preparedness Agency (and which I have updated). These include 1,054 missile silos which are listed as aggregated "complexes." Areas subject to extremely high fallout are also indicated.

You should check to see if your home or potential retreat location appears on this list. You may be surprised to discover that many nuclear targets are located in remote corners of National Forests, etc. It would be better to be surprised now while looking over the list, rather than later . . .

The target list is divided into primary, secondary, and tertiary targets. Primary targets are mainly Strategic Air Command missile and/or bomber bases and support facilities. These targets will be hit within minutes of the outbreak of the war. Secondary targets are industrial or governmental targets and may be hit immediately or may be designated for attention by Soviet bombers several hours after the first strike. Tertiary targets are centers of civilian population. These targets probably won't be hit in the first strike.

As I mentioned in chapter 2, predicting where the fallout from a particular target will go is a shaky business at best. It is impossible to know what direction the wind will be blowing in the 40,000- to 50,000-foot layer at the moment of detonation, and for this reason, most people simply give up on the whole idea. This is a mistake. Although you can't accurately predict where the fallout will go, you can do a pretty accurate job of figuring out where it won't go. Since retreaters are usually more interested in locating safe areas than danger areas, the mapping of fallout-free locations fits in very well with their needs.

First let's establish some fundamentals. The basic idea here is to plot on a map all the areas near your home (or your proposed retreat) which probably will not receive any local fallout from targets nearby or in surrounding states. By "probably will not receive any local fallout" I mean those areas where the probability of any particular spot receiving fallout is less than 2 percent. If you build your house or retreat encampment in such an area, you could expect to receive fallout once in fifty nuclear wars. Good enough?

The next question is, what do we mean by "fallout?" For the special purposes of this discussion, I have arbitrarily defined fallout as sufficient local fallout to produce 150 rem of radiation exposure in the first two weeks following the attack. If you get less fallout than that, you will be in little danger, because even the most modest protection will cut your exposure down to negligible levels; even without protection, the consequences of such radiation would not be too serious. If your area receives more than 150 rem in the first two weeks, you will have a radiation problem, and some more sophisticated measures will be needed to insure your survival. Therefore we will be mapping areas that have less than a 2 percent chance of receiving more than 150 rem in the first two weeks.

The next question has to do with the targets that will produce fallout. The actual selection is up to you, although Appendix A will help guide your decision. Real-life predictions should involve consideration of local fallout coming only from missile silos and certain key military targets with hardened facilities. These include bases located near Omaha, Nebraska; Riverside, California; Washington, DC; Colorado Springs, Colorado; and possibly the submarine bases at Bremerton, Washington, and Charleston, South Carolina. It is a virtual certainty that the other primary targets (mainly SAC bomber bases) will be hit with air bursts and will produce no fallout.

If you are the kind of person who believes that the Soviets will try to generate as much fallout as possible and will hit as many military bases and cities as possible, you are welcome to go to the extra work of taking all targets into consideration, but I suggest that you not bother. Under those circumstances there aren't any totally "safe" areas worth mentioning. If you are more interested in real-world predictions, however, you can rapidly eliminate your local danger areas and concentrate on safer locations.

Who knows where the wind blows? Several years ago the DCPA compiled "effective wind direction" data for the fallout-carrying layers of the atmosphere over forty representative cities throughout the United States. It found that fallout would almost always be blown to the east of any target. When the high-altitude winds were moving very slowly, the wind direction was usually between north-northeast and south-southeast. At normal speeds—around 50 or 60 miles per hour—the wind direction was usually between northeast and southeast. At higher speeds, the range of variation was even less, roughly between east-northeast and east-southeast.

The DCPA people were kind enough to supply me with the raw data from this study in "windrose" format, which gives the exact percentage of time in which the fallout would be blown a particular direction at a particular speed from any of the forty cities. I used these data to define the directions from each city which could be expected to receive fallout more than 2 percent of the time. Most cities had three such fallout sectors, corresponding to 20, 40 and 60 mile per hour wind speeds. In addition, several cities had a fourth danger sector produced by rare winds over 80 miles per hour. These sectors are listed in Appendix B.

Once you know in what direction the fallout may be blown, how do you know how far it may go? This was a difficult question for me to investigate because the sources disagree, sometimes by very wide margins. The "problem" lies in the fact that the Atomic Energy Commission did not want to kill thousands of people with their tests and therefore avoided creating too much fallout in their Nevada explosions. The Pacific tests did generate plenty of fallout, but almost all of it fell into the sea before anybody could measure it accurately. This leaves us with theoretical models which differ from one another almost as much as they differ from real life.

Eventually I selected two sources of information about the downwind extent of the 150 rem exposure area at two weeks. The first, of course, was Glasstone's The Effects of Nuclear Weapons.[1] The second was the DCPA publication User's Manual, Meteorological Data for Radiological Defense.[2] As you will see in comparing the two sources (in table 6), the DCPA figures indicate downwind travel of fallout about one and one-half times as great as the Glasstone figures. Both presume 50 percent fission surface bursts. Which set of figures you decide to use is largely a matter of opinion. If you assume that Glasstone is right, then the DCPA figures represent a substantial margin of safety. If the DCPA figures are right for 50 percent fission, then the Glasstone figures are very close to correct for 30 percent fission, which is a real-world estimate of the actual fission content of the bombs.

I prefer to use the DCPA figures for 1-megaton fallout and Glasstone's figures for the 10-megaton fallout. On one hand, I know that I'm not overestimating the smaller fallout danger areas, which is the safe thing to do. On the other hand, using Glasstone's figures for the 10-megaton patterns assures me that I am not underestimating them by real-world standards, nor am I overlooking potential retreat areas by exaggerating the fallout danger radius. This is a real problem in terms of the Minuteman silo fallout; if you use the DCPA figures, the danger radii are so large that nothing east of the Rocky Mountains could be thought of as a safe area. That makes retreat planning difficult, to say the least.

Mapping Fallout-safe Areas

The following paragraphs describe the method of mapping fallout safe areas within the United States.

Get a folding United States highway map, such as

TABLE 6
150 Rem Radiation Exposure Distances

WIND SPEED	MILES OF TRAVEL			
	1 MEGATON		10 MEGATON	
mph	Glasstone	DCPA	Glasstone	DCPA
20	115	140*	290*	335
40	165	265*	430*	650
60	210	310*	510*	830
80	250	340*	590*	1,000

*These estimates are preferred. (Distances indicate areas from the target at fourteen days.)

the one produced by the American Automobile Association. It is important that the map be relatively large and that it include the whole country, exclusive of Alaska and Hawaii. (Residents of these states can make do with a state map.)

Refer to Appendix A. Mark a circle on the map that encloses the entire area within 1,000 miles of your location (or the proposed location of your retreat). Plot the locations of all missile fields within this circle. (The missile fields are located exactly in Appendix A; generally, these may be found in the following states: Montana, North Dakota, South Dakota, Wyoming, Nebraska, Colorado, Kansas, Missouri, Arkansas, and Arizona—see also figure 7.)

Draw another circle on your map, this time enclosing everything within 350 miles of your home or retreat site. Within this circle, plot the location of all primary, secondary, and tertiary targets. Use a "l" to designate primary targets, a "2" for secondary targets, and a "3" for tertiary targets.

Now consult the list of forty cities in Appendix B, and check off the names of the cities on the list which fall within your two mapped circles. Mark their locations on your map.

Next, carefully plot the fallout danger patterns for each of the cities which you checked in the last step. You will draw these patterns on a separate sheet of paper, cut them out, and use them as tracing templates in plotting the danger regions on your map.

Figures 5A-5F show you how to construct the fallout danger zone for Albuquerque, New Mexico, following a 1-megaton surface burst in that city. The same procedure can be used with any of the remaining thirty-nine cities listed in Appendix B.

Figure 5A: The easiest way to plot fallout patterns is to use "polar coordinate" graph paper. You can use blank paper, a protractor, ruler, and compass if you like, but the graph paper helps. The very center of the concentric circles on the graph paper will be the location of the target—Albuquerque in this case. Write in the directions of north, east and south. (In most cases you won't need to put in west, because the fallout won't go that way.) Now label the radial lines with their "degree" designations. The line running due north from the target is 0 degrees. The line running east is 90 degrees. Due south is 180 degrees. The number of degrees increases as you travel clockwise around the circle.

Now, how far will the fallout travel downwind? For this example I have used the DCPA estimate for a 1-megaton surface burst: according to table 6, the fallout will travel 140 miles at 20 miles per hour wind speed, 265 miles at 40 miles per hour, or 310 miles at 60 miles per hour. Check the legend of your map to see what the scale is. It may say "One inch equals approximately 100 miles"; this means that the 140-mile distance will be a radius of 140/100 = 1.4 inches. A distance of 265 miles reduced by the same method is 2.65 inches, and 310 miles becomes 3.10 inches. If the scale on your map is not 100 miles to the inch, the method still works. Divide the distance concerned by the map's scale to get the inches of distance on the map. Then draw in three arcs representing 140, 265, and 310 miles on your graph paper. You are now ready to start plotting the danger areas.

Figure 5B: Referring to Appendix B, you see that the 20 mile per hour danger zone for Albuquerque extends from 25 degrees to 175 degrees clockwise. Draw two vectors from the target out to the 140-mile line. This wedge-shaped area is where the fallout from Albuquerque will most probably be deposited when the high-altitude wind speed is 20 miles per hour.

Figure 5C: From the table in Appendix B, you see that the fallout danger area for Albuquerque ranges from 45 degrees to 145 degrees clockwise when the wind speed is 40 miles per hour. Draw in these vectors and extend them to the 265-mile line. This is the area where the fallout will most likely be deposited when the high-altitude winds are blowing at 40 miles per hour.

Figure 5D: At 60 miles per hour, the winds deposit the fallout within an area from 55 degrees to 105 degrees clockwise, extending to a range of 310 miles. (Notice in Appendix B that there is no danger area listed for Albu-

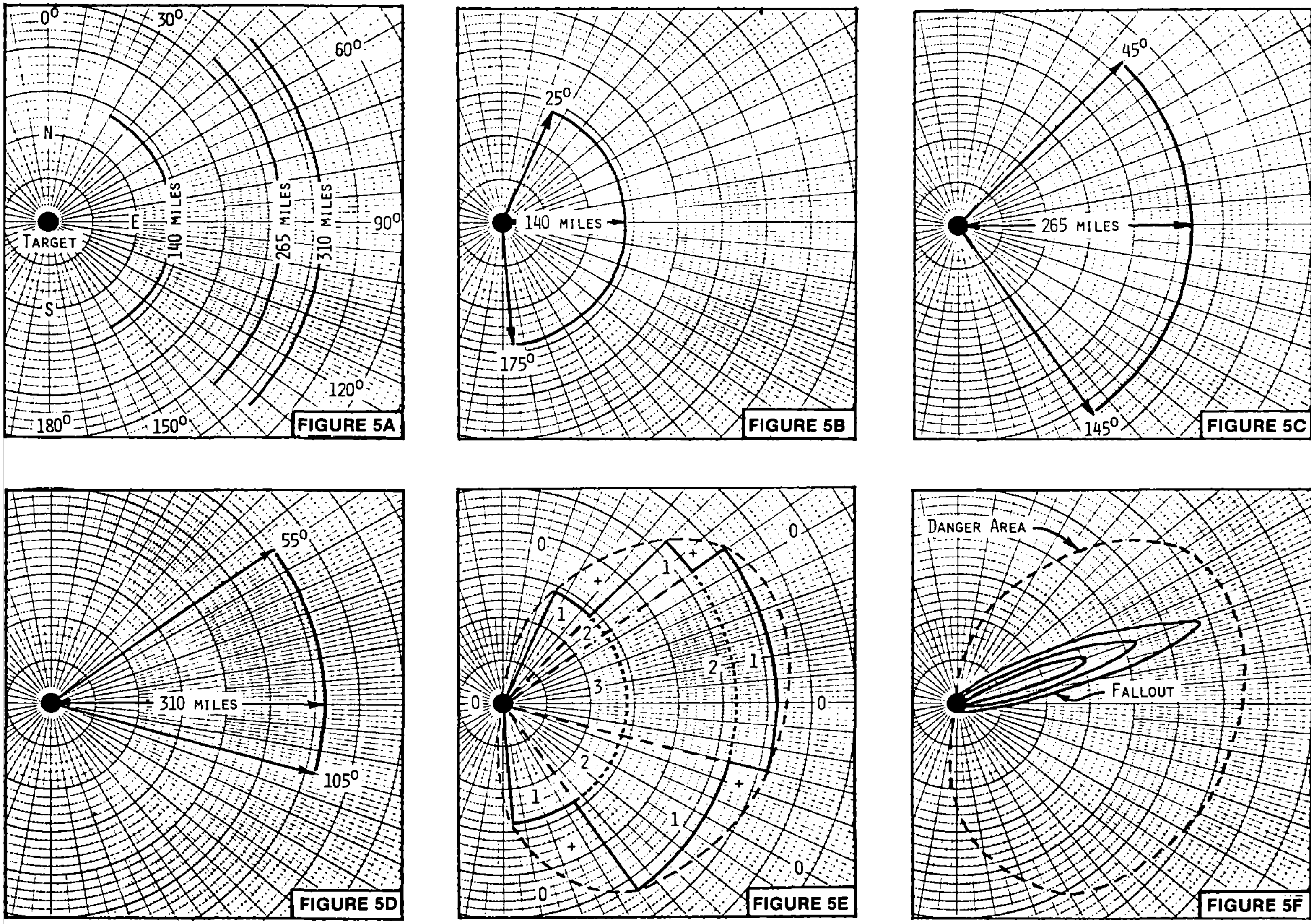


FIGURE 5: Construction of Fallout Danger Area Template.

querque in the 80 mile per hour wind category. In some cases you would have to draw a fourth danger area for the 80 mile per hour winds.)

Figure 5E: In this figure all three danger areas have been plotted together. The 20, 40, and 60 mile per hour danger areas are superimposed in the diagram. The next step is to draw a smooth outline around the ragged and angular pattern of wedges you have constructed. This step will reflect the fact that the winds blow at all the speeds between 20, 40, and 60 miles per hour, too. This outer dashed line represents the total danger area for fallout from a 1-megaton surface burst occurring at Albuquerque.

Figure 5 F: Here the outline of the total danger area has been plotted along with an idealized fallout pattern. Notice that the area covered by the fallout pattern is much less than the total area within the danger zone. The danger zone simply represents the extent of places where the fallout could come down. As figure 6 indicates, the predicted danger zone for the Nevada test site far exceeded the actual location of fallout.

Reconsider figure 5E for a minute. You may have wondered what the numbers were all about. It is not easy to predict the relative risk of living at different locations within the total danger area, but by checking to see how the 20, 40, and 60 mile per hour danger areas overlap, you can get at least a rough estimate of the hazardous locations. The numbers refer to how many of the three individual danger areas overlap each section of the diagram. The wedge-shaped area directly to the east of the target is overlain by all three patterns and has the best chance of receiving fallout. Areas overlapped by only two patterns are not quite as dangerous, and those within only one pattern are safer still. Areas marked "+" are probably within only one pattern. Areas marked zero are judged safe. This method of sub-dividing the danger zone is not statistically sound, but for crude approximation it can be very useful. Note that this method also applies to situations where overlapping fallout from more than one target is a possibility.

There are a couple of important exceptions to be aware of in plotting fallout danger areas by this method. The first is that some cities in the southeastern part of the country have a second danger area listed for wind speeds in the 20 mile per hour category. Sometimes in the spring and summer, the wind blows slowly to the west in these locations. This produces fallout danger maps with a short, stubby "tail" sticking out to the west. The pattern shown for Charleston, South Carolina in figure 7 is one such example.

Another exception has to do with 10-megaton fallout patterns. At extreme ranges (such as those 600 to 1,000 miles downwind) the exact limits of the danger area are very unreliable. The fallout cloud will almost certainly change direction and speed somewhat before traveling that far. The danger area calculated for 10-megaton fallout using this method is only useful for general planning. Don't make the mistake of feeling safe just because you are 1,001 miles from the target. You can't cut it that fine.

I have adopted the expedient of using a 10-megaton pattern as a model for the fallout that will be generated by the destruction of missile silos. There will actually be much more fallout generated by these explosions than a 10-megaton figure would indicate, but the explosions will be spread over such a wide area that you need only worry about 10-megaton's worth passing over you at any particular point downwind. To figure the danger areas for a missile field, just plot a 10-megaton pattern from the edge of the missile field that is closest to you. If the line misses you, you are probably safe.

Now that you have drawn the danger pattern templates you will need for your area, carefully cut them out. You can use these cut-out shapes to plot the danger area boundaries for any target on your map. To draw the danger boundary for a particular target, select the template from the nearest city to the target, place the "target" spot on the template over the target location on the map, line up the east-west line on the template with the east-west line on the map, and carefully trace a line around the edge of the template. Your map now shows where the fallout from that particular target is likely to land. Draw the fallout danger areas for all the missile fields on your map and also for any primary or secondary targets that you suspect will be hit at ground level. (Most of them won't be.) When you are done you will have mapped the dangerous and safe areas near you, and you can proceed to your selection of a retreat site, a new neighborhood, or escape route.

What does this method of mapping fallout tell us about the situation in the United States following a hypothetical attack? Figure 7 is a map of the probable fallout areas in the United States following a real-world attack on military and industrial targets (see also figure 2). As you can see, most of the country is in little danger from fallout. And as noted, even within the plotted danger areas only a small proportion of the area will actually receive fallout. Even so, anyone who lives in the Central Time Zone should give serious consideration to digging a deep fallout shelter. The Dakotas, Nebraska, Kansas, Iowa, and Missouri are clearly in more danger than the rest of the nation.

Notice in figure 7 that the areas outside the fallout danger regions are "safe" only in the sense that they will receive no fallout. There are two or three hundred fairly important targets in the rest of the country which would not generate fallout but which would not be safe to be near.

Figure 8 is a map constructed for the pessimists among us. This map shows "safe" refuge areas under

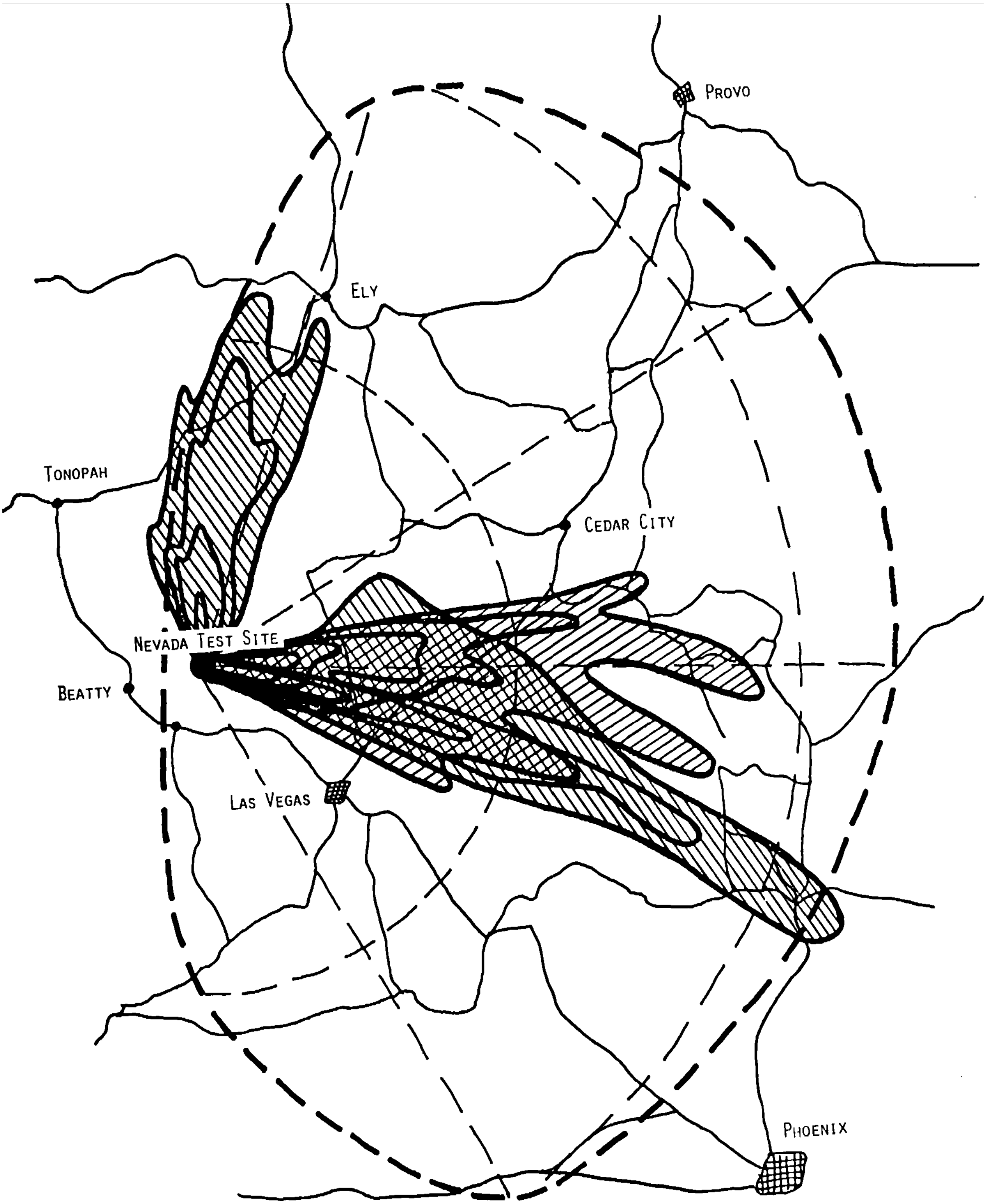


FIGURE 6: Predicted and Actual Fallout Patterns. Patterns illustrated by dashed lines were calculated by the method described in the text for the Nevada test site. These are overlain by three patterns indicating actual areas which received fallout. (Actual patterns after those pictured in Radiological Defense Handbook, Defense Civil Preparedness Agency, June 1974—SM 11.22 2.)

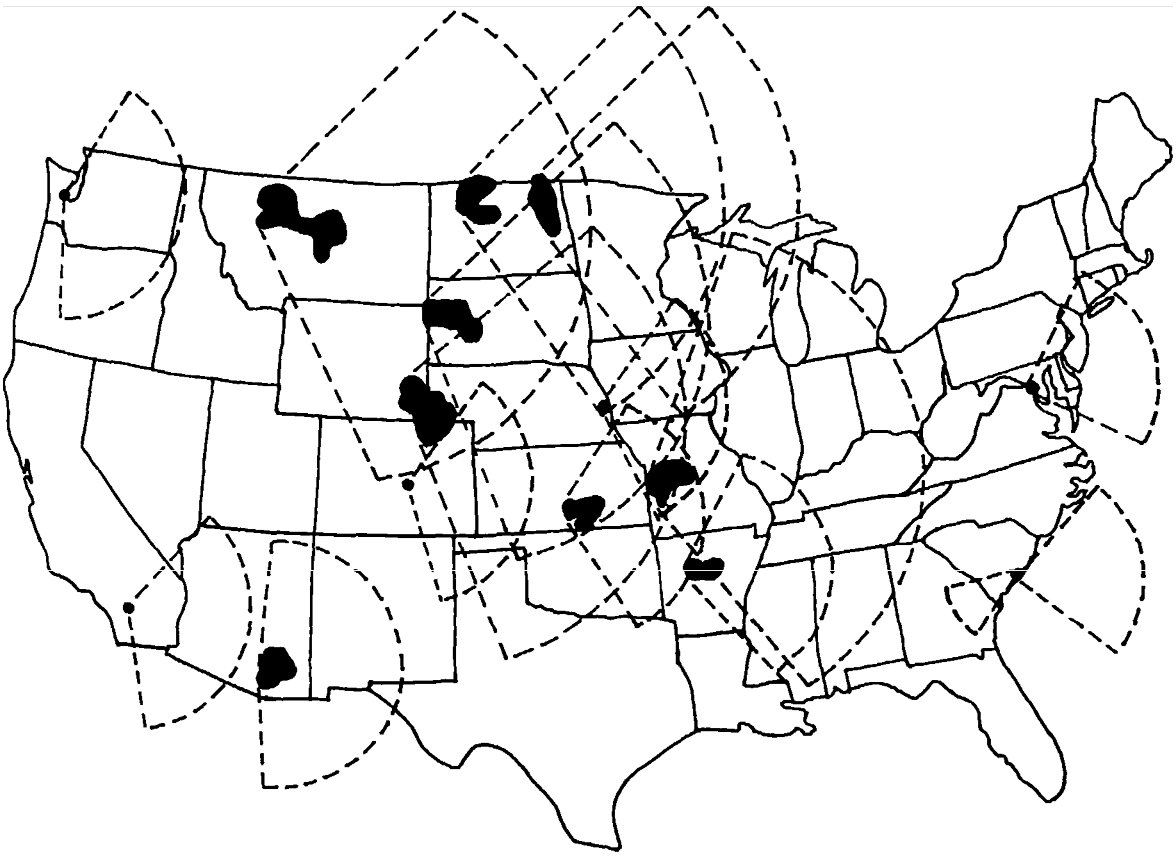


FIGURE 7: Fallout Danger Areas in the United States. As calculated by the method described in the text, areas enclosed by broken lines will receive most of the fallout generated in a realistic attack by the Soviet Union. Targets which generate fallout are missile silo fields and a few special military bases. (Compare to figure 2.)

two "doomsday" assumptions, namely that all primary targets will be hit at ground level, or, alternately, that every target in the country will be hit at ground level.

If all the primary targets are hit with fallout-generating ground bursts, there will still be a selection of potential refuges where the probability of receiving fallout from any particular target is under 2 percent. I refer to these areas as "Type A" refuges. One of the largest of these refuges is in western Canada (area 1). If you like foreign travel, you might dodge to the north. Within the United States, the Pacific coast from San Francisco to the Canadian border will be fairly fallout-free, including a sizable chunk of east-central Oregon (area 2). Near Los Angeles, the safest fallout refuges are the Channel Islands (area 3), forty or more miles off the coast. People who routinely sail to the islands on weekends might decide to take an extended vacation if things start to look bad.

There are Type A refuges in Nevada, Utah, and Arizona (area 4), Colorado and New Mexico (area 5), the Big Bend area of Texas (area 6), and the southern tip of Texas from roughly San Antonio south to the Mexican border (area 7). Much of Mexico itself (area 8), of course, will be fallout-free.

The refuges numbered 9, 10, and 11 are "Type B" refuges. These aren't really good refuges, but considering the circumstances, they are the best the central part of the country has to offer. Assuming that they receive no missile field fallout, the probability of getting fallout from other primary targets is under 2 percent for these areas. That's the best I can do for the Midwest.

On the east coast there are four refuges. The northernmost is in upstate New York (area 12) and extends across the Canadian border into Ontario. This is the only portion of civilized Canada east of Alberta which is unlikely to receive fallout from United States targets (under the assumption that all primary targets will be hit at ground level, of course).

Area 13 is in southern Virginia and North Carolina. This is roughly where our national leaders have their special fallout shelters, complete with offices, dormitories, cafeterias, tennis courts, and the communications equipment necessary to run a country (and a war) from deep underground.

Area 14 extends along the Gulf Coast from New Orleans across the Florida peninsula to Jacksonville. The last Type A refuge (area 15) lies between Fort Myers and Fort Lauderdale, just north of the Florida Everglades.

The Type A and Type B areas assume that all primary targets will be hit at ground level. What if all domestic targets are hit at ground level?

In that case, the probability of getting fallout in the Type A and B areas rises to the point that they cannot be considered refuges any longer. In the case of an all-out, genocidal attack on our country (which is extremely hard for me to envision) only the "Type C" areas will still have less than a 2 percent chance of getting dangerous levels of fallout. There are only three such refuges. The first is in western Canada (area 1), the second is around the Oregon-California border (area 2), and the third is Mexico south of Monterrey (area 8). All of these areas, of course, are also Type A refuges.

As this book was going to press, Congress allocated funds for the development of the controversial MX missile. This is to be a system of 200 land-based missiles mounted on mobile platforms. The idea is that each missile can be moved constantly from one random position to another within a ten-mile long trench, making Soviet targeting problems hopelessly complex. In my opinion, this project is sheer folly. I strongly suspect that the Soviets will respond by developing the capability to pulverize the entire length of each trench. Only their technological limitations and the SALT treaties would hamper them in this goal. Since the MX system is the "answer" to the Soviets' rapidly developing ability to hit every Minuteman missile silo, it doesn't seem likely that missile technology will hinder them much in coping with the MX system. I may be old-fashioned, but I don't think the treaties will hinder them much either.

At present, the MX trenches are to be built on government lands in the states of Nevada, Arizona, Utah, and New Mexico. If these trenches are ever attacked, they will generate twice the overall amount of fallout we would expect to see from existing silos (because it will require several warheads to destroy each trench). The impact on survivalists in the southern

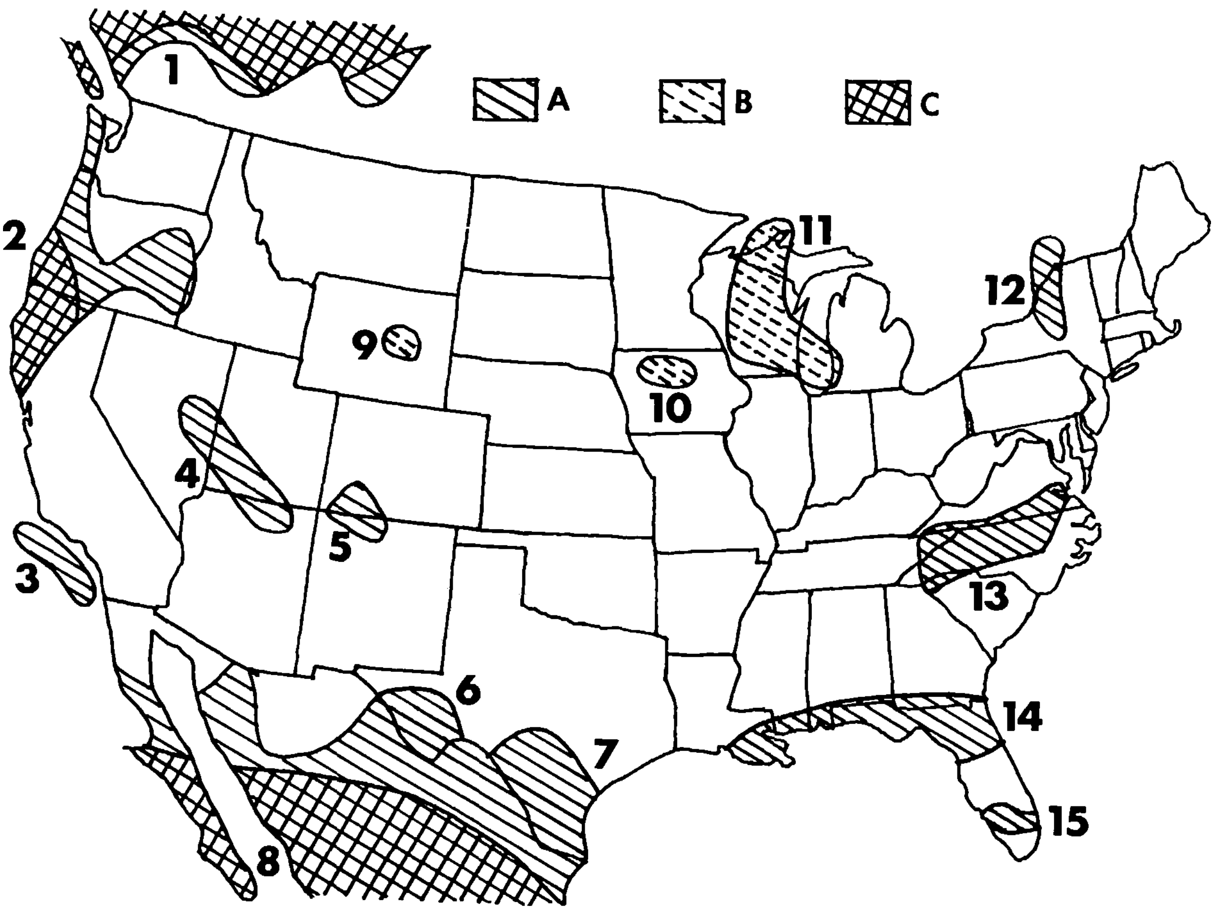


FIGURE 8: Fallout-free Areas of the United States.Type A refuges have less than a 2 percent chance of receiving fallout if all primary targets are hit at ground level. Type B refuges are unlikely to receive fallout other than that generated in nearby missile fields. Type C refuges are unlikely to receive fallout even if all domestic targets are hit at ground level.

Rocky Mountain and south-central states will be severe. If the MX missile reaches the deployment stage, it will mean that there will be no fallout-safe refuges in the southern half of the country from the California border to the Mississippi River.

Still, 1 want to be sure that you have not lost your perspective while looking at these maps. These refuges are not the only safe places to be when the fallout starts. Even under the worst assumptions most of the land area of the country will escape lethal fallout exposure. However, it is only in these refuge locations that you can be confident that you personally will be missed. Outside of the refuges you might be missed by the fallout, or you might not. But don't forget that if the fallout does happen to descend in your area there are still many steps you can take to protect yourself.

Personal Decisionmaking

The series of decisions you will need to make before starting your disaster planning are presented in the form of a dichotomous key—the "Key to Survival." This is a sequence of questions in which the answer you choose to a particular question tells you which question to ask next. Eventually, the questions lead you to a suggested type of disaster planning which fits your particular situation.

Using the key is simple: look at question 1, "Is your primary concern a nuclear war?" If it is, you proceed to question 2. If not, you skip straight to question 23. Keep following the instructions given in each entry and the key will lead you to the information appropriate to your needs.

The Key to Survival

1. Is your primary concern a nuclear war?
Yes-2. No—23.
2. Consult Appendix A to locate the nuclear targets in your state and adjacent states. Do you live within ten tniles of a primary target (twenty miles if the target is listed with an asterisk)? Yes—3. No—14.
3. Are you willing to permanently move to a safer area? Yes—4. No—7.
4. Would you rather move to a local area that is just out of range of the primary weapon effects, or would you rather make a major move to a really safe part of the country? Major move—5. Local move—6.
5. Most retreaters seem to consider the Klamath region of northern California and southern Oregon as about the safest place to go to avoid direct weapons effects, fallout, and starving refugees. Actually, many other parts of the country are "safe" too, if you assume no fallout except from the missile fields. Even if the Soviets hit all primary targets using surface bursts, there are still many parts of the nation which have less than a 2 percent chance of receiving fallout. At this point you should select a possible area to move to and start over again at 2, answering each succeeding question as if you live in your prospective refuge location. This will help you determine if you have selected wisely.
6. You will have to analyze your situation carefully to select a local neighborhood where your risk from direct weapons effects and fallout will be minimal. As a first approximation you should consider moving to a location northwest of the target. If the target is a single military base, such as a SAC bomber base, a distance of 25 miles should be sufficient to preserve you from very much direct damage. For a Minuteman missile complex, however, I would suggest a 100-mile minimum to the west, and 500 miles to the north, south, or east. The fallout generated by 400 or more megatons detonating at ground level is extensive. Select your new location and then return to 2. Start again and answer each question as if you lived at your selected location.
7. You live within ten (or twenty) miles of a primary target but don't want to permanently move somewhere else. In the case of a nuclear attack, would you prefer to dig in at home or evacuate on warning?
Dig in—8. Evacuate—9.
8. You will need to study chapter 2 and chapter 4 very carefully to select an appropriate fallout/ blast shelter for your location. Be sure to allow for the fact that your house may collapse and burn, which means that it would be better to locate the shelter outside. If your problem in finding an appropriate shelter is too difficult, I suggest that you reconsider and decide to evacuate. The whole point of retreating is to avoid sitting

on the bullseye when the missiles start to fly.
Still going to dig in—46. Evacuate—9.

9. You live within ten (or twenty) miles of a primary target and you intend to evacuate in the event of a nuclear attack. The next question is obviously . . . where? This in turn depends on when you will evacuate. Before the attack—10. After—13.

10. Are you willing to evacuate at the first sign of danger or will you wait until the last minute? First warning—11. Last minute—12.

11. In general, you can expect to be forewarned to the extent of knowing a day or two ahead of the time of an attack (remember the days of tension during the Cuban missile crisis). If you are willing to head for the hills as soon as things start to look hot, you can plan on driving to a refuge which is as much as ten to twelve hours away. The same time limit applies to flying, but of course the distance which can be covered is much greater. Go to 5.

12. If you would rather stick it out until the last possible moment, it might be possible to hop into your car and leave town in the last five minutes between the Civil Defense alert and the explosion, but I don't recommend it. Your last-minute warning could come either from hearing your favorite AM/FM radio station suddenly cut off the air, or from the wailing beep of an emergency weather radio (which also reports atomic attack). Weather stations are illustrated in figure 9. Don't count on local sirens. Most of them don't work anymore, and we have all learned over the years to tune out the few sirens that do work. If you prefer not to leave until the last minute, your refuge had better be within one hour's driving time of your home or office. That will give you just enough time to enter a prepared shelter before any fallout arrives. Don't plan to fly out at the last minute; it would be suicidal. Go to 6.

13. If you wait until after the attack to evacuate, you will need a blast and fallout shelter appropriate to your location (see chapter 4), local stockpiles of supplies sufficient until it is safe to evacuate (see chapter 5), a guaranteed route away from the city (or target), and someplace to go. Don't count on flying out after the attack because all light aircraft in your area will probably have been smashed by the blast wave. Driving out could be a problem too, due to damage to automobiles and obstruction of streets. I would recommend evacuating ahead of time if possible, but as a back-up you should plan a route to your refuge that allows you to make use of backpacking, motorcycles, or river rafting. As strange as these suggestions sound, they are ways of leaving a shattered city which do not require broad, clear streets. Having a friend from out of town meet you with a car at a pre-arranged point would be best. Goto 5 and 6, then go back to 2 and begin again.

14. Do you live within ten miles of any secondary target (twenty miles if the target is listed with an asterisk)? Yes—15. No—16.

15. Secondary targets are likely to be hit because of their industrial importance. Sometimes this "importance" is based on a local accident of geography which concentrates railroad and highway routes along a valley, pass, or shoreline and has little to do with industrial output as we normally think of it. In most cases, however, we can reasonably expect that the Soviets will concentrate their missile strike on the primary targets and people living near secondary targets will have a few hours of warning before the bombers arrive. This greatly improves chances of a successful last-minute evacuation, provided you have prepared ahead of time and can load a car quickly enough to beat the rush. (The last thing you want is to be caught in a traffic jam while the Backfire bombers are closing in.) Using motorcycles to leave the city alleviates this problem, provided you have stocked a refuge out in the woods prior to the attack and do not have to carry all your supplies with you. The location of your refuge relative to the secondary target should insure that you will be out of range of thermal and blast effects; there is probably little danger of local fallout. Go to 18.

16. Do you live within ten miles of a tertiary target (twenty miles if the target is listed with an asterisk)? Yes—17. No—18.

17. It would be best to make plans to evacuate to a safe refuge, but there is the distinct possibility that tertiary targets will not be attacked. This puts a different complexion on your preparations. It would be a good idea to get out of town for a few days when things get bad, but you will probably be returning. An elaborate refuge off in the hills is not necessarily required. In most cases a fallout-free spot to pitch a tent for a week or two ought to do nicely. Notice that if you are in an area subject to fallout from a primary target you can't get away with just a tent and a flat space to put it on. In that case, you might be better off to build a fallout shelter at home and trust to luck that your city won't be attacked. Retreaters who don't believe in trusting to luck can still arrange for a permanent refuge in the hills. Go to 18.

18. Do you live within fifty miles of any Minuteman or Titan missile complex (see Appendix A)?
Yes—19. No—20.

19. Your location has a chance of receiving over 10,000 R of fallout radiation, which is more than a typical

home fallout shelter with a protection factor (PF) of 40 can protect you against (see chapter 4 for a more detailed explanation of the derivation of PFs). A permanent underground fallout shelter with a PF between 100 and 1,000 would be a sound investment. You should also make preparations to evacuate after two or three weeks, unless you have the provisions and the patience to stay underground for ninety days. Actually, if you live this close to a missile field your best survival option is to move somewhere else immediately. Moving—5. Staying—46.

20. At this point, you should turn back to the previous section of the chapter and map the probable fallout areas around your location. If you live to the north, south, or east of a missile field, take your predictions with a grain of salt and err on the side of safety. Once you have constructed your fallout map, answer this question: Do you live (or is your retreat) in an area with less than a 2 percent chance of receiving local fallout? Yes—21. No—22.

21. You have no problems. I suggest that you take steps to provide some radiation protection anyway, just in case, but you really don't need any. Your location is suitable for a permanent retreat, at least as far as nuclear weapons effects are concerned. Go to 46.

22. There is at least a 2 percent chance of getting some fallout at your location. Your options are to provide yourself with some kind of fallout shelter, trust to luck that you won't get any fallout, or relocate to a safer area. Relocate—5 and 6. Shelter or trust to luck—46.

23. You are not primarily worried about a nuclear attack. This implies that you are more worried about something else. Natural disaster—24. Man-made disaster—36. Religious or supernatural disaster—45.

24. Natural disasters may be earthquakes—25, tsunamis— 26, tornadoes—27, hurricanes—28, floods—29, droughts—30, crop failures—31, wildfires—32, volcanoes—33, epidemics—34 and blizzards—35.

25. The cardinal rule for surviving an earthquake is to stand in a doorway away from windows, shelves, or other items that could topple over or shatter and shower you with glass fragments. Usually you will have only a few seconds in which to reach such a location, so you should pick it out in advance. Statistically, the earthquake will probably catch you either at home in bed or at work. An earthquake can range from a minor inconvenience to a major disaster. To prepare for the worst, stockpile food and supplies for at least a month of self-sufficiency (see chapter 5). Figure 10 shows a map of earthquake danger areas in case you are not sure how much danger you are in. Notice that there are only three really safe areas... all of them in prime hurricane country. Go to 46.

26. The one obvious thing to keep in mind about tsunamis is that you have to be near the ocean shore in order to be threatened. If you live more than 200 feet above sea level, you should be quite safe, unless you are adjacent to a bay with a long, narrow V-shape. Such bays can magnify the wave. In most areas subject to tsunamis (such as Hawaii), the government has well-maintained alert systems which predict the waves and warn residents hours in advance. You should take precautions for a rapid evacuation as described for "wildfire" in 32. You will be in danger of being taken by surprise only if you live at the water's edge near an active submarine fault (see the shoreline areas in figure 10). If you live on an earthquake coast, don't buy a beach house. Go to 46.

27. Figure 11 shows the country's worst tornado danger areas. In the most dangerous area (central Oklahoma), the number of tornadoes can reach three to four per year in each fifty-mile square area. If you live in a tornado danger area, you should build a storm cellar in your backyard or construct a reinforced shelter in the northeast corner of your basement. Tornadoes usually travel from the southwest toward the northeast, making the northeast part of a building marginally safer than other locations. Some of the fallout shelters described in chapter 4 will also double as tornado shelters, so why not build one shelter for both purposes? An emergency weather radio with an automatic alarm would be a good investment, too. If your house is damaged and your community widely disrupted by one or more tornadoes, you will need to provide temporary shelter (tents, etc.) as well as most of your own food, water, clothing, and other supplies for a day or two at least and for possibly as much as a month. Read the rest of this book with these needs in mind. Go to 46.

28. Hurricanes represent the natural disaster most similar to a nuclear attack. Surviving a hurricane means either that you must seek specially constructed shelter or that you must flee. The effects occur over thousands of square miles and tax the preparedness of entire states. It isn't safe to go outside or to travel; the aftermath can take weeks to come under control. Fortunately, relatively few of us live in the most dangerous hurricane areas (see figure 12). My advice to a retreater who fears hurricanes is to prepare food, clothing, gasoline, and makeshift shelter supplies in boxes or duffle bags that can be loaded very quickly into a car (see 32). If a Civil Defense mass evacuation is under way, authorities will tell you where they think nearby safe areas will be, but I would be more inclined to take a weekend trip entirely out of the danger region. (Drive up to the Lake of the Ozarks—and admire the Minuteman missile silos!) For your own sake, do not even contemplate staying near the shore.

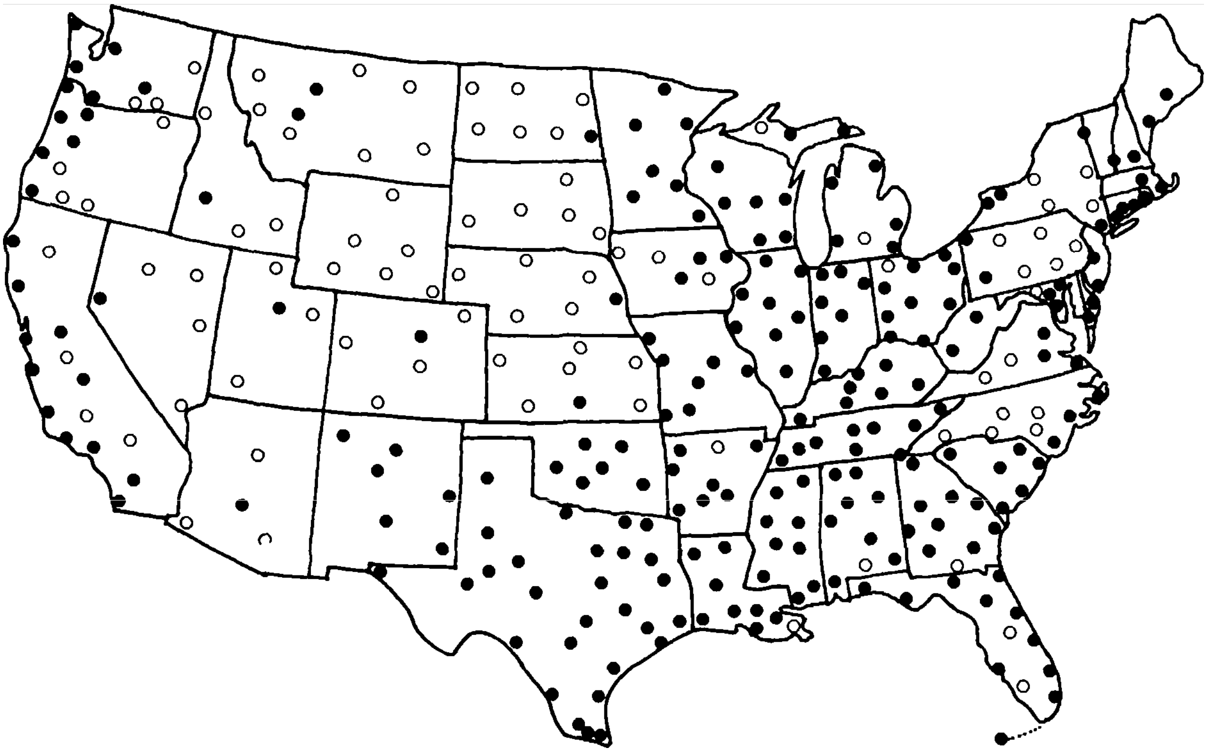


FIGURE 9: Emergency Weather Radio Stations. Black dots represent operating stations, while circles represent stations planned but not yet constructed. The section of the country with the greatest density of first strike nuclear targets has been conspicuously neglected in terms of emergency warning stations. (Compare to figure 7.)

Whole towns have disappeared during hurricanes along with the hardy souls who tried to weather it out. Go to 46.

29. Floods can happen almost anywhere except on mountain peaks. Natural floods result from too much rain (or melting snow) all at once, and no one can be entirely safe from them. A measure of safety can be obtained, however, by deciding not to live within 100 vertical feet of the nearest major river, or within the boundaries of local "100-year" floods. Your county Civil Defense office can supply you with the information appropriate to your location. If you live within an area subject to very wide-scale flooding, you might invest in survival equipment and supplies appropriate to a floating retreat. (This subject is discussed in more detail in chapter 4.) Go to 46.

30. Droughts do not normally threaten direct survival, but they can be very bad for crops and livestock. Stockpiling water isn't the answer unless you have the ability to do it on a grand scale. A solution more to the point would be to drill a deep well on your property or to invest in equipment for purifying brackish or polluted water into drinking water (see chapter 5). The main danger produced by drought is crop failure—31, or possibly widespread wildfire—32.

31. There is only one answer to a serious crop failure. As has been the case for a hundred thousand years, those of us who have stored a little extra food will be much better off than those who have not. A crop failure by itself will probably not produce serious problems in the United States, but even so, there could be nutritional and economic advantages to having a basement full of food after a really bad agricultural year. Go to 46.

32. I have listed wildfire as a natural disaster, but as an ecologist I personally regard runaway wildfires as man-made disasters. Forests used to burn naturally and surprisingly often, but the evidence suggests that most of these natural fires were not very dangerous. After half a century of fire suppression, however, our forests are so full of fuel that they burn violently and uncontrollably whenever they get a chance. (We have Smokey the Bear to thank for that.) If you live in a forested area or in dense chaparral you should take steps to be ready for an emergency evacuation. First, be sure that you have at least two escape routes. Then pack a few boxes or duffle bags with food and clothing, and place a list of items to take with you along with an empty duffle bag in some central part of the house. Without such precautions you might make an irrational selection or waste valuable get-away time

carrying one item at a time out to the car. One more thing: put an extra set of car keys with the evacuation checklist. You may seriously regret it if you don't. To protect the house itself, clear away all native vegetation within 50 feet (100 feet downhill), and substitute succulent plants like iceplant or cactus. Landscape with paved patios, gravel walks, and well-watered lawns. Put a rock or tile roof on the house, or at least have the shingles treated with a flame retardant. Go to 46.

33. Volcanoes are not a threat to you unless you happen to be living next door to one. Even then, you probably have little to worry about, since almost all of the thousands of volcanoes in the United States are extinct. The exceptions are in the states bordering the Pacific Ocean, where there are several definitely active volcanoes: Mt. Baker, Mt. Rainier, and Mt. St. Helens in Washington; Mt. Hood in Oregon; and Mt. Shasta, Lassen Peak, and Cinder Cone (near Lassen) in California. In addition, there are many others along the Cascades which are dormant. Mt. St. Helens, northeast of Portland, erupted violently and repeatedly throughout the 1800s, producing gigantic flows of mud and ash. Since the last eruption, three hydroelectric dams have been built on the slopes of the mountain. Civil Defense planners are worried that a future eruption may produce a mud flow overwhelming the uppermost dam, causing a chain reaction of dam failures that would flood the Portland area. The state of Hawaii is entirely composed of volcanoes, four of which are active: Haleakala on Maui; and Mauna Loa, Hualalai, and Kilauea on Hawaii. Alaska contains about forty active volcanoes, mainly concentrated in a single belt stretching southwest from Anchorage to the outermost of the Aleutian Islands. The one outstanding lesson of volcano safety is that no one has ever died in a volcanic eruption who had the sense to leave early. If you wait too long you could be caught in a trap like the one that engulfed Pompeii: volcanic ash that's too thick to breathe and too thin to walk on. Go to 46.

34. Epidemics concern me as a population ecologist because they are a primary natural remedy to overpopulation and because it has been so long since the human race was subjected to a serious disease outbreak. If a disease should invade your community, there are several steps you might take to avoid contracting it. Running away isn't one of them. Unfortu-

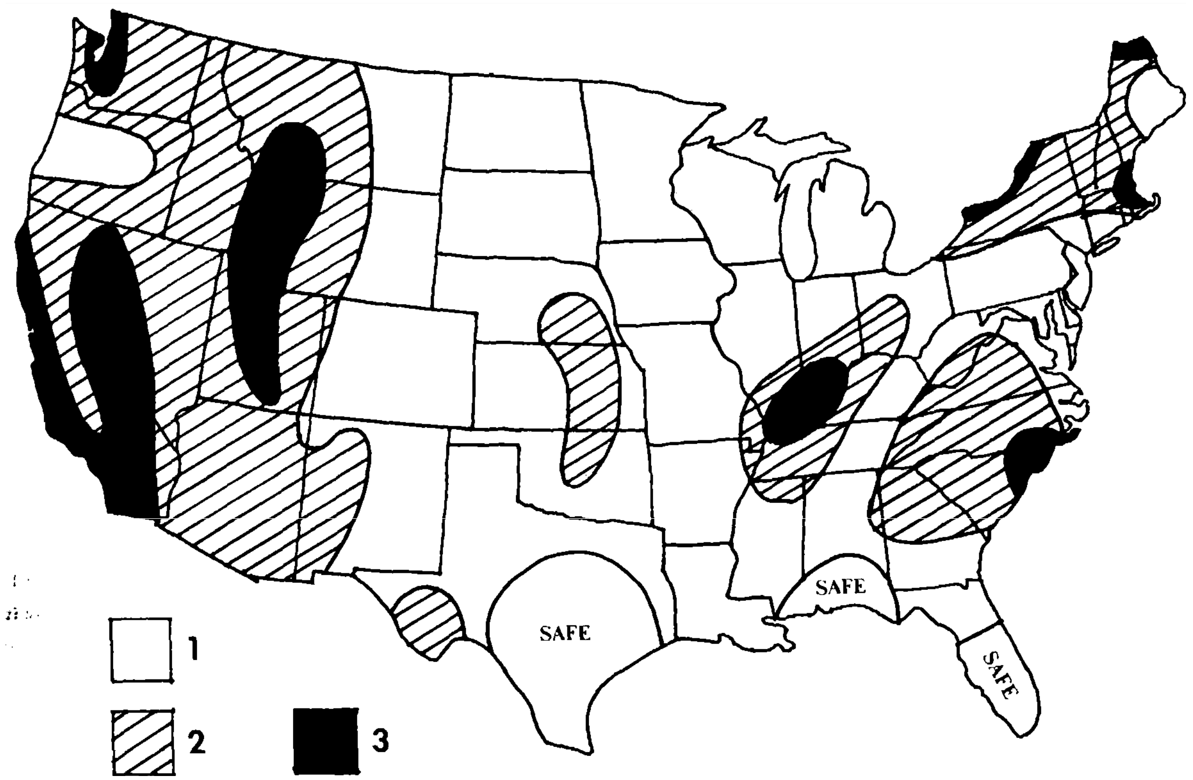


FIGURE 10: Earthquake Danger Areas. Zone I areas may expect minor structural damage, Zone 2 areas risk moderate damage, and Zone 3 areas have the potential for major structural damage. Areas marked "safe" are unlikely to experience any earthquake damage. (After Protected Educational Facilities in Found Space, Defense Civil Preparedness Agency, TR-80, May 1973—DI4.9:78.)

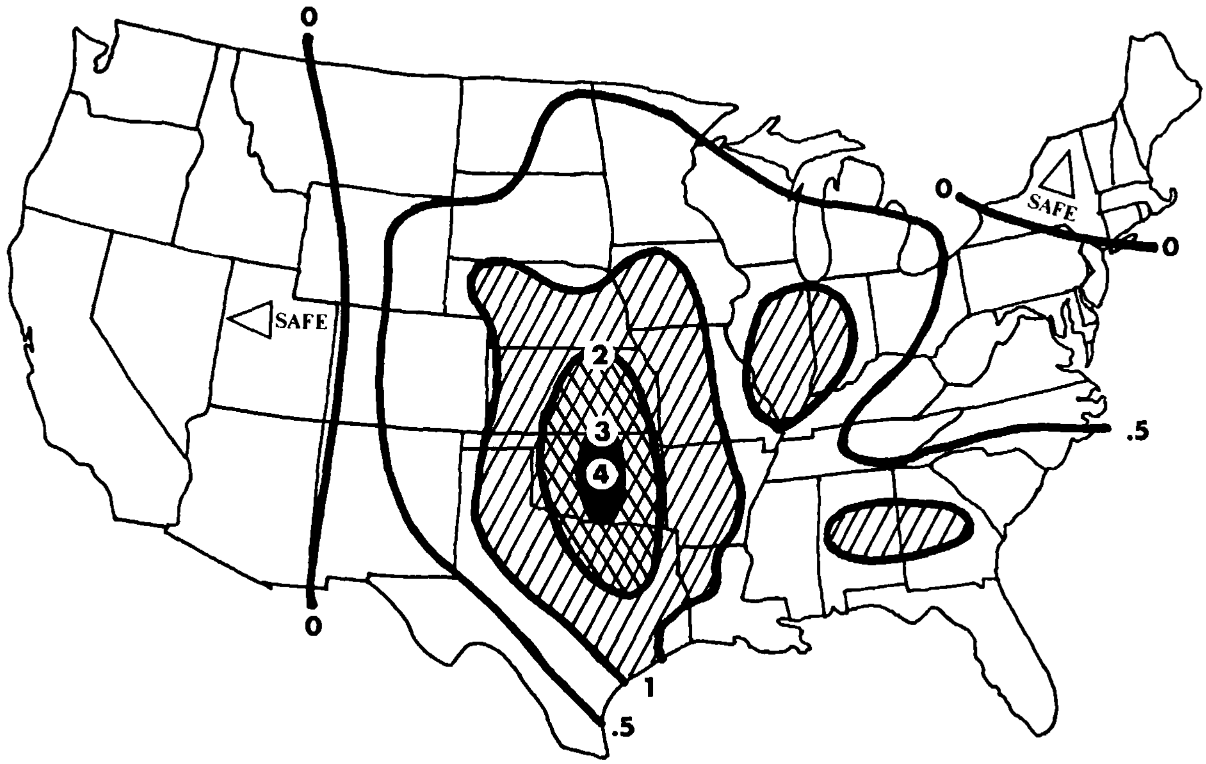


FIGURE 11: Tornado Danger Areas. Contours represent theaverage number of tornadoes each year per fifty-square-mile area. (After the New York Times 5 April 1974.)

nately, getting out in public (as you must do to flee) is about the best way to catch the disease. Also, people in surrounding communities may not take kindly to your intended migration. People have occasionally even been shot for trying to escape from quarantined areas. A better plan is to withdraw into your home and avoid coming into contact with anyone. If you avoid other people and practice rigorous sanitary precautions at home, you will have helped yourself about as much as you can. Of course, such a withdrawal will require an in-house source of food, water, and perhaps medicines. Chapters 5 and 6 will guide you in the selection of these items. Go to 46.

35. Severe winter storms usually don't mean more than three weeks of isolation, but those three weeks could involve hardship if you are not prepared to supply your own heat and food in the meantime. If a blizzard is your main worry, see chapters 4 and 5.[3] Go to 46.

36. Man-made disasters are all around us, more or less waiting for an opportunity to happen. Dam failure—37, city fire—38, nuclear reactor accident—39, train accident (chemical spill)—40, terrorists—41, repressive government—42, personal attack—43, economic collapse—44.

37. How do you know if you are in danger from a faulty dam? Obviously, appearances aren't worth anything. I would suggest that you have a close look at some detailed topographic maps of your area to see just where the dams and reservoirs are actually located. Be sure to check any ponds or lakes in the hills upstream of your position to see what keeps them from suddenly draining. When you have a good idea of the distribution of such potential threats, go to visit your local Civil Defense director. My experience has been that local CD people are very helpful and can usually point out exactly where the floodwaters from a ruptured dam are expected to go. They may also be able to advise you about large dams far upstream which might cause problems. In any case, your options are to move permanently to high ground or to relocate to a motel on high ground during especially heavy rain storms. Dams are particularly vulnerable to failure when they are overfull or when they are filling for the first time. Go to 46.

38. Most of our cities are far less inflammable than they used to be, and except in periods of poor labor relations, our fire-fighting capability is very advanced. Most people need not worry. If you live in a high-rise apartment building, however, be sure you have an enclosed concrete stairwell which you can locate in the dark that leads to an exterior ground-level exit.

You should also look into the possibility of having a rope ladder. Otherwise, if fire is your worry, you should take steps as outlined in 32.

39. The best rule to follow for avoiding nuclear reactor accidents is, don't live near one (see figure 13). You can bet that if the reactor melts down and starts to release radioactive materials into the air, you will be one of the last to know. The history of reactor accidents clearly shows that the authorities don't like to say anything until it is impossible to keep silent any longer. It may only be in the future that the real circumstances of the Three Mile Island incident will be fully known; critics are already alarmed at the apparent lack of communication between controlling agencies. I suggest that you buy a radiation detection instrument and a gas mask or other respiration filter as insurance. That way you can avoid inhaling dangerous particles while you find out for yourself how radioactive your neighborhood has become. As for the area which could be contaminated by a really bad accident, the rules for nuclear weapons fallout do not apply. The best I can offer is the observation that the Russian nuclear accident in the Urals apparently required the evacuation of an area at least twenty-five miles square. Go to 46.

40. Chemical spills from derailed trains are not usually much of a hazard except within half a mile or so of the wreck. If several train cars derail near your home I suggest that you pack up quickly and go visit Grandma until the trouble is cleared up (even if the local authorities don't ask you to evacuate). About one train car in twenty-five carries explosive or toxic chemicals, and many times the Civil Defense people don't know what is in the cars. If the wreck is two or three miles away you might get out your trusty gas mask and keep it handy for a while, and you should certainly carry it with you in the car if you have to drive past the wreckage. Individual gas masks are inexpensive and inconspicuous (stuff them in a paper bag)"and are good insurance for people who live near railroads. Go to 46.

41. The experts disagree strongly about what to do if you are in a group that is taken hostage by terrorists. On the one hand, some advise gradually getting to know the terrorists, under the assumption that if the terrorists begin to see you as a person instead of a "thing," they will have a harder time shooting you. On the other hand, the people who are usually shot first are the ones who stand out in the crowd. I would be inclined to offer one additional piece of advice. If it

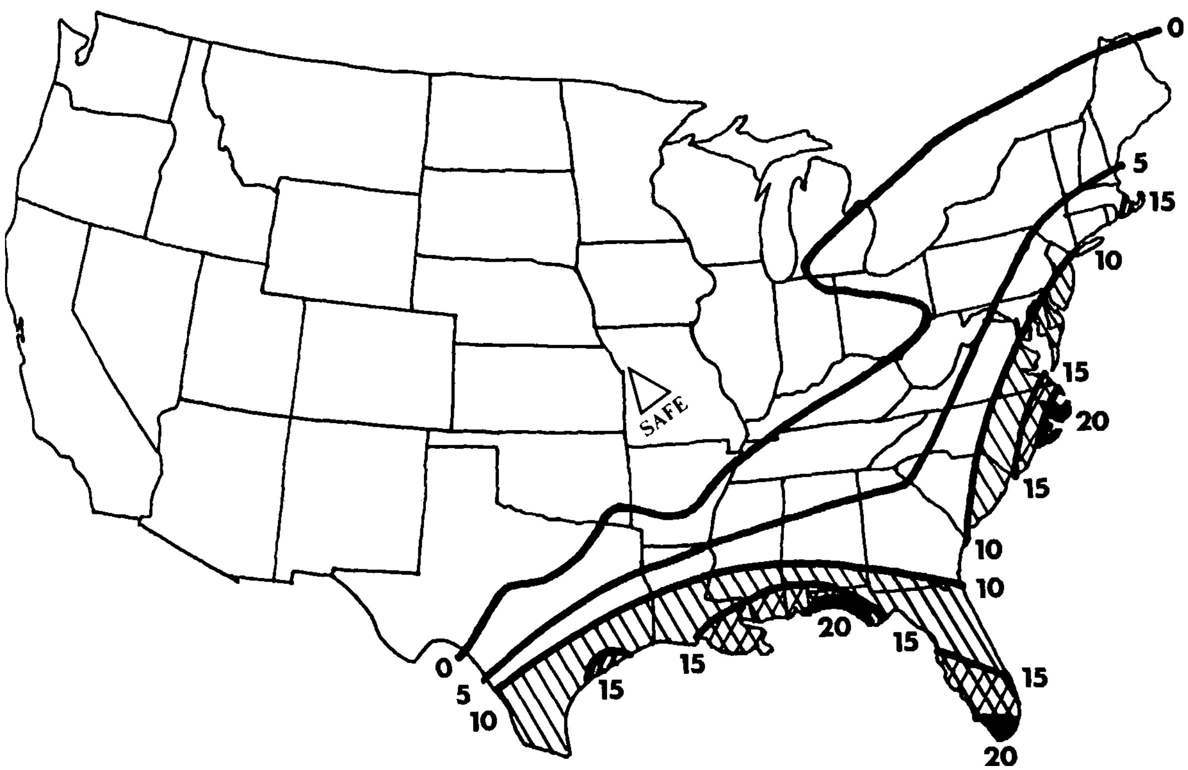


FIGURE 12: Hurricane Danger Areas. Contours represent the relative number of destructive tropical storms which have passed over each area. (After Protected Educational Facilities in Found Space, Defense Civil Preparedness Agency, TR-80, May 1973—DI4.9:78.)

looks like you are going to be killed anyway, do something. A person with a machine gun is not invulnerable—only overconfident. As for terrorist attacks directed at a more general target, such as sabotage of the city power network, there is really nothing you can do except be ready to evacuate or become temporarily self-sufficient. Go to 46.

42. I had not seriously considered the possibility that a totalitarian government could arise in the United States until one day I met a retreater who keeps his passport in his pocket and refuses to travel more than 200 miles away from the Canadian border. I thought he was a little paranoid, but as the saying goes, "That doesn't mean they're not out to get you." After reading Executive Order 11490 I'm not quite as complacent about this subject.[4] In my opinion, flight from a repressive government is the wisest course. The Jews who left Europe just before World War II made the right choice. Six million of their slower brethren paid the price of tardiness. Incidentally, when you hear the conservatives opposing gun control on the grounds that it leads to tyranny—they're right. Totalitarian regimes do have a historical tendency to disarm the civilian population prior to throwing their weight around. Frequently they use very humanitarian arguments, too. If you are the sanguine type who would rather fight, there are many left-wing, right-wing, and military manuals available which will tell you exactly how to go about it. Some of these are mentioned in chapter 7. Go to 46.

43. I put in a paragraph about personal attack because in some parts of the country the possibility of being assaulted ranks very high on the list of things people worry about. Obviously, one tries to avoid dark alleys, rowdy bars, slum neighborhoods, and walking alone at night. As for personal defense, there are really only two ways to go. You can spend several years learning to be a deadly martial artist or you can spend several weeks learning to be a deadly pistolero. Karate gives one the advantage of being "armed" all the time without being in violation of the law. If that doesn't appeal to you, there is the pistol. Don't bother with knives, tear gas, hatpins, and other assorted weapons. If you are going to defy the law by carrying a concealed weapon, you might as well carry a gun. See comments on pistols in chapter 7 for a discussion of selection and use. Go to 46.

44. The survivalists who are preparing for economic collapse tend to follow one or more of three courses. They buy United States common circulation silver coins and hoard them. Your local coin shop can help you find these. The main idea is that even if the dollar suddenly becomes worthless, the silver in the coins will still have value. At present, the coins are worth five times their face value, and they should continue to increase in value as the dollar becomes weaker. The second approach is to invest in "trade goods" to use when bartering becomes necessary. I have usually heard this idea explained in terms of stockpiled ammunition (especially .22 caliber cartridges). In a survival situation, ammunition has an intrinsic value which might make it a substitute for money. The third approach involves buying retreat property which can be farmed. The idea is to retreat to the hills and become entirely self-sufficient until the trouble is over. People concerned about economic collapse usually subscribe to one or more of the survivalist newsletters devoted to this subject. Consult chapter 5 for discussion of these newsletters and other survival resources. One particularly good treatment of the subject is Howard Ruff's How to Prosper During the Coming Bad Years.[5] Ruff does a very good job of describing the economic dangers ahead and prescribes personal financial strategies to cope with them. Go to 46.

45. Build an ark. Not only is there historical precedent but you won't be alone. There are actually people who have built floating emergency houses to be ready for the next "deluge." Otherwise see Jim McKeever's Christians Will Go through the Tribulation . . . And How to Prepare for ft.[6] Go to 46.

46. At this point, your options are either to proceed directly to the rest of this chapter or to return to some point in the key and try a different set of possibilities to see where they lead you.

Additional Considerations

When retreaters plan the location of their refuges, they normally take into consideration factors other than direct and indirect nuclear weapons effects. Very frequently, the location of large population centers is taken into consideration, as well as the availability of good water and suitable land for farming or gardening. Which contributing factors are really important in selecting the retreat site?

The first thing many retreaters point out is that the refuge must be in a place that can be defended or it isn't any good. I've thought a lot about this characteristically immediate response and I am inclined to put it down to the fact that most retreaters tend to be extremely security-conscious. The thought of hordes of desperate refugees or Pancho Villa-style banditos laying siege to the refuge certainly cannot be ignored, but neither should it be paramount in the selection of the site. If the refuge is not biologically capable of supporting the

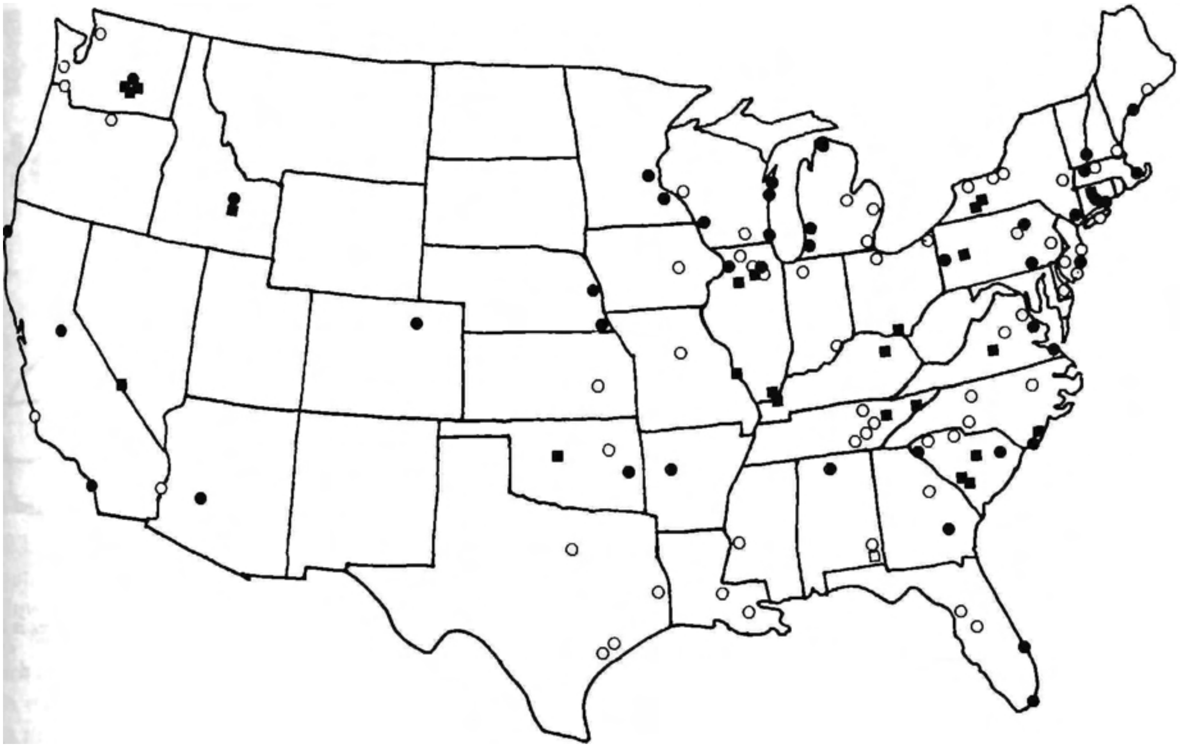


FIGURE 13: Nuclear Facilities in the United States. Black dots indicate existing nuclear power plants; circles represent proposed plants. Black squares plot various kinds of uranium processing plants and facilities; white squares indicate proposed facilities.

retreaters, the retreaters themselves will soon have to become bandits in order to stay alive. The first priority, then, is arable land and dependable water. Once you have located a suitable area with these qualities, you can go on to the problem of defense; first make sure that you have a piece of territory that is worth defending.

What about those ravening hordes? Suppose there is a nuclear attack that leaves all those city-bred people without food and water? Won't they come to the country looking for something to eat? Well, maybe so—but maybe not. One point which is frequently overlooked by retreat planners is the damage to the routes of communication which a nuclear attack will cause. In most states, the main highways run right through the high-priority targets.

If you compare California's nuclear target sites (as illustrated in Appendix A), with the maps in figure 14, it becomes clear that virtually all the north-south arteries in this state would be severed by an atomic attack. Any attack severe enough to drive unprepared refugees from their homes will also interfere seriously with their mobility. There will be virtually no gasoline for them, remember. (A retreater always has a safe route, an alternate route, and plenty of gas.) It will be reasonable to expect a few refugees following an attack, but not as many as you might be inclined to believe.

There is one situation in which there could be a large number of refugees in your neighborhood, however. If things start to look bad, the President might order the cities to be evacuated as a precautionary move. Millions of people would head for the designated "host communities" as the Civil Defense authorities try to execute their crisis-relocation plans. In that case, as a retreater in a secure area, you might suddenly have a score of refugees billetted with you by the local Civil Defense command or the National Guard. You will not be able to legally refuse. This would be a situation where the war has not begun and might never start. Civilization with all its laws and restrictions still stands. You will have to take in the refugees assigned to you. What will you do then?

A third topic concerns the possibility of retreating by boat. Persons who live in seacoast cities may discover that their escape routes are severely limited by surrounding targets and the coast. This situation applies particularly to potential retreaters living in the Boston-Washington megalopolis, Miami, Houston, the suburbs of Los Angeles and San Francisco, and cities on the shores of the Great Lakes. If you can sail out to sea as little as 20 miles off the California coast, you will be quite safe from blast and fallout. On the east coast, a distance of 200 to 300 miles would be better. Retreating out to sea is an

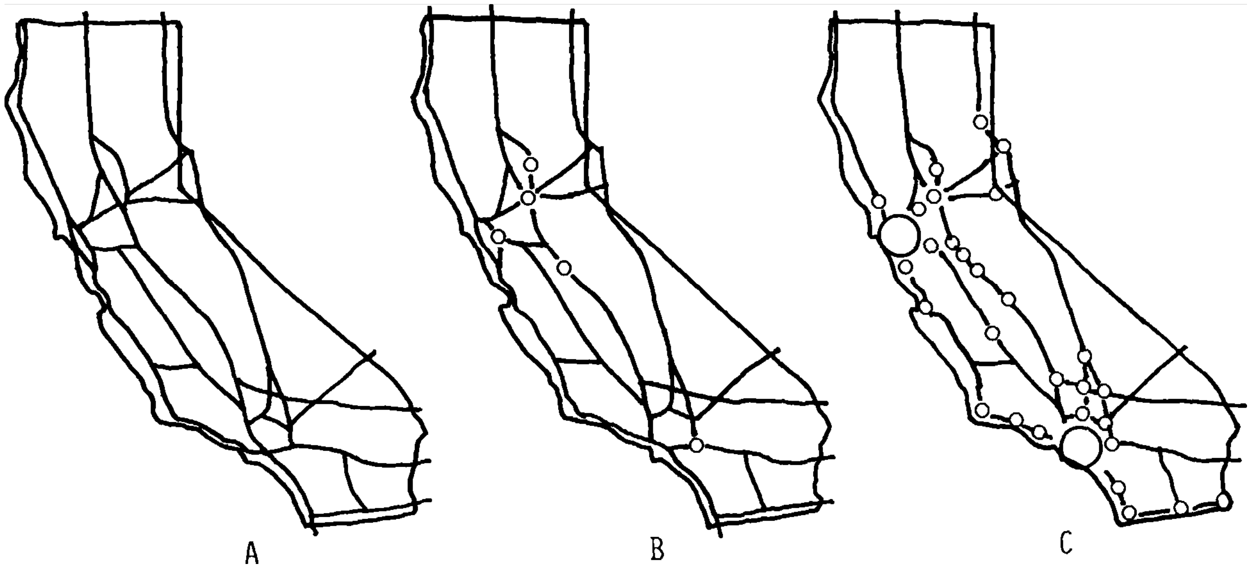


FIGURE 14: Major Highways in California. (A) Prior to a nuclear attack; (B) after an attack on five primary targets; (C) after an attack on all targets in the state. Extreme fragmentation of highways around populated areas will tend to isolate retreaters and refugees in local areas.

unusual suggestion, but in many places it could be the best chance you have. Chapter 4 discusses how to use a small sailboat as a fallout shelter, in case you don't make it far enough out to sea in time.

Commentary

What to do, where to go, and how to get there are the three primary questions retreaters face in beginning to plan their refuges. The right decisions are crucial to success at this initial stage. To make the right decisions, retreaters need information on the nuclear targets and fallout distributions near their locations, as well as information on the agricultural ability of various potential refuges to support them in the long run. Potential interferences from refugees should be considered, but as a secondary factor.

Now that you have made your first decisions about how to organize your survival effort, the remaining chapters will help you begin.

Notes

1. Samuel Glasstone, ed., The Effects of Nuclear Weapons, 3rd ed., a report of the United States Department of Defense and the United States Department of Energy, 1977 (Dl 2:N 88/2).
2. User's Manual, Meteorological Data for Radiological Defense, Defense Civil Preparedness Agency, July 1970 (FG E 5.6/!).
3. See also Evan Powell, "For Winter Survival Build a Warm Room," Popular Science November 1977, p. 110.
4. For a brief summary of the provisions of this order, see chapter 1.
5. Howard Ruff, How to Prosper During the Coming Bad Years (New York: Times Books, 1979).
6. Jim McKeever, Christians Will Go through the Tribulation . . . And How To Prepare for It (PO Box 4130, Medford, Oregon 97501).

4
Home Sweet Hole

SHELTER IS A CONCEPT we don't think enough about. The naked human being is vulnerable to a variety of environmental injuries, such as hypothermia, frostbite, heat stroke, dehydration, sunburn, and others which contribute to death by "exposure." In spite of our high standing on the evolutionary scale, we still share with the lower animals the absolute necessity of being able to get in out of the weather now and then. When we cannot, we are in serious trouble.

There are special kinds of shelters which are associated with extremely violent weather and the various effects of nuclear weapons. Even within structures which are satisfactory in terms of normal shelter requirements, we are still vulnerable to the over 200 mile-per-hour winds of hurricanes and the blast, thermal pulse, and radioactivity of nuclear detonation. For these situations, special kinds of shelter must be provided, and sometimes in a hurry.

This chapter covers the topic of shelter from the standpoint of protecting the vulnerable human body from all the possible external conditions which could threaten it. The discussion is focused mainly on the needs of the person who is preparing for nuclear war, but the interests of those concerned with natural disasters are served in this context as well. Permanent shelters, expedient shelters, and special purpose shelters are examined with the intention of exploring a variety of designs to suit every need and pocketbook. First, however, some principles of protection will be discussed.

Basic Principles of Radiation and Thermal Protection

The basic principle of any kind of shelter is to provide a local environment in which conditions are more comfortable or more healthy than those prevailing outside. The principles of shielding a human being from gamma ray penetration and the thermal heat pulse of nuclear weapons are exceptional, however, and require at least a brief analysis.

Gamma rays are electromagnetic rays very similar to light except that they are invisible, contain extremely high amounts of energy, and can freely penetrate most objects. You might think of fallout particles in this context as being little shining light sources, emitting a light to which most materials are transparent or translucent. If you were to hold a piece of waxed paper up between your eye and a candle, you would be able to see the light of the candle through the paper. If you used two layers of paper, the amount of light reaching your eye would be less. If you were to use twenty or thirty layers of waxed paper, you could block out the light entirely. Similarly, with gamma rays, the key to protection is to get the right amount of material between you and the fallout.

For gamma shielding, the general rule of thumb is to build a mass barrier with a density of 150 pounds per square foot between you and the radiation source (see figure 15). This means if you were to draw a one foot square on the surface of a wall, and then cut that one foot square chunk out of the wall and weigh it, it would have to weigh 150 pounds or more in order to shield you effectively from fallout on the other side of the wall. Notice that the thickness of the wall doesn't really matter, nor does the composition of the material in the wall. A foot of concrete or twenty feet of snow (150 pounds in each case) will shield you to about the same extent.

The second principle of gamma ray shielding is to put as much distance between yourself and the fallout particles as possible. The gamma rays from any particular fallout particle spread out as they get farther and farther from the particle. If you increase the distance between yourself and the fallout particle by a factor of two, the gamma exposure you will receive from that particle will fall off by a factor of four (2x2 = 4). At three times the distance you will get only 1 /9th the exposure (3x3 = 9). At ten times the distance, you receive only 1/100th the exposure. This rule (called the "inverse square law") becomes somewhat obscured when you start talking about large areas contaminated by fallout particles, but the general effect holds true. If you can get some distance between you and the fallout, you can greatly reduce your exposure whether or not you have mass shielding.

The third principle of gamma ray shielding is geometry. A house built in the side or top of a convex hill is naturally protected from fallout radiation by the geometry of its position. Fallout particles on the slopes of the hill have a tremendous mass of earth between them and the inhabited portions of the house. Only those particles which actually fall in the immediate vicinity of the house pose any threat. This kind of effect can greatly reduce radiation exposure.

By the same token, the edges of a basement floor near the exterior walls are usually better protected than the center of the basement, but this depends on the size of the house. If you were to lie down on the basement floor against the wall, the gamma rays from the nearest fallout particles on the soil surface next to the foundation wall would have to travel diagonally downward through several feet of earth and concrete to reach you (see figure 16).

At this point, it should begin to be obvious why most home fallout shelters are built in basements. In the basement, the designer can take advantage of the foundation walls for mass shielding. The distance from the basement shelter to the fallout on the roof can help to reduce exposure. Finally, by placing the shelter in a corner or against a foundation wall, the designer can increase protection through geometry. These are the principles of radiation shielding to keep in mind when considering shelter designs.

The effectiveness of a fallout shelter is usually expressed as a protection factor or "PF." A PF of 40, for example, means that persons inside the shelter receive only l/40th of the radiation that is present outside. PF 40 is the standard protection factor for home fallout shelters, established by the Office of Civil Defense in 1962.

With these principles in mind, there are several

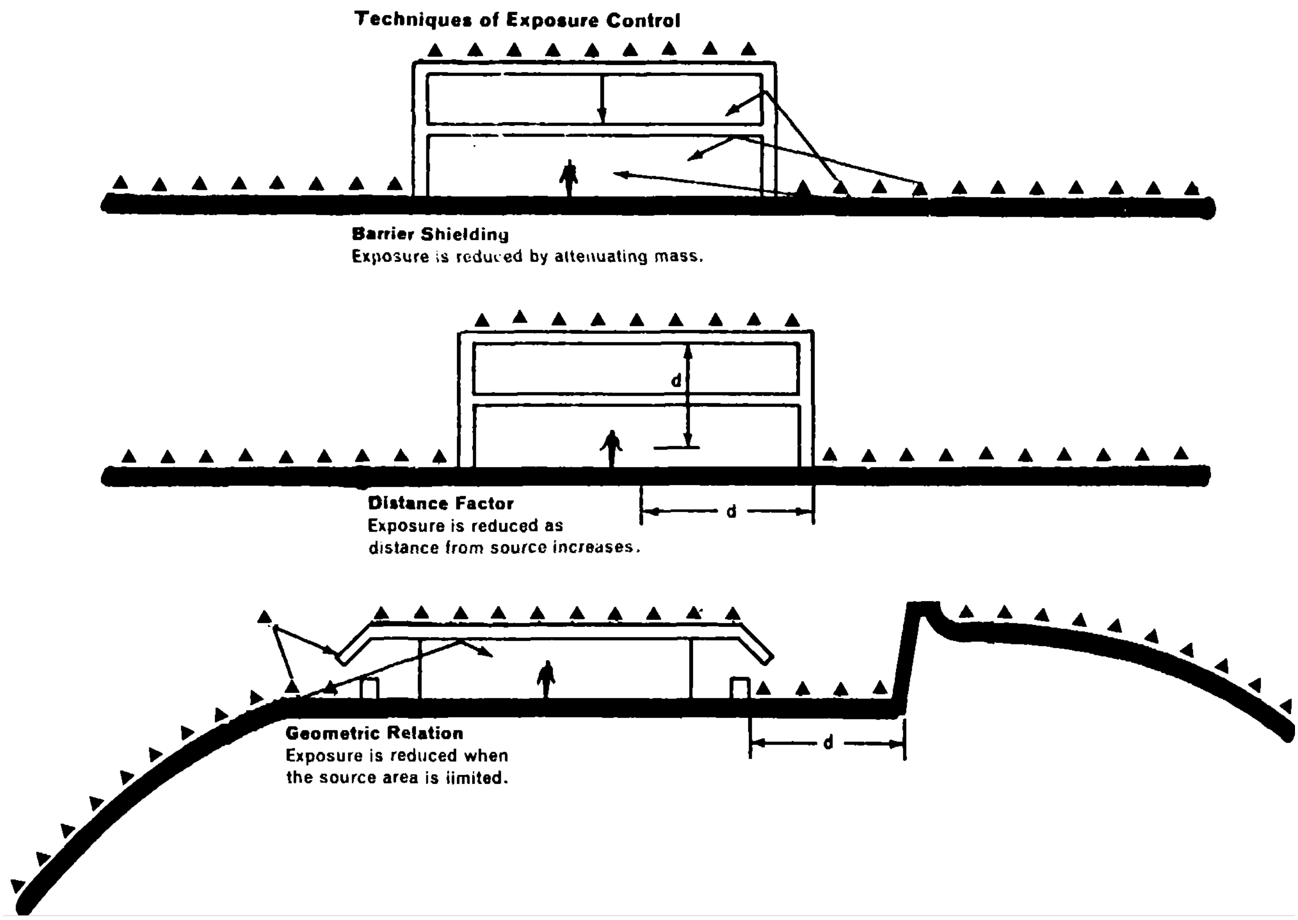


FIGURE 15: Principles of Gamma Ray Protection. Radiation exposure can be limited by mass shielding, distance, and geometry. (After Highlights of the Architect and Engineer Activities in Shelter Development, Office of Civil Defense, TR-29, June 1956—D119.9.29.)

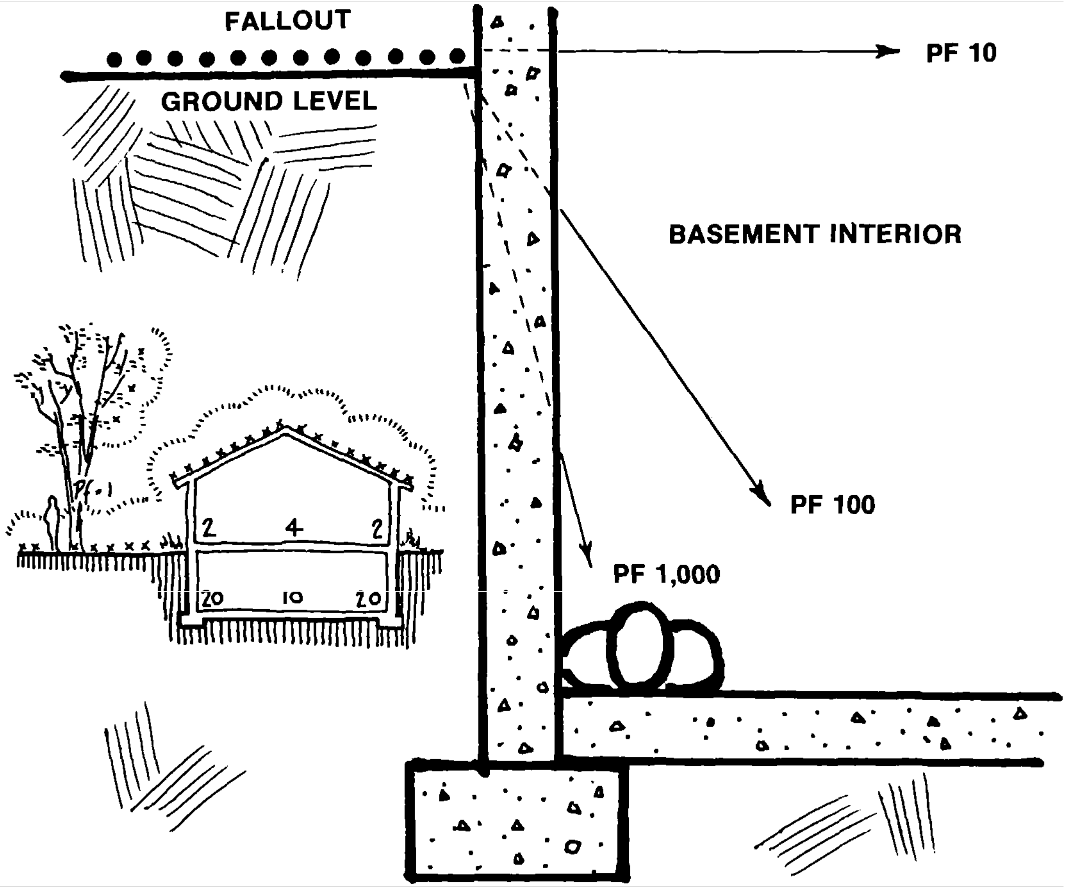


FIGURE 16: Geometric Shielding in a Basement. The PF provided by a concrete foundation wall increases greatly as the basement floor is approached. Radiation must pass through several feet of earth and concrete to penetrate the wall at such a steep angle. The insert shows overall PF values within a one-story wood frame house. (Insert after Shelter Designs in New Buildings, Office of Civil Defense, TR-43, March 1967—D119.9:43.)

precautions which you can employ in the landscaping of your property to cut down on the amount of fallout radiation which will be able to penetrate your home. The radiation resistance of a house can be greatly increased by banking earth up around the house. This can be done by skillfully using wide planters, raised concrete or flag-stone porches, and large terrace patios. Don't make these barriers more than about ten feet wide or you will catch so much fallout in them that their shielding effect will be reduced. The idea is to provide a slightly elevated mass barrier between the interior of the house and the fallout in the surrounding yard (see figure 17).

Additional radiation resistance can be provided by nearby outbuildings which interpose mass between the house and portions of the yard, and which elevate fall-out particles on their roofs, increasing the distance between the particles and the interior of the house. The paved surfaces of a porch or terrace patio lend them-selves to easy decontamination with a garden hose, allowing much of the fallout to be washed away from the immediate vicinity of the house. A swimming pool can help increase decontaminated area because fallout which lands in a pool sinks to the bottom and is shielded by the water. Massive but decorative garden walls can be used to shield a house from portions of the yard. These walls do not have to be tall, but they should be fairly thick and constructed of solid masonry.

Trees surrounding a house contribute to radiation resistance, too, by catching the fallout in their leaves and holding it high up in the air away from the inhabited portion of the house. Just as in the case of adjacent roof tops which increase the distance between the fallout and your basement shelter, tall trees also produce a distance effect and can cut down the amount of gamma radiation entering the house by a significant factor.

What about shielding against thermal effects? The thermal pulse of a nuclear explosion is a very brief but very intense flash of radiated heat which occurs at the instant of detonation. The damage caused by this pulse of heat is usually confined to the surface of the house which faces toward the fireball, and in many cases the damage is limited to instantaneous surface charring.

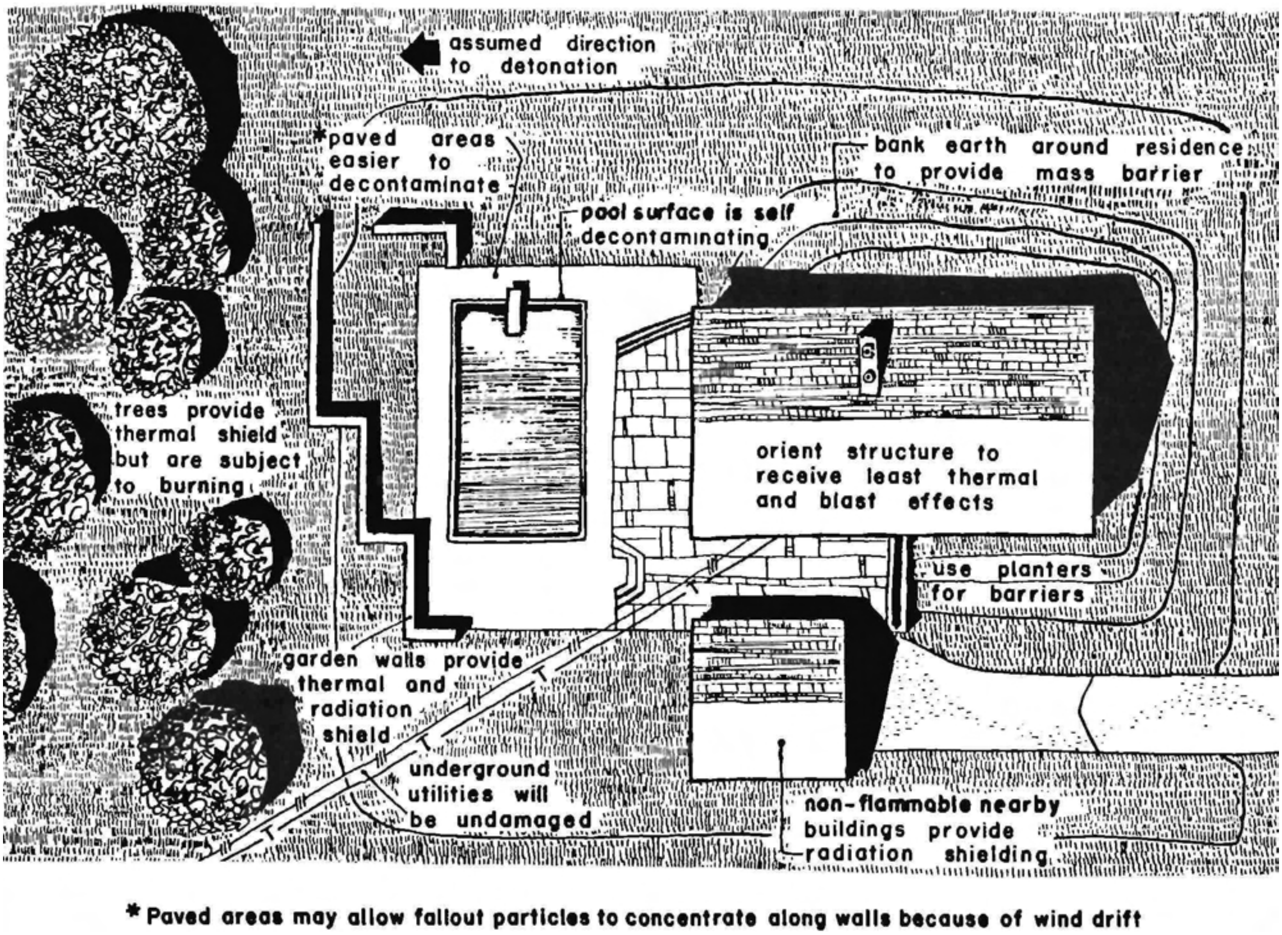


FIGURE 17: Landscaping for Protection. Landscaping can help make a house resistant to fallout radiation, nuclear blast, and thermal pulse. (After Reducing the Vulnerability of Homes, Office of Civil Defense, PG-80-11, August 1963—D13.8/6:80-11.)

Sometimes when kindling material or loose papers are lying around, this pulse can result in the ignition of small fires, which subsequently spread.

Protecting a building from thermal pulse is relatively simple. Tests at the Nevada proving grounds and actual experience recorded in Japan have shown that most exposed portions of a house are not likely to catch fire following a thermal pulse—even though the side of the house facing the explosion may be badly charred. The depth of charring is not usually great enough to sustain subsequent burning. In fact, in some very intense explosions, the charring occurs so abruptly that the surface of the wall is literally "exploded" away, leaving the bulk of the wall intact and unheated. Houses painted white can withstand much greater thermal exposure than can dark colored or weatherbeaten structures.

If you are building a house, it is a good idea to orient it so that the smallest side faces the direction of the nearest nuclear target; this means that the house will be exposed to the least possible dynamic pressure and thermal heating. Most people don't have much say about what direction their house faces, though. If you have a choice, however, try to point a narrow side of the building toward the closest danger area.

The value of plants in resisting thermal damage is rarely considered but can be of overwhelming importance. A stand of shade or fruit trees in the portion of the yard between the house and the presumed nuclear target could intercept most of the incoming thermal pulse, and although it might catch on fire, it would protect the house. A hedge set a few feet away from the side of the house would serve the same purpose. Be sure that the side of the house exposed to the thermal pulse does not have any bushes or trees growing right against it, however, since the plants could ignite easily and then spread the fire to the house.

Fires which begin inside the house are more likely to result in the destruction of the building than are exterior fires. Such fires are ignited by heat rays passing in through glass windows or open doors. You can take two approaches toward cutting down this hazard. One is to install heat-reflecting (solar) glass or opaque coverings over the windows. Venetian blinds or thick white draperies will do, especially if you splash water on the draperies during the danger period. Ordinary window glass will not reflect enough of the heat to significantly cut down the fire potential.

The second approach is to furnish the exposed rooms of the building with materials that are flame-resistant. Tests have shown that houses furnished with rayon and cotton catch fire easily when exposed to a flash of heat, but houses furnished with vinyl plastics and wool resist ignition. Some fires do occur in the latter case, but these are minor and tend to be self-limiting.

Fires from the thermal pulse take several minutes to start, so if your home will be exposed to this danger you should make plans to spend the first few minutes after the explosion searching for and extinguishing these fires. (Wait until after the blast effects have subsided.) Be careful if you go outside during this period, since there is the possibility of subsequent detonations. This is a risky business, but if you don't catch the fires in the first few minutes, they can get out of control. In any case, several large fire extinguishers would be a good investment.

Permanent Interior Ground-level Shelters

I want to discuss built-in ground floor shelters first to dispel a widely held notion that fallout shelters (or storm shelters) are vaults buried in the ground, something like mausoleums. The design presented here is intended to be incorporated directly in the construction of an average house without a basement. The important thing to note here is that although the house has a built-in fallout shelter, no one but you and the contractor need to know about it. Mass shielding is built into the walls and ceiling in such a way that nothing out of the ordinary is detectable.

The design illustrated in figure 18 is for a one-story house built on a concrete slab. Several of the interior walls surrounding the bath-utility area have been made of foot-thick reinforced concrete. These walls can be finished in brick, paneling, plaster, or whatever you like. The extra thickness is noticeable only in the doorways and can be disguised even there to avoid the "monolith" look. The shelter area is capped with a slab of reinforced concrete a foot thick, which is poured in place to interlock with the walls and provide extra structural strength

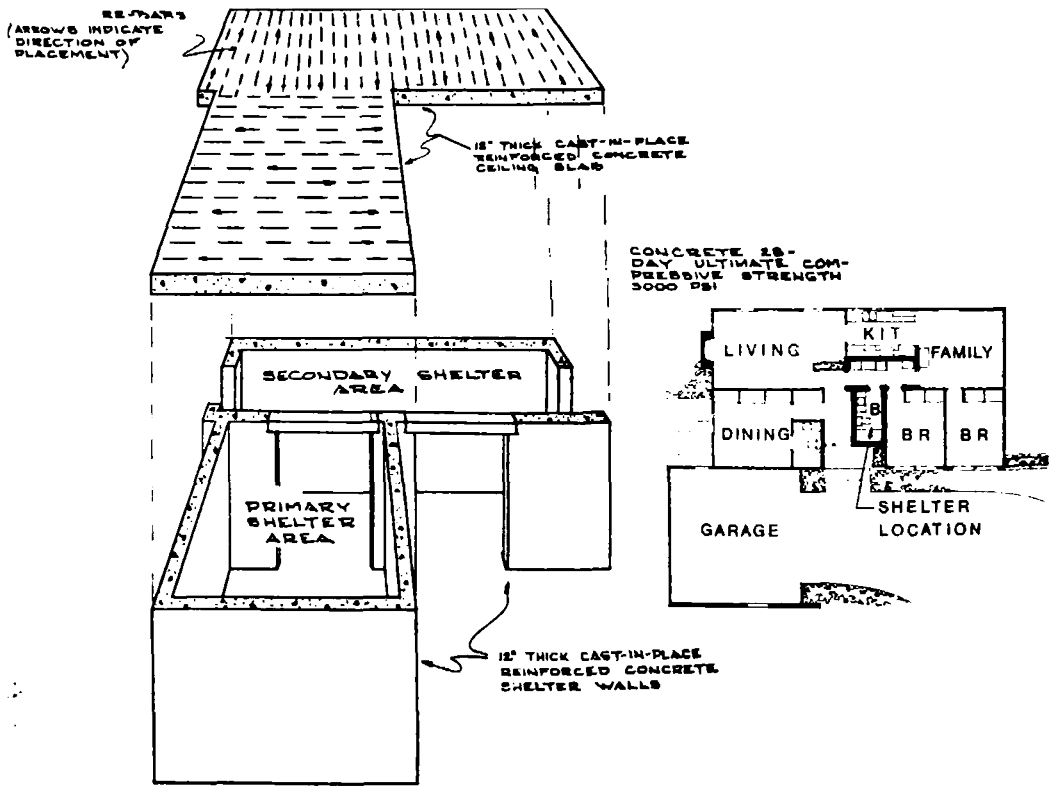


FIGURE 18: Permanent Ground Floor Shelter. This shelter is built (luring the construction of the house by substituting reinforced concrete for conventional materials in several interior walls. (Reprinted by permission of the National Association of Home Builders, 15th and M Streets NW, Washington, DC 20005.)

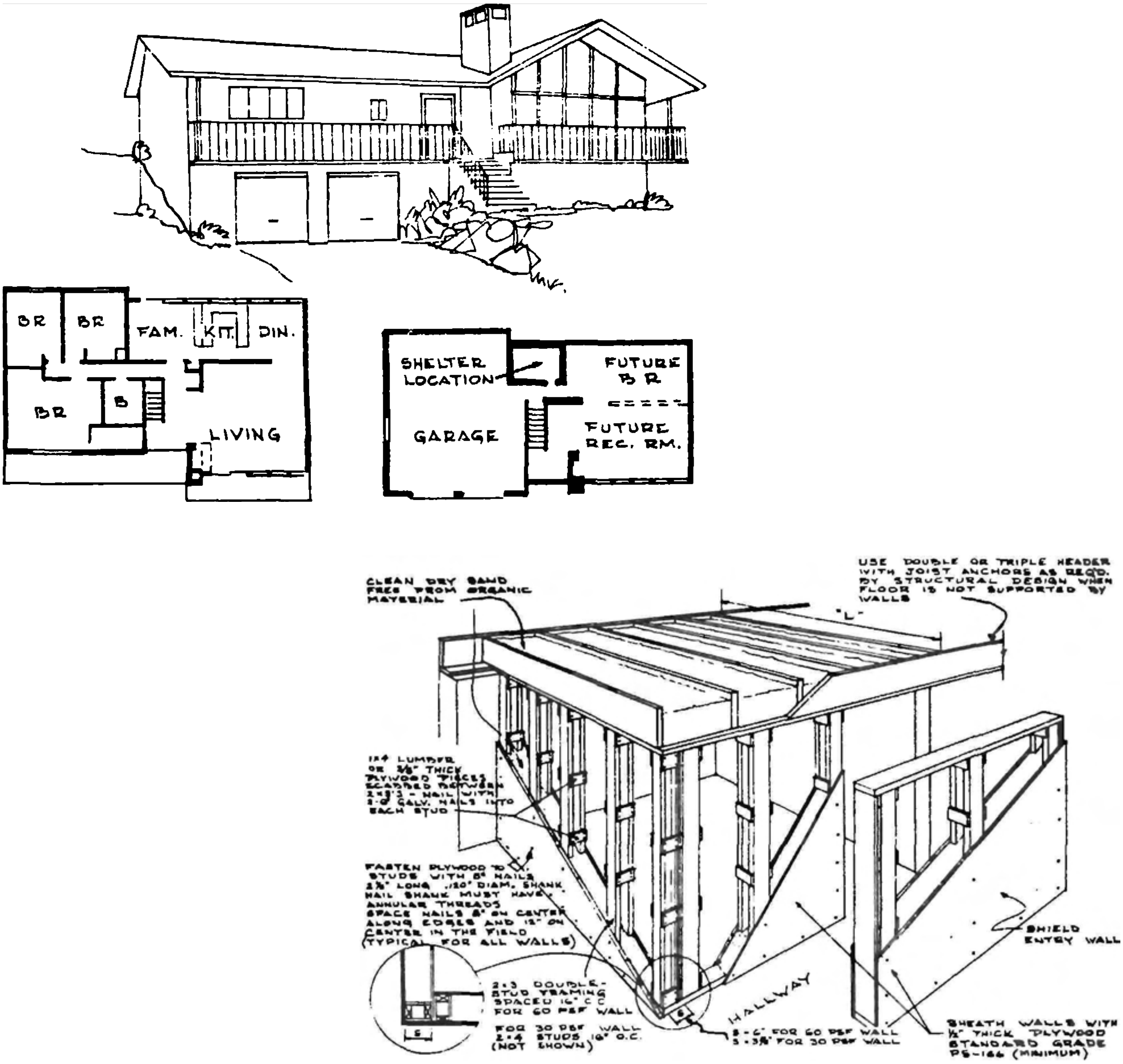


FIGURE 19: Permanent Basement Shelter. This shelter is constructed by filling normal interior walls with sand or gravel. (Reprinted by permission of the National Association of Home Builders, 15th and M Streets NW, Washington, DC 20005.)

to resist earthquakes, windstorms, and atomic blast. This interior module would certainly survive the rest of the house in the event of a tornado or hurricane; it provides a radiation PF of about 40. This would be enough to insure the survival of a family unlucky enough to live in an area receiving as much as 6,000 R during the first two weeks after an atomic attack.

I have deliberately selected a bathroom shelter design to underline an important point. If you have to stay in a single room for several days or weeks, it would be nice if the room had running water and a toilet. Many areas of the United States will not lose their utilities during a fallout or storm crisis, and the use of a bathroom as a shelter could add to the comfort of the experience. Just be sure there is enough room to allow everyone in the family to lie down to sleep.

Permanent Interior Basement Shelters

1 suspect that just about everybody has seen the type of concrete block bunker which was so popular in the 1960s as a permanent basement fallout shelter, and which amounted to little more than a dark, damp hovel

to huddle in. I have selected a different kind of built-in shelter as an example of a more enlightened design (see figure 19). This shelter can be built as part of a new house for about 500 dollars or so, depending on local costs and the exact dimensions of the room to be shielded.

The mass shielding of this shelter is made of hollow plywood walls filled with dry sand or gravel. The ceiling mass is provided by making bins out of the normal floor joists and filling them, too, with sand or gravel. I favor this design for several reasons. The first is that a person building a house or remodeling a basement could build such a shelter without attracting attention to these efforts. Also, the finished shelter is quite undetectable. Depending on the circumstances, an adequate PF can be achieved with walls only four to six inches thick. (The physical location of the shelter in a basement makes up for the lack of mass in the walls.)

There are two additional reasons why this design appeals to me. The first is that the bins of sand overhead can be replaced with galvanized water tanks. The water will not provide as much shielding as sand, but your situation might allow for less shielding in order to store more water. The second reason is that putting sand in overhead bins strikes me as safer than creating the same overhead mass by storing bricks or concrete blocks in such bins, as many designers suggest. If a shock wave or earthquake should happen to rupture one of those bins, it would be nice to have a cascade of sand, gravel, or water rather than a rockfall of concrete blocks. Remember who will be under it.

Permanent Exterior Ground-level Shelters

If you don't plan to build a new house in the near future, you might be interested in building a permanent fallout/tornado/ hurricane shelter outside your home in the backyard. The design presented in figure 20 is a very solid above-ground fallout shelter which can be used as a workshop, garden tool shed, potting shed, or changing area next to the swimming pool. The walls are twenty-inch thick concrete block capped with an eight-inch reinforced concrete slab. A wooden shingled roof covers the ceiling slab and gives it a more traditional appearance.

The shelter can be made either with or without windows; in areas subject to very high winds (or nuclear blast) you will want as little window space as possible. The windows and door can be shielded from gamma radiation by placing loose stacks of concrete blocks in them, but a hurricane or tornado would simply blow these away. An atomic blast could pick up the bricks and fling them into the shelter with a great deal of force. If you expect high winds or blast effects, you should leave windows out. Aside from the loose brick baffles, this shelter was designed to resist blast effects as severe as five pounds per square inch overpressure as close as four miles to a 1-megaton burst. It should also withstand winds over 150 miles per hours, although the decorative roof would, of course, be blown off.

One point of particular interest in this design is the ventilation openings near the top of the walls. In chapter 7, I'll discuss the defense of a refuge, but for now it is sufficient to say that these ventilation ducts could be easily modified to form very useful loopholes. If that kind of thing is important to you, take a closer look at this design.

Permanent Exterior Below-ground Shelter

The permanent, buried exterior shelter provides the best protection from winds, blast, and radiation you can obtain, and at a reasonably low cost. Constructed as a part of a new house, such a shelter will add about 1,000 dollars to the cost of the house while providing a fallout PF of 1,000. For those of you living less than 500 miles to the east of Minuteman missile silos, a very high protection factor is a good idea. A good buried shelter would protect you against a cumulative exposure of 150,000 to 200,000 R. This is enough to kill every other living thing in your neighborhood, crabgrass included.

The design shown in figure 21 was initially intended to provide a PF of 40, but an option is to cover the roof slab with three feet of dirt. This is where the PF 1,000 comes from, so don't overlook that portion of the plan.

No provision is made in this plan for water or sanitation, or even for internal drainage. 1 visited a shelter of this design tucked away under an expensive house in Pacific Grove, California and was surprised to find two inches of water standing on the floor. It seems that the hatch over the door leaked rain and the water had no way to run out. Be sure to include a floor drain in your plans.

Even so, with some modification and attention to detail, this could be a very useful shelter, either as an initial part of the construction of a house or as a later addition. I don't like the look of the air vents which protrude and form first-class eyesores, advertising the presence of a "bomb shelter." I would be inclined to mask the vents inside shrubbery or disguise them as part of permanent patio light stanchions, tetherball poles, or beach umbrella poles. Anything to make them less conspicuous.

The hatch might also be redesigned to form the wooden top of a masonry bench or table, perhaps as part of a barbeque area next to the patio. (My intention in this suggestion is not only to make the presence of the shelter unobvious, but to remove the aspects of shelter design which are positively annoying. If you like trap-doors and air pipes springing out of the ground in your backyard, you are welcome to them. I prefer more natural-looking surroundings.)

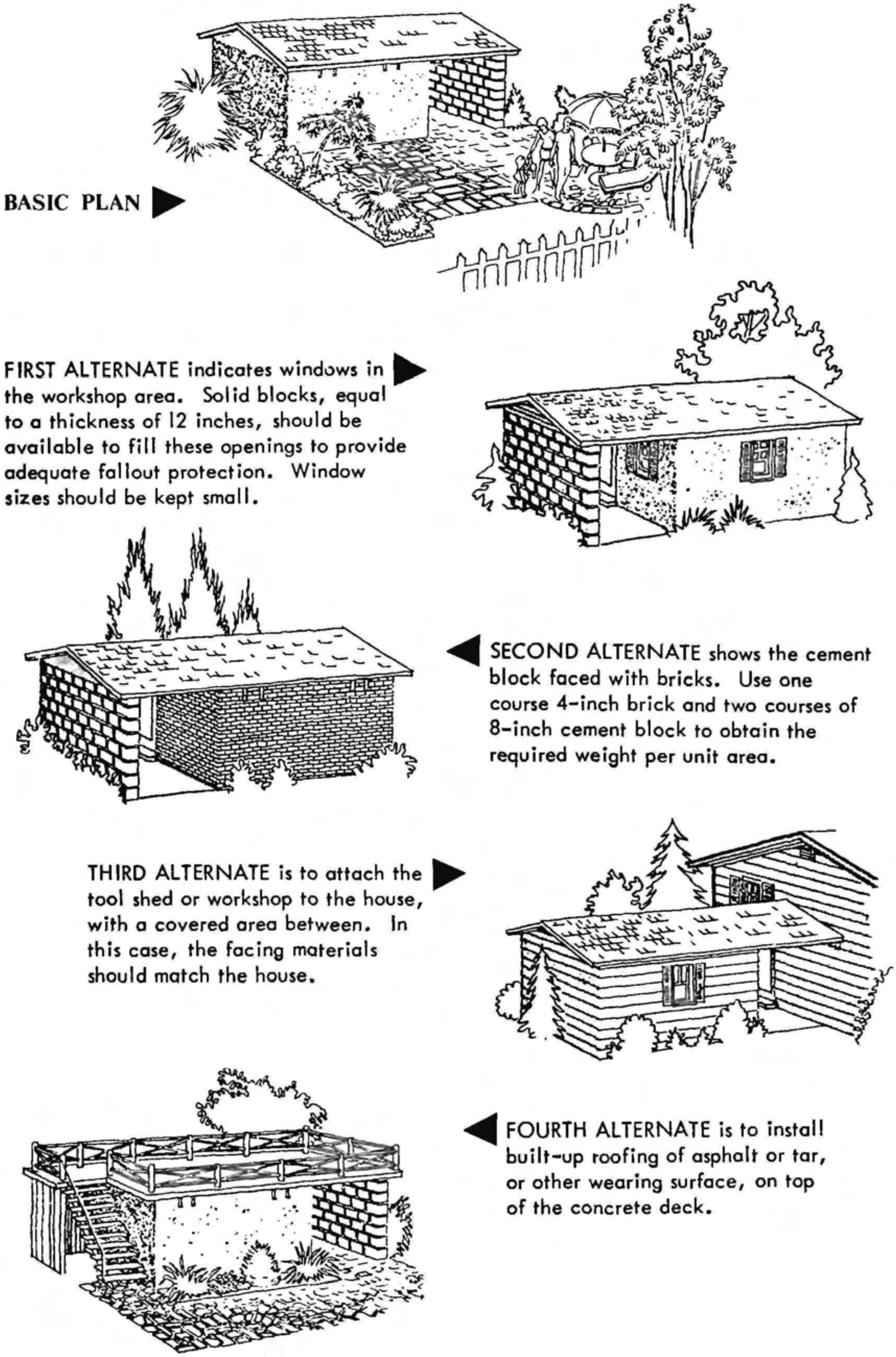


FIGURE 20: Permanent Exterior Ground Level Shelter. This design provides excellent fallout, thermal, blast, and storm protection for areas where underground shelters are not practical. (After Aboveground Home Shelter, Defense Civil Preparedness Agency, H-12-2, February 1973—D14.8/ 3:12-2.)

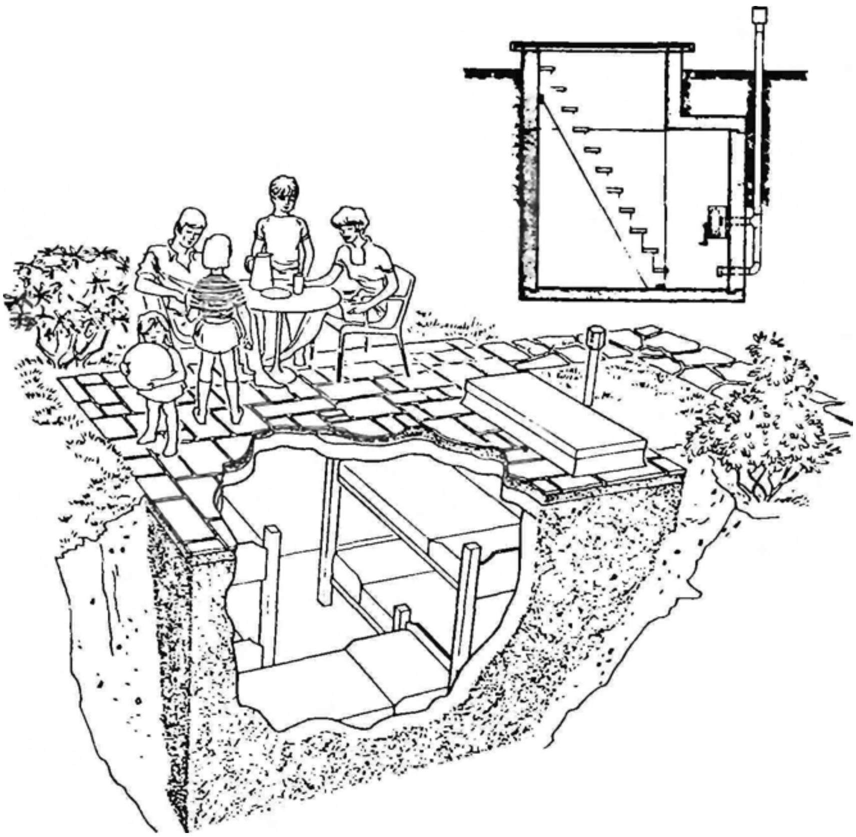


FIGURE 21: Permanent Exterior Below-ground Shelter. Although the perspective view shows the roof of this shelter used as a patio, a much better PF can be achieved by burying the entire structure beneath three feet of earth, as shown upper right. (After Home Fallout Shelter. Office of Civil Defense, H-12-1, January 1969—DL19.8/ 2:12-1.)

It is best to build an underground shelter as far from nearby buildings as possible so they do not collapse on top of the hatch as a result of wind or blast effects. If you desire, however, this kind of shelter can be built right next to the house with a door directly into the basement. In areas where no blast is likely, this arrangement would be preferred because it allows access to the interior of the house without exposing anyone to contamination by fallout particles.

Prefabricated Basement Fallout Shelters

Prefabricated fallout shelters can provide adequate protection from fallout in most areas if the shelter is located in a corner of a basement where the outside ground level is well above the roof of the shelter. A prefabricated shelter is simply a collection of shelter parts which serve other purposes until the time when they are needed for radiation barriers.

The virtues of prefabricated shelters are that the materials are inexpensive (up to about 400 dollars 1978 prices), they can be installed in any basement by the homeowner, and it is not really necessary to do anything but buy the components and keep a copy of the plans. If hard work isn't your bag, you can stack the pieces away and know that they will be there when you need them. The design discussed in this section is described as providing shelter for four persons and requiring only twenty man-hours to build. A frantic family of four could assemble it in an hour.

This is the Basement Concrete Block Shelter illustrated in figure 22. It is a vault built in the corner of a basement from concrete blocks and a few pieces of wood. The official Civil Defense construction plans assume that you will mortar the blocks together to form a permanent shelter in the corner of your basement, but this is not necessary. If your home is not within a short blast radius of any target, there is no need to use mortar. (If it is subject to blast, your shelter shouldn't be in the basement anyway.) Just stack the blocks dry and fill them with sand. If you go to the trouble of cutting and labeling all the wood parts ahead of time, you can assemble the shelter and occupy it in about an hour. If you don't live near any target, you should have at least that much warning before receiving any fallout.

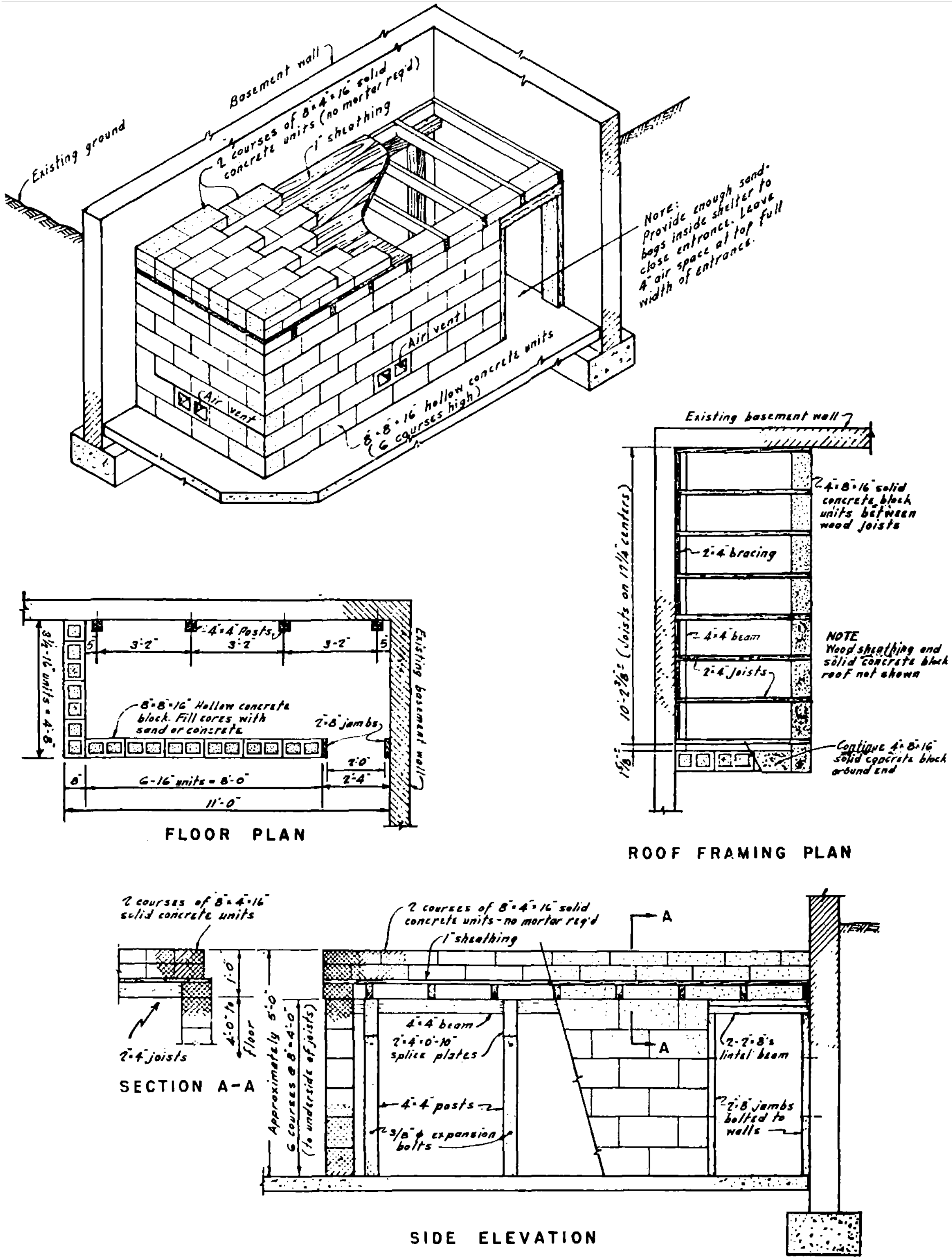


FIGURE 22: Prefabricated Basement Concrete Block Shelter. This type of shelter can be stored as components and then assembled quickly if necessary. In the building plans, note that the hollow blocks can be filled with concrete ahead of time to save construction time in a crisis. (After Fallout Protection for Homes with Basements, Office of Civil Defense, May 1967—D119/8/2:12-3.)

The only difficulty with this plan is figuring out how to store a ton of sand and 200 concrete blocks. This is a problem with all prefabricated shelters. One of the best ideas 1 have heard is to build yourself a nice patio. Level out a section of the backyard, spread a bed of sand, and lay the concrete blocks as if they were flagstones. A little more sand between the cracks and you have your patio. There are enough blocks for a ten by twenty foot area. If the worst happens some dark day, you can rip the patio up and assemble the shelter. (It would be a good idea to paint the wood parts a garish and improbable color to prevent their being used in a home woodshop project by accident—it would not be nice to lug in all those bricks and then discover that you had made a bookshelf out of the rest of the shelter.)

Underground Homes as Whole-building Shelters

For those readers who will take the idea of personal blast/fallout/weather shelters extremely seriously, I would like to point out that the technology now exists to build new homes in such a way that the entire house is a "shelter" in every sense of the word. I am referring to underground homes.

For those of you who may be interested, underground houses are basically simple solar designs built of reinforced concrete and buried partially or wholly beneath ground level (see figure 23). Do not get the idea that they are vaults, however; underground houses are just as light, warm, open, and dry as conventional wood-frame houses. They have picture windows opening out onto the hillside, sunken patios and gardens open to the sky, and numerous skylights. The underground houses I have seen have had more window space than most conventional houses.

The advantages of underground structures (other than as shelters) stem from the thermal insulative properties of soil and the inexpensiveness of concrete. Depending on who designs the house, the total cost of construction can be as much as 20 percent less than a wooden house of the same size. If you go to a high-priced architect who has grandiose ideas, the cost overrun can be equally high. The long-term savings, however, make up for any additional expense. Because the temperature of a house is buffered by the surrounding soil, an underground home can be heated and cooled very efficiently. In one experiment, the owner of an underground house in Illinois turned off the heat for two weeks when outside temperatures were about 40 degrees below zero. The house lost about 1 degree a day. A standard home would have been freezing in a few hours. Fuel economy is outstanding.

From the standpoint of fallout, there are several advantages to a whole-house shelter. A typical underground design has all the shelter potential of a standard

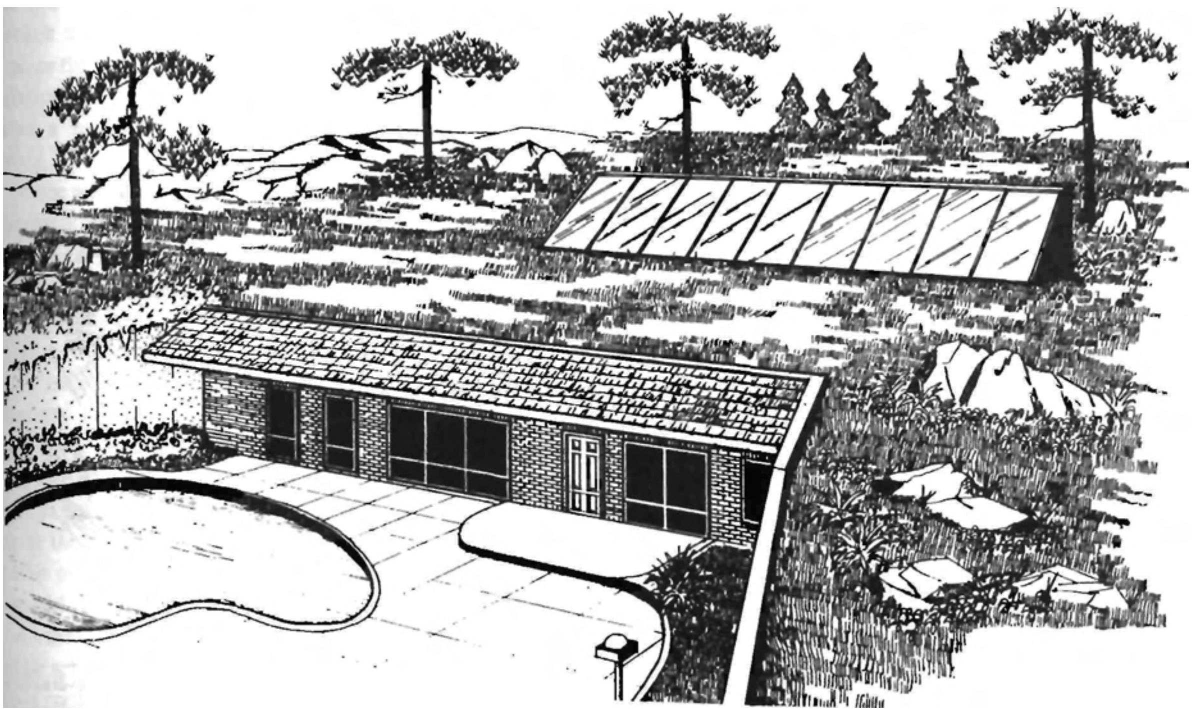


FIGURE 23: Underground Home. Not designed with fallout protection in mind, this home still provides excellent radiation shielding with easily decontaminated patio and pool areas. Compare the landscaping in this drawing with that in figure 17. (Drawing courtesy of Underground Homes, PO Box 1346, Portsmouth, Ohio 45662.)

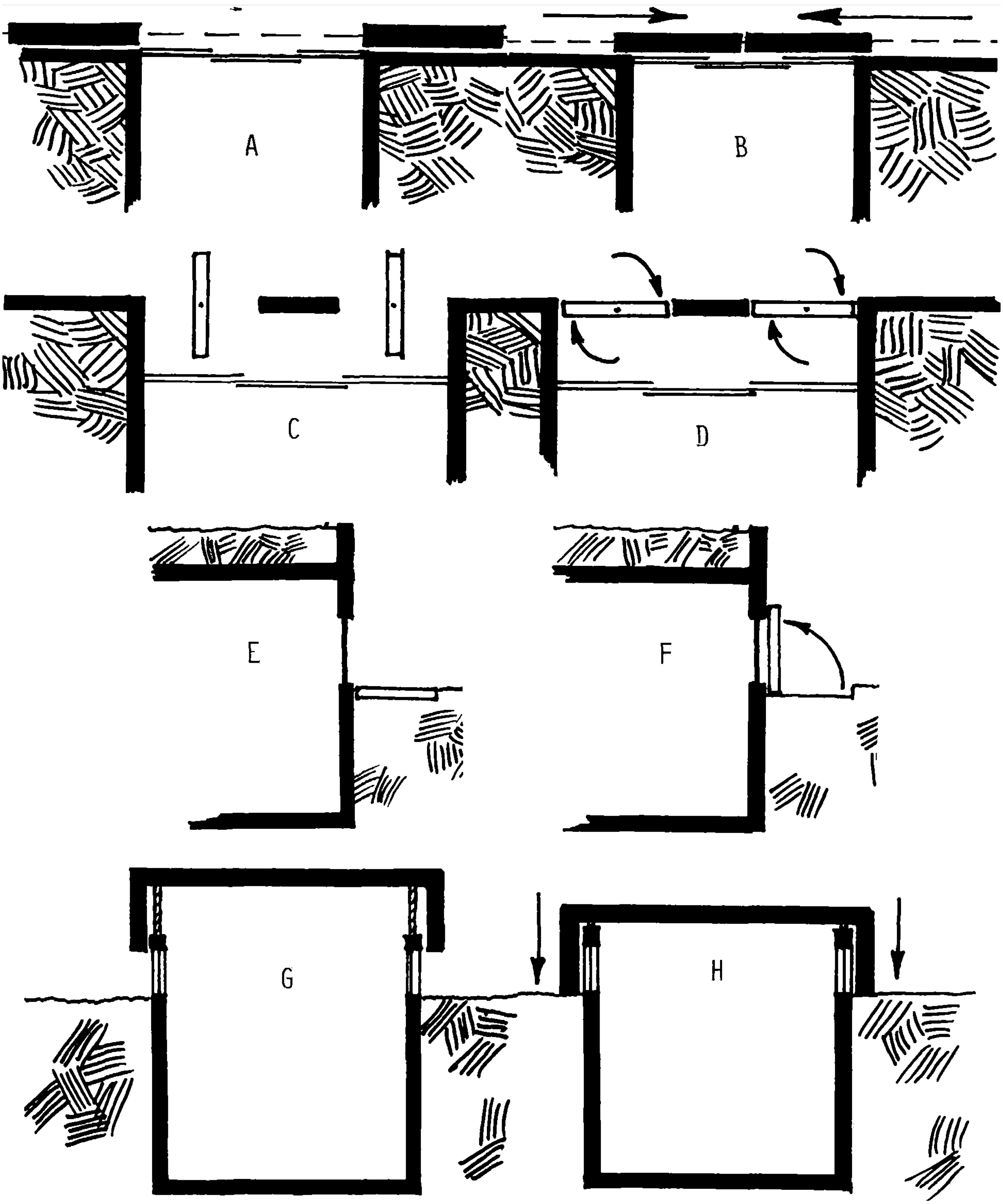


FIGURE 24: Protecting Windows from Blast and Radiation. (A) Sliding concrete panels on tracks in the front of a glass wall can be (B) slid in front of windows when the attack is imminent. (C) Pivoting concrete panels can be (D) rotated into place. (E) Cast-in-place concrete slabs can be jacked up (F) over ground level windows. (G) The roof of the underground house can even be lowered on hydraulic jacks (H) to seal off the building. (After National School Fallout Shelter Design Competition Awards. Office of Civil Defense, TR-19, February 1963—D13.12:19. Also, thanks to Cresson Kearny for the idea shown in E and F.)

basement but has two or three feet of soil over the roof. With a little attention to detail, a PF of over 1,000 can be attained. Even without any serious attempt to maximize the shelter potential, the deeper portions of a typical subterranean home provide protection well in excess of a PF of 40, the standard set by the Office of Civil Defense. As for blast resistance, in experiments conducted at the Nevada test site, buried concrete structures withstood up to 200 pounds per square inch overpressure. This is a pressure high enough to kill any unprotected humans outright, and corresponds to that at a location only half a mile from the center of a 1-megaton burst. This is within the radius of the fireball I do not suggest that a typical residential underground house (or its inhabitants) would survive this kind of treatment, but the potential is there and could be exploited.

The main vulnerability of underground houses to the effects of nuclear weapons is the windows and skylights. Of course, you could design the house with an interior area that could be completely sealed off, but for my money, it would be worth it to make the whole house resistant to blast and radiation. The architects who competed in the 1960s fallout shelter design contests suggested several answers to the problem of protecting windows; these deserve some discussion here.

One common suggestion was to construct rolling panels of concrete which could be pushed into position across the vulnerable windows prior to an attack (see figure 24). These panels were to be at least eight inches thick and would have to run on steel tracks. Another approach was to mount the concrete panels on pivots and place them within the outer portion of each window or doorway. In an emergency the panels could be rotated a quarter turn, effectively blocking off the opening.

There were two suggestions that I thought might be particularly useful. One of them, described to me by Cresson Kearny of the Oak Ridge National Laboratory, was to cast concrete panels horizontally on the ground in front of each window, as if the concrete were to form part of a sidewalk. Since the windows of an underground house are frequently set at grade level, in an emergency these cast-to-fit concrete slabs could be jacked upright to cover the windows. This seems like a simple solution which could even be applied to existing basement windows. A similar but expedient approach is to cover the windows with logs, lumber, or door panels and then pile an earthen berm against them. Obviously, this would take time, perhaps several days in some cases.

A really original suggestion was part of an award-winning school fallout shelter design. The idea was to cast the roof of a building as a single slab of concrete and support it at the corners with hydraulic jacks. The windows make a wide band of glass just below the level of the roof all the way around the building. In the event of a crisis, the jacks are used to lower the roof right down on top of the walls, covering the vulnerable windows and essentially sealing the building. The windows were designed to slip up inside the lip of the roof so that they would not be crushed.

I think that the potential for underground housing has not been properly appreciated by the public in general; the shelter aspects of underground living make a close examination of these possibilities necessary. I keep wondering if the time will come when the individuals who built underground homes will be the only people capable of normal, comfortable day-to-day living. Tiny fallout shelters are adequate for survival, but it would be much better during such trying times to have the run of an entire house. Weathering the crisis within the familiar surroundings of home can be a great psychological plus.

Expedient Interior Shelters

If you are reading this book, I can't imagine that you are the complacent type who will one day be caught with no fallout protection at all, but a war might start while you are on vacation with relatives—or you might be forced to evacuate from your home—so a few words about building a fallout shelter from nothing are in order.

The basic idea is to enclose a space with as much mass as you can scrape together. This is best done in a basement, where the natural shielding of the surrounding earth provides substantial protection even without additional efforts on your part. Two approaches to constructing a makeshift shelter in a basement are shown in figure 25. A sturdy workbench or a table formed of chests of drawers topped by two or three interior doors can be used as a platform on which to pile up everything heavy you can find. Drawers and boxes filled with dirt are best, but newspapers, books, firewood, tools, or anything that is heavy may be used. Your goal is to pile 150 pounds of material on every square foot of the table and in front of every square foot of the sides of your shelter. Piling up heavy furniture in the room over the shelter location or filling up a bathtub or child's wading pool in the room over the shelter can help achieve the needed mass. (If you can get your waterbed into the room over the shelter, that would be excellent protection.) Shielding of this sort provides a PF of about 40.

If the house does not have a basement and there is no time or no way to reach better shelter, a makeshift shelter can be constructed in the center of the first floor (see figure 26). Again, the plan is to pile heavy things on top of a sturdy table to achieve a mass of 150 pounds per square foot. This is a poor shelter, but it will be better than no shelter at all. If you have garbage pails or wastebaskets, you can fill them with water and take them into the shelter space with you—if you sit and hug a garbage can full of water, one whole side of you will be

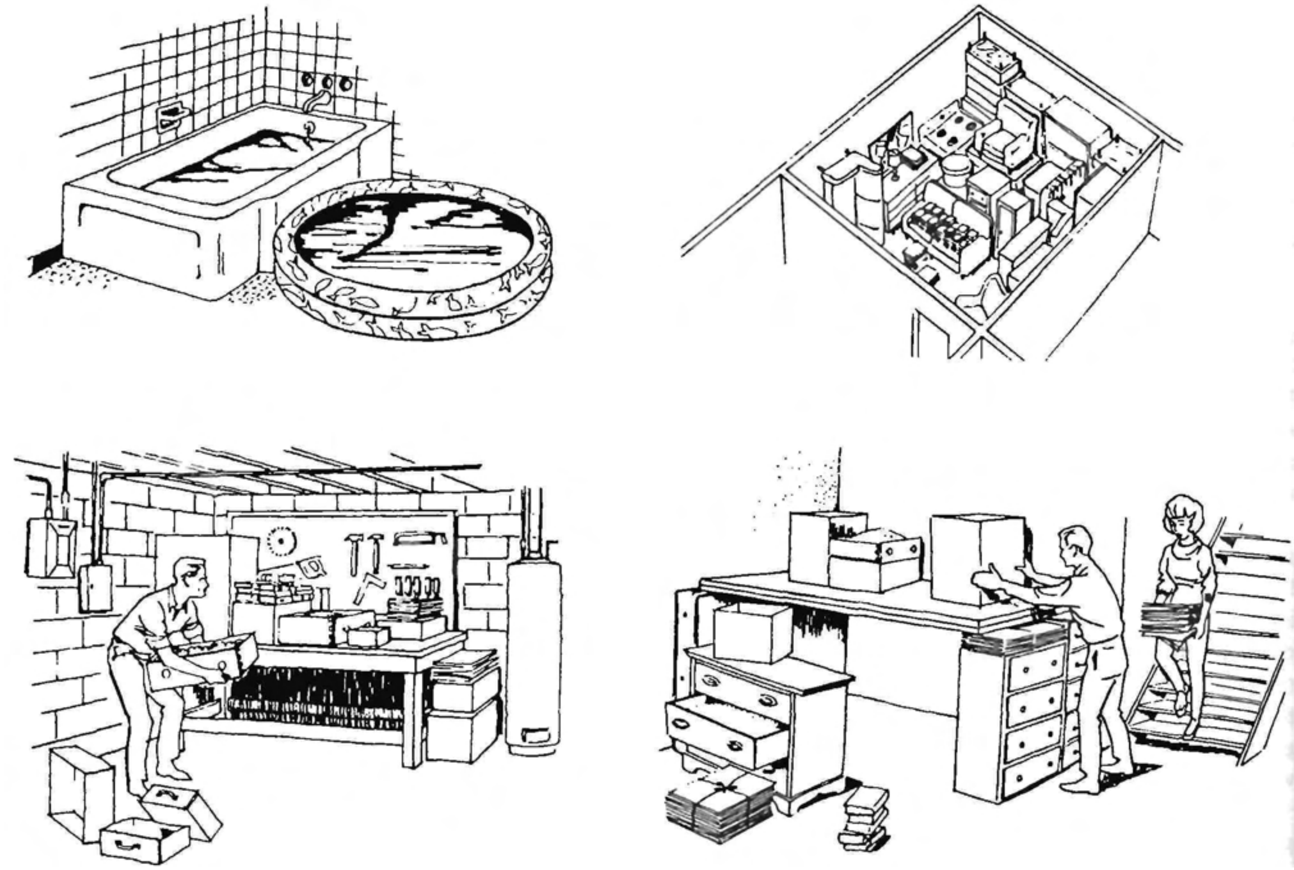


FIGURE 25: Two Expedient Basement Shelters. Shelters should be located in a corner of the basement beneath a sturdy workbench or table. Overhead mass is created by piling heavy objects in the room over the shelter; a supply of children's wading pools can be very effective in creating overhead mass. (After Personal and Family Survival, Office of Civil Defense, SM-3-11, June 1966.)

well-shielded. The bodies of several people crammed in the small space will tend to shield one another, too. In most kinds of shelters, one tries to be sure that there will be enough space for each person to feel comfortable, but in a ground-level makeshift shelter like this, the more crowded you get the safer you will be. Remember that radiation sickness can be significantly reduced if any large part of your body can be protected. Arrange your few really good shields to protect your legs if you can. Undamaged marrow in your leg bones might pull you through, even though the rest of your body is severely irradiated.

For those of you who will be seeking shelter from blast and fallout radiation in apartment buildings, there are some special considerations to keep in mind. In multiple-story buildings (six or more floors), the basement is often deep enough, large enough, and far enough from the roof to provide exceptionally high radiation protection (a PF of over 200). Interior areas of floors about halfway up the building are also very good fallout shelters because of the distance between them and the fallout particles on the roof and on the ground. Remember that nearby roofs will catch fallout particles and raise the effective "ground" level. Keep this in mind when you select the story to use as your refuge (see figure 27).

A few special locations in a multiple story building are particularly well protected. The very center of an intermediate floor, the central core of an "X"-shaped building, and the windowless interior room formed by an "L"-shaped building are all especially good places to take refuge (but only on intermediate-level floors). As mentioned before, a basement or sub-basement is by far the best shelter if it is available. When a blast wave hits a modern high-rise building, there is a tendency for the contents of the upper stories to be blown sideways through the walls and out of the building. Use the basement if you expect blast.

Expedient Exterior Fallout and Blast Shelters

A far better way to deal with the threat of nuclear attack than using interior space is to build an expedient fallout and blast shelter outside in your back yard or in some other small vacant area of land. Such areas are

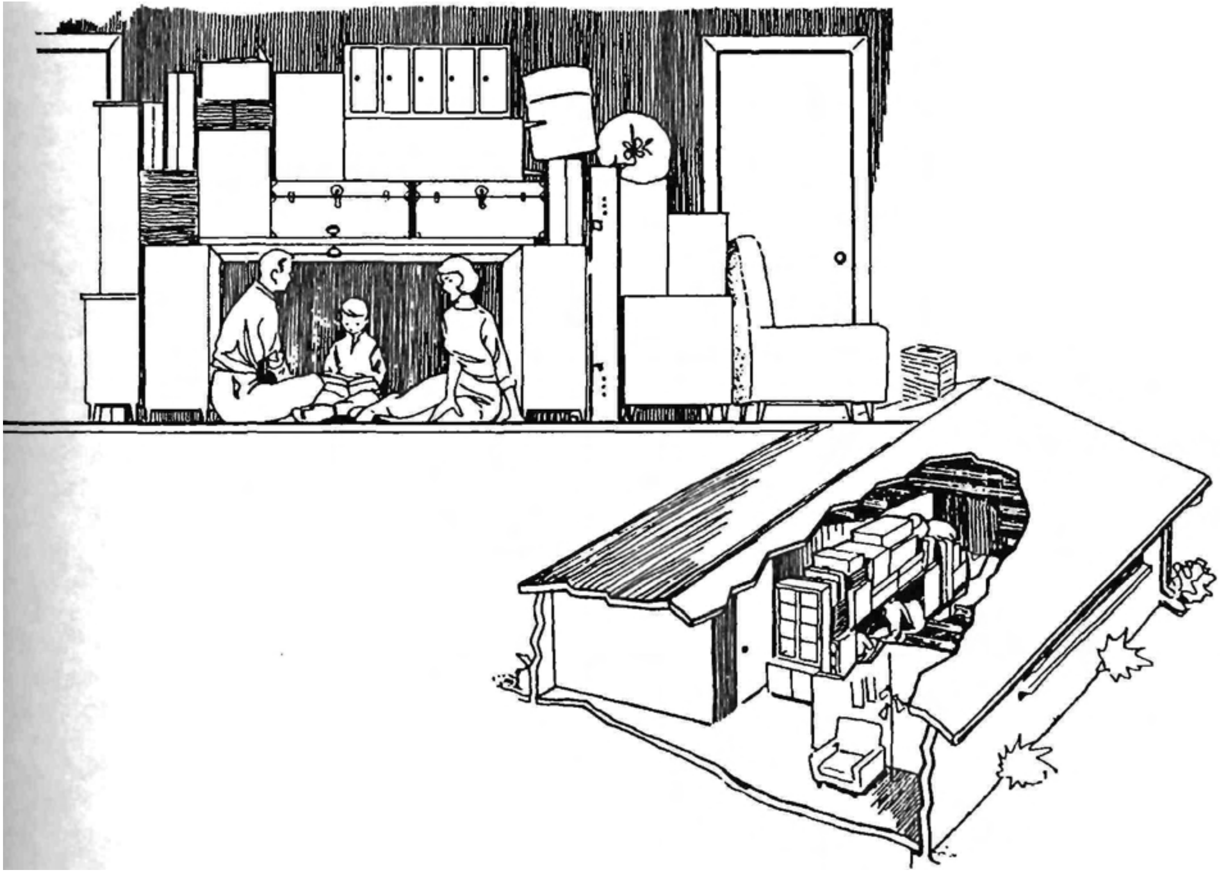


FIGURE 26: Expedient Interior Ground-level Shelter. A very poor kind of shelter, but it could save your life if you have nothingelse. The shelter should be built in the center of the house with as much mass as possible overhead and to the sides. The family in this d rawing is totally exposed on two sides—don't imitate their mistake. (After Personal and Family Survival, Office of Civil Defense, SM-3-11, June 1966.)

literally made of shielding, and all you have to do is remove a little of it and insert yourself in the hole. Even a simple open trench about four feet deep provides a PF of 10.

Two designs for expedient exterior shelters invented and tested by researchers at the Oak Ridge National Laboratory are particularly useful. Both are intended to be built by an average family of four, using only hand-powered tools and materials which are likely to be found in the home.

The first design, the Door-over-Trench Shelter, consists of a trench dug in firm ground which is covered with door panels and then buried under three feet of mounded earth. With suitably constructed makeshift blast doors, the fallout PF of this shelter is about 1,000—and it will resist blast pressures up to about 15 pounds per square inch, the equivalent of a 300 to 400 mile per hour wind. Although the door panels are very flimsy, the earth over them forms an arch and supports its own weight as the doors sag. The strength of this natural earth arch is amazing. One of the tests the Oak Ridge researchers conducted involved burying the door-covered trench under six feet of dirt and driving a heavy piece of earth moving equipment up on top of the mound. The doors held.

The Door-over-Trench Shelter has been successfully field-tested on two occasions. In the first instance, a father who had never dug a trench before completed the shelter within thirty-six hours of receiving the instructions. His wife was an invalid, and he was assisted by only one little girl. On the second occasion, a fatherless family worked together to build the shelter in only thirty-four hours. These building times could be greatly reduced by any increase in the number of workers, their experience, or the quality of the tools available to them.
A roto-tiller could greatly speed up the excavation of the trench, for instance.

The second design is the Car-over-Trench Shelter; it makes use of the same principle as the Door-over-Trench design. Suppose you must leave your home in a hurry, evacuating in the family car to a remote refuge. (Local Civil Defense authorities have the power to force you to evacuate in some areas.) If there isn't any prepared fallout protection provided, you can still build a shelter using a trench and the car itself. The car is driven over the trench to form a roof, after which the interior, the trunk, and the top of the hood are filled with dirt to provide overhead shielding. Earth is also piled up around the sides of the car, using special sandbags made of sheets and pillowcases. This is not a blast-resistant shelter, but it can make you safe from fallout for the few days during which you would need protection.

The Car-over-Trench Shelter was field-tested in Colorado in the winter of 1973 by a couple with one nine-year-old child. The family received the instructions at their house in town, spent a few minutes reading them, and then packed up their Ford Maverick and headed for the hills. Once there, the father did all the work, but even so, the shelter was completed in fourteen and one-half hours. The PF was judged to be between 80 and 100.

Complete, step-by-step instructions for both shelters are provided in Appendix C. If neither design suits your particular needs, I suggest that you consult the Expedient Shelter Handbook, from which these designs are drawn (G. A. Christy and Cresson Kearny, Oak Ridge National Laboratory, ORNL4941, August 1974). The manual contains complete plans for fifteen expedient shelters, housing from 2 to 100 people, constructed of almost every imaginable material from living room rugs to moving vans. Truly an expedient shelter for every pocketbook.

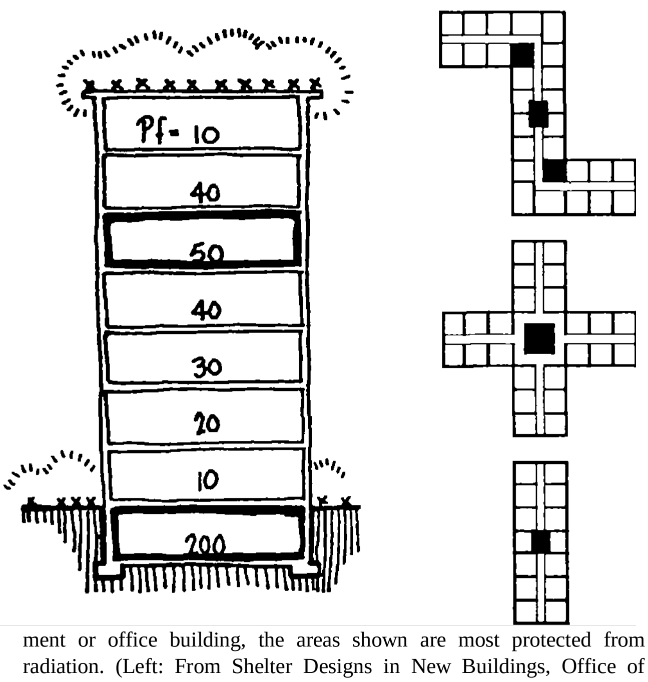


FIGURE 27: Preferred Shelter Locations. In a multiple-story apartment or office building, the areas shown are most protected from radiation. (Left: From Shelter Designs in New Buildings, Office of Civil Defense TR-43, March 1967- D119.9:43. Right: From Incorporation of Shelter into Apartments and Office Buildings, Office of Civil Defense PSD-PG-80-4, November 1962—D13.8/6:80-4.)

The Ultimate Expedient Shelter

What if I were to tell you that there was a well-made fallout shelter waiting for you, and all you had to do is spend 50 cents on a key for the door in order to take possession? Furthermore, that this shelter is made of I reinforced concrete and is proof against very high levels of blast and heat as well as fallout? Sounds unbelievable? It's true.

If you live in a suburban area with paved streets and underground utilities, you also have a plentiful supply of manholes. Beneath each manhole is a small underground room or possibly a six-foot diameter drainpipe, either of which will serve admirably as a shelter from nuclear effects.

All you have to do to gain access to this haven is to get the lid up. These lids are made of very thick steel, intended to support the weight of trucks and buses, and they are not light. Usually, though, a motivated adult can pull open a manhole cover by using a simple "key" made of two bolts and a short length of steel cable or rope. Tie the cable between the centers of the bolts (making an "H"). Then insert one bolt through the hole in the edge of the cover. Jiggle it around inside to get it crosswise under the hole, use the other bolt as a handle, and pull the cover off. Simple.

Some manholes do lead to sewers, of course, but others are nice and dry and clean. It pays to do some shopping around.

Expedient Shelter on the Farm

Unfortunately, the lethal effects of ionizing radiation are not confined to humans. Most large mammals react to fallout radiation about the same way people do; therefore, they need shelter in the event of atomic attack. Obviously, you cannot afford to build extensive underground facilities to house your herd of cattle or flock of sheep, so any shelter for the animals will have to be makeshift.

The key to protecting livestock is to get them indoors where you can keep the fallout from getting into their coats. If you can prevent contact beta burns from the fallout, you have solved half of the problem. The beta burns from fallout particles can produce large open sores which are extremely vulnerable to infection. You must also keep the fallout out of the animals' feed for at least two weeks following the attack, even if it means starving them. (You will have to supply water, of course, contaminated or not.) This will prevent internal burns and will help reduce radioactive damage to the thyroid from iodine-131.

The second half of the problem is to shield the animals from penetrating gamma radiation (see figure 28). If you herd the animals into a barn in a crowded group, you can achieve some degree of self-shielding; the animals in the center will be partially protected by the

The door to the ultimate in expedient fallout and blast shelters, along with a "key" for opening it (a crowbar works, too). WA RNING: Manholes are frequently full of explosive, poisonous or unbreath able gases. Use a commercial lest kit to test air purity before entering. Leave the manhole cover in place only during the period of blast danger. Remove it for ventilation later, and power ventilate the hole if possible. Cover the hole with an elevated rain fly to keep out fallout.

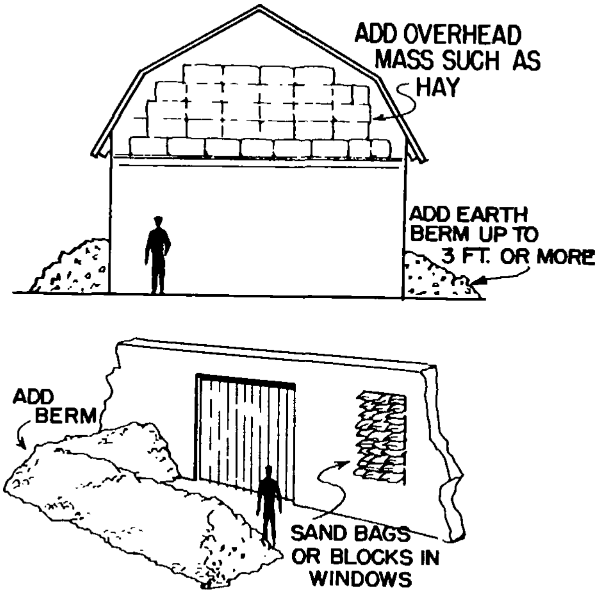


FIGURE 28: Expedient Shelter for Livestock. Even without the precautions shown, a herd of animals crowded into a barn tends to be self-shielding. (After Rural Fallout Shelter Analysis Design Workshop, Instructor's Manual, Office of Civil Defense, IG 18-1, March 1966—D119.9/7:18-1.)

bodies of those around the edges of the group. Filling the loft with hay, wetted if the barn will stand the strain, will help provide overhead mass. Most barn roofs are high enough to produce some distance attenuation of radiation. You will have to shield the sides of the barn with an earthen berm if possible, piled to a depth of three feet or more against the sides of the barn. If the barn is constructed of concrete, some additional sheltering effect may be achieved by stacking sandbags in the windows. Hosing off the roof of the barn after the fallout has stopped will greatly increase the protection, but don't even think about it unless you can rinse off the barn without exposing yourself to a significant dose of radiation in the meantime. In many rural areas, the initial fallout concentration will be light enough to allow you to run out for a few minutes before diving back into your fallout shelter. Be sure that your dosimeter is working properly before you try it, however, and make certain that you have proper anti-contamination clothing to wear. (Radiation equipment is discussed in chapter 8.)

Boats and Airplanes as Shelters

Obviously, it is not a good idea to choose a small boat or a private plane as a shelter from a severe storm or from the blast effects of a nuclear explosion. In terms of fallout, however, there are situations in which a boat or plane could be used as a refuge from gamma radiation, at least temporarily.

With a little preparation, a small sailboat can be successfully used as a fallout shelter (see figure 29). This fact derives from the tendency of fallout grains (which resemble sand) to sink when they land in the water. This makes the surface of a large lake or an ocean self-shielding, because once the fallout particle has sunk through five or six feet of water, it is effectively nullified as a source of radiation. People on a boat, therefore, would only need to be worried about the fallout particles which land directly on the boat itself. Even without taking any steps to wash away this fallout, their exposure would only be about 20 percent of what they would have received on shore.

To reduce the dose even more, the boat should be anchored several hundred yards from shore and covered with a waterproof rain fly. By rinsing off this fly periodically while the fallout is arriving, the inhabitants of the boat can greatly cut down their exposure. With more advanced preparation, retreaters could rig up a pump and sprinkler system to automatically wash off the rain fly—without human intervention. Some provision should be made to inject a little detergent into the spray water to help dislodge the fallout grains and to break up the surface tension of the water around the boat. Most of the smaller particles that might otherwise have remained as a layer of dust on the surface of the water will then sink.

My model for this discussion is a twenty-seven foot sailboat with a small cabin, arranged with a walkway

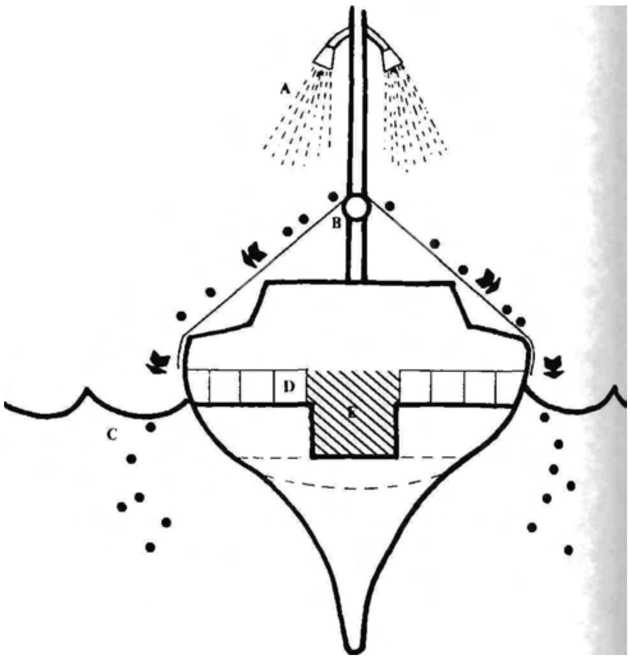


FIGURE 29: Sailboat Fallout Shelter. This plan is a scaled down version of a technique currently employed by the United States Navy. (A) Remotely controlled sprinklers rinse fallout off the boat. (B) boom tent is used to keep fallout out of cockpit, (C) fallout particles sink into the water, (D) makeshift mass barrier at the level of the waterline, (E) the safest location, on the deck below the waterline.

Sailboat equipped with a boom tent, the first essential piece of equipment in making a floating fallout shelter. (Tent courtesy of the Seattle Tent & Fabric Company, PO Box 33576, Seattle, Washington 98133.)

down the center and a bunk on each side. (This is a fairly standard arrangement for small sailboats.) I would suggest piling the supplies, particularly the water jugs, on the bunks to form a makeshift radiation shield at the level of the waterline. The people should try to stay down as low as possible on the deck area between the bunks, in the space which is normally below the waterline. This is the best-shielded location on the boat. Remember that if there are too many people to fit into this area in a prone position, you can still successfully beat the radiation by keeping at least the lower half of your body well shielded. Don't just put the kids down there and sit it out above the waterline yourself. What survival potential has an orphan, after all?

The usefulness of an airplane as a radiation shelter is limited. For those of you who anticipate flying away to a remote refuge, however, there is one very important thing to realize about fallout radiation. Since fallout is like sand, it sifts down out of the air fairly rapidly; a few hours after a detonation, the amount of fallout in the air over the target or immediately downwind of it is very small. By that time, most of the particles have settled to the ground. A person flying over the contaminated area at an altitude of 3,000 to 4,000 feet (relative to the local ground level) is so far removed from the radioactive material on the ground that the dose received is only about 1/1,000th of the ground level dose (see figure 30). This means that it is safe to fly across contaminated areas which would be lethal to cross on foot or in a car. If you pick your time wisely and avoid flying through a

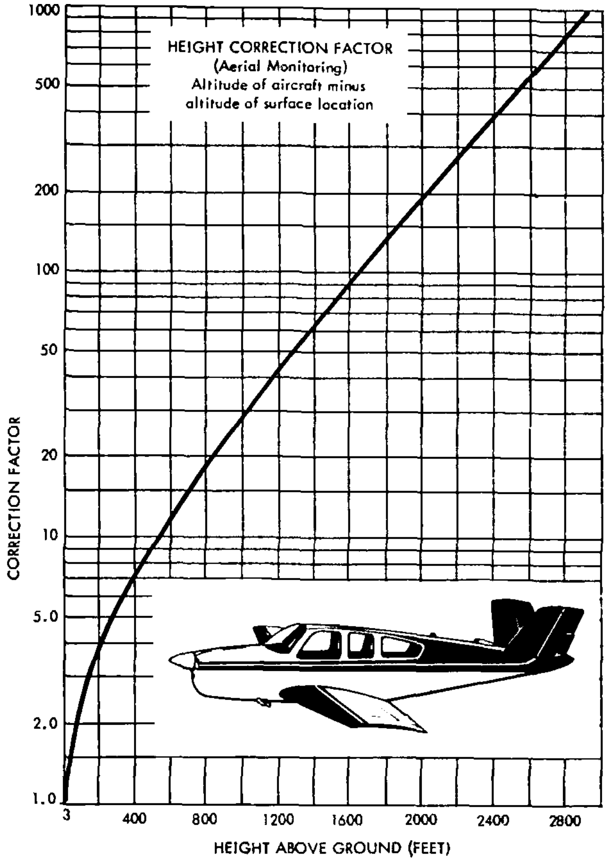


FIGURE 30: Airplane Radiation Shelter. The distance between a plane in flight and fallout particles on the ground provides excellent protection. (After Handbook for Aerial Radiation Monitors, Office of Civil Defense, FG-E-9.5.1, July 1966—D119.8/3:E-9.5.1.)

drifting cloud of fission debris, you will be able to cross dangerous country without incurring very much radiation exposure.

Special Shelter Topics

If we agree that the term "shelter" means a refuge from a hostile external environment, a broad range of possible circumstances and special protections become appropriate for discussion. These cases include simple protections from cold, rain, wind, heat, and sun, as well as more exotic precautions against the danger of noxious gases, radioactive dust, nuclear thermal flash effects, and flooding.

If you are subject to any threat which means that you might one day be forced to evacuate from your home, provisions for shelter are uppermost. If your household is already equipped with a full complement of camping gear or a truck camper, you will not need to make many further preparations. If not, several kinds of equipment must be obtained.

The first item is a tent. There are many fine family-sized tents on the market, and one which suits your taste and budget should be easy to find in a local sporting goods or department store. (Sears' tents are particularly suitable, well-made, and are reasonably priced.) One of the most interesting tents I have seen is made by the Beckel Canvas Company (Box 20491, Portland, Oregon 97220). It is designed to accommodate a wood stove, a very unusual feature. (The stove is also supplied by Beckel.) I suggest that you get a tent that is larger than you think you will need because your whole family will have to stay in it, along with all your supplies and salvaged belongings from your damaged home. Since tents always seem to be crowded even under normal circumstances, this is not the right place to economize. It is best to get a tent with an external framework of aluminum poles rather than the kind with the poles inside. Interior supports are a nuisance, and the outside framework can be much steadier in a wind.

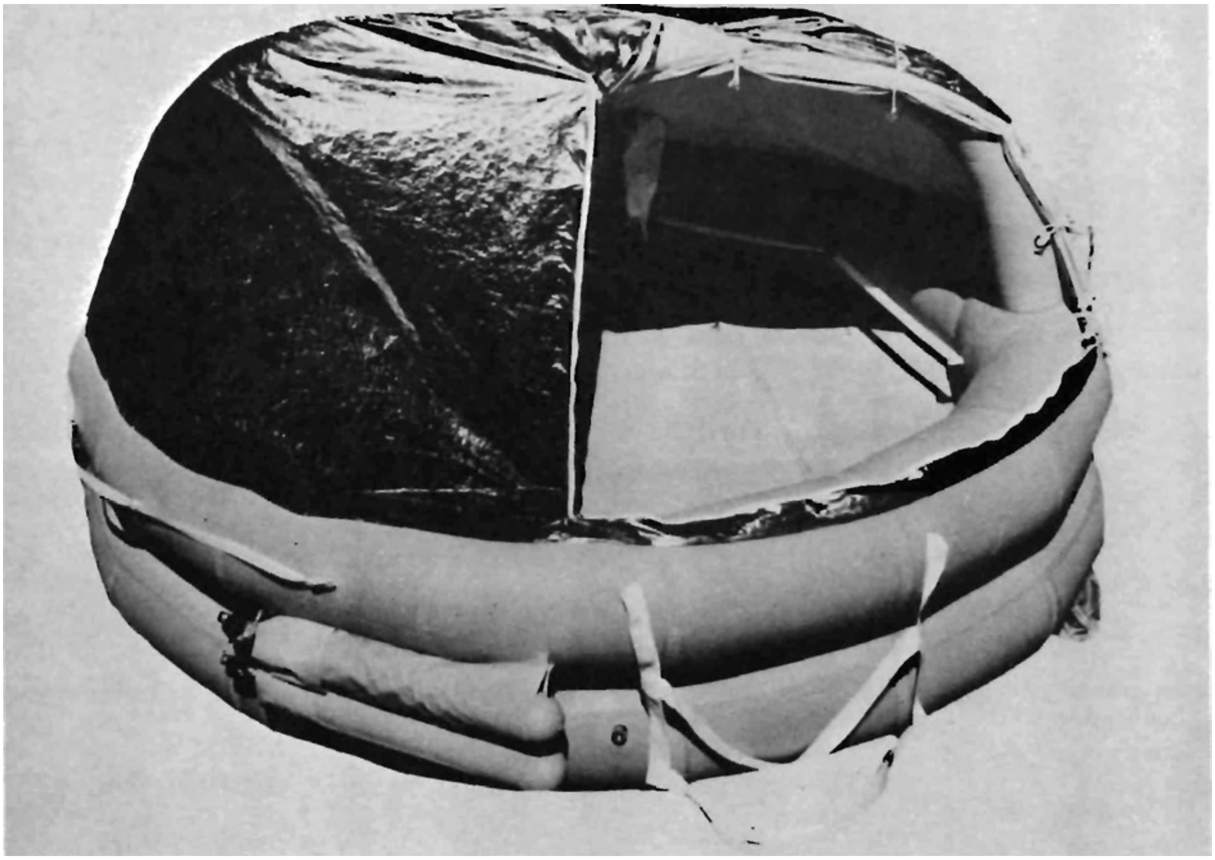
The second category of necessary items is sleeping gear. If you are not familiar with sleeping on the ground, be warned that there is much more here than meets the eye. If you are forced to camp out, possibly in the snow or rain, the proper sleeping bags and accessories will be essential to your comfort and health. Having spent a few cold, miserable, and completely sleepless nights because of poor sleeping gear (in the summer at that), I cannot emphasize this point too strongly. You will need a down-filled sleeping bag (two and one-half to three pounds) for each person, or the equivalent in heavier synthetic fiber-fill. The new mountaineering bags stuffed with Dupont Hollowfill II or Celanese Fortrel Polarguard polyester fiber are especially good because they stay warm when wet—a big advantage over down. Get sleeping bags with drawstring hoods that close tightly around the sleeper's head rather than the "slumber party" type which cannot be closed at the top. "Modified mummy bags" are handy because they can also be unzipped and used as blankets. Remember that light summer bags will not keep you warm in the winter, although numerous blankets, towels, or even carpeting can help bridge the gap. In any case, be sure to buy a full-length Ensolite pad for each bag, as well as an inexpensive Mylar emergency blanket. The pad makes sleeping more comfortable by preventing body warmth from soaking into the ground, and the Mylar "space" blanket will reflect radiated heat back to your body. Both can make the difference between comfort and utter misery.

The third category of items for cold weather includes special outdoor clothing. The crisis simulation field tests of expedient fallout shelters made it obvious that most people do not have proper outdoor clothing. We scuttle from heated homes to heated cars to heated offices on a routine basis and usually experience very little exposure to the elements. For extended outdoor living, however, each member of the family must be equipped with insulated boots, two layers of wool socks, full-length thermal underwear, woolen pants (two layers, one over the other), several wool shirts to wear as multiple layers of insulation, an insulated hat or parka hood, a muffler, and a good pair of insulated gloves or mittens.

If this sounds extreme, I suggest that you try a simple experiment. Go out in your back yard some winter night about 2 AM. Sit down on a stool and don't move for an hour. If you still feel warm after that length of time, your selection of clothing was equal to the challenge. Before making the test, however, be sure that someone will come to look for you after an hour, in case you don't return.

What about the opposite problem—not too little warmth, but too much? For people on the west coast who may have to flee a nuclear threat by evacuating to the inland deserts, the danger of unbearably high temperatures is very real. In this case, the shelter requirement is a sunshade and a cool local environment. The shade could be provided by a tent or self-supporting awning (there are no trees to tie ropes to on the desert). The cool environment can be produced by digging a narrow trench about three feet deep along an east-west line. The cool soil at that depth will help keep your body from overheating. Incidentally, don't forget that deserts are only hot during summer days. At night and in the winter, they are bitterly cold.

A special kind of shelter problem is produced by flooding such as that which occurs periodically in parts of the Mississippi valley—spring run-off puts thousands of acres under water every few years. In these areas, whole counties can become submerged under three or



A top-of-the-line floating shelter, this emergency life raft comes with a radar reflecting tent. (Courtesy of the Winslow Company, PO Box 578, Osprey, Florida 33559.)

more feet of water. The difficulty here is that you might be trapped at home with water up to your waist and have nowhere to go. Even if the water doesn't get any higher, you will have a problem finding a place to sit down or go to sleep.

For people who live in areas which flood, it would be a good idea to buy a surplus six-man military life raft. There are more expensive river rafts, but the surplus kind will do if in good condition. The best rafts are the kind that make up into a floating tent, but you can easily adapt a cheap surplus tent to your raft with a pair of scissors and a tube of silicone cement or "shoe goo." The raft should be stored partially inflated to keep it from cracking along folds and to facilitate rapid inflation in an emergency. A good place to keep it is in the rafters or on the wall of your garage. Obviously, it is better to store the raft in an elevated position rather than in the basement. When you wake up in the middle of the night with the water around your knees, getting the partially inflated raft out of your flooded basement will be very difficult.

Such a raft will provide both shelter and transportation until the flood subsides. If you decide to get a raft, be sure to include a few useful accessories, such as a large-volume air pump for inflation (and re-inflation if your raft leaks air), a set of inflatable life vests, and perhaps even a small electric outboard motor. If you keep the battery charged, an electric motor is much more dependable than a gasoline powered motor. (One can even be scavenged from your car.)

Personal protective clothing and equipment has also been designed to safeguard individuals who for some reason are forced out in the open where they may be subjected to fallout, thermal flash, high ultraviolet exposure, or noxious gases.

Suppose a nuclear warhead detonates a few miles away and the thermal pulse starts a fire in the bushes next to the side of your house. Knowing that the fallout shouldn't begin to arrive for at least thirty minutes, you might rush outside to put out the fire before it spread to the house. Suddenly a second warhead detonates over the same target, catching you in the searing thermal pulse. How could you protect yourself?

For personal protection against the danger of flash burns, it is sufficient to place any opaque object between you and the fireball. In Hiroshima, people who were very close to the epicenter received "pattern burns" where the thermal pulse burned exposed skin but was absorbed or reflected by their clothing. A light-colored item of clothing was sufficient to reflect the heat, especially if it was composed of heavy cloth or was several layers thick.

For a retreater forced by circumstances to be outside in an area of thermal flash effects, the lesson is clear. Light-colored clothing several layers thick is called for, as well as complete head and face protection. White wool is very resistant to ignition by flash effects, especially if you take the precaution of dousing yourself with water before going outside. Head protection can be as simple as a hood of white cloth, held in place by a hat or headband. The best way to protect the face is to shape the hood to form a veil, exposing only the eyes. A wide-brimmed hat angled to shade your face from the nearest likely target will help too. Sunglasses should be worn to cut down on the chance of temporary flash blindness, but do not expect them to shield your eyes from the thermal pulse—it is much too intense to be stopped by a pair of sunglasses. Whatever you do, don't look over toward the potential target even for an instant.

If one of the worst nightmares of nuclear war should come true, we may have to endure several years of exposure to abnormally high levels of ultraviolet light, caused by thermonuclear side-effects which destroy atmospheric ozone. This exposure to ultraviolet light can be extremely serious from the standpoint of sunburn and snowblindness. Calculations have shown that it might be possible for a Caucasian to receive a second degree burn after a few minutes of exposure to sunlight under these conditions, and some form of protection is necessary for anyone who has to venture outside even for brief periods.

Fortunately, sunburn is a common malady, and snowblindness is not unfamiliar. Just as in the case of flashburns, the secret is to cover up. The Arab-like protective clothing, hood, wide-brimmed hat, and sunglasses will go a long way toward removing the risk from a high ultraviolet environment. Don't forget to stock up on sunscreen ointments, zinc oxide, and sunburn remedies when you are putting together your survival stockpile.

Remember also that the ultraviolet light is associated with sunlight and presents no obstacle to going outside at night. This is the time when you will be able to spend hours in the garden or take care of your farm. If the ultraviolet menace materializes, we may all simply become nocturnal for a few years, shifting the business day to the hours of darkness and sleeping when the sun is up.

If there is any chance that you will have to go outside while the fallout is still active in your area (for instance, to tend livestock or to decontaminate the paved areas around your house) you will need anti-contamination clothing. The main purpose of such clothing is to protect your skin from beta radiation burns which occur when fallout particles come into contact with your skin. Beta radiation is very limited in penetra-

FIGURE 31: Anti-contamination Protective Clothing. Pictured in an official Soviet civil defense text. (P. T. Yergorov, I. A. Shlyakhov and N. I. Alabin, Grazhdanskaya Oborona, Moscow, 1970.)

The author models a rain suit and other gear intended for protection against thermal flash, fallout, and high ultraviolet levels. Wrap-around Lexan glasses block 80 percent of incoming ultraviolet light and fit comfortably over the Navy MK-5 gas mask.

tion and is substantially deflected by clothing, but particles of fallout caught in folds of the skin can produce weeping open burns after a day or so. The burns themselves are not serious and heal after a few weeks without appreciable scarring, but they could easily become infected in the meantime.

Once again the secret is to cover up (see figure 31). This time the color of the clothing doesn't matter as much as the material used. You will need a suit of dustproof material such as rubberized cloth or plastic. A suit of inexpensive plastic rain gear will satisfy the requirement, provided that the coat has a fairly large hood. Plastic garbage bags will provide material with which to improvise coverings for your feet, and a roll of sticky silver "duct" tape will help you seal up your ensemble. Don't forget to wear rubber gloves and tape the coat sleeves tightly around the gloves at the wrists.

As for your head, bear in mind that one of the worst places to get fallout is inside your lungs. The best arrangement is to wear a gas/ dust mask on your face with the hood of the coat pulled out on to the surface of the mask and taped in place. The whole-face MK-5 gas mask supplied to the Navy is one of the best for this purpose and can be used to protect you from a wide range of noxious gases as well. (These are available from the Ruvel Company, 3037 North Clark Street, Chicago, Illinois 60657, for about 15 dollars.) If you don't have a gas/dust mask, improvise a filter with a terrycloth washcloth and tie it to your face like a surgeon's mask.

You may find that you will grow too hot inside your sealed anti-contamination suit, especially during hard physical labor. You can cool off a little by wearing a water-soaked shirt over the plastic suit. As the water evaporates, it will help cool your body. Even so, you might have to stop work after an hour or so to avoid overheating.

Commentary

Shelter is a very broad term, covering protection from normal weather as well as special conditions brought about by natural catastrophes and nuclear war. Even so, by carefully deciding what kinds of shelter you may require, you can protect yourself with a minimum of inconvenience and expense.

At the very least, a retreater should have a clear idea of how to build an expedient fallout shelter in an emergency. I would suggest that your family take steps to acquire a significant degree of fallout protection and a complete set of outdoor equipment and camping gear. The expense can be managed with a little care, and the security of being prepared is priceless. That's my kind of bargain.

5

A Loaf of Bread, a Jug of Wine, and Chow

SELF-SUFFICIENCY IS THE BASIC THEME which ties together all of the various political, moral, and religious factions of the survivalist movement. Left-wing "hippies," right-wing "patriots," back-to-the-landers, and religious and economic survivalists all puzzle over the same questions. How much food to store? How to store it? How much water? How to purify it? What about power? How much fuel? How much land? What crops to plant? The list is endless.

This chapter and the next (which is devoted to do-it-yourself medicine) present an overview of this very broad subject. There is so much popular literature on self-sufficiency that it is impossible to do more than briefly review the field. Even so, I hope to accomplish three things in this chapter. First, I think it is important to provide a general treatment of survival self-sufficiency for readers who are just starting to explore the subject. Second, more experienced readers may be interested in a critique of some common survivalist attitudes regarding stored food, hunting, and other subjects. Finally, vital survival tips relating to the ecological consequences of nuclear war will be discussed.

In any case, there is a lot of ground to cover.

Stored Food Stockpiles

Survival self-sufficiency depends largely upon stored emergency food. Since the Mormon church adopted its emergency food storage program a few years ago, the proliferation of food storage plans, products, and technology has been explosive. I feel that an overall picture of this trend will be more helpful to most people than itemized instructions which don't quite apply to anyone's particular situation. (That way you can pick out the approach that best fits your philosophy—and pocketbook—and pursue it as you see fit.)

The subject of emergency food storage is tied inextricably with nutritional considerations, shelf life, food faddism, and blatant sales promotion. It can be very difficult to separate one influence from another. For example, what exactly is meant when a prominent authority advises you that a food item is "no good?" It might mean that the nutritional content deteriorates to an unacceptable level by the time the product is to be used. The vitamins disappear. Usually, though, vitamin deterioration takes place soon after the package is sealed, and the rate of deterioration slows down after a few weeks have passed. To allege that the nutritional content of a stored food item is adequate until the fourth or fifth year (when it suddenly drops like a stone) is difficult to justify. That allegation, however, is very common.

Maybe the expert meant that the food becomes inedible or unwholesome after a certain period of time. Could be. Some foods slowly undergo chemical deterioration and finally become inedible even in the absence of microorganisms. The published figures forshelf lives are quite varied, however. Some manuals list powdered milk as an item that is inedible after six months. Others describe twenty-year-old powdered milk that is still as edible as the day it was packaged. The truth of the matter is that we haven't been storing food items long enough (or carefully enough) to know exactly what their shelf lives are.

My personal suspicion is that when a survival nutrition expert says your stockpile of food is "no good" after a certain period of time, that person's primary motive is to get you to discard it and buy more. I know this sounds cynical, but the only practical approach to the shelf life question is to routinely sample items from your stockpile to see what condition they are in. Your own experience is your only safe guide. No one else is storing your food under the conditions found in your house.

Let's begin our tour of emergency food programs by examining regular supermarket foods which come in

TABLE 7
Suggestions for Shelter Basic Food Supply

Food	*Amount required daily for 1 person*	*Quantity required for 2 weeks*	*2-week supply of standard-size containers*	*Maximum shelf life (months)*
Staples:				
Crackers, cookies, pretzels	4 oz.	56 oz.	2 cans or jars.	36
Candy:				
(chocolate bars, hard candies)	1 oz.	16 oz.	1-lb. jar or box.	18
Sugar	2 tsp.	4 oz.	¼ lb. (lb. per 4 persons).	36
Salt	2 tsp.	4 oz.	¼ lb. (lb. per 4 persons).	Indefinite.
Beverages:				
Instant coffee or tea	2 cups	2 oz.	2 jars	Indefinite.
or				
Chocolate	2 cups	4 oz.	2 (1-lb.) pkgs.	Indefinite.
or				
Soft drinks	1½ bottles		24 bottles	Indefinite.
Milk:				
Nonfat, dry	⅓ cup	20 oz.	2 pkgs.	
Evaporated	1 oz. (2 tbsp.).	14 oz.	4 cans	48
Juices:				
Orange, tomato, grapefruit, pineapple.	½ cup	64 oz.	6 bottles	36
Fruits:				
Peaches, pears, prunes, apricots.	1 cup	112 oz.	4 jars or 2 (1-lb.) pkgs.	36-40
Vegetables:				
Peas, corn, lima beans	½ cup	112 oz.	8 cans	60
Soups:				
Vegetable, pea, noodle, beef, clam chowder, mushroom, other than tomato.	1 cup	112 oz.	8 cans	36
Meats and substitutes:	1 cup	208 oz.	8 (1-lb. and ½-lb.) cans.	36-48
Canned beef stew, salmon, tuna, spaghetti and meatballs, baked beans and frankfurters (without tomato sauce), chicken and noodles.				
Other foods:				
Cheese, peanut butter		7 oz.	4 jars	
Jam, jelly, marmalade		7 oz.	2 jars	24-30
Cereals			14 pkgs. (individual serving size).	

SOURCE: Personal and Family Survival, Office of Civil Defense, 1966—D119.8/8.3 11-A cans, jars, boxes, and plastic wrappers. Some people stock up on frozen or refrigerated items. I have never been able to see the wisdom of this, unless you have an iron-clad guarantee of refrigeration even in a major crisis. Therefore, this discussion will be restricted to items which are normally stored at room temperature.

Can you construct an emergency food stockpile from supermarket foods? Of course you can—within reason. Food storage experts usually frown on canned goods because of their supposedly short shelf lives. The foods we find in the market are not intended to remain palatable for more than a year. Industry efforts have concentrated on achieving that one year span, as that is sufficient time to grow (and can) an entirely new crop. How much longer the food may last is usually not known.

Since the foods will last for at least one year, it is obvious that a carefully managed stockpile containing a year's supply of canned food can be organized. It is only necessary to acquire the stockpile gradually and then use up and replace year-old items as necessary. This requires a lot of organization, however, and most people don't want to bother with the involved record keeping and constant attention this system requires. Therefore, the canned-food approach to stockpiling is usually reserved for people whose interest is in a short-term stockpile. (By short-term I refer to a food supply sufficient for one week to one month.) In any case, it is relatively simple to do your grocery shopping on the basis of "one can for me and one for a friend" until you have built up your supply.

As an example of this kind of plan, see table 7, a suggested list of civil defense foods, originally provided by the Office of Civil Defense. This stockpile is designed for a two-week shelter stay when there will be no opportunity for cooking. (That's a point to consider carefully.) The "maximum shelf life" column in this table is interesting for several reasons. For one thing, the stated shelf lives greatly exceed those quoted by people who sell freeze dried food. The eighteen-month life of candy must refer to chocolate bars, because hard candy is nearly indestructible. The expiration date for sugar is also hard to understand, since sugar can't rot and doesn't contain any vitamins. There are no figures for nonfat dry milk, cheese, or peanut butter because their shelf lives depend on many uncontrolled factors. Tomato products are excluded because they are acidic and tend to corrode the cans they are stored in.

For large-scale food preparedness, a program of supermarket-type foods is obviously inadequate. What about the Mormon "basic four" food storage program, involving bulk containers of wheat, sugar (honey), powdered milk, and salt? This approach to food stockpiling is really as old as agriculture. It is simple and cheap, and three of the components have the virtue of nearly unlimited shelf life. The usual program consists of storing wheat in large plastic trash barrels or sealed cans in which carbon dioxide or nitrogen has been used to drive out the oxygen (an anti-insect precaution). Powdered milk is somewhat more difficult to store, but it can be continually recycled or purchased in special nitrogen-packed cans for long storage. The salt and sugar are packaged to keep out moisture and, barring accidents, will keep forever. A year's supply of these staples for one adult costs less than 300 dollars.

There are some drawbacks to be expected in the face of such economy. The "basic four" diet is austere, and to most people it is disturbingly unfamiliar. A frequently heard warning is that old people and children may refuse to eat these foods in a stressful situation and will starve to death instead. It would be best to try the program out for a week or two before limiting your options to this plan.

The allegation that the basic four program is boring (wheat—wheat—wheat) has some basis, but don't assume that bread is all you would be able to make from these staples. There are an amazing variety of ways to prepare whole wheat products. As a single example, consider gluten, the protein fraction of flour, which is easy to extract and can be made into a meat substitute that is difficult to tell from the real thing. I have prepared chicken-fried gluten steaks which my "tasters" mistook for breaded veal. They had never heard of gluten and thought I was referring to the breading on the outside of the "meat." There can be variety in this diet.

The published authorities disagree in their recommendations of how much of each staple to store. I reviewed the recommendations of seven "experts"; the results are shown in table 8. In the column indicating range, the lower figures are based on the assumption that you will store other kinds of food as well as the basic four. The higher figures follow the assumption that the basic four represent almost everything you will eat.

TABLE 8
"Basic Four" Storage Amounts

ITEM	POUNDS	
	Average	Range
Wheat	300	200—365
Powdered Milk	85	60—100
Sugar (or Honey)	60	35—100
Salt	6	1 — 12

Figures reflect an average drawn from seven published storage plans.

My evaluation of the basic four approach is that it is the cheapest and most trouble-free way to compile a large supply of food. There are definite drawbacks in the amount of skill and the amount of energy (in terms of heat) needed for preparation, however. The nutritional quality of the diet is disputed and may be seriously deficient in certain amino acids. For a nuclear war situation, though, nothing else will do as well. Because of their low cost and long life, I suggest that a nuclear war survivalist store a five-year supply of these foods. When you are preparing for severe climatic disruption and several years of ultraviolet-seared crops, you will need the largest reserve of staples you can handle. A stock of wheat, milk, sugar, and salt is the easiest way to stretch your money into supply.

The third major approach to emergency food involves stockpiling large amounts of commercially packed air dried or freeze dried foods. There is a great deal of sales pressure behind these products, a factor to keep strongly in mind when reading about them or talking to sales representatives. I think it is safe to say that these foods offer variety, taste, and familiarity (in most cases), as well as relatively long storage life. Unfortunately, they are very expensive. A year's supply of meats, vegetables, fruits, stews, and various other products for one person can cost more than 1,500 dollars. The manufacturers say (correctly) that this is less than you would normally pay for food in a year, but you could buy five years' worth of the "basic four" for the same price. This is the trade-off. The freeze dried products are good, tasty, and easy to prepare, but they cost more than many people are willing to pay.

Hand-in-hand with the dried food companies are the companies that specialize in selling"nutritional supplements." These are special packages containing high-potency vitamin and mineral capsules, and usually a form of soybean protein for making "fortified" drinks. My feelings about these supplements are mixed. The protein supplements are a good idea, but if you are a self-reliant kind of person (i.e., a survivalist) you can buy the soy protein in bulk at a health food store and package it yourself for 10 to 20 percent of the commercial price. (That's five to ten times more protein for the same money.) The vitamins are essential, but again, you can get more for your money at a discount drug store.

My overall recommendation to someone who wants to start a food stockpile would be the following:

1. Increase your normal home supply of canned goods to include a two-week to one-month surplus. Recycle it periodically. This will give you a supply of your everyday foods which will not require special skills to prepare, will not require added water, and will not require cooking. This is your first line of defense.
2. Get a six-month supply of commercially packaged freeze dried (or air dried) foods. Make your own selection to suit your tastes. Be sure to remember that this is your best form of stored meat; buy accordingly.
3. Use the "basic four" to fill in the gaps. A six-month supply of wheat, sugar, salt, and powdered milk added to the freeze dried meals will be a reasonable compromise between variety and expense. It is best to buy milk in nitrogen packed cans from a survival food supplier. It will last longer that way. Nuclear war survivalists should seriously consider storing up to five years' worth of the "basic four" to see them through in case of repeated crop failures due to climate and ultraviolet levels.
4. Arrange for vitamin/mineral and protein supplements, either from commercial suppliers or from your own manufacture. A modest investment here will free you from worries about nutritional inadequacies in the stockpile.

Water Storage and Purification

When the discussion turns to water, there are only two alternatives. You can store a very limited supply of it, or you can obtain it from outside. The assumption, of course, is that you will not be able to get safe drinking water out of the tap. An earthquake, a labor dispute, a nuclear strike, or a terrorist attack could easily cut off your municipal water supply and leave you on your own.

It is easy enough to set aside an emergency supply of water in jars, bleach bottles, or five-gallon cans, but it is very hard to store enough to supply a family for more than a few weeks. The inescapable problem with water is that a cubic foot of it weighs over 60 pounds and cannot be concentrated into a smaller volume. Four hundred cubic feet of water contains 3,000 gallons and represents a scant supply of drinking water for a family of four to stretch over a year. That quantity weighs about ten tons and requires a tank the size of an average bedroom. But you can buy (and bury) such a tank if you are serious about storing water.

On a smaller scale, it is possible to buy commercially canned water at outrageous prices, or you may can it yourself using canning jars and a water bath canner. I have had excellent results storing water in one-gallon plastic milk bottles which have been thoroughly washed with soap and water, then soaked in a hot, bleach solution for several days. Some people add a few drops of tincture of iodine or household bleach to the stored water to prevent microorganisms from growing in the bottles, but this isn't usually necessary. Most city tap water is so full of chemicals already that nothing can possibly grow in it—it even kills yeast in bread dough.

Rationing of stored water is discussed further in chapter 8, but it is important to mention here that the amount to store for each person ranges between one quart and two gallons per day. One quart is the bare minimum for maintaining life under optimum conditions (no activity, high carbohydrate diet, and cool temperatures). Two gallons provide water for drinking, cooking, and limited bathing. The more the better.

If you get your water from a stream or river, or from a questionable municipal water supply, you will

The Waterpik Portable Instapure water purifier kills microorganisms and removes objectionable particles and odors from drinking water. (Available from Holubar Mountaineering Ltd., Box 7, Boulder, Colorado 80306.)

have to purify it. Purification involves the removal of objectionable tastes, harmful microorganisms, fallout grains, and dissolved radioactive chemicals from the water. The process sounds complex, but actually it isn't.

There are several portable water purification kits on the market which use silver, iodine, or chlorine to kill bacteria while filtering the water through activated charcoal and spun glass to remove particulates and dissolved chemicals. The units are small (about the size of a can of tennis balls) and very easy to use. I recommend the Waterpik Portable Instapure Model PI-1 for nuclear war applications because it uses iodine as the antibacterial agent. The iodine is in the form of small tablets marketed as "Potable Aqua" by the Wisconsin Pharmaceutical company. The tablets cost about 3 dollars for enough to treat fifty pints, but if you visit your local surplus store, you can get the same thing in a GI bottle for about 70 cents. The tablets start out gray but turn rust color after a few years when they lose their potency. Be sure to check the color of the surplus tablets.

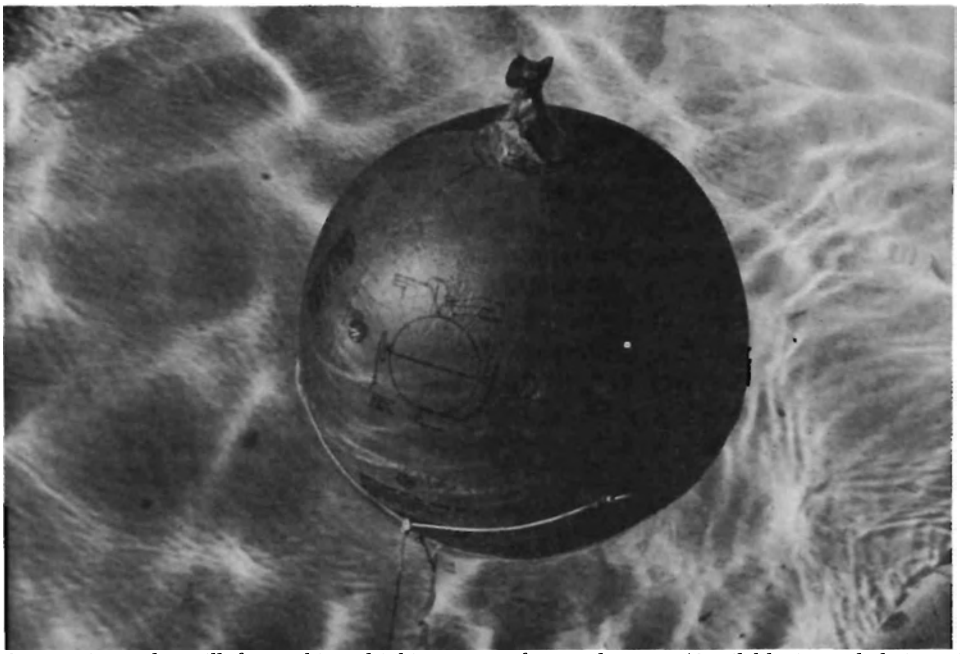
The normal procedure with the Portable Instapure is to drop an iodine tablet into a pint of water, let it sit for a while to kill the germs, and then run the water through the activated charcoal filter. This removes all particulates and bad tastes—including that of the disinfecting iodine. The end result is sweet, pure water. This is not the way to use the kit in a nuclear war setting, however. If the water has been contaminated with fallout, you must run it through the filter first, and then add the iodine tablet. Drink the water with the iodine still in it. It tastes bad, but it isn't a health risk unless you have thyroid problems. Consult your doctor to determine whether this will be a hazard to you.

The point of the purification is to diminish the effect of iodine-131 on your body. This radioactive chemical is present in fallout and dissolves in water. If you drink contaminated water, the iodine-131 winds up in your thyroid gland, where it can do a surprisingly great amount of damage.[1] The activated charcoal filter removes most of the dissolved iodine-131 from the water. When you drink the purified water, you flood your thyroid with harmless iodine and block the absorption of the remaining radioactive iodine. This precaution is vital in fallout areas for the first two or three weeks following the attack. Iodine-131 has a very short life and is most dangerous during this time.

If you're not concerned with fallout problems, it isn't necessary to use iodine for your water purifying agent. Other chemical agents, or just boiling, will do very well.

If you have purchased retreat property out in the woods, you will want a well, or maybe even two wells. A good deep well is the only absolutely dependable source of untreated water, especially in the case of nuclear attack. Just be sure that you can pump it by hand if you have to. Those electric pumps won't work when the power fails.

For a retreater on a sailboat or life raft, drinking water may be the biggest single survival problem. At sea you have fish, shellfish, and so forth for food, but there is no drinkable water. I had not regarded retreating out to sea as a viable possibility until I discovered the answer



A seagoing solar still for making drinking water from saltwater. (Available in sealed tins of three from the Ruvel Company, 3037 N. Clark Street, Chicago, Illinois 60657. Write first for a catalog.)

to this difficulty. If you intend to sail away into the sunset, you will want several sets of surplus military life raft solar stills. These are, more or less, big beach balls which use sunlight to distill drinking water from sea-water. Each still produces about a pint of water a day, which means that nine stills per person will be necessary.

For further reading on the subject of "water preparedness" see Bill Pier's column in the December 1977 issue of the Personal Survival Letter.[2] This is the best one-stop discussion of the subject 1 have seen.

Those of you to whom the "basic four" food stockpile is appealing will want to see Passport to Survivalby Esther Dickey.[1] This is one of the earliest books in the field and unquestionably one of the best. In a single sentence, Passport to Survival is a cookbook written for the survivor of a major disaster who has had the foresight to store a lot of wheat. Dickey makes a basement full of grain sound like a gourmet supermarket.

Running a close second to the above is Lorraine Tyler's The Magic of Wheat Cookery.[4] This is not a survivalist publication, but it does introduce methods of wheat cooking using flour you grind yourself. This book is specifically oriented toward the Bosch Magic Mill and Magic Mixer, both of which are excellent products.

A book which provides a broader discussion of home food storage is Family Storage Plan by Bob Zabriskie.[5] Zabriskie presents a detailed emergency food storage plan and does it with commendable brevity. He covers canned goods as well as basic staples and provides inventory forms for stockpile management.

For people interested in a comprehensive program involving bulk staples, freeze dried food, and nutritional supplements, the classic survivalist text is Howard Ruffs Famine and Survival in America." Ruff is one of the outstanding figures in survivalism, with a popular newsletter (The Ruff Times) and a television series to his credit. He is also a salesman, a fact which leaps out of every page of his book. There is no more detailed consideration of survival nutrition at present than that in Ruffs book.

In my opinion, the best information on state-of-the-art food stockpiling can be found in Bill Pier's articles in the Personal Survival Letter, which Pier co-edits with Mel Tappan.[7] His articles are forthright, sensible, a pleasure to read, and worth the 125 dollars per year subscription fee for the newsletter.

For additional information in the form of catalogs, price lists, and sales brochures, I suggest you write or call the following companies: Survival, Inc. (also known as SI), 16809 S. Central Avenue, Carson, California 90746—800-421-2179 or 213-631-6197 (in California); and Martins Health & Survival Products, Inc., PO Box 5069, Tahoe City, California 95730—800-824-7861 or 916-583-1511 (in California).

SI is associated with Bill Pier and follows his philosophy of food storage. Martens markets a food program based on Howard Ruffs "target" scheme of stockpile planning. Both offer individual food items and pre-planned programs which you may purchase or use as models for your own stockpile.

Growing Your Own Food

One popular approach to retreating has been to buy rural property or a small farm and to plan on raising food in the event of an emergency. This branch of survivalism is almost indistinguishable from the back-to-the-land movement, in which the object is to be self-sufficient even if there is no emergency. Survivalists can make use of the experiences of the back-to-the-land people in planning self-sufficient farms and homesteads. Keep in mind, however, that the anti-technology attitude of many neo-homesteaders can also be anti-survival when things get tough.

The first consideration, choosing the property for your retreat, is a subject fraught with legal problems, financial hurdles, and agricultural questions. It is commonly said that in order to be self-sufficient, about two acres of land per person are needed. You can get by on less, but only if everything else is going your way in terms of climate, growing season, fertilizer, and insecticides. The two acres must be land that can be farmed, not woodlot, mountain, or rocky ground. One of the most common mistakes which starry-eyed neophytes make is to buy "farm" land that can't be farmed. I visited one idealistic commune which consisted of fifty acres perched on the spur of a mountain. The land was on a 30 to 50 degree slope, and the nearest available water was 1,000 feet below in the valley. The inhabitants carried water up the hill in a truck to keep their tiny vegetable patch going. That's okay if you can afford it (they had jobs in town), but it isn't self-sufficiency.

For finding and selecting land, there are two sources of information which I regard as indispensable. The first is Finding and Buying Your Place in the Country by Les Scher.[8] Scher describes himself as an "attorney-at-law and consumer advocate" and covers every angle of this subject in slightly under 400 pages. Scher points out in detail the many potential pitfalls in buying rural land. Getting swindled by a sharp real estate salesman could ruin your survival plans permanently, so it pays to be very careful.

The second resource is Jim McKeever's Investment and Survival Letter, generally referred to as McKeever's MISL.[9] I was fortunate to be able to visit Jim at his ranch in Oregon, and I came away convinced that he is the man to talk to about planning a small survivalist homestead. He is actually on the land learning to grow crops and to milk goats, and he has many valuable observations about survivalist farming. The last I heard, the subscription rate was 95 dollars for twenty issues per year. It's worth it if you are planning on a farm for survival.

Once you have your land, you will need some guidance about how to use it. Running a small farm or ranch is a full-time profession, not a task you can lightly assume. There are hundreds of books available on how to run a homestead; you will need several dozen of them if you aren't lucky enough to have a friend who can teach you the ropes. Unfortunately, it seems that people who farm well frequently don't write well. (The opposite may also be true.) A few homesteading guides are excellent, however.

One resource I wouldn't be caught without is John Seymour's THE Guide to Self-sufficiency.[10] This manual must be seen to be believed. The illustrations are shaded drawings as precise and detailed as photographs. They are generously used to provide step-by-step instructions for every imaginable homestead procedure from butchering hogs to building barrels. It is relatively thin (250 large-format pages) but is so packed with information that I wouldn't trade it for a shelf of other homesteading books.

A second manual is Grow It! by Richard Langer.[11] Langer does with words what Seymour does with pictures. H is analysis of managing a small farm is very good and is heavily loaded with practical pointers. This is more of a textbook than a reference manual, intended to teach the reader all about farming.

Third is a unique manual for rural living. I refer to Carla Emery's Old Fashioned Recipe Book.[12] I was fortunate to acquire my copy during the period when Carla was still printing it herself, mimeographing it at home on colored paper. This "recipe book" was written with the wisdom of the old Chinese proverb that begins "For rabbit stew: First catch a rabbit..." My copy has over 600 pages of closely typed instructions, recipes, anecdotes, observations, and suggestions. I can't imagine learning to be self-sufficient without consulting this manual.

Gardens and Gardening

Nuclear war presents special problems for the would-be survivalist gardener. Not the least of these problems is the fact that seeds must be stored until planting is possible. An interesting solution is the "Survival Garden," a vacuum-packed assortment of seeds packaged by the Clyde Robin Seed Company and marketed through Survival, Inc. The Survival Garden contains a selection of green beans, beets, cabbage, carrots, corn, onions, peas, spinach, summer squash, and tomatoes.

I bought a can of these seeds with the intention of debunking them. The idea that perishable seeds could be canned for prolonged shelf life struck me as an impossibility, and that a single selection of seeds would be useful anywhere in the country seemed very improbable. I was surprised on both counts. The varieties selected represent a nice blend of true-breeding characteristics and rapid development. (By "true-breeding" I mean that succeeding generations of seeds will produce the same quality of plant each year.) The spinach is an exception. It is a hybrid, and can be expected to deteriorate in quality and yield with each generation of inbreeding. Hybrids are genetic manipulations, like mules, and do not reproduce well.

The Survival Garden seed assortment, packaged by the Clyde Robin Seed Company. (Available from Survival, Inc., 16809 S. Central Avenue, Carson, California 90746.)

The rapid growth of the Survival Garden seeds is important for two reasons. First, the seeds can be used in almost any part of the country and will mature before the growing season is over. Even in the warmer parts of the country, it might be necessary to start your garden in midseason, in which case rapidly maturing plants are useful. Second, if a nuclear war produces a cooling of the climate (as discussed in chapter 2), short-season crops will be needed even in parts of the country which normally have long growing seasons. Frosts will be coming early for several years.

The thing which surprised me the most about the Survival Garden is the quantity of seeds provided. The can of seeds costs under 10 dollars; you could spend over ten times that much buying the same seeds in packets at your local nursery. I thought that this was remarkably generous until I realized the reason: Stored seeds lose their viability on a percentage basis. If a crop of seed is 98 percent viable when it is packaged, it might be only 50 percent viable the next year. In the third year it might be only 10 percent viable, and so on. The Survival Garden contains half an ounce of carrot seeds, which is enough to plant thousands of carrots, if all the seeds germinate. If the seeds lose most of their viability, however, the large quantity insures that you will still be able to grow a respectable number of carrots. If the number of living seeds is very low, you can still use the few resulting carrot plants as a seed source for the following season. I think it's a good arrangement.

How long will such a can of seeds last? Since the seeds are vacuum packed in a metal container, they are safe from insects and rodents. Spoilage should not be a problem. Corn and onion seeds tend to lose their vitality within the first two years under normal circumstances, however, and I would be somewhat suspicious of the entire seed supply after it had become four or five years old. I suggest buying a supply of corn seeds every year to be sure of their viability.

Obviously, I endorse the Survival Garden seed supply. Unfortunately, there is a very serious flaw in it from the standpoint of nuclear war. If the war affects the ozone layer and increases ultraviolet radiation at the earth's surface, as it almost certainly will, most of the Survival Garden plants won't be able to survive. They'll die of sun scald very rapidly. The scientific information on this phenomenon is not as detailed as we would like. For now, table 9 will serve as a general guide to the ultraviolet sensitivity of crop plants.

TABLE 9

Sensitivity of Common Crops to UV Radiation

EXTREMELY SENSITIVE	MODERATELY SENSITIVE	RESISTANT
Peas	Cantaloupe	Wheat
Tomatoes	Cauliflower	Corn
Beans	Collards	Rye
Pumpkin	Parsnip	Soybeans
Okra	Radish	Barley
Onion	Chicory	Alfalfa
Endive	Carrots	
Watermelon		
Cucumber		
Turnip		
Beets		
Spinach		
Lettuce		
Eggplant		
Potato		
Cabbage		

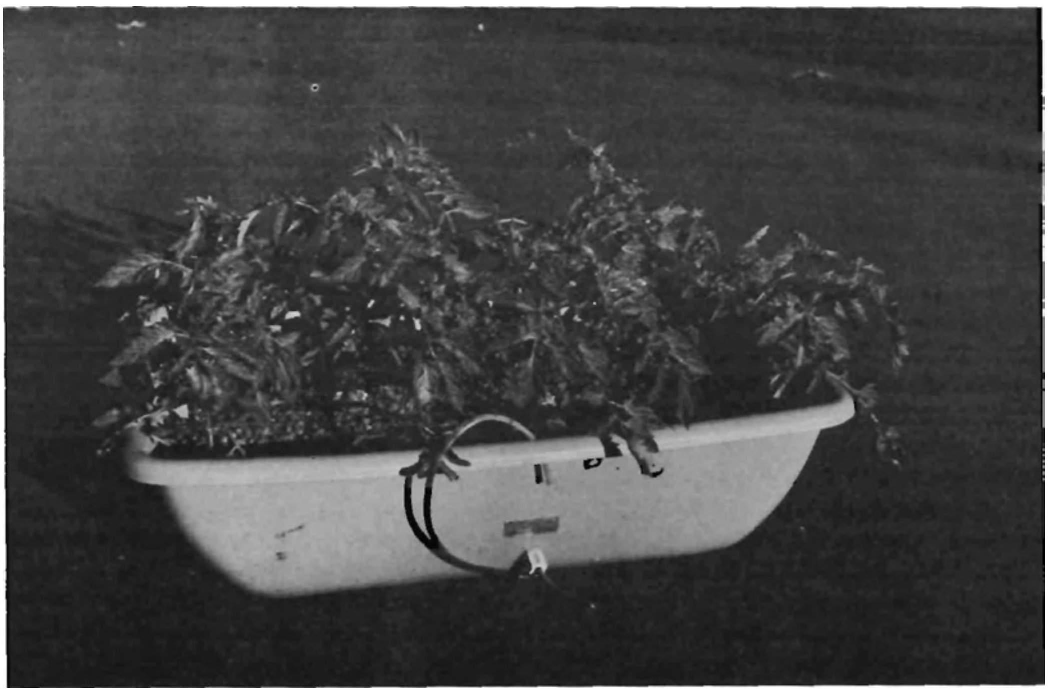
Based on information in Long-term Worldwide Effects of Multiple Nuclear Weapons Detonations, National Academy of Sciences, 1975; and M.G. Cline and F.B. Salisbury, "Effects of Ultraviolet Radiation on the Leaves of Higher Plants," Radiation Botany 6 (1966), pp. 151-163.

From this table you can see that most of the seeds in the Survival Garden selection may be impossible to grow in a post-attack environment. Corn should do well, however, especially after the first year or two is past and ultraviolet levels are starting to drop back to normal. I suggest that you supplement your emergency seed stockpile with enlarged supplies of the "resistant" crops, just in case. Some plants, such as onions, cannot survive ultraviolet exposure and cannot be stored long enough to bypass the high-ultraviolet period following the war. We will be forced to grow them in protected greenhouses or they will become extinct. Fortunately, wood frame, plastic-covered greenhouses are cheap and can be stored as bundles of precut wood parts and compact rolls of plastic. (Plastic coverings which will block out 80 percent or more of incoming ultraviolet are available.) I think the expense and trouble to preserve these species are worth it.

Hydroponics, the science of growing plants in artificial nutrient solutions instead of soil, is also a viable alternative to traditional gardening. Hobbyist hydroponic tanks can be readily adapted to automatic care of greenhouse plants. This is definitely the way to derive the maximum production from minimum space in a greenhouse. I suggest consulting Home Hydroponics and How to Do It by Lem Jones, or see Jim McKeever's "Your Own Food Factory" in MISL number 151.[13] For a good general introduction to greenhouse management, try Organic Gardening under Glass by George and Katy Abraham.[14]

Preserving Food

If you plan on producing your own food, the subject of home food preservation will become important to you sooner or later. Growing a large crop of cherries doesn't mean you can have cherry pie anytime you want



Home hydroponics, the culture of plants without soil, is simple and productive, as these tomato plants testify.

it in the next year. You have to preserve the food you grow or you'll wind up being fat in the fall and thin in the spring.

There are many possible ways to approach food preservation. You can take your pick of canning, drying, smoking, pickling, jellying, freezing, salting, fermenting, bulk storage, or storage in a root cellar. The main investment involves the purchase of lots and lots of jars and a generous supply of canning lids. I favor water bath and pressure canning for most applications, since you can preserve nearly anything, including whole chickens, without the blessings of refrigeration. It's simple and quite safe—if you follow the directions to the letter.

There are many good books on the topic. A novice should start with the Ball Blue Book, the manual published by the company that makes Ball canningjars. It is usually available in supermarkets and is kept constantly up-to-date.

For more advanced home food preservation, see Stocking Up, edited by Carol Stoner, and Keeping the Harvest, by Nancy Thurber and Gretchen Mead.[16] Both are excellent.

If the prospect of facing an uncertain future with a limited supply of canning lids makes you uneasy, let me call your attention to Morris Reusable Home Canning Seals and Lids, produced by National Manufacturing. These lids are plastic and may not keep out external oxygen for as long as metal lids, but they are certainly good for a year, and you can use them over and over again. They are well worth trying out.

A more expensive approach to resealing jars is provided by the Luminarc wide-mouth glass storagejar, manufactured by J.G. Durand International. These are heavy glass jars with hinged glass lids. They can be used just like conventional canning jars, with a red rubber "o-ring" providing the seal. With a little care, the jars and rings can be reused time after time.

Food Gathering

Under the topic of "gathering" I have included foraging for wild edible plants, hunting, and fishing. As a botanist/ecologist/survivalist, I have been interested in wild edible plants for quite a while, and have more than once participated in a day of group foraging climaxed by a 100 percent natural dinner. As a hobby, collecting and eating natural foods is very entertaining, but as a survival proposition, there are very few ways for the average person to starve faster.

Most of the wild plants regarded as "edible" are the gustatory equivalent of lettuce. If you can find enough to eat, get the snail tracks, spider eggs, and dirt washed off, swallow the greens without objecting to the unusually strong or bitter taste, and avoid an allergic reaction, all you get in the end is a stomach full of water and indigestible roughage. Humans are not cows. Cellulose does not break down in our digestive tracts. And if you are a normal person, you probably aren't too excited about a dinner of unseasoned green leaves anyway.

Left, a jar sealed with a standard metal ring and lid. Center, a Luminarc jar sealed with a reusable rubber ring. (Available from J.G. Durand International, Millville, New Jersey 08332.) Right, a jar sealed with a plastic seal from Morris Reusable Home Canning Seals and Lids. (Available from National Manufacturing, PO Box 700, Ventura, California 93001, or from Survival, Inc., 16809 S. Central Avenue, Carson, California 90746.)

Fish as a source of nourishment is almost as bad. Most of the calories in fish come from the butter or oil you fry it in. Unless you can provide incredible quantities of fish (more than one pound of cooked meat per person each day), a diet of fish is a diet of slow starvation. Sometimes not so slow.

As for hunting, it seems that just about everybody interested in retreating envisions himself as Daniel Boone. ("If 1 get a mite hon-gry I'll jest take 01' Betsy and kill me a bar!") Some people even take this sense of identification so far as to buy a black powder Kentucky rifle as their only survival hunting weapon. Others go a step further and purchase bows and arrows. They will be very hungry on the day after doomsday. Or dead—killed by a wounded "bar."

Although I have derided hunting, fishing, and gathering wild foods, wild edibles are still an important resource which retreaters ought to learn how to exploit. If you have just a marginal familiarity with the sources of wild food in your area, you can stretch your emergency food supply into a pleasing and well-balanced diet. With advanced hunting and gathering skills, you will have a very substantial buffer against starvation. How do you go about acquiring this degree of skill?

Foraging for edible plants. Basically, there are three kinds of plants: edible plants, non-edible plants, and poisonous plants. In some cases there are edible, non-edible, and poisonous parts on the same plant. To be able to collect edible material only, you really must know what you are doing.

Begin by learning to identify plants. To do this you will need a manual of the flora of your area. Don't waste your money on a simplified book of wildflower pictures. The kind of book you need will be lengthy and might not have any pictures at all. You'll have to spend from 20 to 50 dollars for it. I won't recommend one here since these books are local in geographic coverage. Call your local university botany department and ask the taxonomist to suggest one for your location. Be sure that your interest isn't underestimated.

Once you have the manual, you will need someone to teach you to use it. You might enroll in a botany class, but be sure that the class deals strictly with "local flora." There are few things in life as useless as a general botany course. If you can't enroll in an appropriate course, you may have to find a tutor. At first, you will definitely need the assistance of someone who has experience in identifying plants.

The reason you will need help is the almost universal failing of floral manuals. The joke among botanists is that the manuals are written by people who don't need them for people who can't use them. It's true. The problem is complicated by the fact that many "species" of plants pay no attention to the manuals and interbreed so freely that it is impossible to identify them. In an area containing several species of oaks, for instance, almost every individual is a mixture. If you don't have the advice of someone who has been there before, that could be baffling. It's even a good idea to make up a collection of properly identified specimens to keep as references. Any botanist can tell you how.

After you have learned to identify the most common plants in your area, you can move on to the "edible" ones. There are many books on collecting "natural" foods, but I warn you that most of them are worthless. Some are even dangerous. One reliable resource, however, is Edible Native Plants of the Rocky Mountains by H. D. Harrington.[17] It is a useful guide; once you have seen it, you will know what the others lack. Many of the plants covered in this book are common throughout the country.

If you own retreat property, you should consider managing the native vegetation in favor of edible species. Without too much effort, you can dig up edible plants and replant them on your property. Plants present on your land which are not edible can be thinned or removed to make way for the newcomers.

Hunting and fishing. Most people are more confident about their ability to recognize edible animals than edible plants. After all, if it walks, flies, swims, or slithers, there is a very good chance it can be eaten. All you have to do is kill it and cook it, right? Yes, but there are several catches. The biggest one is the part that begins "All you have to do ... "

Any study of survival hunting should begin with Mel Tappan's Survival Guns.[18] Most survivalists are familiar with this book, but for the uninitiated, Survival Guns is a 450-page text on firearms for pest elimination, hunting, and defense under conditions of long-term survival. No survivalist can be well-informed without this book. (My dog-eared copy wore out and I had to buy a new one.)

I recently spent an afternoon in conversation with a friend who is a game manager on a large Indian reservation. We discussed survival hunting under post-attack conditions and came to some startling conclusions. Sport hunters will have some drastic changes to make in their expectations, equipment, and methods before they are ready to live off the land following a nuclear war.

For one thing, most hunters are "sportsmen." Modern hunting laws are designed to give animals a fair break and usually stipulate that you can't shoot anything between sunset and sunrise; use lights to find game at night; employ walkie-talkies or motor vehicles; use bait; shoot at sitting game birds; shoot at songbirds; use unattended baited lines, nets, or traps for fish; set snares; shoot females; or have more than five cartridges in your rifle at one time. By turning these rules around, the advantage is given back to the hunter—a virtual checklist of survival hunting techniques is obtained. In short, hunters must unlearn the rules of conduct which they are currently expected to follow.

Consider big game hunting. Shooting a large animal for food is an attractive idea because one bullet brings down so much meat, and the target itself is large and fairly easy to hit—if you have your wits together. But in the aftermath of a nuclear war, big game hunting is not likely to be a very productive pastime. There are many reasons for this. First, if your area receives lethal doses of fallout, there just won't be any big game. Deer are just as sensitive to radiation as people. Second, the high level of ultraviolet light will force deer and other animals into exclusively nocturnal habits, and for a while at least it may force you into nocturnal habits, too. If you live in an area with winter snows, the ultraviolet light will blind animals and indirectly result in very high mortality during the first winter. You may be able to take large numbers of animals while they are blinded, but what about later?

Add to this the fact that most game animals have yearly migrations which will leave you without anything to hunt during half the year, even in "good" game areas. In the summer the animals seek the security of the peaks while in the winter they migrate to the milder lowlands. If your retreat is high in the mountains, you will have some long, meatless winters. If you have homesteaded in the valley, your summers will be mainly vegetarian. A fancy hunting rifle is clearly not a meal ticket.

In addition, sport hunting rifles will be virtually useless for survival hunting in a nuclear war context. Assuming that there are deer or other animals in your area at all, they will be staying in very dense cover by day and moving only at night. You and the animals will both be trying to avoid ultraviolet burns, and the deer will be trying to avoid you and all those other starving hunters in the neighborhood. You will never get a 400-yard shot, not in the brush during the day and certainly not while you are hunting at night. Super-accuracy will not be required. Instead, you will need a 12-gauge shotgun loaded with buckshot or a rifle capable of firing rapidly and repeatedly.

Clamping a powerful flashlight on the barrel of the gun will help you locate and hit game in the dark. (A deer's eyes shine in the beam of light as much as 100 yards away.) If you adjust the beam to coincide with the shot pattern or bullet trajectory, you can even use it as an aiming device. Another variation of this trick is to use a red filter on the flashlight. Many large mammals are blind to monochromatic red light. You can see them clearly, but they think they are safely hidden in the darkness.

For a nuclear war situation, I suggest hunting with a military assault rifle. For one thing, with such a rifle you can keep shooting as long as a target is visible (or audible, dangerous as that is). Bolt actions are too slow on successive shots for survival hunting. Then there is the problem of other hunters. As soon as you pull the trigger, everybody within five miles will know two important things about you. First, they will have at least a general notion of where you are. Second, they will know that you have seen something worth shooting. They will be hungry too, and may decide that their best chance of bringing home the venison will be to locate you.

History has shown that about 1 person in 10 will rob for food if starving; about 1 in 100 will commit murder for food; roughly 1 in 1,000 will eat human flesh if hungry enough; and 1 in 10,000 will actively hunt people. Are you sure you want to be out in the woods hunting with a bolt-action rifle? Not me.

What about small game? In Survival Guns, Tappan makes a pretty convincing case for doing small game hunting with air guns, and I totally agree with his reasons. Adult pellet rifles are available which have sufficient accuracy and power to kill small animals at ranges as great as thirty to fifty yards. Furthermore, these rifles are quiet enough to avoid spooking the game if you miss, and they do not advertise the fact that you are out hunting. They need very little maintenance, and pellets can be obtained by the thousands for just a few dollars. Silence, accuracy, and reliability make air guns very attractive to survivalists.

I asked Robert Beeman, Ph.D., for his thoughts on air guns and survival applications, and, not surprisingly, he had kind words to say about the Beeman line of air rifle products. According to the expert, the most popular items he sells for survival hunting include the Beeman/Feinwerkbau 124, the Beeman Model 35, and the Beeman/Weihrauch Model 35 rifles.[19] The rifles are usually fitted with a metal aperture sight or a scope, and perform best when used with Beeman/H&N or Silver Jet pellets. The inherent accuracy of these rifles ranges from 0.15 to 0.25 inches at 25 feet, with velocities between 700 and 800 feet per second.

When hunting with an air rifle, be sure that you do not overlook the potential of songbirds as game. It is only recently that these birds have been legally protected; our heritage includes centuries of "four and twenty blackbirds baked in a pie." When you consider that, as protected species, these birds do not fear humans, you begin to appreciate them as a fairly easy source of food. Once you shoot and clean the first bird of the day, you can set up the refuse as bait. Back off a measured distance with your air rifle and wait. Something will come to investigate the offal. Score number two. Now you have twice as much bait—and so on. Or you might scatter a little corn or wheat around. When you have attracted enough birds, you can "ground sluice" them—shoot the whole flock with one shotgun shell. (You've heard of "sitting ducks." You have to admit it's economical.)

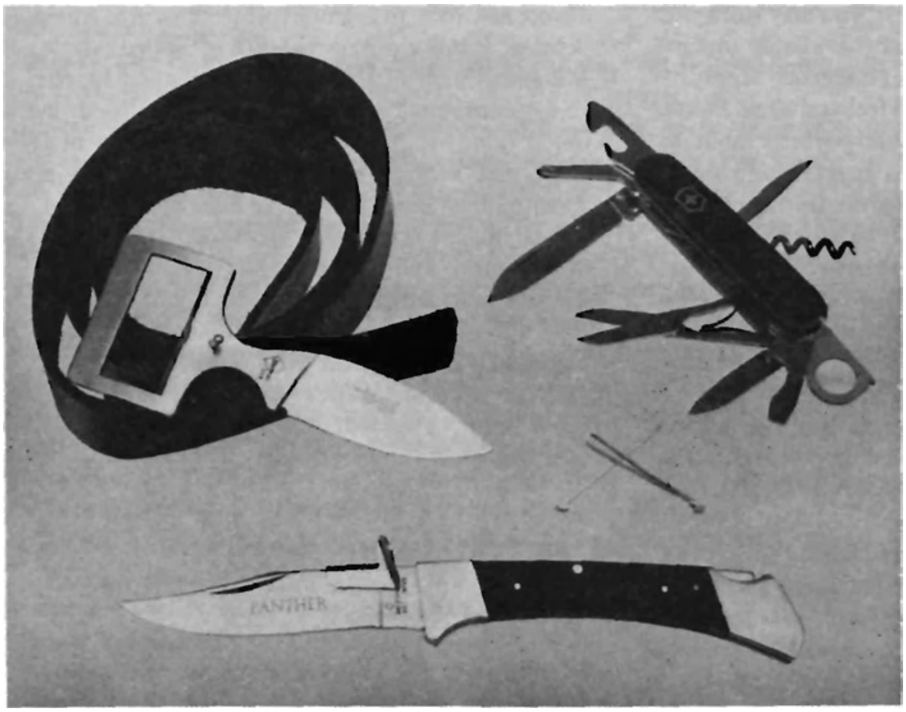
The Federal Ammunition Guide (a brochure available in sporting goods stores) lists number 6 shot for almost all kinds of small game. You may also want shells loaded with buckshot and rifled slugs, depending on the big game in your area. Be wary of the buckshot loads, however. The 3 inch magnum loads contain marginally more pellets and kick a lot more than a 2% inch variety, but few people realize that the smaller shells actually propel the pellets faster (which means greater penetration and range).

Of course, the most efficient possible way to obtain small game is to trap it. Trapping is very valuable to a survivalist, because the trap stays outside working twenty-four hours a day while the trapper hunts, gardens, sleeps, and generally ignores it. For survivalists, the Havahart repeating bird and rodent traps are especially useful.[20] Havahart's sparrow and pigeon traps capture one bird after another, alive, without needing any attention. They will hold up to ten pigeons or twenty smaller birds at one time. The rodent traps will take up to fifteen mice or several rats without being reset; this could be quite a blessing if your homestead develops rodent problems.

The same principle applies for fishing as for hunting both big and small game. Leave your trusty fly rod at home. You can practice sport fishing if you want to, but filling the pot requires a different approach. If you look through a typical book on emergency survival, you will find examples of netting and trapping fish en masse which would be foolish for a survivalist to ignore. These techniques are widespread in survival literature and need little coverage here.

If I were to recommend a single book to get you on the right track for survival hunting and fishing, it would be Modern Hunting with Indian Secrets, by Allan A. Macfarlan.[21] Macfarlan covers a very wide range of "dirty hunting" tricks which will help to break the habits of sportsmanship and bring in some food.

For all types of survivalist tasks, a good utility knife is indispensable. I asked the people at the Atlanta Cutlery Company to suggest a good survival knife, and they generously sent me several to try out. Two were especially interesting. One was a Bowen "survival" model, which is a belt-buckle knife. The handle is in the shape of a large square buckle, and the blade slips into a sheath sewn into the belt itself. It is not only a very nice looking knife, but it comes with a very presentable belt. The edge is serviceable, the blade strongly made. It has two drawbacks, however. The first is the ludicrous possibility that whenever you want to use the knife, you will have to hold up your pants with the other hand. Second is the equally ludicrous fact that legislators in several states have decided that this little knife is a "concealed weapon" and have passed special bills to outlaw it. (My



Three utility knives for survivalists: the Victorinox Swiss Army "Explorer," the Bowen belt-buckle knife, and the Panther lock-blade folding hunter. Note the "Flicker attached to the blade of the Panther. This inexpensive device allows one-handed opening of the knife and subsequently serves as a finger guard. (Bowen, Panther, and Flicket courtesy of the Atlanta Cutlery Company, PO Box 839, Conyers, Georgia 30207.)

evaluation of this blade as a weapon is such that I'd rather fight bare-handed, knowing that my pants would stay up.)

The second knife was a Panther, a lock-blade folding hunting knife. This is a heavy-duty pocket knife which I have used in all kinds of kitchen, garden, workshop, hunting, and survival tasks with complete satisfaction. It holds its edge very well. Although it has only a single blade, I find that I use it all the time. Incidentally, Atlanta Cutlery also sells a little device called a "flicket," which clips on the Panther blade and allows you to open the knife instantly with only one hand. You'll appreciate that someday when you are in a hurry and your other hand is occupied. I wouldn't be without it.

Something else I wouldn't be without is my Victorinox Swiss Army pocket knife (the Explorer model). This knife is a three-inch toolbox which includes a can opener, bottle opener, wire stripper, two standard screwdrivers, a Phillips screwdriver, a magnifying glass, scissors, two knife blades, an awl, a corkscrew, tweezers, and a toothpick. This, too, I use every day for routine chores and unpredictable minor maintenance. One caution: Be sure it's a Victorinox. There are many cheap imitations.

Energy and Utilities

Energy is a topic of utmost importance to survivalists. What about light? Cooking? Electrical power? Heating?

There are two approaches. First, you may stockpile fuel. It is easy to use commercially available underground storage tanks to house your emergency supply of gasoline, propane, or whatever you feel you need. Don't try to store such fuels in above-ground portable tanks or cans. The object of survivalism is to increase your chances in a crisis, not to make life dangerous during normal times. You can use your stored fuel to heat your home, to cook your meals, or to power an electrical generator. It would be best to make your house as thermally efficient as possible, even to the extent of adding additional layers of insulation which would normally not be economical. Try to see that the waste heat from the generator and from cooking is used again to heat the house. The exhaust from the generator must be vented directly to the outside, of course, but it can be routed through a heat exchanger first.

The obvious problem with stored fuel is that it must inevitably run out. Fortunately, the proponents of "soft technology" have been at work for several years devising more and more efficient solar collectors, windmill generators, deep discharge storage batteries, and other devices for home energy production and storage. You can now provide most of your own heat, hot water, and electricity if you take advantage of this research. There is still some difficulty with providing heat for cooking, however. At present, the best source is heat from burning wood. As an alternative, you can use a solar oven to cook your main meal—provided you are content to eat only at noon on sunny days.

A very convenient way to provide a fallout shelter with emergency power is to set up a twelve-volt system based on automobile batteries and accessories. This allows you to make use of equipment designed for motor homes, campers, and vans such as refrigerators, lights, fans (both for air circulation and for venting kitchen steam outside), vacuum cleaners (for removing fallout from hair and clothing), air compressors, water pumps, spotlights, clocks, winches, burglar alarms, AM-FM radios, CB radios, tape decks, PA systems, and coffee cup warmers! All the comforts of home.[22]

For a good general introduction to alternative energy systems, see Producing Your Own Power, edited by Carol Stoner; continuously updated information is provided in Alternative Sources of Energy Magazine.[23] Frequent articles of interest appear in Popular Science and Popular Mechanics, too.

The Small Town As Refuge

Recently, more and more survivalist leaders have come to the conclusion that the easiest way to insure the continuity of essential goods and services is to move to a small rural community.[24] They say that an agricultural town which produces most of its own food (or could do so) has a good probability of avoiding starvation. It can devote attention to essential projects, such as community defense. It has a proper balance of skilled people and a full assortment of tools, equipment, and supplies. All things considered there is no possible way for an individual or family to duplicate the self-sufficiency of a town.

These survival experts practice what they preach. Their addresses are places like Eureka and Yreka, California; Rogue River and Medford, Oregon; Spokane, Washington; and Kalispell and Stevensville, Montana. These communities aren't all small, but on the average they will have fewer difficulties in times of crisis than places like Los Angeles, New York, and Chicago.

If you decide to move to a small rural community, do it soon. You will want to be a well-established member when things get nasty.

Commentary

The hardest part of being a writer is not finding enough to say, but knowing when to stop. The topic of self-sufficiency is so large that I could write several chapters (or books) about it without feeling that I had covered the topic adequately. I will have to content myself for now by advising you to consult other resources.

Survival, Inc., mentioned earlier in this chapter, publishes a catalog of note. Also, be sure to see the catalogs offered by Garden Way Publishing and Mother's Bookshelf.[25] Neither should the concerned survivalist overlook The Survivor's Primer and Updated Retrealer's Bibliography, by Don and Barbie Stephens.[26] Books listed in these sources will give you the broadest possible access to information on self-sufficiency short of joining a commune.

Three survivalist newsletters, also already mentioned, are indispensable: McKeever's MISL, Pier's and Tappan's Personal Survival Letter, and Ruffs Ruff Times. In addition, Kurt Saxon's The Survivor should be mentioned.[27] Saxon splits his attention between exploring nineteenth-century technology from the survivalist viewpoint and inventing novel ways to undermine the Eureka, California city council. Some of the articles in The Survivor are very useful; others are macabre, but are still very useful. The subscription rate is low and the volume of information in each issue is large, but The Survivor isn't for everyone.

Finally, if you are ready to progress from the planning stage to action, be sure to write for the catalog of the Cumberland General Store and for the Countryside Catalog.[28] These firms carry a large selection of hand-powered cultivators, seeders, dough kneaders, bottle cappers, grain mills, meat grinders, fruit presses, washing machines, corn shellers, sausage stuffers, and nearly everything else.

Remember that food and other necessities can only be compiled during pre-crisis times. Don't wait too long.

Notes

1. See chapter 2 and Appendix D for a more complete discussion of the effects of iodine-131.
2. Bill Pier, in Personal Survival Letter December 1977, Bill Pier and Mel Tappan, eds., PO Box 598, Rogue River, Oregon 97537.
3. Esther Dickey, Passport to Survival (Bookcraft Publishers, 1848 W. 2300 South, Salt Lake City, Utah, 1969).
4. Lorraine Tyler, The Magic of Wheat Cookery (Salt Lake City, Utah: Magic Mill, 1974).
5. Bob Zabriskie, Family Storage Plan (Bookcraft Publishers, 1848 W. 2300 South, Salt Lake City, Utah, 1966).
6. Howard Ruff, Famine and Survival in America (Target Publishing, PO Box 172, Alamo, California 94507, 1974).
7. Back issues and subscriptions are available. Write Bill Pier and Mel Tappan, eds., Personal Survival Letter, PO Box 598, Rogue River, Oregon 97537.
8. Les Scher, Finding and Buying Your Place in the Country (New York: Collier Books, 1974).
9. Jim McKeever, ed., MISL: McKeever's Investment and Survival Letter, PO Box 4130, Medford, Oregon 97501. McKeever is also the author of Christians Will Go through the Tribulation . . . And How to Prepare for It, mentioned in chapter 1.
10. John Seymour, THE Guide to Self-sufficiency (New York: Popular Mechanics Books, 1976).
11. Richard Langer, Grow ///(New York: Saturday Review Press, 1972).
12. Carla Emery, Old Fashioned Recipe Book (New York: Bantam Books, Inc., 1977).
13. Lem Jones, Home Hydroponics and How to Do It (Beardsley Publishing Company, 5523 N. Homestead Lane, Paradise Valley, Arizona 85253, 1975).
14. George Abraham and Katy Abraham, Organic Gardening under Glass (Emmaus, Pennsylvania: Rodale Press, 1975).
15. Ball Blue Book, Ball Corporation, Muncie, Indiana 47302.
16. Carol Stoner, ed., Slocking Up (Emmaus, Pennsylvania: Rodale Press, 1973); Nancy Thurber and Gretchen Mead, Keeping the Harvest (Charlotte, Vermont: Garden Way Publishing Company, 1976).

17. H.D. Harrington, Edible Native Plants of the Rocky Mountains (Albuquerque: University of New Mexico Press, 1967).

18. Mel Tappan, Survival Guns (Rogue River, Oregon: The Janus Press, 1976-77).

19. For information on the Beeman line, write Beeman's Precision Airguns, Inc., 47 Paul Drive, San Rafael, California 94903.

20. A thirty-six page booklet on trapping is available from Havahart, PO Box 551, Ossining, New York 10562.

21. Alan A. Macfarlan, Modern Hunting with Indian Secrets (Harrisburg, Pennsylvania: Stackpole Books, 1971).

22. For more information on the miscellaneous equipment that may be run off twelve-volt batteries, see the Sears recreational vehicle catalog or write for the catalog of the J.C. Whitney Company, PO Box 8410, Chicago, Illinois 60680.

23. Carol Stoner, ed., Producing Your Own Power (Emmaus, Pennsylvania: Rodale Press, 1974); Alternative Sources of Energy Magazine, Route 2, Milaca, Minnesota 56353.

24. Jim McKeever provides a concise discussion of selecting a small town retreat in MISL: McKeever's Investment and Survival Letter, number 164.

25. Garden Way Publishing, Charlotte, Vermont 05445; Mother's Bookshelf, PO Box 70, Hendersonville, North Carolina 28739.

26. Don Stephens and Barbie Stephens, The Survivor's Primer and Updated Retreater's Bibliography, Drawer 1441, Spokane, Washington 99210.

27. Kurt Saxon, ed., The Survivor, Atlan Formularies, PO Box 438, Eureka, California 95501.

28. Cumberland General Store, Route 3, Crossville, Tennessee 38555; Countryside Catalog, 312 Portland Road, Waterloo, Wisconsin 53594.

6

Nobody Makes Housecalls Anymore

IN THE SPACE of the last three months, I have been brought into contact with physicians and hospitals altogether too frequently. In that period of time, an elderly relative became involved in a serious automobile accident and subsequently suffered a stroke. A young woman who is a close friend of the family developed a brain aneurysm and had to have very dangerous surgery to correct it. Another close friend developed a 104-degree fever that ran on for days and turned into meningitis. He was in the hospital under codeine sedation for a week before he began to improve. My family and I participated in a holiday get-together after which everybody but me got sick (I don't like potato salad). Another friend developed a cyst in his head the size of an egg and had to have it treated. Yet another friend had a miscarriage. Last but not least, I spent five days taking care of a fourteen-month-old infant while his parents were out of town. He had the flu the whole time.

What would we do if we needed professional medical help and couldn't get it? The retreaters I have met regard that possibility as the single most difficult problem they face. After all, growing crops is not all that complicated. Pulling a trigger to bring in meat or defend your life is pretty simple, too. But if someone gets a small cut, and it becomes infected, and ominous red streaks start to spread—what do you do? If one of your sentries accidentally shoots himself in the foot—what do you do? If several members of your group arrive at the retreat suffering from flashburns or blast injuries—what do you do? Without a team of physicians, a fully stocked pharmacy, and a well-equipped hospital, these questions and others like them present life threatening dilemmas.

Obviously, the best answer to medical problems would be to have a physician join your group. This might not be as difficult as it sounds. A surprisingly large number of retreat groups are composed partially or wholly of physicians (particularly the commercial "rent-a-shelter" groups in California). I suspect that this is due to the fact that doctors are at home with emergency situations, death, and, particularly, preventive attitudes. Their profession makes them tend to think like retreaters; it is only a small step to full-scale emergency preparedness.

If you can't interest a physician in your group, there are several other medical professionals who could be of assistance. The Office of Civil Defense suggests the following "doctor substitutes," in order of priority: dentists, veterinarians, registered nurses, pharmacists, licensed practical nurses, trained medical corpsmen, podiatrists, and students of these disciplines.

And if your circle of friends does not include any veterinarians, podiatrists, or medical corpsmen? Don't despair. If you have to supply your own medical aid there is still quite a lot that you can do for yourself, even in severe emergencies. This chapter is a guide to the books, equipment, and supplies you will need in order to act as your own doctor under emergency conditions. In Appendix E I have also provided a selection of technical information about nuclear war injuries. These additional materials are included because it is unlikely that whatever doctor you eventually contact will be familiar with them. There are perhaps a dozen physicians in the country who have seen a case of radiation sickness. Your doctor isn't likely to be one of them.

There are two other points to bring up here. Don't be complacent just because your brother-in-law the pediatrician has joined your retreat group. You will need to prepare for do-it-yourself medicine anyway. What will you do if he doesn't make it to the retreat site? What if he arrives but is so badly injured that he needs a doctor? Be prepared.

Lastly, be aware that modern physicians are relatively inexperienced in medical techniques which lie outside of their fields of specialization, and may never have studied therapies which are more appropriate to a retreat than a hospital. They know the best way to treat a particular problem using the most modern hospital equipment and supplies, but the second-best way (using two spoons and a can opener) is something that they have never tried, seen, heard of, or thought about. You will have to provide the books, supplies, and equipment to assist your doctor in the difficult transition from modern medicine to retreat medicine. Otherwise, the doctor may be unable to help you.

WARNING!

Self-medication under circumstances where a physician's care is available is not only illegal, it is extremely dangerous. The author and the publishers of this book do not recommend or endorse self-medication or the practice of medicine without a license in any way, shape, or form. The responsibility for any such activity is borne entirely by the reader. Seek professional medical help if there is any possible way to obtain it.

Basic Medical Self-help

In the next section I'll discuss "first aid" for retreaters, but first I want to cover a new and unique resource of medical self-help which is gaining popularity around the country. Public health authorities have begun to implement self-help training courses for the general public which go far beyond the traditional Red Cross "first aid" curriculum. These classes are intended to help a layman make the right decision about whether or not a particular medical problem requires the attention of a doctor. From 30 to 70 percent of the cases a family doctor sees each day are people who don't really need help. Most patients have discomforts that they can treat themselves or which are self-limiting. Medical self-help courses are designed to teach a layman how to tell the difference between these conditions and the more serious ones which do require professional treatment. The basis of these programs is a course originated by Dr. Keith Sehnert, author of the best-selling book How to Be Your Own Doctor (Sometimes).[1] I highly recommend this book to all people who are concerned about their health, and to retreaters in particular. The book contains clearly written advice on teaching yourself how to monitor your family's health using simple medical instruments such as the stethoscope, thermometer, sphygmomanometer, otoscope, and penlight.

How to Be Your Own Doctor (Sometimes) includes chapters on general preventive medicine (living like you like to live), as well as extensive sections on understanding your doctor's medical jargon, putting together a "black bag" of your own, assembling a selection of emergency drugs and medical supplies, and evaluating your doctor. Sehnert also includes a really helpful section on how to interrogate your doctor to really find out what is wrong with you. It's the perfect preparation for the patient whose doctor says, "Take two of these pills and call me in the morning."

Within the main body of Sehnert's book is a second book, The Self-help Medical Guide. This manual is the heart of the matter for retreaters, because it guides one by a series of questions to a determination of what is wrong and to a decision about whether or not to see a doctor. If professional help is not called for, the guide includes complete instructions on treating the problem at home. I have used this guide with my family and I have found it to be comprehensive and easy to follow.

There is one book which you might consider buying as a supplement (or a poor substitute) for Sehnert's manual. This is The Well Body Book by Mike Samuels, M.D. and Hal Bennett.[2] This book has an excellent section on self-examination but is heavily laced with Eastern mysticism and I cannot whole-heartedly recommend it.

A "Family Black Bag Home Health Kit" containing all the equipment necessary to complement Sehnert's book is commercially available from the Clayton Division of Marshall Electronics.[3] The kit contains a special cut-down version of the book, but I suggest you visit a bookstore and get the complete text, too.

First Aid for Retreaters

For the emergency situations which retreaters may have to face someday, standard first aid training will be hopelessly inadequate. You may be called on to administer first aid to persons, possibly loved ones, who have suffered severe injuries caused by blast, flash burns, flame burns, chemicals, or possibly even small arms. For these reasons a retreater needs a somewhat unusual manual on first aid technique and lifesaving.

The best manual I have seen along this line is the United States Army Field Manual 21-11, First Aid for Soldiers, available commercially from Normount Technical Publications under the title First Aid for Soldiers and Sportsmen.[4] This is the manual to consult first in an emergency because it tells you what to do to keep the victim alive long enough either to get him to a doctor or to figure out how to treat the injuries yourself. This book contains all the standard information on bleeding, artificial respiration, closed-chest heart massage, bandaging, and treating shock. It also includes an unusual degree of information on first aid for victims of massive wounds, severe burns, bullet wounds, and poison gas. Have you ever stopped to consider how you would give artificial respiration to a person wearing a gas mask? This manual describes two procedures.

The chapter on psychological first aid is also unusual. Psychological injuries don't show like wounds of the flesh, but they can be just as incapacitating, and special skills are needed to deal with them. The manual discusses how to recognize a psychological casualty, how to give first aid, and how to control your own attitude toward a person who is helpless but apparently uninjured. (Saying "Snap out of it!" usually makes things worse.) If you contemplate being prepared for disaster, you will certainly need to give some thought to the psychological health of your group of survivors.

In one other aspect First Aid/or Soldiers is unique. Most first aid manuals tell you never to move a wounded person for fear of aggravating injuries. This manual, designed for use on the battlefield, assumes that there will be times when the only thing you can do is to pick up and carry the casualty. The details of immobilizing the injury and protecting the patient under these circumstances are described at length. As a retreater, you may someday be forced to transport a member of your group under just such primitive conditions. If that happens, you will need this manual.

Advanced Self-help

Up to this point I have been describing skills which fall into the general category of home care or first aid. Once you have become qualified to handle routine situations, what can you do about the more serious medical problems which may arise? Are there any steps you can take to further increase your medical capabilities?

The isolated position of the retreater may seem unique, but in fact there are several relatively common situations in which laymen are cut off from professional medical aid for long periods of time. Scientific explorers of the arctic wastes and mountaineering teams in the Himalayas or Andes are frequently removed from medical aid for weeks or months at a time. Seafarers develop medical emergencies in mid-ocean when ships are days from land. In China, where the general population hopelessly outnumbers the doctors, specially trained paramedics have assumed medical duties of virtually every description. A similar situation prevails in Mexico. When the Apollo astronauts were on the surface of the moon, they were about as far from the hospital as anyone can get. You can bet some careful thought went into their self-help kit. Finally, there has even been some formal effort to provide for the needs of isolated survivors of a nuclear attack.

There are several advanced self-treatment books which you should own. The first is available under two titles. Through the United States Public Health Service, it is called Austere Medical Care for Disaster; you can also find it as Medical Care in Shelters through the Office of Civil Defense.[5]

Austere Medical Care (for the sake of convenience) is the manual supplied with official fallout shelter medical kits. It covers a wide range of survival medical questions, but it assumes that you are sitting in a well-stocked shelter and that you will be able to obtain professional help within two weeks at the most. Discussion focuses on about sixty emergencies likely to occur in a fallout shelter. I was particularly impressed with the sections on the medical care of premature and newborn infants. In many other departments, however, the manual is disappointing. Under "death," for instance, it tells you to reassure the dying patient's relatives that death is painless, kind, merciful, etc. It doesn't tell you how to tell if the patient is really dead, though. The manual is written at about the eighth grade level, and although its overall quality is fairly good I would feel very uncomfortable if this were my only medical book. (I would also feel uncomfortable without it, however.)

The next manual on my shelf is Medicine for Mountaineering, edited by James A. Wilkerson, M.D.[6] This is a small but detailed manual designed for mountaineering expeditions in places where medical help cannot be obtained. Wilkerson's instructions are clear and well-illustrated, and he doesn't hold back in describing what to do until he reaches problems which require major surgery. Under the rugged conditions of mountaineering, Wilkerson explains, heroic attempts at surgery would probably kill the patient faster than the original sickness or injury. For a few extreme cases, Wilkerson recommends transportation to a hospital at all costs, but for most conditions the manual contains everything you need to know, including how to select and administer several prescription drugs.

One section of Medicine for Mountaineering is particularly important for retreaters. Chapter 15 deals exclusively with the prevention and treatment of sunburn and snowblindness caused by the ultraviolet light encountered at high altitudes. Since a nuclear war may allow a serious increase in ultraviolet radiation at the earth's surface, this information is crucial.

In spite of its general quality, Medicine for Mountaineering has a serious flaw, at least from my point of view. Wilkerson assumes that if you are going to hike off into the Himalayas you will be in shape for the trip. The book does not cover the medical needs of stay-at-home types who may have heart disease, ulcers, arthritis, or terminal acne. There is no information about pregnancy, of course. Even so, this is one of the clearest and most up-to-date medical guides you can get. Don't be without it.

The most comprehensive medical self-help book I have been able to find is Where There Is No Doctor, written by David Werner.[7] This is a really excellent village health care handbook. It was written to be the medical guide for a person living in a remote Latin American village, where medical care is hours or days away. If there is a single book which you should own on advanced self-help, this is the one.

Where There Is No Doctor contains simple and clear instructions for treating everything from abcesses to yeast infections, including every kind of injury and disease which is likely to appear in a rural village. Its usefulness to us is reduced slightly by Werner's concentration on tropical diseases and impoverished people, and one feels a certain sense of culture shock when reading it. Many of the procedures are set forth in cartoons to help explain the treatment to an illiterate patient, for instance. Even with these drawbacks, Where There Is No Doctor is by far the best single manual a retreat group can possess.

A similar manual has been written for Americans, but unfortunately it is rather out of date. I refer to The Ship's Medicine Chest and First Aid at Sea, published by the United States Public Health Service.[8] This manual is nearly 500 pages long and covers every medical emergency that could possibly happen aboard a ship at sea. The only problem is that The Ship's Medicine Chest was originally written in 1947 and only sketchily revised in 1956; the medical advice is weak on antibiotics and strong on enemas. (It even suggests enemas for mentally disturbed patients.)

Even though this manual should not be your only medical book, it has a definite place on your survival shelf. When the time comes for action, you may discover that you do not have the selection of miracle drugs called for in the more recent books. In that case, you will appreciate the value of a manual that tells you how to proceed using epsom salts. In addition, the book contains miscellaneous topics that you will not find covered anywhere else, such as how to prepare a medical report for transmission to a doctor over the radio. This is vital.

If you have any worries about dentistry or obstetrics (you should), the manual you will need is Medical Handbook for Unconventional Operations, edited by William C. Kothe, M.D.[9] Although this is apparently a manual for military medics, it contains a really excellent section on delivering babies and the only useful discussion of do-it-yourself dentistry I have been able to find. (I particularly liked the first line of the obstetrics section: "Do not become involved with obstetrics if there is any way to avoid it.")

There is one more medical book for laymen which I would like to point out because it is unique. This is A Barefoot Doctor's Manual, the official American translation of Ch'ih Chiao I Sheng Shou Ts'e, the 1,000-page Chinese paramedical manual.[10]

A Barefoot Doctor's Manual is unlike any other self-help book. For one thing, it was written by physicians for use by paramedics in a country where the patients vastly outnumber the doctors. The authors assumed that the paramedic would have to serve in the physician's place almost all the time, and that the paramedic would have to concoct medicines at least part of the time. Altogether, A Barefoot Doctor's Manual is very much the kind of thing a retreater might need following a nuclear attack.

Once again there are drawbacks, however, a few of which are really blessings in disguise. The manual covers a wide range of ailments and suggests several methods of dealing with each of them. The suggested treatments are acupuncture, moxibustion, herbal remedies, and conventional Western medicine. The first part of the list sounds like a primitive and motley assortment of techniques, but let me warn you not to take this book too lightly. The Western medicine sections are detailed and accurate, as well as being more recent than those in most American manuals. Although acupuncture is alien to our culture, it really seems to work when used for the relief of pain, or so say many American physicians and dentists who have tried it. Moxibustion is similar to acupuncture, but the treatment is accomplished with small burns instead of pin pricks. As for herbal remedies, don't forget that aspirin is just willow-bark tea condensed into a tablet. Many herbal remedies are quite effective.

Detailed, modern instructions for treating injuries and performing surgical procedures are also provided which you will not find in any other manual for laymen. Where else are you going to find a handbook that tells you how to perform a vasectomy, for instance?

The next few books I want to recommend are not intended for laymen at all. The first is The Merck Manual of Diagnosis and Therapy, published by the Merck, Sharpe and Dohme Research Laboratories.[11] This book contains 2,000 pages of vital information in pocket-reference format for physicians and pharmacists. Much of the discussion is unintelligible to the average reader, but since the scope and depth of the information greatly exceeds anything written for laymen, it could be a vital source of information in an emergency. If someone gets sick and the other books disagree or tell you to go to a hospital. The Merck Manual will fill you in on the missing information. It might tell you exactly what to do, or it might tell you that there is nothing you can do. Either way it will settle your doubts.

And what if the problem can't be solved by a handful of pills? What if surgery is necessary? This subject is probably better left alone by the layman, but I find that I cannot resist making a few comments about it. I agree with Wilkerson that in primitive circumstances there is little point in attempting amateur surgery—the shock and inevitable infection would surely doom the patient. However, a retreat group of any size ought to be able to establish a sterile environment and provide some form of anesthesia; this eliminates Wilkerson's most serious objections. If members of your group are injured by nuclear weapon effects or small arms fire, you could easily wind up with one or more patients for whom surgery would be the only hope of survival. If one of your friends intercepts a buckshot pellet (or a glass splinter) three inches to the left of the navel, you can either write the person off to a prolonged and very painful death or you can try to repair the damage.

In this context, the book to get is Emergency War Surgery, published by the United States Defense Department.[12] This manual is written by military surgeons to brief newly inducted physicians in the techniques of battlefield surgery. Since many drafted doctors are specialists in non-surgical fields (such as pediatrics, dermatology, obstetrics, and internal medicine), the directions in the manual do not presume that the reader is at home with surgery. There are a few portions of this manual which are impossibly loaded with medical terms, but the procedures themselves are very clear. If you are ever unfortunate enough to be forced into a gun battle in defense of your retreat, you will need this book. Badly.

One point I should make here is that most bullet wounds will be in your patient's legs (about 40 percent), arms (about 30 percent), or head (about 20 percent). Only about 10 percent of wounds will be in the chest or abdomen. This is because most of the people who will be shot in the chest or abdomen will die before you can get to them. Your task will be mainly one of cleaning wounds in the extremities and sometimes amputating limbs, neither of which is a very complicated kind of surgery when your only goal is to save life.

The subject of amputation is particularly important. Before the advent of sterile operating procedures and antibiotics, the threat of gangrene was so great that bullet wounds in extremities were routinely treated by amputation, often by "surgeons" who had no formal training, and never with the blessing of anesthesia. In spite of these circumstances, over half of the patients lived. One physician I talked to recommended amputation as the "primitive" treatment of choice in the case of a large third-degree burn on an extremity. He felt that the stump would be easier to manage than the burn.

When you pick up a scalpel, though, remember that you are walking a very thin line between medical treatment and manslaughter. Such an extreme measure as amateur surgery is justified only when professional help cannot be obtained and it is certain that your patient will die without your intervention. Do-it-yourself surgery is an expedient for a time of complete anarchy and chaos. It would be utterly reprehensible to use it as anything other than a desperate last resort.

If you decide to purchase these recommended books for your family or retreat group, you will need at least two additional volumes to help you interpret the previous manuals. First, you will need a pocket medical dictionary designed for laymen, such as The New American Medical Dictionary and Health Manual, by Robert E. Rothenberg, M.D.[13] The paramedical manuals are full of such terms as keloid, keratitis and anorexia, a fact which makes the dictionary very useful.

The second back-up book is Gray's Anatomy, the classic text of doctors and medical students for decades.[14] You will be able to get this edition or maybe even a newer one in any medical school bookstore. A knowledge of anatomy could be vital to your patient's survival. You might study the appropriate sections of Gray's and decide not to try it. (Note: There are two circa 1900 nostalgia editions on the market. Get the modern medical text.)

The books I have recommended are not the only useful medical and paramedical manuals available. They seem to me to more than cover the information which the non-physician can handle and which the retreater may need to know. If you happen to know of better resources, please bring them to my attention by writing to me; useful suggestions will be incorporated in later editions.

Laboratory Procedures

There may be considerable doubt that the average person can perform a successful surgical procedure, but performing lab tests is another matter entirely. The subject of do-it-yourself medical laboratory work has been totally neglected in the emergency and survival literature, in spite of the fact that many of the techniques are simple and require little or no training.

The medical tests I am thinking of are those associated with basic urinalysis, blood analysis, and bacteriology. The tests of most immediate use to the retreater are blood tests. The ability to perform A-B-O typing, RH typing, and donor compatibility tests will be the difference between achieving successful transfusions and watching your patients die for lack of blood. The ability to perform a white blood cell count will be vital to retreaters after a nuclear attack—white blood cell count will be one of your best indicators of the severity of a person's radiation injury. (See Appendix D.) It is a simple test that will leave you in little doubt about who is going to live and who is not. (If you are a well-prepared group, the test will tell you that you are all fine. That's worth knowing, too.)

To perform your own simple lab tests, you will need a copy of Laboratory Section of the Packaged Disaster Hospital, published by the United States Public Health Service.[15] This manual describes nineteen simple lab tests you can perform with a minimum of equipment. Fortunately, the most vital tests are also the simplest, requiring only a microscope, a few chemicals, and a glass microscope slide designed for blood tests. You could put it all together using a hobbyist microscope for about 50 dollars.

Medical Supplies

Now that you have a selection of medical manuals to consult in an emergency, it is time to consider acquiring the supplies you will need. There are three primary questions to resolve. The first is, which medicines to store? The second is, where to get them? The third is, can they be stored for maximum shelf life?

If you don't feel confident in your ability to analyze long lists of drugs to see if they meet your needs as a retreater, get a photocopy of the Therapeutic Guide for Pharmaceuticals in the Packaged Disaster Hospital.[16] This is a simplified summary of the action, use, cautions, side effects, and dosage of a hundred drugs which are particularly appropriate to disasters. This manual tells you everything you need to know to safely use these preparations, but it does not use difficult technical language. No retreat medic should be without it.

The question of which medicines to store is a difficult one to resolve. As I mentioned previously, government paramedical manuals are mostly out of date, and in some cases the medicines they discuss are simply not available anymore. Also, I have found that information on the shelf life of prescription drugs is difficult to obtain. This is critical information; it won't do much good to stockpile a five-year supply of medicines that expire in eighteen months.

I have attempted to solve this problem by passing on to you three lists of medicines which I have updated from the available literature. I was fortunate to be able to interest several physicians, a professor of clinical pharmacy, and a veterinarian in this problem. Their suggestions, combined with available lists, have provided the basis of what I believe to be a very comprehensive medical checklist for retreat groups.

The first list is that compiled by Keith Sehnert for How to Be Your Own Doctor (Sometimes). He calls it the "Moon Kit" because he based the list on the medical kit carried by the Apollo astronauts. The list as it appears in Sehnert's book contains information on cost, quantity to have on hand, average adult doses, and prescription use, but no information on shelf life. I have supplied the missing shelf life information in table 10.

TABLE 10
"Moon Kit" Medical Supplies

SUPPLY	YEARS OF SHELF LIFE
Achromycin Caps	2—5
Ampicillin	1—5
Aspirin	Several
Bacitracin Eye Ointment	1—2
Benadryl	Several
Bronkaid	Several
Cepacol Gargle	Several
Darvon Compound	5
Di-Gel Liquid	1—2
Debrox Drops	1—2 (tentative)
Dome-Boro Tabs	Indefinite
Emetrol	Several
Fleet Enema	Indefinite
Lomotil	Several
Marezine Tabs	Several
Merthiolate	Several
Neosporin Ointment	1—2
Neosynephrine Nose Drops	1—2
Parcpectolin	Several
Robitussin CF Syrup	Several
Seconol	5
Senakot Granules	1—2
Sudafed Tabs	5
Syrup of Ipecac	Several
Tincture Benzoin	Indefinite
Triaminic Syrup	1—2
Tylenol	5
Vaseline	Indefinite

Reprinted by permission of the publisher from Keith Sehnert, How to Be Your Own Doctor (Sometimes) (New York: Grosset & Dunlap, Inc., 1975).

You will notice that the shelf life information is not precise. This lack of consistency is due to variations in the quality of the products supplied by different manufacturers. Most pharmaceuticals have expiration dates stamped on the bottles. Be sure your pharmacist includes this information when your order is filled. Those items marked "indefinite" will store without deteriorating for many years provided they are tightly sealed and not subjected to extremes of temperature or moisture. Any item which is opened in normal use should be immediately replaced with a fresh package and removed from the stockpile.

The second list of medicines was derived from the United States Public Health Service's Austere Medical Care in Disaster (see table 11). It has been updated slightly, using as few substitutions as possible to allow you to follow the directions in the manual. Some substitutions were necessary because the manual doesn't specify the exact nature of the medicine (for example, "nose drops") or because the medicine is no longer commercially available. The list is intended to supply the medical needs of fifty people during a two-week shelter stay.

In both tables 10 and 11, there are several items which can only be obtained with a doctor's prescription. The items on Sehnert's list are for day-to-day use under the direction of a physician and should not be difficult to obtain. Show your doctor the "Moon Kit" list. Most family doctors will respond by helping you plan your emergency kit if approached in this way. It might be even easier to obtain the medicines for the Austere Medical Care list because there are fewer prescription preparations than are in Sehnert's list.

Don't be offended if your physician doesn't like the idea of handing you several bottles of narcotics, barbiturates, and antibiotics. Most doctors are all too aware of the ingenious games some patients can play to feed a

TABLE 11

Supply List from Austere Medical Care in Disaster

ASPIRIN TABLETS: 5 gr, one bottle of 500, $1.25; good for several years if tightly closed.

CASCARA SAGRADA TABLETS: 5 gr, one bottle of 100, $1.00; good for several years.

EUGENOL: One 1-oz. bottle, $2.40; good for several years if kept tightly closed (volatile).

EYE AND NOSE DROPS: Substitute Visine eye drops, one I-oz. bottle, $1.87, and Neosynephrine nose drops 1/4%, one 1-oz. bottle, $ 1.06; both last 1—2 years.

ISOPROPYL ALCOHOL: Two 1-pint bottles, $0.50 each; indefinite shelf life if kept tightly sealed.

KEOLIN AND PECTIN LIQUID: One l-pint bottle, $1.60; lasts for several years but may cake in bottom.

PENICILLIN G TABLETS: 250 mg, 400,000 units, two bottles of 100, $2.45 each; good for several years if kept dry at room temperature. (Prescription drug.)

PETROLATUM, WHITE: One 1-lb. can, $1.05; shelf life indefinite.

PHENOBARBITOL TABLETS: 1/2 gr, one bottle of 500, $1.40; shelf life several years. (Prescription drug.)

SURGICAL SOAP: 2% hexachlorophene, six l 3/4-oz. cakes. Substitute Phisohex liquid soap, 3% hexachlorophene, two 5-oz. bottles, $1.74 each; good for several years.

SODIUM BICARBONATE: One 1-lb. can, $0.75; common baking soda, shelf life indefinite.

SODIUM CHLORIDE: One 1-lb. can, $2.00; common table salt, uniodized, shelf life indefinite. (Costs less at the grocery store.)

SULFADIAZINE TABLETS: 7 1/2 gr, five bottles of 100, $1.70 each; shelf life 2—5 years depending on manufacturer. (Prescription drug.)

IODINE WATER PURIFICATION TABLETS: Fifteen bottles of 50, cost from $0.79 to $2.50 per bottle depending on the source; shelf life about 2 years, discard when normal gray color fades to red.

SOURCE: Austere Medical Care for Disaster. United States Public Health Service, 1964—D.13.8:M46/3.

drug habit. Your doctor may naturally be a little suspicious at first, and it will be up to you to dispel doubts. If your doctor hesitates, you might offer to accept a partial supply at first. You can bring the unopened bottles in at a later date, after you have made two or three routine office calls for check-ups, chest X-rays, and runny noses. Once trust is established, your doctor will be more inclined to assist you. In fact, it wouldn't hurt to talk a little about retreating in general. Who knows?

The third list of medicines (given in table 12) is the complete pharmaceutical list from the Packaged Disaster Hospital program. This is a list for doctors, not laymen, and consists of all the pharmaceuticals needed to run a 200-bed disaster relief hospital for one month. These supplies are specifically selected, storable pharmaceuticals appropriate to a disaster situation. I have included information on the minimum useful amount of each preparation to give you a lower limit, in case your group doesn't feel the need for 6,000 patient-days of supplies. In some cases, the lower limit is the unit package, while in others the minimum useful amount is that required for one full course of treatment. (One penicillin tablet isn't good for anything.)

Notice that this list is intended for the use of a physician in a hospital and contains many items which would not be useful in a remote refuge. Barium sulfate, for example, is of no use unless you have an X-ray •machine. Soda lime requires an anesthesia machine. I -have preserved the list in its entirety so that you (and your doctor) will know that nothing has been left out.

The Packaged Disaster Hospital list is about ten years old—it is not too outdated, but a few comments are in order. The clinical pharmacist who revised the list for me suggested that you include a supply of an aminoglycoside antibiotic (like Gentamicin) for Gram negative infections. This was as a partial substitute for chloramphenicol, an antibiotic on the list which is currently out of favor because of its dangerous side effects. Chloramphenicol is still useful for combating typhus and typhoid fever, both of which are "disaster" diseases, and it has a comparatively long shelf life. It should not be used on radiation victims, however, because it tends to injure bone marrow and may only aggravate the patient's problems. It would be a good idea to stock up on chloramphenicol anyway; three or four years after the war, it might be the only antibiotic on your shelf that is still potent.

If there will be infants in your retreat group (or if you contemplate taking in the children of refugees), it would be a good idea to include a sizable stock of powdered baby formula. Also, you should heavily overstock your "clinic" with antibiotics. Burn injuries and radiation sickness both require months of continuous antibiotic therapy for each patient. I would suggest a minimum of 100 daily doses per expected patient in addition to the standard supply.

This brings up a new problem. Where are you going to lay your hands on cases of antibiotics every year, as

TABLE 12
Packaged Disaster Hospital Supply List

HOSPITAL QUANTITY	MINIMUM AMOUNT	PRESCRIPTION	USED BY	YEARS OF SHELF LIFE	WHOLESALE PRICE
GROUP ONE: Store these items in a heated area (SO to 86°F).					
ASPIRIN TABLETS, USP: 0.324 Gm (5 gr), bottle of 1,000.					
36 bottles	100 tablets	No	Layman	Several	$2.50/bottle
ATROPINE SULFATE TABLETS, USP: Soluble, 0.4 mg (1/150 gr), bottle of 100 tablets.					
12 bottles	1 bottle	Yes	Doctor	Several	S1, 13/bottle
CHLORAMPHENICOL CAPSULES, USP: 0.23 Gm (4 gr), bottles of 100.					
6 bottles	28 capsules	Yes	Paramedic	5 years	$11.10/ bottle
CHLORPROMAZINE HC1 TABLETS, USP: 25 mg, sugar-coated, bottle of 100.					
8 bottles	1 bottle	Yes	Paramedic	3—5 years	$2.11/bottle
DIGITOXIN TABLETS, USP: 0.1 mg (1/600 gr), bottles of 100. (A good product is needed because of bioavailability problems.)					
12 bottles	I bottle	Yes	Paramedic	Several	$1.00/bottle
HYDROCORTIZONE TABLETS, USP: 20 mg. (1/3 gr), scored, bottle of 100.					
6 bottles	1 bottle	Yes	Paramedic	Several	$4.00/bottle
LUBRICANT, SURGICAL: 4-oz. tube, jelly.					
48 tubes	1 tube	No	Layman	Indefinite	$0.40/tube
PHENOBARBITAL TABLETS, USP: 32 mg. (1/2 gr), bottle of 100.					
264 bottles	1 bottle	Yes	Paramedic	Several	$0.70/bottle
PILOCARPINE HCI OPTHALMIC SOLUTION, 2.0%, 15cc bottle. (Physostigmine S04 ointment may be substituted.)					
12 bottles	1 bottle	Yes	Doctor	1 year	$1.45/bottle
POTASSIUM PENICILLIN G FOR INJECTION, BUFFERED, USP: 1,000,000 units per bottle.					
3,200 bottles	60 bottles	Yes	Paramedic	1—5 years	$0.55/bottle
POTASSIUM PENICILLIN G TABLETS, USP, BUFFERED: 250 units, bottles of 100. (250 mg, 400,000-unit tablets may be substituted.)					
24 bottles	28 tablets	Yes	Paramedic	Several	$1.90/bottle
SODIUM CHLORIDE/SODIUM BICARBONATE MIXTURE, 4.5-gm packet. (Will have to be specially made up: 3 Gm NaCl = 1.5 Gm bicarbonate.)					
1,500 packets	1 packet	No	Layman	Indefinite	(not known)
SODIUM DIPHENYLHYDANTOIN CAPSULES, USP: 100 mg(l'/, gr), bottles of 100 capsules. (Phenobarbital might be used instead but is not a direct substitute.)					
1 bottle	I bottle	Yes	Paramedic	Several	$2.15/bottle
SULFASOXAZOLE TABLETS, USP: 0.5Gm (7 1/2 gr), bottle of 1,000.					
12 bottles	28 tablets	Yes	Paramedic	2—5 years	$17.40/bottle
TETRACAINE HCI, USP: Spinal anesthesia, sterile, 20-mg ampul, box of 10 ampuls. (To be mixed with dextrose injection. Do not use if solution is dark or cloudy.)					
16 boxes	I box	Yes	Hospital	I —2 years	$10.00/box
TETRACAINE OPTHALMIC SOLUTION, USP: 0.5%, 15cc bottle, box of 12.					
6 bottles	1 bottle	Yes	Paramedic	1—2 years	$1.00/bottle
TETRACYCLINE HCI CAPSULES, USP: 0.25 Gm (4 gr), bottle of 100.					
40 bottles	28 capsules	Yes	Paramedic	2—5 years	$2.35/bottle
TETRACYCLINE HCI FOR INJECTION, USP: Powder, 0.5-Gm (7 1/2 gr) bottle.					
144 bottles	28 bottles	Yes	Hospital	2—5 (dry)	$2.35/bottle
TR1PELENNAM1NE HCI TABLETS, USP: 50 mg (3/4 gr), bottle of 1,000					
2 bottles	100 tablets	Yes	Paramedic	Several	$7.10/bottle

TABLE 12—Continued

HOSPITAL QUANTITY	MINIMUM AMOUNT	PRESCRIPTION	USED BY	YEARS OF SHELF LIFE	WHOLESALE PRICE
GROUP TWO: Store these items in a heated area (50 to 86°F.) Protect them from freezing temperatures.					
BENZALKONIUM CHLORIDE SOLUTION, USP: 17% concentrate, 4-oz. bottle. (It would be better to substitute an iodine disinfectant such as Betadinc.)					
96 bottles	1 bottle	No	Layman	Several	$0.50/bottle
CHLORPROMAZINE HC1 INJECTION, USP: 25 mg per ml, 2 ml, box of 6.					
8 boxes	1 box	Yes	Paramedic	3—5 years	$2.16/box
DEXTROSE INJECTION, USP: 10.0%, 3-ml ampul, box of 10. (Diluent for Tetracaine HC1.)					
16 boxes	I box	Yes	Hospital	1—2 years	$2.40/box
DIGOTOXIN INJECTION, USP: 0.25 mg (1/250 gr) per ml, 2-ml ampul, box of 12.					
12 boxes	10 ampuls	Yes	Doctor	1—2 years	$2.00/box
EPINEPHERINE INJECTION, USP: 1:1000, 1-ml ampul, box of 25. (Do not use after solution turns dark.)					
5 boxes	10 ampuls	Yes	Paramedic	I—2 years	$4.75/box
HYDROCORTISONE SODIUM SUCCINATE FOR INJECTION, USP, Sterile, equivalent to 100 mg of Hydrocortisone base, in mixing bottle with diluent.					
50 bottles	10 bottles	Yes	Paramedic	I—2 years	$2.40/bottle
LIDOCAINE HCI INJECTION, USP: 2.0%, 20-ml bottles.					
72 bottles	1 bottle	Yes	Paramedic	I—2 years	$0.70/bottle
PROMETHAZINE HCI INJECTION, USP: 25 mg (3/8 gr) per ml, 10-ml bottle.					
10 bottles	I bottle	Yes	Paramedic	2 -5 years	$2.10/bottle
SODIUM CHLORIDE INJECTION, USP: 5-ml ampul, box of 25. (Normal saline solution.)					
24 boxes	1 box	Yes	Paramedic	I—2 years	$6.25/box
SODIUM THIOPENTAL FOR INJECTION, USP: 5-Gm (75 gr) ampul, box of 25.					
2 boxes	1 box	Yes	Hospital	1 —2 years	$5.48/ampul
WATER FOR INJECTION, STERILE, USP: 5-ml ampul, box of 25.					
144 boxes	1 box	Yes	Paramedic	1—2 years	$7.50/box
GROUP THREE: Store these items in a refrigerator (35 to 46°F.) Protect them from freezing temperatures.					
INSULIN INJECTION, USP: 80 Units per ml, 10-ml bottle. (Some NPH or Lente insulin will also be needed.)					
50 bottles	I bottle	No	Paramedic	1 year	$3.20/bottle
PROCAINAMIDE HCI INJECTION, USP: 100 mg (I '/3 gr) per ml, 10-ml bottle. (Do not use after solution darkens. Hylocaine 2% could be substituted.)					
1 bottle	1 bottle	Yes	Paramedic	1—2 years	$2.63/bottle
TETANUS TOXOID, USP: 7.5-ml bottle.					
36 bottles	1 bottle	Yes	Paramedic	1 year	$2.90/bottle
GROUP FOUR: Store these items in a dry, covered area. Temperature is not critical.					
BARIUM SULFATE, USP: 10-lb. can. (For X-ray studies.)					
1 can	I can	No	Hospital	Indefinite	$26.00/can
ENTERAL FEEDING FORMULA: Nasogastric or oral, with feeding tube, 5-lb. can. (Sustagen.)					
144 cans	l can	No	Layman	1 year	$17.44/can
NITROUS OXIDE, USP: Filled size M cylinder, 2,000 gal.					
8 cylinders	1 cylinder	Yes	Hospital	Indefinite	$105.00/cyl.

TABLE 12— Continued

HOSPITAL QUANTITY	MINIMUM AMOUNT	PRESCRIPTION	USED BY	YEARS OF SHELF LIFE	WHOLESALE PRICE
OXYGEN, USP: Filled size M cylinder, 750 gal.				Indefinite	$l00.00/cyl.
20 cylinders	1 cylinder	No	Paramedic		
PETROLATUM, WHITE, USP: l-lb. can.				Indefinite	$1.05/can
12 cans	1 can	No	Layman		
SILVER NITRATE, USP: Crystals, l-oz. bottle. (For washing the eyes of newborn infants.)				Indefinite	$l.25/bottle
48 bottles	1 bottle	No	Layman		
SOAP, SURGICAL: 3% hexachlorophene, 5-oz. bottles (Phisohex).				Indefinite	$1.74/bottle
288 bottles	1 bottle	No	Layman		
SODA LIME, USP: 4—8 mesh, 5-lb. bottle. (For use with anesthesia machine.)				Indefinite	$19.05/bottle
12 bottles	1 bottle	No	Hospital		
GROUP FIVE: Store these items away from others in a fire-proof location.					
ALCOHOL, DENATURED: 23 H, 1-quart bottle.				Indefinite	$2.00/bottle
6 bottles	1 pint	No	Layman		
ETHER, USP: l/4-lb. can. (For Anesthesia.)				Indefinite	$2.33/can
480 cans	1 can	No	Hospital		
ISOPROPYL ALCOHOL, NF: 1-quart bottle.				Indefinite	$1.00/bottle
72 bottles	1 pint	No	Layman		

SOURCE: Therapeutic Guide for Pharmaceuticals in the Packaged Disaster Hospital, United States Public Health Service, 1969 HE 20.2013:C-1.

you may have to in order to keep your stockpile up to date? Unless one of the members of your retreat group owns a pharmacy and can arrange to enlarge inventory to suit your needs, there is only one workable possibility. You say "moo" and go to see a veterinarian.

About 90 percent of the items listed in table 12 can be obtained as veterinary medicines. These drugs are prominently labeled "not for human use," but in many cases they are exactly the same preparations used in hospitals. With the exception of certain drugs which are never used on humans, these veterinary medicines represent an easy way to build up an emergency drug stockpile.

My advice to a retreater is to stick to human medicines as much as possible, but to provide large stocks of veterinary antibiotics. Remember also that if you offer the medicine to a vet at a discount price three or four months before it expires, it will probably be bought back eagerly. That way the antibiotics aren't wasted and you can recover some of your invested money with which to buy new supplies. In turn, the veterinarian gets a discount source of drugs (a principle operating expense).

What about other medical supplies and equipment, such as bedpans, sutures, bandages, splints, and surgical instruments? In this area, virtually nothing is restricted except for hypodermic syringes and needles, which require a doctor's prescription in some states. Once again, a veterinary supply catalog-will have most of the unusual items, and your local discount drug store will have the rest. For a few items, like bedpans, you might have to resort to a surgical supply store.

Table 13 is a list of bandages and similar supplies from The Ship's Medicine Chest and First Aid at Sea, which I felt was sufficiently comprehensive to be included here. The other paramedical manuals specify stocks of supplies which would be inadequate for any retreat application; even this list is a little skimpy. If you would rather do your planning from a really complete list, you should see Packaged Disaster Hospital Component Listing and Storage Data.[17] This is the list of everything needed to run a 200-bed hospital for a month. It's more than anybody ought to need.

In looking over table 13, you should keep in mind that this is not a disaster list. It is more appropriate to industrial accidents. Some adjustments are therefore in order. (For one thing, a single "male" urinal will surely prove inadequate if any of your patients are females. Some of the small containers and labels for dispensing pills may not be necessary.) I suggest that this list would be roughly adequate for a party of five for one year in a nuclear war setting. It's a one-year supply for a party of ten otherwise.

If dental supplies are of concern to you, the best

TABLE 13
Medical Supplies from The Ship's Medicine Chest

Adhesive plaster, 1 inch by 5 yards spool	3
Adhesive plaster, 2 inch by 5 yards spool	3
Adhesive plaster, 3 inch by 5 yards spool	3
Applicator, wood 72 dozen per box	1 box
Bandage, cotton, elastic, 3-inch 12 in a box	1 box
Bandage, Esmarch triangular	6
Bandage, roll, gauze, 1-inch 12 in a box	2 boxes
Bandage, roll, gauze, 2-inch 12 in a box	4 boxes
Bandage, roll, gauze, 3 inch 12 in a box	4 boxes
Bandage, suspensory, with leg strap, small, medium and large size	2 each
Bandage, triangular, compressed	6
Basin, pus, 8-inch	2
Basin, wash, 12-inch	2
Bedpan, "relax" type	1
BOOK: *SHIP'S MEDICINE CHEST AND FIRST AID AT SEA*	1
Bottle, with screw cap 2-ounce and 6-ounce	1 dozen each
Catheter, soft rubber sizes 12F, 16F, 18F	1 each
Clinical record chart pad	3
Cotton, absorbent, sterilized ¼-lb. package	1 dozen
Cotton, absorbent, sterilized 1-lb. package	5
Crutch, adjustable, with rubber tip	1 pair
Dressing, adhesive strip, sterilized, 1 inch by 3 inch 100 per box	2 boxes
Drinking cup, paper 100 per box	2 boxes
Enema can (*see* Irrigator)	
Envelope, small, dispensing	500
Eyecup, glass	4
Feeding cup	2
Forceps, hemostatic, straight 6-inch	2
Forceps, splinter	1
Forceps, thumb, serrated 4½-inch and 6-inch	1 each
Gauze, plain, sterile, 36-inch 1-yard package	36 packages
Gauze compress, approximately 3 or 4 inches square, sterile, wrapped separately 25 per box	3 boxes
Hot-water bag	2
Ice bag, medium size	2
Irrigator can with handle, 2-qt., with complete fittings, including rectal tube	1
Labels, for prescription bottles, gummed, assorted (including plain, "Poison," "For External Use Only")	500
Ligature, catgut, 28-inch 12 in tube	6 tubes
Ligature, silk, braided or twisted, medium size 3 to a package	6 packages
Litter, Stokes	1
Medical log note book	2
Medicine dropper	12
Medicine glass, 1-ounce	6
Napkins, paper (mouth wipes), 2-ply, 9 by 10 inches 500 to a box	2 boxes
Needle, hypodermic, 1-inch, 24-gage (see p. 107)	1 dozen
Needle, surgical (*see* Suture)	
Ointment tin, 1-ounce	4 dozen
Safety pins, assorted sizes	3 cards
Salt tablet dispenser	6
Sanitary log blanks	150
Scalpel (surgical knife), No. 3 handle	2
Scalpel blades, No. 10 or No. 11 package of 6	1
Scissors, bandage	1
Scissors, surgical, 5½-inch	1
Sheet, waterproof, 45 by 72 inches	2
Splint, basswood, 18 by 3½ inches	1 dozen
Suture, catgut, No. 1, needle attached, in glass tube	6 tubes
Suture, catgut, No. 2, needle attached, in glass tube	6 tubes
Suture, dermal, medium size, with attached straight skin needle, in individual glass tube	6 tubes
Suture, dermal, medium size, with attached full curve skin needle, in individual glass tube	6 tubes
Syringe, hypodermic, 2-cc. (see p. 107)	2
Syringe, plungerless, 2-dram	1
Thermometer, oral	4
Thermometer, rectal	2
Tongue depressor, wood box of 500	1 box
Tourniquet	1
Urinal, male	1

SOURCE: The Ship's Medicine Chest and First Aid at Sea, United States Public Health Service, 1956—FS 2.29:9/3.

listing I have been able to find is in the United States Navy's Polar Manual, published by the United States Navy Medical School.[18] This manual lists expedition dental supplies as follows: dental mirror, probe, tweezers, excavators, filling instruments (mixing spatula and paste tamper), extracting forceps, hypodermic syringe, cement mixing papers (or slab), air syringe, zinc oxide and oil of cloves (for making temporary fillings), 2 percent lidocaine, 1:1000 epinepherine, absorbable hemostatic gauze, codeine, dental floss, sandpaper, formalin solution, fluoride paste (10 gm Kaolin, 10 gm NaF, 10cc glycerine), and Sansidine paste. These items are presumed to be in addition to a fully stocked expedition medical kit containing antibiotics and other drugs. Dentistry poses unique problems for the retreater. And what about glasses? What will you do during the attack or disaster if your eyeglasses are damaged or destroyed? Many retreaters face this question with resignation. Others overlook it entirely. Good eyesight is vital to your survival; you should take steps to be sure that it is not imperiled. Save old glasses when they are replaced by new prescriptions. The old prescriptions might not have been perfect for your vision, but in a pinch they will be better than nothing. Just put the old pairs in with your survival stockpile. Or, order an extra pair of glasses the next time you visit your optometrist. If you get caught without your glasses and desperately need clear vision, there is a temporary expedient you can try which usually works. You can manufacture a set of corrective "lenses" quickly and easily by punching pinholes in a sheet of aluminum foil. Hold the foil up near your eye and look through the holes. This sounds idiotic, but it works pretty well. The pinholes focus the incoming light on the retina of the eye. The image obtained isn't perfect, but it is an improvement.

Herbal Remedies

What do you do when the stockpile of medicines finally runs out? A partial answer lies in herbal medicine.

We are normally accustomed to talcing our medicine in the form of tablets, capsules, or syrups. Never having been treated with concoctions of leaves, berries, and bark, we tend to assume that such "natural" remedies do not work. This is not correct. About one quarter of the new prescriptions written in any particular year specify plant extracts of various kinds. Experienced field botanists can make respectable livings by collecting and selling wild medicinal plants to drug companies, where the plants are repackaged into "tiny time capsules" and similar single-dose containers. If you are ever really up against it, you can collect the plants and extract the medicinal ingredient yourself, usually in the form of

WARNING

Most medicinally useful plants derive their beneficial characteristics from mild doses of poisons. Establishing the correct dose of a medicinal tea can be extremely dangerous and difficult. The author and the publisher of this book can accept no responsibility for the actions of the reader in this regard.

Many "herbals" are being printed these days, too frequently written by those whose interest in the drugs is not medicinal. Two of the most reliable books I have seen are The Practical Encyclopedia of Natural Healing by Mark Bricklin (executive editor of PREVENTION magazine) and A Guide to Medicinal Plants of Appalachia, published by the United States Department of Agriculture Forest Service.[19] Both books list many other sources and give good, practical advice about plants found throughout the country.

If you become involved in the subject of herbal medicine in any great depth, you may find Charles F. Millspaugh's American Medicinal Plants useful.[20] This is a reprint of a medicinal plants manual prepared for physicians and pharmacists in 1892 which is over 800 pages long and is extremely detailed. The publishers have taken the trouble to update the botanical nomenclature, but unfortunately the medical information is a century out of date. Millspaugh presents "cures" for diseases that modern medicine doesn't believe in, and of course there is no information on preparing your own antibiotics. Still, if making your own medicines is important to you, this book will give you many recipes.

The Marshall Family Black Bag Home Health Care Kit, available from Marshall Electronics, Clayton Division, 7440 N. Long Avenue, Skokie, Illinois 60077.

Commentary

Table 14 is a summary of the many books reviewed in this chapter, arranged in a single list for quick reference. Even if you are totally cut off from medical aid, with these resources and some preparation you can meet most emergencies with confidence. You can begin now by handling your simple medical problems yourself (under a physician's guidance). You can stockpile a supply of medicines in case they become unavailable in an emergency. In a case of real desperation, you can even prepare to meet challenges which would normally require the attention of a skilled surgeon. It's mainly a matter of getting started now so you will be ready then.

TABLE 14
Summary of Medical Manuals for Survivalists

MANUAL	NOTES
American Medicinal Plants, Millspaugh [3]*	Herbal remedies; dated, but has detailed recipes.
Austere Medical Care in Disaster, US Public Health Service [1—2]	Official shelter manual.
A Barefoot Doctor's Manual, US Public Health Service [2—3]	Acupuncture and other Chinese techniques.
Emergency War Surgery, US Department of Defense [3]	Life-saving battlefield surgery.
First Aid for Soldiers, US Army [1—2]	Battlefield first aid.
Gray's Anatomy, Warwick and Williams, eds. [3]	Professional anatomy text.
A Guide to Medicinal Plants of Appalachia, USDA [1]	Herbal remedies.
How to Be Your Own Doctor (Sometimes), Sehnert [1—2]	Home health care.
Laboratory Section of the Packaged Disaster Hospital, US Public Health Service [2]	Laboratory tests for disasters.
Medical Handbook for Unconventional Operations, Kothe [2—3]	Good obstetrics and dentistry.
Medicine for Mountaineering, Wilkerson [2]	Assumes you're young and healthy; no obstetrics.
The Merck Manual of Diagnosis and Therapy, Merck Sharpe and Dohme Research Laboratory [3]	Covers nearly everything except surgery.
New American Medical Dictionary and Health Manual, Rothenberg [1]	Explains medical terms.
Packaged Disaster Hospital Component Listing and Storage Data, US Public Health Service [3]	Lists everything needed by an emergency hospital.
Polar Manual, US Navy Medical School [2]	Good dentistry section.
The Practical Encyclopedia of Natural Healing, Bricklin [1]	Herbal remedies.
The Ship's Medicine Chest and First Aid at Sea. US Public Health Service [2]	Comprehensive, but dated.
Therapeutic Guide to Pharmaceuticals for the Packaged Disaster Hospital, US Public Health Service [2]	Explains use of drugs.
The Well Body Book, Samuels and Bennet [1]	Good examination section, but is somewhat "mystical.
Where There Is No Doctor, Werner [2]	Comprehensive; Latin American context.

*Numbers following titles indicate level of difficulty; 1—elementary, 2—advanced, 3—professional.

Notes

1. Keith Sehnert, How to Be Your Own Doctor (Sometimes) (New York: Grosset & Dunlap, Inc., 1975).
2. Mike Samuels and Hal Bennett, The Well Body Book (New York: Random House, Inc., 1973).
3. Despite the similarity in names, I have no affiliation with this company or with any other firm mentioned in this book, with the exception of the publisher.
4. First Aid for Soldiers, United States Army Field Manual 21-11 —D101.20:21-11/4; also available from Normount Technical Publications (PO Drawer N-2, Wickenburg, Arizona 85358) under the title First Aid for Soldiers and Sportsmen.
5. Austere Medical Care for Disaster, United States Public Health Service, 1964—HE 20.2013:D-1. Or, Medical Care in Shelters, Office of Civil Defense, 1964 D l3.8:M46/3.
6. James A. Wilkerson, Medicine for Mountaineering (Seattle, Washington: The Mountaineers, 1967).
7. David Werner, Where There Is No Doctor (Palo Alto, California: The Hesperian Foundation, 1977).
8. The Ship's Medicine Chest and First Aid at Sea, United States Public Health Service, 1956—FS 2.29:9/3.
9. William C. Kothe, ed.. Medical Handbook for Unconventional Operations (Boulder, Colorado: Paladin Press, 1968).
10. A Barefoot Doctor's Manual, United States Public Health Service, 1975—HE 20.3708:B23.
11. The Merck Manual of Diagnosis and Therapy, 3rd ed. (West Point, Pennsylvania: Merck Sharpe and Dohme Research Laboratory, 1977).
12. Emergency War Surgery — Available from Supt. of Documents, Government Printing Office, Washington, DC 20402. Stock number - 008-000-00211-8. Catalog number - D 1.6:Su 7/975 Price: $7.10
13. Robert E. Rothenberg, The New American Medical Dictionary and Health Manual (New York: Signet, 1975).
14. Henry Gray, Gray's Anatomy, 35th ed., edited by Roger Warwick and Peter L. Williams (Philadelphia, Pennsylvania: W.B. Saunders Company, 1973).
15. Laboratory Section of the Packaged Disaster Hospital, United States Public Health Service, 1965—HE 30.2013:F-4.
16. Therapeutic Guide for Pharmaceuticals in the Packaged Disaster Hospital, United States Public Health Service, 1969 HE 20.2013:C-1.
17. Packaged Disaster Hospital Component Listing and Storage Data, United States Public Health Service, 1969—HE 20.2013:F-19.
18. Polar Manual (Bethesda, Maryland: United States Navy Medical School, n.d.). See also E. Joseph, "Dentistry for the Ship's Surgeon," British Medical Journal 24 March 1956, pp. 679-81.
19. Mark Bricklin, The Practical Encyclopedia of Natural Healing (Emmaus, Pennsylvania:
20. Charles F. Millspaugh, American Medicinal Plants (New York: Dover Publications, Inc., 1974). See also Kurt Saxon, Medicines Like Grandad Used to Make (Atlan Formularies, PO Box 438, Eureka, California 95501).

7
To Have and to Hold

AT ONE POINT or another almost everyone asks me a question like "But what do you do when outsiders try to barge in and steal your supplies or throw you out of your own shelter?" The answer is obvious. You either let them have their way, or you oppose them. If you feel morally compelled to share your supplies and survival equipment with all comers, you may do so. In that case you should skip straight to chapter 8. If not, you will need to give the subject of defense some serious thought.

There is one point which I want to make very clear before proceeding. This chapter is about defending a refuge. Any superficial resemblance to the militarism of right-wing private armies or left-wing revolutionary cadres apparent here is painfully regretted. Such groups use the same weapons and methods which I describe in this chapter, but this is due to the realities of combat and not to any similarities in philosophy. I have too many troubles already to allow readers and reviewers to classify me as a "hard-line anti-communist" or a "left-wing anarchist." (Both have happened in the past.) If readers intend to be prepared for a life-threatening calamity, they should give some thought to surviving a direct attack on their lives, too. One could easily bring about the other.

This chapter covers the problems and methods of defending your group, family, and property against the hostile attentions of outsiders. This is a unique subject in a book of civil defense techniques, simply because no government or humanitarian organization is capable of discussing it. If you try to envision the Red Cross telling you the best way to shoot people, you will see what I mean. One of the advantages of producing a book like this on a private basis is that one can say the things that disaster relief agencies regard as taboo.

The first question here is a moral one. Are you justified in refusing to share your supplies with a stranger in order to protect the lives of your family and friends? There is a pervasive humanitarian attitude that it is "noble" to sacrifice yourself and loved ones for a stranger. I do not agree with this point of view. I feel that I have a moral obligation to warn people of the troubled times ahead and show them how to prepare themselves, but once they have been warned, I feel no further obligation to them.

I prefer the moral lesson described in Aesop's fable of the grasshopper and the ant: All summer long the ant toiled to set aside enough food to last him through the winter, while the grasshopper sang merrily and ignored the ant's warnings of hard times to come. (This situation is familiar to all survivalists.) When winter came, the ant was comfortable and well fed, but the grasshopper was starving and cold. When Aesop has the grasshopper beg the ant for food, he is posing the exact moral dilemma which troubles retreaters. Should the person with foresight be obliged to succor the unprepared and foolish neighbor? Aesop said no. You may dance in the winter to the tune that you sang in the summer.

The next question is also a moral one. If you refuse to share your supplies on the grounds that you have only enough to save yourself and family, are you justified in using force to protect those supplies? I think you are fully justified. If the supplies are your only hope of survival, anyone who attempts to steal or sabotage those supplies is attempting to murder you and your family. The principle of self-defense clearly applies. If someone is trying to kill you, you are morally justified in resisting to the utmost.

I will presume in this chapter that you are a person who has taken every reasonable step to be prepared for disaster, and that you will make every effort to avoid trouble when times get bad. If you do get into a fight, therefore, you will be in a morally justifiable position, and I will not have to concern myself with whether or not it is right for you to fight. I'll stick to the much simpler question of how you should go about it.

Selecting Your Defense Arsenal

To help you get oriented to the world of defensive firearms, I have prepared a discussion of four weapons which you will want to acquire for your arsenal. I say "arsenal" because you will find that one thing inevitably leads to another. Once you decide to defend yourself, you discover that you are committed to prepare properly. Otherwise, there is no point in preparing at all.

I formed my own ideas of what constitutes a basic arsenal for a survivalist some time ago, and was then pleasantly surprised to find that most other retreat planners had come to the same conclusions. There isn't much room for latitude. The realities of combat and the commercial availability of weapons forces everyone into essentially the same mold. For a "proper" assortment of defensive firearms, each member of your group should be equipped with a military assault rifle, a reliable combat pistol, and a 12-gauge riotgun. This assortment represents the basic defense "tool kit" needed for resisting an attack on your refuge.

Before I discuss actual hardware, there are several philosophical and practical points to make. First, most firearms are not weapons, strictly speaking. They are sporting equipment. Let me make my point clearer by analogy. Although we all recognize that a baseball bat can be used as a club, we also realize that a bat is neither designed nor intended for such use, and therefore is not a weapon. Similarly, a firearm designed for putting holes in a paper target can be lethal, but it is not a weapon either.

Yes, you could shoot and kill a person with such a firearm, but that is not the point. As a survivalist defending the lives of your loved ones, you are not "shooting to kill." You are shooting to live. Although all firearms have the ability to take a person's life, only a few have been designed to save lives.

I am referring to firearms designed to fire man-stopping bullets; to shoot time after time without jamming; to stand up to misuse and mishandling; to require a minimum of skill for effective use; to minimize the time spent in reloading; and to provide the penetration, range, and accuracy needed for combat. Out of the total range of firearms available, only a few meet all of these criteria. These are the military assault rifles.

An assault rifle is a wicked-looking black steel and plastic weapon intended only for combat. It can be operated successfully with a minimum of training and a maximum of confidence. It will keep firing reliably even under circumstances where a sporting rifle would overheat and malfunction. This is how it saves your life—by continuing to fire when a jam or a delay in reloading would be fatal. In my opinion, the question of which assault rifle you should buy isn't nearly as important as the fact that you must get one. Otherwise, your "defense" will be a noisy version of suicide.

In preparing this chapter, I sought the advice of several experts; after comparing their comments I have decided to discuss only four weapons. Although there is a wide selection of apparently adequate defensive firearms, most have hidden flaws which make them undependable or inappropriate for survivalist use. Fortunately, there is one heavy assault rifle, one light assault rifle, one combat pistol, and one combat shotgun of which most survivalists approve. I suggest that you confine your shopping to these weapons. They will do the job—many of the others won't.

First on the list is the Heckler & Koch HK91. This is a heavy assault rifle which fires the 7.62 NATO cartridge, a standard United States military caliber. Many survivalists regard the HK91 as absolutely the best defensive firearm available. This rifle will fire time after time for hours or days on end without jamming. It is so reliable that deliberate attempts to jam it usually fail. It is also extremely rugged and amazingly accurate. Mel Tappan (the survivalist gun guru) has reported 100-yard three-shot groups as small as 3/8 inch with this rifle. This figure represents a center-to-center variation in point of impact only slightly larger than the diameter of the bullet. (Most combat rifles are doing well to make two-inch groups at 100 yards.) In skilled hands the HK91 has an effective range of 1,000 yards, about half a mile. The 7.62 NATO cartridge is powerful enough to penetrate trees, car bodies, and brick walls with enough energy left over to do lethal damage to an attacker on the far side. The rifle can be purchased with a convenient collapsible stock, if desired, and costs between 400 and 550 dollars, depending on the exact model and the dealer.

The second rifle on the list is the Armalite AR-180, a light assault rifle which fires the standard United States military 5.56mm round. Compared to the HK.91, the AR-180 is smaller, lighter, less powerful, and less accurate. Its effective range is 450 yards, but there is some question about the man-stopping qualities of the bullet beyond 150 yards. If you are shooting the AR-180, the guy on the far side of the tree will be relatively safe. On the other hand, this assault rifle is easy for an inexperienced person to shoot because of its light weight and almost total lack of recoil. It is also less expensive than the HK91, selling for 270 to 350 dollars in most gun stores. The AR-180 comes with an integral folding stock.

The third recommended weapon is the Colt Government Model Mark IV .45 caliber automatic pistol, or one of its Colt variants. This model has been in service with the United States Army for seventy years and is the favored pistol of most combat-shooting hobbyists. The reader should understand that pistols in general are under-powered, unreliable, inaccurate, and difficult to shoot. This situation encourages gun buffs to

The Heckler and Koch HK91 heavy assault rifle.

The Remington 870 "Brushmaster" 12-gauge shotgun, configured for combat. This version of the 870 is designed for rifled slugs and buckshot, and has adjustable rifle sights. Note the Choate folding stock, pistol grip, magazine extension, and sling. (Choate Machine and Tool Co., PO Box 218-FA Div., Bald Knob, Arkansas 72010.)

The Armalite AR-180 light assault rifle. Note the telescopic sights and the thirty-round magazine.

indulge in endless arguments about which gun is "best" for defense. There really isn't a "best" pistol for defense. If you want the "best," you get a rifle. A pistol is a self-defense first-aid kit which you carry when you want to be armed but it isn't convenient to carry your rifle (i.e., when you are on top of a ladder washing fallout off the barn roof). The pistol also serves as a second line of defense in case the rifle jams or runs out of ammunition. It is not a primary weapon—but it is indispensable. The Colt automatic is one of the few pistols for which there is any general approval. Learn to shoot it skillfully and it will save your life in situations where you would otherwise be caught unarmed. It costs about 250 dollars.

Finally, the fourth weapon on the list is the Remington 870 12-gauge riot shotgun. Survivalists equip themselves with shotguns for special situations, such as close-range confrontations with mobs, night fighting (when aiming is difficult), and firing from a moving vehicle. In these situations the massive firepower and spreading pattern of a shotgun blast is likely to be more effective than single shots from a rifle or pistol. The Remington 870 is a pump gun which, when loaded with eight 2 3/4-inch magnum number 4 buckshot shells, can launch 240 pellets in as little as 2.5 seconds. No other kind of firearm even comes close to a shotgun for putting lead into the air. On a pellet-for-bullet basis, a riotgun is the equivalent of ten typical submachine guns. Once again, be warned. There are many kinds of shotguns on the market, but the Remington 870 is the only one which all of my reviewers, including Mel Tappan, agreed would do the job. The Remington 870 costs in the vicinity of 175 to 225 dollars, depending on the model and the dealer.

The number of weapons to acquire and what order to acquire them in are matters left largely to the individual's judgment. Among survivalists the general rule is to

The Colt Commander .45 autopistol, one of the acceptable variants on the basic Colt design. This one has been customized for reliable operation in combat. Note the Pachmayr grips, the flat mainspring housing, the oversized slide release and safety levers, the King-Tappan fixed combat sights, and the long National Match trigger. Internal modifications (ramping, throating, and trigger job) were also performed. (Customizing by B&B Sales, North Hollywood, California.)

have one assault rifle and one pistol for each responsible adult in the group or family. Some people go a little farther and buy one spare rifle and pistol for each couple. One riotgun per couple seems to be fairly representative. As for the order of acquisition, it would be ideal (but expensive) to purchase all the weapons at once. Failing that, it is best to start with the assault rifles, purchasing the riotgun and pistols as finances allow. Persons severely restricted by budgetary limits buy the shotgun first because it is versatile and least expensive. Then they buy their rifles, and finally, their pistols.

Firearm Accessories

The selection of a proper assortment of accessories for your firearms is extremely important, especially because it is a side of defense preparation which is not immediately apparent.[1] If you do not allow for these accessories in your planning, they can bankrupt your defense fund very quickly.

For an assault rifle, the first essential accessories are extra magazines. Most assault rifles come with a single five-round magazine. This is the only size that can be used for legal hunting, but it is utterly useless for defense. You will need an assortment of twenty- or thirty-round magazines which hold 150 to 200 cartridges in total. The exact number isn't critical. Various experts recommend anywhere from 90 to 250 cartridges in magazines for each rifle. My preference with a light assault rifle is to keep one twenty-round magazine in the rifle, four more twenty-round magazines in a belt pouch, and three thirty-round magazines in a second belt pouch. That gives me 190 shots before I have to reload a magazine. This represents the maximum number of 5.56mm magazines it is convenient to carry. More aren't really necessary. Unless you are shooting like a maniac or are very heavily pressed, you can't fire this many shots without (1) having a chance to reload magazines, (2) having a chance to flee, (3) winning the fight, or (4) getting killed. If you are firing wildly in undisciplined bursts, you deserve to run out. If you are so hard pressed that you can't reload and can't escape, you'll be dead before you run out of ammo anyway. Don't worry about it. (You'll have to pay 100 to 200 dollars for a full set of rifle magazines.)

After you get your magazines, you will need a supply of stripper clips and several clip guides. Stripper clips are inexpensive little tin devices which hold ten cartridges in a neat, uniform row. When used with a clip guide, stripper clips help you reload an empty magazine wry quickly. Although it may take a frantic, fumbling person as much as a minute to refill a twenty-round magazine by hand, with the clips the same task can be completed in less than five seconds. The "guides" are essential to the process since they mate the clips to the magazines during reloading. The clips usually cost about 20 cents for a ten-round clip, and the guides run about 80 cents each. It is best to store your entire ammunition supply in clips, and you should also have two or three guides for each rifle. They're easy to mislay.

If your defense will be conducted where targets more than 100 yards away are a possibility, a telescopic sight will be a significant aid to you. But first you will have to order a special scope base (or "mount") for your assault rifle. These cost from 30 to 200 dollars. It is very important that the scope base does not block your view of the iron sights and that the base be quickly detachable. If somebody starts shooting and you dive into the nearest ditch head-first, you may bend that expensive scope into a pretzel. It is essential for your survival that you be able to shift to the iron sights with a minimum of delay.

For combat applications you need a short, rugged scope with about 4X magnification. Some people get variable power scopes (3X to 9X) but these really aren't necessary. Just don't make the error of getting a 9X fixed-power scope or some similar high-magnification device. Powerful scopes add marginally to your accuracy, but they greatly increase the amount of time you spend trying to find the target through the scope. When the "target" is shooting back, it is better to employ a less powerful scope with a wider field of view. Such a scope may cost you anywhere from 50 to 650 dollars, depending on the model you choose.[2]

Once you have installed your telescopic sight, you will immediately appreciate the utility of a bipod. This is a simple two-legged support which snaps on the end of the rifle and holds it steady while you squint through the scope. It will cost you about 15 dollars for the AR-180, or about 100 dollars for the HK91.

Many "civilian" assault rifles come with a bayonet mount as standard equipment (an odd kind of thing to find on a rifle supposedly being marketed for hunting or target shooting). It would be difficult to think of a situation in which a survivalist would need a bayonet without invoking absurdly unlikely possibilities. In war it sometimes happens that both sides run out of ammunition before the battle is over, and bayonets are brought into play. This isn't likely to happen to survivalists. Anybody who runs short of ammo while attacking you is going to withdraw, not fix bayonets and charge. If you run out of bullets, the bad guys will simply shoot you. No chance for bayonet work there.

There is another problem with bayonets. Light assault rifles are not designed for the stresses of bayonet combat. A rifle with a broken stock and a bent barrel will not add much to your survival potential. If you feel that you must have one, however, the bayonet for the AR-180 costs from 15 to 30 dollars; that for the HK91 costs about 70 dollars.

Don't forget to get a cleaning kit for your rifle.

Commercial kits costing 5 to 10 dollars include cleaning rods, bore brushes, solvent, oil, and patches, all of which are essential to routine maintenance. You should also lay in stocks of oil, solvent, and patches in large quantities against the possibility of lean times ahead. As for cleaning your rifle, there is some difference of opinion about how often to do it. In the days of corrosive primers, firearms had to be cleaned thoroughly after each use or they became rusty junk in a short time. Modern non-corrosive primers do not present this problem, and although the rifles do need to be cleaned once in a while, the primary threat to the longevity of the rifle barrel is that you may clean it too often. You will have to strike your own balance in this matter.

The last accessory you may wish to obtain is a spare parts kit for your rifle. I doubt that you will be able to wear out your rifle in actual combat, but you might "burn up" a barrel by firing too fast or lose a vital piece while cleaning it. A spare parts kit for an assault rifle should contain an extra barrel, firing pin, extractor, both front and back iron sights, and a full selection of springs. An assortment of miscellaneous tiny pins, screws, and other "losable" parts should also be included. Don't forget to acquire a field manual or training manual appropriate to the weapon. The "exploded" diagrams in such manuals are very useful when reassembling a gun from pieces. Also, for a survivalist it would be wise to get a good gunsmithing book or two and a selection of special tools required for minimum maintenance and repair in the field.

Suppose you have purchased a full set of accessories for your rifle. Spread them all out on the livingroom floor and take stock. There should be seven to ten magazines, a telescopic sight, a bipod, maybe twenty stripper clips full of ammo, two or three clip guides, a cleaning kit, and perhaps even a bayonet. (We'll ignore the rest of the ammo and the spare parts kit for now.) Now here is the challenge: With your rifle in your right hand, pick up the accessories in your left hand and run out of the room, as if someone were shooting at you. Impossible, right? The accessories form a collection of thirty to forty separate items—far too many to carry in your hands or pockets. Fortunately, the military solved this problem long ago, and for 20 to 40 dollars you can obtain a surplus infantryman's pistol belt, suspenders, fanny pack, bipod holder, bayonet scabbard, and magazine pouches. The cleaning kit fits in a special compartment of the bipod holder, and the fanny pack holds your clips of extra ammo, as well as your scope. You can even hang a canteen on the belt. (Don't make the mistake of thinking this is a paramilitary attempt to "dress up and play soldier." Your rifle's accessories won't do you much good if you have to leave them behind or rummage around in a paper bag to find them while under attack.)

An important word of advice about how to arrange the pouches on the pistol belt: Don't put anything up in front next to the buckle. You frequently see thirty-round magazine pouches hung right in front; this is a terrible mistake. When you throw yourself flat on your face (as you might have to do someday), the magazine pouches swing out into a very awkward position. The effect is like landing on two upturned bricks. If you get lucky, the pouches don't swing out as you dive. Instead, they catch you sideways—in the groin. Attach them to the belt along the sides of the body, at least as far around as the hipbone on either side.

For the Colt .45 automatic pistol, it is wise to have enough extra magazines to hold fifty or more rounds of ammunition, as well as a cleaning kit, a spare parts kit, and a holster. Getting the right holster is so important that you really ought to buy three holsters for each pistol. One should have a big wrap-around flap to protect the gun from rain, snow, or mud, if necessary. Another should be designed for speedy access, a useful attribute when circumstances require it. The third should be a shoulder holster which hangs the gun under your left arm, where it will not interfere with using a rifle or shotgun.

This consideration is more important than it might appear at first, since most people don't wear the pistol while practicing with a rifle. If you try doing both at once, you may find that you are always banging one weapon against the other. When the rifle is slung over your right shoulder, getting it off in a hurry cart be an awkward and tangled business if there is a big holstered pistol hanging on your right hip. Better to have the holster under your left arm in this case.

There are about forty custom modifications which people perform on the Colt .45 autopistol, most of which are appreciated only by the true pistolero. The pistol should be taken to a gunsmith to be throated and ramped, which means a little grinding here and there to help the pistol feed recalcitrant cartridges more reliably. This is a standard modification which nearly everyone regards as routine. It is also worthwhile to have the trigger worked on at the same time. I prefer to replace the standard trigger with the longer National Match trigger, which has a built-in adjustable stop to prevent overtravel. The pistol illustrated here has had several external modifications as well. It has Pachmayr neoprene grips and a special flat mainspring cover, both of which aid the shooter in keeping a tight grip on the pistol. Oversized safety and slide-release levers make operation of the weapon more positive under the pressures of combat. Finally, the standard iron sights have been replaced with highly visible King-Tappan combat sights, which I find exceptionally helpful.[3] Total cost of all modifications was under 100 dollars.

Shotguns do not require the range of accessories that rifles and pistols do, but there are a few accessories for the Remington 870 which are well worth having. The Choate Machine and Tool Company manufactures several 870 accessories, chief of which are a folding stock with pistol grip, an eight-shot magazine tube extender, and a very convenient sling (with hardware). They also make a device which holds a flashlight parallel to the barrel of the gun. (That's great for nocturnal hunting and pest elimination, but suicidal in night combat.) Don't overlook the fact that you'll need some kind of pouch or bandoleer to carry extra shells, too. Shotshells are heavy and bulky, and you will want to carry forty or fifty, minimum, when the shooting starts.

Ammunition Supply

The quantity of ammunition you will need for each firearm will depend on the nature of the gun, its intended use, and your expectations about the severity of the troubled times ahead. Someone who carries a pistol in the street for personal defense is usually content with little more than the number of cartridges contained within the gun. On the other hand, a retreat group of fifty people preparing for a major catastrophe might feel the need for hundreds of thousands of rounds of ammunition. What kind of general guidelines can we establish for planning purposes?

I have previously said that 150 to 200 rounds in magazines is about the maximum one individual with an assault rifle is likely to need in a single fire fight. If you are deliberately aiming your shots, it is difficult to imagine how you could expend more than 1,000 rounds before becoming a casualty yourself. I tend to take the 1,000-round supply as the basic, minimum quantity of ammunition which should be stored for each assault rifle. For a group anticipating a prolonged period of anarchy, five to ten times this amount of ammunition might eventually prove useful, but the probability of any one person being able to expend it all in combat is very small. Remember, too, that any member of your group who becomes a casualty will supply the rest of you with ammunition. (So will casualties from the opposing side, if you win.) Just don't get into the endless mire of always wanting a little more ammunition than you have. You have to draw the line someplace.

You don't need as large a stockpile for a pistol as for an assault rifle, because you won't live as long if you are depending on a pistol in a battle situation. Fifty rounds ifo magazines and another 300 in boxes is about the limit. (That's 3,000 rounds for the extended-anarchy people, although how they intend to use it up, I don't know.) You'll need a few additional boxes for periodic testing, sighting-in, and similar purposes.

If you envision raking the landscape with shotgun fire, you should lay in 1,000 rounds or more for each gun. If the role of the shotgun in your defense will be confined to close-quarters kill-or-be-killed action, much less ammunition is needed. In that case, 200 combat rounds per gun is more than enough. That number represents about forty successful face-to-face shootouts before you run out of shells. If you seriously expect to survive more than 40 such duels, you're a better man than I am—or you're an incurable optimist.

Training

Individual combat training is a very complex and sophisticated process, one which very few people would be willing to undergo "just in case." There are a few elements of this training, however, which are absolutely essential. If you really expect the firearms to do the job, you must learn to use them effectively. This implies a basic familiarity with the weapons at the very least.

Your most minimal training goal should be to teach your group members the fundamental skills they will need to load cartridges into a magazine, seat the magazine in the weapon, advance a round into the chamber, release the safety, fire the round, remove the magazine, check for a live round in the chamber, and extract it. A person who cannot perform these procedures is dangerous, as well as totally ineffective as a defender.

To develop practical shooting skills, nothing will do quite as well as Finding a good teacher. The first-class route is to enroll in one of Jeff Cooper's courses at the American Pistol Institute.[4] Failing that, inquire at your local gun club. If that doesn't work out, either, there are many shooting books in print which may help. In this regard, be sure to see the catalog from Paladin Press, which contains many titles on sniping, combat training, and weaponry.[5]

Defense of a Fixed Position

The defense of a fixed position is a difficult topic to approach with any certainty. The difficulty increases because there is no way to anticipate what kind of force may attack you. The situation most survivalists seem to fear is that during a crisis, a desperate mob or a gang of cutthroats will hear of the food stockpile and come after it. There is also the unlovely possibility of attack to obtain women (for this there is ample historical precedent) or confrontation out of general meanness. Having the guns and ammunition is just the beginning of being ready to resist such an attack.

By far the best way to win a fight is to avoid it altogether. If nobody knows about your food stockpile, nobody will be making plans to steal it. (You might still be vulnerable to systematic looting, but if a gang of desperate refugees starts ransacking every house on your street, you should have ample warning before they get to you.) This principle is called "security of information." Before the disaster your special equipment should remain well-hidden, and after the event you should do nothing to call attention to yourself. During periods of famine, a well-fed person has either been hoarding food or has been indulging in cannibalism. Either way, it's bad if rumors start to spread.

Security of information also involves guarding your defenses. Never show your defense preparations to anyone who doesn't have a direct need to know about them. One untrustworthy person visiting your refuge could carry away vital information about your strengths and weaknesses. Sadly, it is common for a survivalist to encounter people who have prepared for disaster by buying thousands of dollars worth of guns and ammunition—but no food. The implication is obvious. Be very careful when you share your secrets.

After you have taken care of the security of information angle, you will need to carefully plan the conduct of your defense. Military manuals will be of some help, but remember that as a survivalist your goals are not the same as those of an army. Military planning tends to be based on the concept of "acceptable losses." How many members of your family are you willing to regard as acceptable losses? How many close friends? Your goal as a survivalist must be defense with zero casualties (on your side, at least).

The second point where your methods will have to differ from standard military practice is in the "chain of command." Survivalists tend to be very independent, and expecting them to unquestioningly obey "orders" given by some arbitrarily designated "commander" is plainly unrealistic. Soldiers submit to such arrangements because they know they will be shot by a firing squad if they refuse, but individual armed survivalists are not likely to conform to that same mold. Your military leader will not be able to sit back and direct the fight from some safe bunker. The group must be led by example, with the commander out in the worst of it, or you won't have any defense.

The third way in which your plans will have to differ from the military pattern is in the goal of your activity. Holding your tactical position is the only purpose of your defense. You will not be trying to slow down the enemy advance; you will have to hold your position without any chance of retreat, reinforcement, or surrender. The unique circumstances of survivalist defense simplify the situation to a very elementary level: You win or you die.

With these philosophical preliminaries out of the way, let's get down to the practical steps to take in planning your defense. A typical infantry attack of a fixed position (such as a machine gun nest) consists of the attackers dividing into two or more groups (see figure 32). One group creeps forward while the rest of the attackers fire heavily into your position. They don't really intend to shoot you at this point, but are trying to

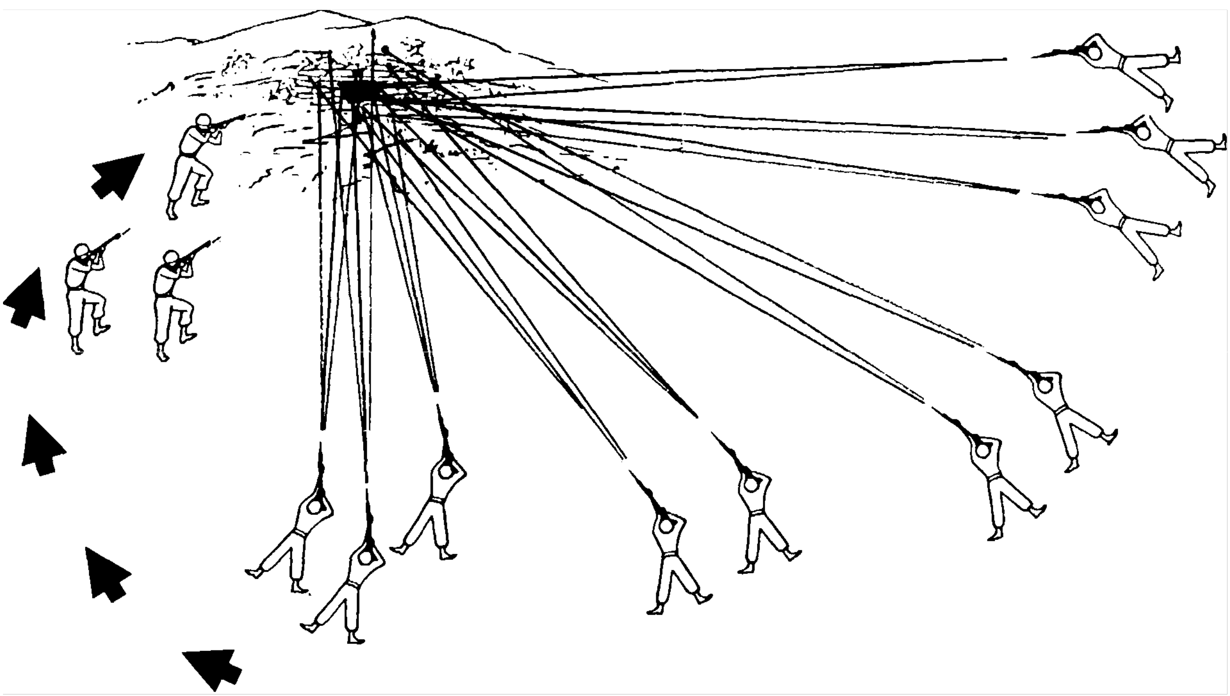


FIGURE 32: Classic assault of an isolated military outpost. One attacking group forces the defenders to keep their heads down while a second group attacks from very short range.

force you to keep your head down. (That way the creeps in the grass can crawl up close without getting shot for their trouble.) When the advance party reaches good cover near your position, they start shooting and keep you pinned down while the rest of the attackers advance. In this manner, the whole attacking band can crawl right up to your door. Then, while several attackers keep you busy by shooting at you, the rest suddenly rush you. A very brief and very fatal close-quarters fight follows. That's the approach you have to be able to frustrate. The first thing to do is to go out to the actual site you plan to defend and take a good look at it. Walk all around and be sure to get a worm's eye view of all the angles. Locate every possible area of concealment. Get a large-scale topographic map and plot out every feature that could hide a prone person. Systematically examine every patch of trees, every bush, each rise and dip in the ground. Check ditches, road banks, buildings, haystacks, deeply furrowed fields, flower beds, and anything else which might hide attackers from your view. Plot all such areas on your map. Then go back and double-check the areas which seem to offer no concealment. Look at them through the sights of your rifle while tying flat on the ground. Sometimes very slight changes in elevation can create areas of "dead ground" where attackers will be invisible from your position.

Now it is time to plot the position of all obstacles. Is there anything out there which restricts the movements of someone who is trying to sneak up on you? Are there any steep hills, cliffs, deep ravines, bramble patches, rose hedges, large streams, or overgrown thickets? Plot these obstacles on the map along with the areas of concealment. (Use two different colors.)

Draw a circle on your map, centered on your defensive position, with a radius of 1,500 yards. This represents the absolute maximum distance at which a skilled sniper is likely to be a serious threat. Draw another circle (with the same center), representing the maximum range of your rifles (450 or 1,000 yards for light and heavy assault rifles, respectively). Take a good, long look at the map and ask yourself two questions: First, is there anywhere within the 1,500-yard circle where someone might be able to shoot at you, but you wouldn't be able to shoot back? If there is, you will need to think about a contingency plan to deal with this problem. The solution might be as simple as buying one or two long-range rifles. At the very least, you will want to keep an eye on these possible sniper locations while trouble is brewing.

The second question concerns how the areas of concealment and 1he obstacles around your position combine to create corridors through which attackers will be channeled as they approach you. Perhaps a narrow ravine crosses your property. Attackers could crawl up the ravine and get near your house without being seen. Even discontinuous areas of concealment may link up in unexpected ways at dusk and after dark. (At sunset or sunrise, an attacker might cross an open area by staying directly in front of the sun. It is very hard to see a figure in the shadows when you have to look right at the sun in order to do so.)

Once you have identified the natural corridors approaching your position, you can begin to plan your defense. Your planning should concentrate on finding ways to block the approach corridors and ways to use the corridors as traps.

To seal off corridors, three methods can be used. The first is to remove the cover that allows the enemy to approach unseen. You might cut down a few trees or open up a thicket here and there. You might have to replace a board fence with one made of chain link or barbed wire. Deep shadows can be dispelled by eliminating the object that casts them or by lighting the area artificially. Maybe the dark side of the barn could use a coat of light paint. Most people won't want to bulldoze a no-man's land around their homesteads, but anyone can remove some of the unessential cover.

The second way to close a corridor is to obstruct it with a barrier. That ravine I mentioned earlier might better serve the ranch as a pond. A wild rose thicket or cactus patch can be planted across a line of approach. A barbed-wire or chain-link fence forms a very effective barrier. Even though such obstacles can be defeated, you can arrange things so attackers must expose themselves or set off an alarm to do so. A few rolls of barbed wire strung concertina-fashion can be set up quickly at critical points. Concertina-wire barriers are cheap and very formidable when properly arranged.

While you are setting up barriers, you might give some thought to blocking the driveway or road that leads to your property. That way no one can come speeding up and penetrate your defenses by surprise. The Cableguard barrier gate, an inexpensive steel cable barrier which can be installed between two moderately large trees in about an hour, may be of use to you in this situation.[6] This cable forms a padlocked gate which you can open at any time, but which is extremely difficult to force or defeat.

The third way to close an approach corridor is simply to bring it into your field of fire. With modern rifles it is not necessary to stand on top of an object in order to defend it. After looking at your map of approach corridors, you might discover that the best way to protect your house will be to conduct the defense from a different part of the property. It might be better to establish a stronghold on the hill behind the house, for instance. You should especially consider the possibility of spreading your defenders around in two or three locations. Three fortified positions with mutually supporting fields of fire can be extremely difficult to assault.

As for setting a trap, once you have identified the approach corridors, your trap is half set already. The trick is to conceal the fact that a particular corridor has been brought under your field of fire. Returning once more to the imaginary ravine which crosses your property, you might decide not to obstruct it, but to leave it as an inviting line of approach. The trap consists of setting up a well-hidden outpost from which your defenders can fire down the length of the ravine. If your defenders hold their fire until the attackers have crawled well up the ravine, very few of the interlopers will escape. The battle will be very brief and very one-sided. That's the way you want it.

When you are arranging your defenses, remember that cover from sight is worth more than cover from bullets. (If the bad guys can't see you, they can't shoot at you.) You will be safe, and they will be wasting ammunition on every tree and bush in the neighborhood.

If you will be shooting from an unconcealed position (such as a house), head cover and loopholes will be vital to your success. Trying to shoot through a window or door is suicidal, in spite of the countless examples of it seen on television. A wall of sandbags arranged to allow you to fire without exposing more than a tiny amount of your face is the only prudent course. Even better is to make more loopholes than you need, and then avoid the really conspicuous ones. Let the attackers waste their ammunition and attention on fake targets. While they are plinking away at the obvious loopholes, you can be firing back from unobvious ones. To see how well-concealed these loopholes really are, you will have to view them from the enemy's position well in advance of the fight. Remember that what is hidden at one time of the day may be very plain at other times.

A word of caution: Be sure that your "bulletproof barriers are truly capable of stopping bullets. If they won't do the job, they are worse than useless since they show the attackers exactly where you are and give them a good target to concentrate on. Barricades intended to be bulletproof can easily be tested. (See table 15 for the suggested bullet-stopping thickness of common rampart materials.)

Although it hampers your style a little, there is a fairly secure way to shoot at attackers from within a house. Since your goal is zero casualties, you may find this useful. The technique involves using sandbags to build a small fort, complete with loopholes, set back about eight feet from the exterior wall of the house (see figures 33 and 34). You keep the interior of the house as dark as possible and fire at the attackers from within this bulletproof nest. In this way you can shoot through door and window openings (and through specially cut loopholes in the external walls), but the attackers can't see the loophole you are firing from. The probability that one of their bullets will find the loophole in your hidden internal fort is very low. The trade off is that your view (and field of fire) is restricted by this technique, but defenders occupying several mutually supporting positions can sacrifice a little flexibility for greatly increased security. As long as somebody can keep an eye on each approach corridor, the defense will be tight.[7]

TABLE 15

Safe Thicknesses for Bulletproof Barriers

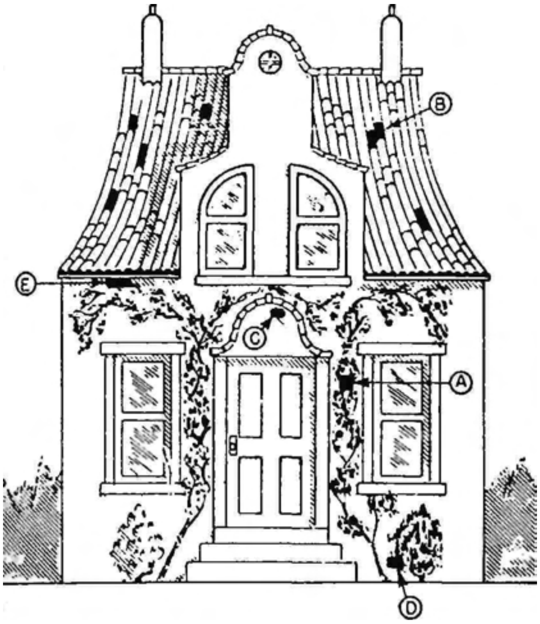
Reprinted from F.S.P.B. Pamphlet No. 4, 1939, page 19. Amendment 1 (December, 1940) by permission of the Controller of H.M. Stationery Office.

MATERIAL	NORMAL FIELD DEFENCES. Safe thickness in inches at 100 yds. against (a) S.A.A. up to 7.92 mm. (bursts of 5 rounds L.A. fire or single shots A.P.); (b) bomb splinters	DEFENCE AGAINST A.TK. WEAPONS. Safe thickness in inches at 100 yds. against light A.Tk. weapons to 10 mm.	REMARKS.
(1)	(2)	(3)	(4)
1. Brickwork in lime mortar	13½	27	Good quality brick.
2. Brick rubble confined between 1 in. boards	12		
3. Chalk loose, as in new parapets	24		Consolidation decreases protection.
4. Clay loose as in new parapets	36		Much depends on type of clay. Good factor of safety is allowed here.
5. Coal (hard), confined between boards	13		Unsatisfactory owing to pulverizing effect of bullets.
6. Coal (kitchen), ditto	18		
7. Concrete, reinforced	6	15	
8. Earth or loam as in parapets	36	60	
9. Road metal, 1½ in. to 2 in. between 1 in. boards	9		
10. Sand between 1 in. boards	12		
11. Sand, loose	24	48	Protection given by coarse sea sand is considerably greater.
12. Sandbags filled with—			Thicknesses are the lowest multiples of sandbag dimensions to give the required protection.
Brick rubble	20		
Chalk ...	20		
Clay ...	30		
Earth ...	30	60	
Road metal ...	10		
Shingle up to 1 in.	20	30	
Sand ...	20	40	
13. Shingle or broken stones between 1 in. boards	9		

Defense of Moving Vehicles

One especially difficult tactical problem is the defense of one or more moving vehicles. A family is extremely vulnerable to armed attack when driving along in a car.

If you are traveling in only one car (as a single family group), your main defensive effort should concentrate on avoiding any possibility of trouble. In a



A Loophole behind vine.
B Tiles lifted on roof. Dark patches are painted on roof as dummy loopholes.
C Loophole under shadow of porch.
D Loophole at ground level behind bush.
E Loophole under the eaves. Dummies should be painted all along under the gutter.

FIGURE 33: Technique of fortifying a house. Diagram shows methods of hiding loopholes to avoid the necessity for firing through windows. (From Combat in Fortified and Built-up Areas. United Slates Army Field Manual Number 31-50. 10 March 1964.)

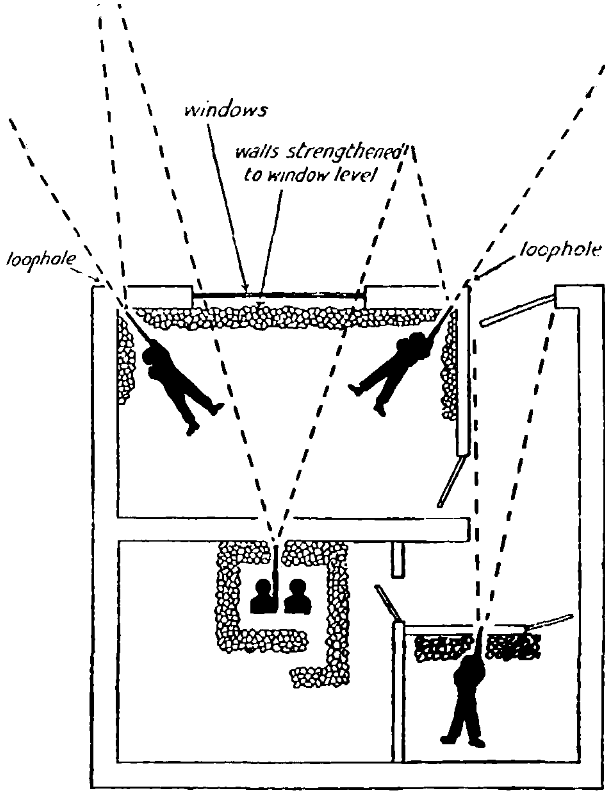


FIGURE 34: Shooting from internal forts. This technique makes it very difficult for attackers to achieve a hit. (Adapted from S. J. Cuthbert, We Shall Fight in the Streets. Paladin Press. PO Box 1307, Boulder, Colorado 80306, 1965.)

riot situation or other large-scale disturbance, you will be safest leaving the area just after dawn. Most people are asleep at that time or have been driven indoors by the cold, and yet there is enough light for you to see barricades and rioters in time to avoid them.

If the police or National Guard are trying to subdue disturbance in your area, be sure to time your dawn escape to be after the official curfew period. Otherwise you could be risking your life. Jittery National Guardsmen can be far more dangerous than rioters. Also, if you will have to pass a police or National Guard roadblock, don't do it in a car bristling with weapons. You'll wind up in jail at the best, and if you sneeze at the wrong moment you could get shot.

If you know from listening to the radio or television that there are no official roadblocks in the area, the need for weapons in the car may outweigh the potential peril of being caught with them by the authorities. If so, a good arrangement for a single-family vehicle would be to arm the driver with a pistol and place the children on the passenger side of the front seat. The second adult should be alone in the back seat, armed with a high-firepower weapon such as an assault rifle. The front right window should be up to protect the children, but the remaining windows should be open at least two or three inches. The object is to stick the muzzle of the rifle out either back window and make a lot of noise, panicking the mob of rioters long enough for the driver to break off contact and speed away. Note that the rifle is used as a psychological weapon. It is completely irresponsible to shoot into milling crowds when it is so easy to break them up with the sound of the shots alone. Be sure that the driver is equipped with excellent ear protection. It's needed—the driver's ears could be less than two feet from the rifle's muzzle when you shoot.

If your retreat group is larger than a single family, you can take more sophisticated precautions. Modern techniques of mobile reconnaissance on the battlefield apply fairly well to a convoy of retreaters. The basic requirement is that the group use at least three vehicles.

In this method, the first vehicle contains one skilled driver acting as a scout. The scout probes ahead of the convoy, ranging about 200 yards in front of the second car and locating obstacles, ambushes, or other hazards that might otherwise entrap the entire party. It is important to realize that the job of scout should not necessarily be hazardous; the escape route can be planned and studied ahead of time to eliminate or circumvent potential problem areas. The scout approaches blind corners with caution and waits for the second car to draw near if anything looks suspicious.

The second car in the convoy carries a heavily armed team whose duty is to counter-ambush anyone who attacks the first car, giving the scout an opportunity to escape. The team in the second car should be armed with heavy assault rifles and skilled in long-distance marksmanship. It would be best to have several members of this team keep the scout under observation with powerful field glasses at all times.

People waiting in hiding to surprise a vehicle tend to concentrate on the first car that comes into view and overlook a following vehicle until too late. The moment that the scout gets into trouble, the riders in the second car open fire, pouring bullets into every spot that could possibly conceal attackers. The attackers, stunned that their ambush has suddenly turned into a pitched battle, dive for cover, and in the confusion the scout has a chance to execute a bootlegger turn and get away.[8]

Following another 100 yards behind the second car is the third portion of the convoy. This could be a single car, or several cars, trucks, or buses. These are the vehicles you are trying to protect. The theory is that any ambush will be sprung by the first two cars, preventing the non-combatants from driving into a trap. Some of the riders in the third section should be armed with assault rifles and shotguns in case someone plans a back-ambush for you, a trap in which the first two cars are allowed to pass but the third section of the convoy is attacked. In this case the second car can reverse course and come to the rescue.

In very hilly country or in built-up urban locations where turns in the road put the scout out of sight of the second car, the convoy should proceed "inch-worm" fashion. The scout drives forward to the next bend in the road and then stops. If all is clear, the scout signals the second car to follow. The third car maintains its position just within sight of the second car. In this manner, the scout proceeds one curve at a time, immediately backed up by the team in the second car. The third portion of the convoy remains one curve farther back, where it will be out of the line of fire if trouble develops.

In an emergency when time is running out (the fallout is coming), an alternative to the "inch-worm" technique is to proceed through "blind" areas at the highest safe speed of the slowest car in the convoy, widening the intervals between cars so that no more than one is likely to be attacked before the others realize it. This is a risky approach, but if the alternative is equally risky you have nothing to lose.

It is essential in this kind of convoy to have two or three methods of fool-proof communication between vehicles. CB radios will do for a start, but bear in mind that attackers may have them, too. A system of headlight-taillight signals and a system based on gun-shots should also be instituted. In addition, every car should have maps of main and alternative routes to the refuge in case of separation. Be sure, however, that the maps are drawn in such a way that they won't guide unwanted strangers to your location if they fall into the wrong hands.

Commentary

Remember that although you may not be a professional military officer, you can still plan and carry out a successful defense of your refuge. You can concentrate your efforts on a single location, and with a little luck you will be able to spend months or years in preparation before putting your plans to the test. But don't put it off. The weapons and ammunition you need are increasing rapidly in price, and the future may hold shortages or restrictive legislation which could fatally hamper your efforts if you wait too long. Prepare now.

Notes

1. Many of the accessories discussed in this section are available from your local gun shop or Army surplus outlet. A selection of accessories is also available from Sherwood Distributors, Inc., 18714 Parthenia Street, Northridge, California 91324 or from the Ruvel Company, 3037 N. Clark Street, Chicago, Illinois 60657. Write first for their catalogs.
2. Leatherwood Brothers (Route 1, PO Box 111, Stephenville, Texas 76401) issues a catalog of special range-finding military rifle scopes.
3. The King-Tappan combat sight and the King speed safety are available from King's Gun Works, 1837 Glenoaks Boulevard, Glendale, California 91201.
4. Cooper's Institute is located at the Gunsite Ranch, Paulden, Arizona 86336. Don't overlook his excellent articles in the Personal Survival Letter, Bill Pier and Mel Tappan, eds., PO Box 598, Rogue River, Oregon 97537.
5. The catalog is available from Paladin Press, PO Box 1307, Boulder, Colorado 80306.

6. For information regarding the Cableguard barrier gate, write Cableguard Systems, Inc., 42 Alco Place, Baltimore, Maryland 21227.
7. One resource you should not overlook in planning your defense is the discussion of the Rhodesian guerilla war provided in numbers 1 and 2 of Bill Pier and Mel Tappan's Personal Survival Letter. The kind of attack that white Rhodesian farmers have learned to frustrate is similar to the situation survivalists envision: confrontation of an isolated family by superior numbers of well-armed soldiers. As an example of the farmers' resourcefulness, it is common for them to set a switch which turns on lights at a far end of the house. During a surprise night attack, fire can be drawn away from the family for a few seconds—long enough for defenders to grab their weapons and take cover. It's a simple and effective diversion.
8. For those unfamiliar with the maneuver, see S. Dick, Executing the Bootlegger Turn (Mason, Michigan: Loompanics, 1977).

8
Wake Me When It's Over

IMAGINE THAT THE NUCLEAR WAR you have prepared for is actually taking place. There have been serious threats and counter-threats. A hot war using tactical nuclear weapons is taking place in Europe. You have left your city home and arrived at your refuge. In the company of several other families, you are preparing to dig in and wait it out. Then the bombs start to fall. You're on your own.

What do you do now?

This simple question is probably the least discussed and the most crucial question in retreat planning. Once you get your ten or twenty or fifty people into your fallout shelter—what do you do then? How do you keep their spirits up? How do you organize them to do the work that needs to be done? How do you keep them from panicking? From losing hope?

This is the problem which the Civil Defense people refer to as shelter management. They have spent much time and effort on this subject, and the Shelter Management Textbook is one of the most useful publications in the whole preparedness field.[1] One of the only useful publications, in fact.

That doesn't mean that the official approach to shelter management is not flawed, however. The people who laid down the rules for shelter living were out of touch with reality on many points. In official shelters, for instance, the shelter manager or the manager's deputies are required to go around among the shelterees and confiscate all food, drugs, alcohol, and firearms. Now I admit that in certain parts of the civilized east you might be able to get away with that, but any fool who tries it in El Paso, Texas or Great Falls, Montana is going to get shot for his trouble. (Every time I read those instructions I mentally picture some pompous official in a CD armband trying to confiscate Mel Tappan's forty-seven-gun "basic no-frills" survival arsenal.)

The short-sightedness of rules like these has occasionally shown up in real-life emergencies. The confiscation of alcoholic beverages is one such example. During hurricane Camille, the CD "security team" for a large public shelter discovered a room full of alcoholics who had somehow sneaked out into the storm and looted a liquor store. When discovered, they were quietly drinking themselves into a stupor. Righteously, the security team confiscated the booze and destroyed it. Within a few hours, they had a growing number of winos with alcohol withdrawal convulsions and delirium tremens—and no medical help.

Fortunately, private disaster preparedness is a remedy for such official myopia. You can prepare ahead of time and provide better food, better accommodations, and better leadership than the official shelters can offer. This chapter is a guide for the shelter leader which tells how to manage a group of people to give them the best chance of survival. I have also included certain suggestions about equipment and supplies, where appropriate.

Leadership

One of the sad things that modern psychology has taught us is that a natural leader is someone who is tall, has a deep voice, and is strongly prejudiced. Of the three, the prejudice is the most important quality. Having made up his mind beforehand about nearly everything, the natural leader is ready with a course of action while everybody else is still trying to figure out what the problem is. The natural leader always has a plan and always acts confident. Of course, he is also wrong most of the time.

Your retreat group will need leadership. In some situations, a confident leader, even if wrong, will contribute more to your survival potential than any other factor. Such a leader will inspire people to work together and to look forward with some assurance to a hopeful future. This is absolutely necessary. If your group does not have a natural leader, you can fall back on your own resources and perform the same function even better by imitating the behavior of the natural leader while substituting rational plans in place of blustery posturing. The principles of leadership are as follows:

1. Assume command rapidly. Like the natural leader, you must begin to organize your group members and direct them before they get their bearings.
2. Demonstrate authority. That is the official jargon for "act like a leader." Take charge, display the fact that you know what you are doing. Act confident and well-organized.
3. Delegate authority. The leader's responsibility is to oversee all aspects of life within the retreat group during the crisis, but it is a mistake to get bogged down in every petty detail. Delegate. Don't let vital tasks be left undone because you personally cannot perform them.
4. Refrain from personal overinvolvement. That means don't play favorites in the retreat—not if you want to remain the leader.
5. Establish a priority of action. First things first. Make a list of the things that need to be done and decide which are the most important. The list will help you resolve conflicts in your own mind and will preclude differences of opinion among your shelterees. Remember, you don't have to be right. But you do have to be ready to answer when someone asks, "What next?"
6. Provide an example of behavior. Make a strict point of following your own rules and of living exactly like the people you are trying to lead. Be energetic, hopeful, helpful, and your followers will respond in kind.
7. Recognize the changing needs of the group. At first, the people in your group will need to be reassured, guided, organized, and generally cared for. Later, they will be able to function well on their own, and you will be faced with the task of keeping them occupied. Even later, your primary function may be to encourage them to be patient and not leave the shelter too soon.
8. Recognize the need for compromise. Even under the best circumstances there will be situations where two legitimate but opposing needs will have to be reconciled. Be ready with a compromise, or be ready to firmly back one side. Don't let a general debate get started. You won't have the time to spare.

Management Objectives

Once you know how to act like a leader, you will need to have a clear idea of the goals you are trying to accomplish. Obviously, the survival of the group is the main goal, but there are several lesser objectives which will contribute substantially to your survival.

The first of these is to rapidly organize the group members into "teams" responsible for various vital functions in the shelter. The size and composition of the teams will depend on the size of your total group. (Clearly, there will be little point in assigning "team leader" titles to the members of a group composed of only four people.) Large groups, on the other hand, may require extensive organization.

In general, you will need to assign teams to meet the following needs. First, you will need a radiological defense team to begin immediate work monitoring your fallout meters and watching for the first grains of fallout. You will need a security team, too, as well as a medical team, a communications team, a food-and-water team, a safety team (for fire prevention and control), a ventilation team, a sanitation team, and perhaps even a few other special groups, depending on your situation. Assign your people to these teams rapidly and direct them to begin their duties at once. Later on, you can sort out individual skills and change assignments to make the best use of everybody's abilities. At first, the emphasis should be on speed, not efficiency.

The second task is to obtain information from your teams which will allow you to clearly define your situation. How much food and water do you have? What problems can your medical team foresee? What news from communications? Will ventilation be adequate? What fire hazards are there? Has any fallout arrived, and if so, how rapidly is the external radiation hazard building up? Does the security team report any sign of strangers near the property who might be inclined to force their way in with you? You should build as complete a picture as possible of the expected duration of your stay in the shelter as well as an appreciation of your capabilities and the hazards which the shelter itself may represent. From this assessment of your situation, you can begin to set up an actual survival plan.

The next step is to develop your rules for shelter living and to set up a detailed daily schedule. The rules and schedule will give the members of your group a framework within which to live as a substitute for the way of life they have left behind. The rules will help prevent conflicts and problems, while the schedule will allow everyone to settle into a predictable pattern. The importance of this step must not be underestimated.

The fourth step is really the most crucial part of the whole effort. Managing for survival is really directed at maintaining the group's morale and preventing members from getting bored, morose, depressed, and defeated. The Golden Rule of shelter management is keep them occupied. We will return to this primary theme again and again in this chapter.

The Shelter Schedule

The following is a sample shelter schedule which you may adopt. I have annotated it to briefly explain the use of some of the time periods. Most are either self-explanatory or are covered in detail later in the chapter.

7:00 AM Reveille (rise, clear away bedding, dress, etc.)

7:30 AM Prepare breakfast.

8:00 AM Serve and eat breakfast (water ration).

8:30 AM Clean up after breakfast.

9:00 AM Sick call (a general medical inspection and discussion of medical topics, if necessary).

9:30 AM Leader's option of continuing sick call or starting training sessions, recreation time, group meeting, etc.

10:00 AM Snack time (water ration).

10:30 AM Training session (entire group).

11:00 AM Training session (special groups, including school for the children).

11:30 AM Free time for quiet activities (nap time, etc.).

12:00 PM Prepare lunch.

12.30 PM Serve and eat lunch (water ration).

1:00 PM Clean up after lunch.

1:30 PM Information and training session, nap time for small children.

2:00 PM Information and training session, school for the children.

2:30 PM Emergency drills (finding emergency exits while blindfolded, fighting mock fires, etc.).

3:00 PM Snack time (water ration).

3:30 PM Recreation (free time).

4:00 PM Recreation (free time).

4:30 PM Recreation (quiet activities, nap time).

5:00 PM Prepare dinner.

5:30 PM Serve and eat dinner (water ration).

6:00 PM Clean up after dinner.

6:30 PM Official daily briefing (team leaders report to the group; discuss and make group decisions).

7:00 PM Training session.

7:30 PM Planned recreation (group singing, etc.)

8:00 PM Planned recreation (radio, television viewing, etc.).

8:30 PM Free time for quiet activities (some people will want to turn in early).

9:00 PM Free time for quiet activities.

9:30 PM Snack time (water ration).

10:00 PM Free time for quiet activities.

10:30 PM Prepare for sleep.

11:00 PM Lights out.

11:00 PM to 1:00 AM First night watch.

1:00 AM to 3:00 AM Second night watch.

3:00 AM to 5:00 AM Third night watch.

5:00 AM to 7:00 AM Fourth night watch.

This schedule is a loose framework which you can alter to suit your needs. For example, first and second, and third and fourth night watches might be combined. You or the group can decide to change the schedule at any time, but don't change it too often or you will lose the reassuring psychological sense of routine.

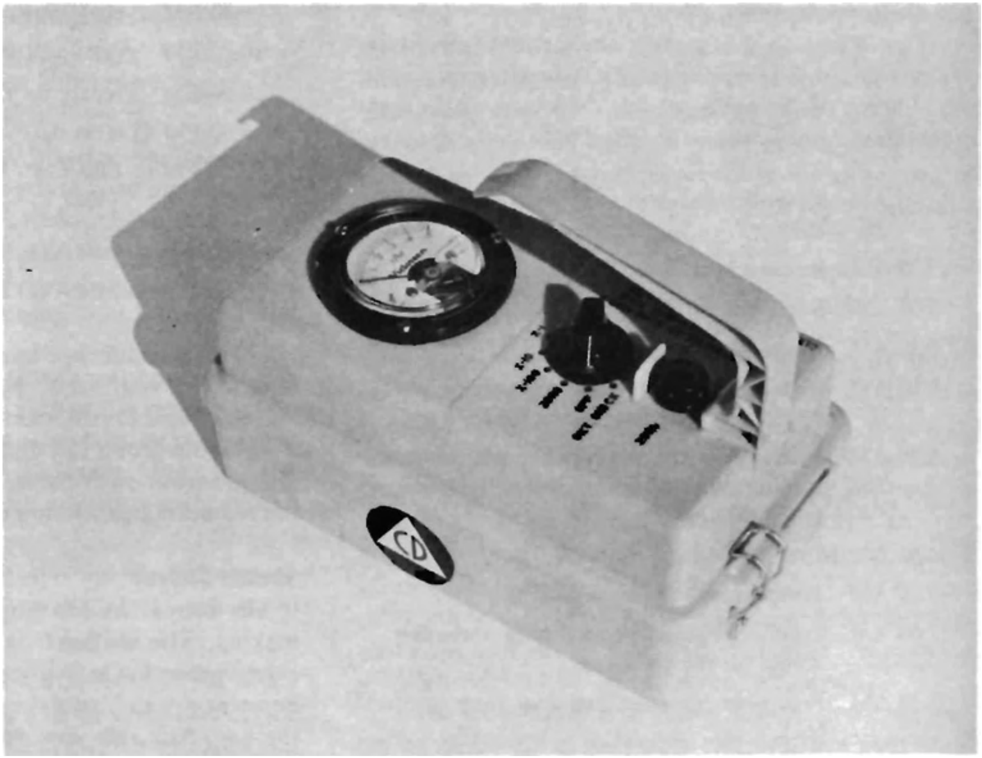
Shelter Rules

The retreat leader must deal very early with rule-making. The shelter living situation will be novel to everyone, and at least a few carefully designed rules will be necessary to insure the survival of the group. That is the key. Any rule, any decision about a rule, and any disciplinary action must be clearly in line with the survival goal, or your group will rebel.

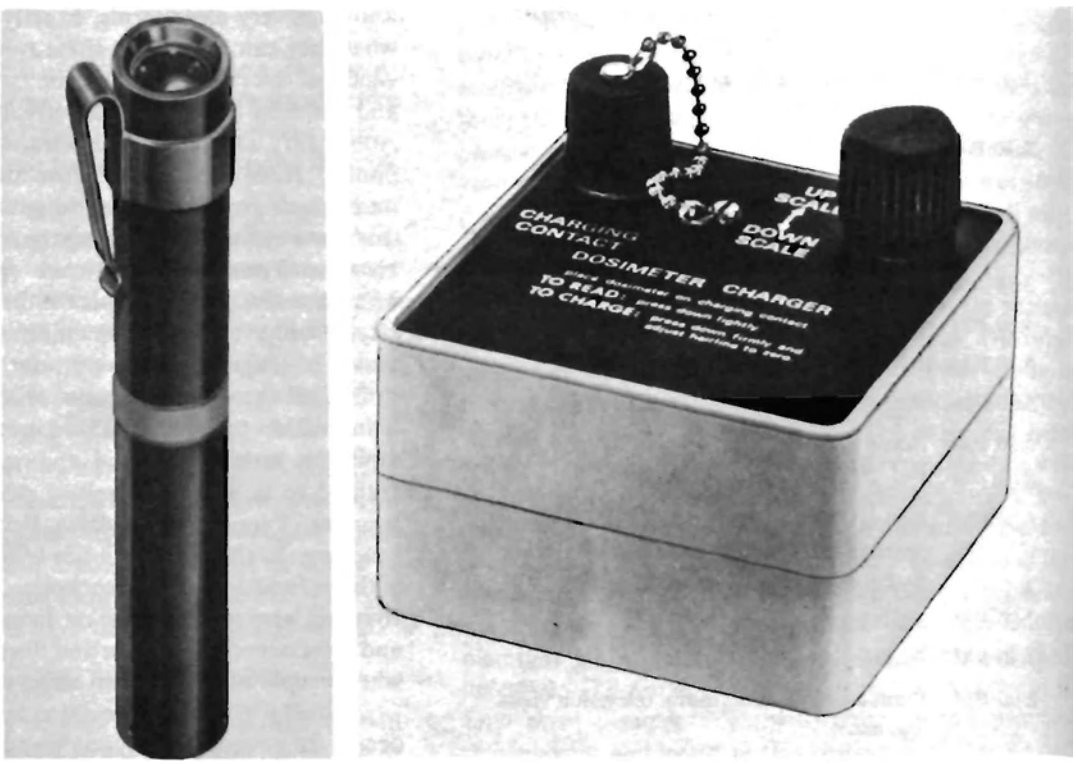
You will need rules for several functions. First is entering and leaving the refuge. Your group should know, in very clear terms, exactly who can enter and what they can bring with them (preferably, well in advance of the crisis). If the basic family unit of parents and children belongs in the retreat group, what about Aunt Mary and Uncle Bill, who were visiting with the family? How about pets? How about strangers? You must know clearly where you will draw the line. You can't save everybody. Leaving the refuge is equally troublesome. Your rules must cover who, when, and for what reason a person may leave the shelter or the property, if only to impress on children (and some adults) that it is dangerous to go outside.

Then there are the rules which cover day-to-day living within the shelter. There must be clearly defined limits on how much food and water each person is entitled to in a day, as well as rules against misusing supplies. People under stress frequently show it by snacking. In that direction lies a band of fat retreaters with no food left in the stockpile. There must be rules covering who will dispense medicine (to prevent waste) and rules covering the time and duration of quiet hours, when people may expect to sleep undisturbed.

Finally, there are special rules. You will have to decide for yourself what you think of smoking, alcohol, drugs, sex, gambling, and fighting. These decisions will depend on your circumstances. Just remember, the cardinal rule is to prohibit anything that reduces the



High-range Civil Defense fallout meter available from Survival, Inc., 16809 S. Central Ave., Carson, CA 90746. Write first for a catalog.



Individual radiation dosimeter and charger. This pen-like device gives a direct reading of personal radiation exposure. (Photograph courtesy of Nuclear Associates, Inc., 100 Voice Road, Carle Place, New York 11514.)

group's chances of survival or the length of time the group will be able to survive without outside aid. Don't fall into the trap of proscribing activities just because they "aren't nice." There is more than enough of that advice in the official books.

While you are working up your list of rules, bear in mind that restrictions will be better received if you leave a few for people to set for themselves. The determination of quiet hours could readily be made by group members, for example. As long as you have a definite eight-hour period in which people can sleep, it doesn't really matter when it is. Let your group decide for itself. This makes the whole issue of rule-making less arbitrary.

Radiological Defense

Detecting, measuring, and keeping track of fallout radiation levels is a vital activity for a retreat group for three reasons. First, you will need to know exactly who has been exposed to exactly how much radiation. This will allow you to choose the right people to send outside on brief but important errands (such as getting the can opener out of the car). Second, taking definite action to measure and record radiation dosages will reassure your group that you really are doing everything you can to keep them safe, and will dispel members' inevitable fear that they are dying of invisible radiation. Third, the time the group will spend in taking measurements and calculating cumulative doses will be time that you will not have to find ways to fill.

There are several approaches to acquiring radiation detection equipment, some very expensive and others extremely economical. On the expensive side are the sensitive survey meters sold for use in health physics applications. These meters are much too sensitive for most civil defense work, but they can be useful in decontaminating people and equipment. A sensitive survey meter (detecting 0 to 0.5, 0 to 5.0, and 0 to 50 milliroentgens per hour) will help you get the last vestige of fallout out of your hair and out from under your fingernails. You can buy such meters, intended for the measurement of gamma and beta radiation, for prices ranging between 250 and 400 dollars, depending on your source.

For nuclear war radiation dose rate measurements, however, you will need a meter that will measure radiation levels greatly in excess of those indicated above. Official civil defense fallout meters give readings in the 0 to 0.5, 0 to 5.0, 0 to 50 and 0 to 500 roentgen per hour range, more than 1,000 times higher than a health physics instrument can manage. Unfortunately, these instruments are not routinely manufactured any more. If you want one, you will have to buy it on the surplus market or you will have to build one yourself.

At the time this book was written, Survival Inc. was offering surplus civil defense CD V-710 survey meters for a very reasonable price. I recently purchased and tested seven of these meters and found them to be in operating order. They responded well to a cobalt-60 gamma source and unquestionably represent one of the best bargains in the whole field of survivalism. They run for 400 hours on two D-cells and a Mallory M-215 22.5v battery (available at Radio Shack).

An alternative to buying the meter as surplus is to build it yourself. This is easier than you think. Cresson Kearny of the Oak Ridge National Laboratory recently completed a set of step-by-step instructions on how to assemble an accurate and dependable fallout meter from materials normally found around the house.[2] Unfortunately, his budget allowed him to print only 100 copies of the plans, all of which went into files or libraries. (See Appendices in the back of this book for detailed instructions of Kearny's meter.)

Dosimeters are another kind of radiation measuring device, used for automatically recording the total radiation exposure received by a particular person. A dosimeter is a pen-like device which clips to your belt and is worn all the time. At any moment you can unclip it, look into the end of the device, telescope fashion, and read your personal total exposure on a tiny internal scale. A dosimeter needs recharging about once a week, for which you must buy a special recharger. The recharger costs about 60 dollars; each dosimeter also runs about 60 dollars. For gamma radiation, get direct-reading dosimeters in the 0 to 200 R or 0 to 600 R range.

I recommend that a well-equipped retreat group have a high-range civil defense survey meter at the very least. The ultrasensitive health physics survey meters are second in priority, and although useful, are not essential. A full set of dosimeters will be reassuring to your group, but again, they are not essential. Be sure to buy extra batteries for the meters and dosimeter charger; store them in the refrigerator.

You may be able to find sources for radiation detection equipment just by looking in the yellow pages. If not, try writing to the following companies:

Edmund Scientific Company
1875 Edscorp Building
Barrington, New Jersey 08007
(Surplus CD low-range meter)

Nuclear Associates, Inc.
100 Voice Road
Carle Place, New York 11514
(Survey meters, dosimeters)

Applied Health Physics
PO Box 197
Bethel Park, Pennsylvania 15102
(Survey meters)

Eberline Instrument Company
PO Box 2018
Santa Fe, New Mexico 87501
(Survey meters)

Dosimeter Corporation of America
6106 Interstate Circle
Cincinnati, Ohio 45242
(Dosimeters)

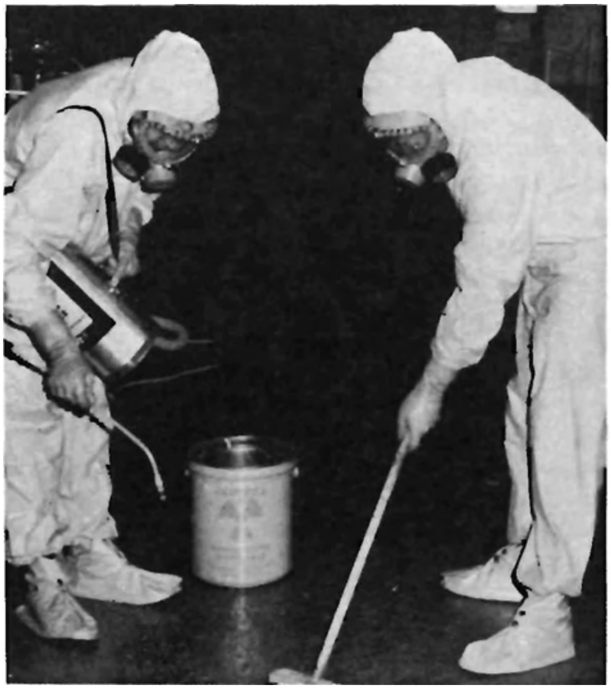
Detection Procedure

The first duty of the radiological defense team will be to detect the arrival of fallout particles. The easiest way is to place a white plate or a sheet of paper outside on the ground and check it every few minutes. When the fallout arrives, it will appear as a sprinkling of grit on the paper or plate. At night, you will be able to see the grains descending like snow through the beam of a flashlight. Although radiation is invisible, the fallout grains are not.

Until the fallout does arrive, the radiological defense team can be kept occupied with tasks that improve the shielding around the shelter. Piling sandbags against exterior walls is an example of such activity. The team should collect hoses, brooms, and buckets of water to store outside the shelter entrance. This will speed up the decontamination of the premises later. If possible, the team should plow the land within 100 feet of the main building and parking area, leaving deep furrows. This will greatly cut down the radiation exposure of persons in the center of the plowed area. (Plow the furrows in circles around the building like the grooves in a record, not radially like the spokes of a wheel.)

The second duty of the radiological defense team is to decontaminate incoming group members who arrive after the fallout. Imagine that the people to be decontaminated have had a few ounces of ground pepper thrown at them, and that your job is to get it off their clothes and out of their hair without breathing it. The best arrangement is to have the contaminated people shower and shampoo several times; then check them over closely with a sensitive survey meter. Pay particular attention to all hairy areas and folds of skin.

If shower facilities and survey meters are not available, you can make do by thoroughly brushing the hair and carefully dusting off the person's clothes. Don't forget the shoes, which are likely to be heavily contaminated. Tell group members to report any itching around the ears, neck, armpits, or ankles—fallout can enter the clothing and lodge against the body. Itching may indicate the first stages of beta burns, and the affected area should be carefully washed at once. (See Appendix E for additional information about beta burns.)



A professional decontamination team at work. Although workers are taking elaborate pains to see that no radioactive material touches them, the fundamental activity is no more complex than scrubbing the floor. (Photograph courtesy of Nuclear Associates, Inc., 100 Voice Road, Carle Place, New York 11514.)

The third duty of the radiological team is to keep careful and accurate records of the radiation level outside the shelter. For one to several hours after the first fallout arrives, the readings will continue to rise, but soon they will peak and begin to drop. At any time following this maximum level, you can use the dose rate measurement and the estimated time since the explosion to calculate how long you will have to stay in the shelter. (This, obviously, is a vital piece of information. The technique is described fully in Appendix E.)

If food and water thought to be contaminated is brought into the shelter, the radiological team should examine and decontaminate it as soon as possible.

Radioactive fallout must not be eaten. Although I stressed in chapter 2 that the long-term radioisotopes which will eventually work their way into our bodies are not a very great cause for individual concern, actual fallout grains are another matter entirely. Don't eat fallout contaminated leafy vegetables. If you have nothing else to eat, wash the leaves carefully first. The same goes for apples and other fruits. Some vegetable products such as apples, oranges and potatoes form their own "containers" and can be decontaminated by washing or peeling. Other foods, like unwrapped bread or unwrapped fresh meat, can be best decontaminated by carefully cutting off the outer layers and saving only the uncontaminated inner core. You may find that there will be still other kinds of food that can not be treated at all, such as individual slices of bread. These should be disposed of outside.

Food in sealed containers (cans, jars, bottles, or plastic bags) is edible as long as no fallout gets on the food itself. The exposure of the food to the radiation alone does not affect the edibility of the food. (Many grocery store foods on your shelves right now have been sterilized by radiation as a routine commercial process.) You can decontaminate the food by washing the outside of the container or by wiping it carefully with a dry cloth.

The meat from cattle which have received a lethal dose of radiation may be used for human consumption, but only if the slaughtering is performed within the first week following exposure and the animals have not eaten any fallout. After that, the animals become bacteremic, and their flesh constitutes a source of food poisoning. They literally rot on the hoof and become inedible while still alive. If the animals have eaten fallout you will run a risk of receiving a dose of radioactive cesium from their flesh. This should be avoided if possible, but remember that it is far less harmful than outright starvation if that is the choice.

Water brought in from local streams or ponds should be purified as described in chapter 5 by straining and running it through an activated carbon filter to remove radioactive chemicals. A standard home water softener will also remove most of these chemicals. Be sure to add a few drops of iodine to each gallon to kill germs and to help prevent radioiodine uptake by the thyroid gland.

The final and most important duty of the radiological team will be to determine when it is safe to go outside. As a general rule, a person can withstand up to 6 R of radiation per day in a nuclear war context without serious ill effects. By the time the outside radiation dose rate has fallen to 2 R per hour, it will begin to be safe to go outside. At this level, a person who has not been exposed to too much radiation previously can afford to stay outside for up to three hours per day. As the dose rate continues to decrease, the periods of outside activity can be made proportionately longer. (See table 20 in appendix F.)

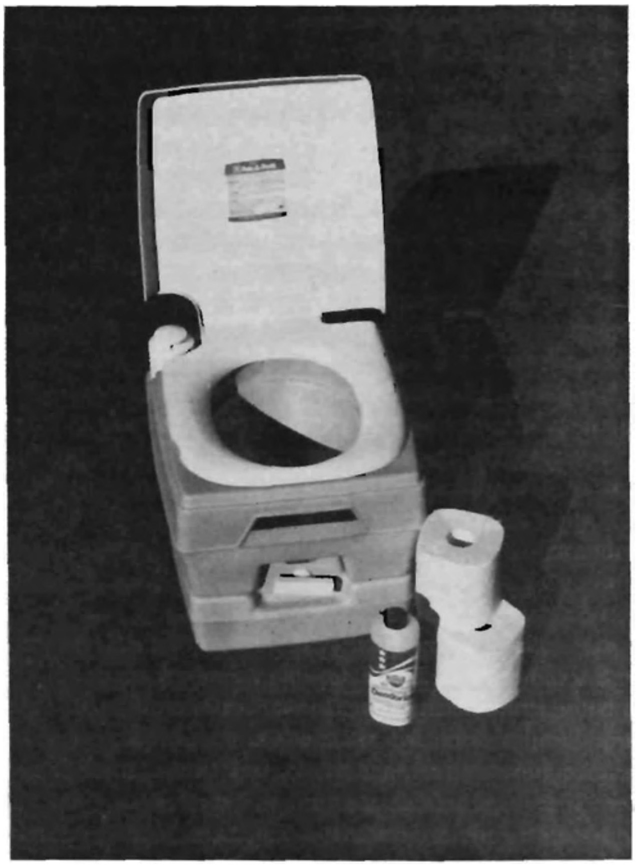
Sanitation

As 1 remarked in chapter I, we tend to take proper sanitation for granted. Virtually every building any of us has ever seen has contained a flush toilet. We consider ourselves victims of governmental neglect when we are confronted by such an outrage as a pit toilet in a national park.

Like it or not, the success or failure of your retreat group could well depend on the strength of your sanitary resources. Poor sanitary facilities can quickly produce disease and demoralization. If you haven't really considered the toilet question, a big part of your survival planning has been left undone.

Official fallout shelters are provided with garbage cans or metal drums with toilet seats to serve as commodes. Once again, you can do better. Portable flush toilets can be purchased for reasonable prices in many department stores. Powerful deodorizing chemicals are also available. Even if you decide not to buy a toilet, you should get the chemicals.

The official suggestion is to have one commode for every fifty people under optimal circumstances, but I suggest that you provide two or three times that many toilets—you might develop a group diarrhea or nausea problem. The toilets should be partitioned off from sight and sound nearthe point wheretheventilation air leaves the shelter and as far from the food preparation area as possible. You can isolate each individual toilet or group them into men's and women's facilities. If your group is very informal, you can have "unisex" restrooms, but I don't recommend it except within family groups. Remember that your purpose is to promote a sense of routine, and radical departures from the patterns of day-to-day living will not help.



The Pak-A-Potti. A flushing portable toilet available from Sears; no shelter should be without one.

The cleanliness of the toilets and surrounding area is also important to health and morale. (The CD people suggest that everybody should do everything sitting down to avoid spattering, and that toilet-trained but still small children should be supervised.) The medical team should supply soapy water for washing hands.

One really staggering problem is posed by the admittance of an infant into the refuge. You can expect to have to deal with a ballpark figure of 200 to 400 dirty diapers per month per child. This is your single largest argument for having the ability to do laundry. Adults can just rinse out their clothes now and then, but diapers have to be properly washed. The alternative is to let the kids run around naked in a restricted corner of the shelter and to clean up after them as need be, like puppies. (That suggestion is straight from the official guide.)

While you are stocking your refuge, don't overlook sanitary napkins, toilet paper, and bathing soap. The person who forgets to stock the shelter with these items may well be sent back out to get them.

Safety

If your retreat group is forced to live for several days or weeks in the confined quarters of a fallout shelter, the group leader must be extremely sensitive to the hazards inherent in the shelter situation itself. Don't concentrate so much on the dangers outside that you overlook the calamities which can happen within the shelter.

Of primary concern is the possibility of fire. You will have many people in a relatively confined space. You will have cooking stoves, candles, and perhaps sparks from electrical equipment as ignition sources. You may have white gas stored for stoves, gasoline for the generator, and goodness knows what kinds of gunpowder and explosives if you belong to one of the more security-conscious groups. It all adds up to too many people in too small a space with too much dangerous fuel. Safety precautions will be extremely important.

Precautions will fall into two categories. First, you must take steps to see that fuel (and ammunition, if applicable) is stored as far as possible from the cooking area, preferably next to the toilets and near the ventilation exit. This will be a most emphatic no-smoking area. Flashlights, not candles, should be provided for people visiting the toilets at night. Be sure that the main sleeping area is immediately adjacent to one or more exits, and that there is nothing near those exits that could possibly catch on fire or fall over and block the door. Your last job every night should be to check the exits to be sure that they are unobstructed.

The second precaution is to train everyone in what to do if there is a fire. Members should be able to get up from their normal sleeping locations and crawl to the nearest exit by feel, not by sight. Run that drill at least once a day. Teach everyone how to put out burning clothing by wrapping the victim in a blanket: gasoline-soaked clothing can't be put out by rolling on the ground.

Place buckets, cans, or boxes of sand at various locations around the shelter and asign specific fire-fighting duties to persons normally nearby those points. Don't use water or chemical fire extinguishers, at least not at first. Water will spread a gasoline fire, and most chemical extinguishers will release smothering gases. Chemical extinguishers put out the fire, but they will also drive you out of the shelter. Keep the carbon dioxide extinguishers and several buckets of baking soda in reserve. If the fire can't be controlled with sand, get everybody outside and then use the chemicals. Be sure everybody understands that in a choice between radiation and exploding gasoline, the radiation is the lesser evil.

Ventilation

You will need about three cubic feet of air per person per minute circulating through the shelter in order to avoid carbon dioxide buildup, oxygen depletion, high humidity, high temperature, and that unmistakable locker-room smell. The ventilation team will be responsible for air quality and air-related safety. In Appendix D I have included drawings of the Kearny Air Pump (KAP). This is a simple "flap-valve" air pump which you can make from items found in any house. A kind of Venetian blind that opens when it swings away from the shelter and closes (pushing air ahead of it) when it swings toward the shelter, it may be used in a door, window, or hallway to provide ventilation.

If the KAP will be used to insure adequate ventilation, be sure to check first to see in what direction the air naturally flows through the shelter space. Open up the air intake and exhaust hatches, window, or ducts and see if there is a natural flow. Always install the KAP so that it operates in the same direction as the natural air flow. If you try to force the air to go against its own inclinations, you won't have much success.

It may have occurred to you that fallout particles might be sucked into your shelter by your ventilation pump or blown in by a draft. If you have a powerful ventilation pump, you might want to filter the incoming air through a common furnace dust filter, but if you are using a low-pressure high-volume pump (like the KAP), you won't need this precaution. Even the slowest fallout grains fall like snow, at rates of about half a foot per second. These settle to the ground very quickly. You won't have any fallout in your air supply if you arrange your ventilation so that the air enters through ground-floor windows that have been left slightly open, use a

KAP in the basement stairwell to pump air from the ground floor to the shelter, and let the air exit through a basement window. It is possible that a small amount may enter the house, but it won't get down to the shelter.

The ventilation team should be constantly on guard for gases which might pose a danger. Carbon dioxide from breathing or carbon monoxide from stoves and Coleman lanterns are two examples of potentially dangerous gases. If people start fainting and their lips look either blue or cherry red—it's time to go outside. Fast. Blue lips mean lack of oxygen. Bright red lips indicate carbon monoxide poisoning. Retreaters frequently buy hand-powered ventilation air pumps to help stave off this kind of problem, but there are simpler ways, too. If you bring a generator inside the shelter and provide a pipe to channel the exhaust to the outside, your air-pump problem will be solved. Internal combustion engines are powerful air pumps, and even a very small gasoline generator will keep fresh air circulating through your shelter as long as it is pumping exhaust to the outside. A fireplace or wood stove vented to the outside has exactly the same effect.

The fumes from stored gasoline within the shelter will be a particular problem. The safety team will want to locate the gasoline storage area next to the ventilation outlet so the fumes will be carried directly out of the shelter: the ventilation team will probably agree. What they may not agree on is where the cooking stove should go. The safety team will want the cooking area to be as far from the stored gas as possible. The ventilation team may want both the gas and the stove near the outgoing air duct. The group leader will have to resolve such opposing desires.

Shelter managers are frequently preoccupied with the possibility of too much heat and humidity in the shelter. I want to caution you about this fear. It is true that in overcrowded public shelters the heat of 200 to 600 bodies can quickly raise the temperature to unacceptably high levels, but a family or small retreat group in a concrete basement is going to be too cold, not too hot. You must look over your situation carefully and decide which category you fall into. If your shelter is likely to be too cold, you will want to plan on forms of cooking, lighting, and recreation which will raise the temperature. If your shelter is likely to be too warm, you will need pre-cooked foods and cool light sources. In either case, you will want to take steps to keep the level of humidity as low as possible. Humidity makes a hot shelter feel even hotter, and it makes a cold shelter damp and miserable. More ventilation is the cure in either case.

Illumination and Power

The period in which your group may have to be confined in a crowded fallout shelter will be one with many difficult emotional overtones. If you have to spend those days trapped in total darkenss, your survival potential will be very low. Even those of us who do not normally fear the dark may find that the total darkness of a night in a shelter may be more than we can stand. (This has been indicated in shelter simulation studies.) Imagine what the effect would be on claustrophobics and insecure children.

In many parts of the country, commercial power supplies will not be knocked out by a nuclear attack. Coal and oil powered generating stations may be able to stay in operation for days or weeks, at least until the fallout has decayed to the point that people can come out in the open again. Nuclear reactors will continue to generate electricity for a year or two after the attack, provided only that the operating crews stay on the job. Hydroelectric dams will work even longer in many areas. If you live in such an area, you may be able to use normal electric lighting during your shelter stay.

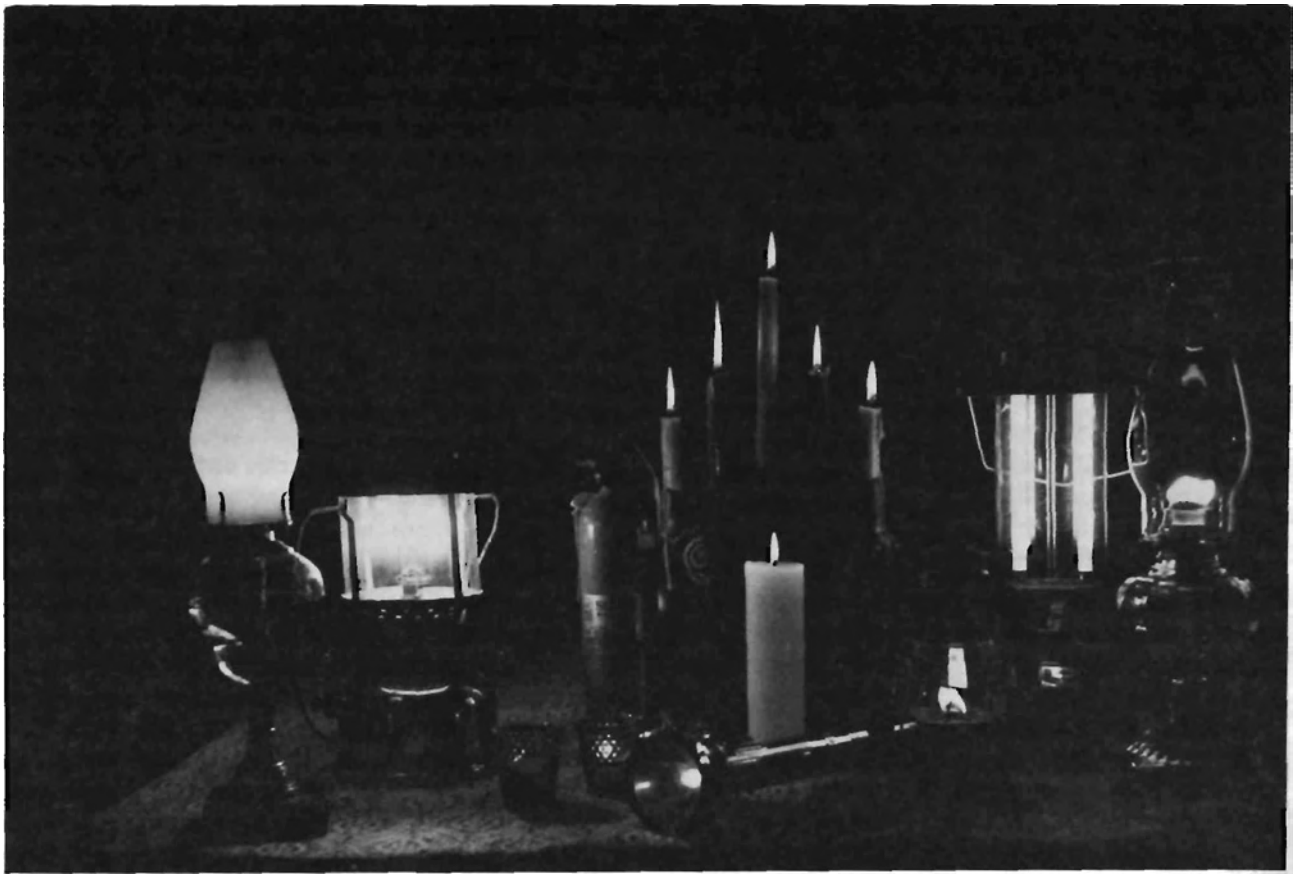
If not, you will have to provide illumination some other way. As well-prepared retreaters, you have no excuse for not buying a small gasoline-powered generator and storing enough fuel to keep it running for a week or two, until you can leave the shelter. Battery-powered lights are useful, too, as are candles and kerosene lamps. White-gas Coleman lanterns produce the brightest light available from a non-electric source, followed closely by large kerosene lamps, battery lanterns, and candles, in order of diminishing intensity. Small kerosene lamps are frequently dim and smoky.

Votive candles make good night-lights. An enclosed flame is less bright than an exposed flame, but the enclosed flame presents less of a fire hazard. The fire problem is also why I prefer candles to liquid-fueled lamps. If a candle falls off a table, it will usually put itself out. If a kerosene lamp falls off the table . . .

During the day, you may be able to bring light into the shelter by using mirrors set up in entrances to reflect sunlight. Be sure to maintain a reasonable day/night cycle of light and dark periods. It is fine for Eskimos to live on a twenty-four-hour free-running cycle, but modern Americans won't take to it very well. They will develop psychological, and perhaps even physical, problems if deprived of the diurnal cycle.

Communication

You will need to set up a special communications area within your refuge where you can house and use your radio equipment. In this "radio shack" you can install a telephone, intercom, amateur radio transceiver, CB radio, weather alert radio, multi-band receiver, and/or scanning receiver, and monitor them on a twenty-four-hour basis. A special team of communications people should be in charge of this equipment, and no one else should be allowed to fool with it. (If some-



Sources of illumination photographed by their own light. From left: kerosene lamp with a frosted glass chimney, Coleman white-gas mantle lantern, votive candles, fire extinguisher (an essential), candles, flashlight, "little red lantern," Ray-O-Vac fluorescent lantern, and large kerosene lamp with a clear chimney. The Coleman lantern is the brightest, the Ray-O-Vac the coolest.

body's kid blows up the radio set, you will be a long time waiting for a new one.)

There are several advantages to having an amateur radio operator as a member of your group. HAMs, as they are called, are radio hobbyists licensed to operate very sophisticated equipment, some of which could be vital to the success of your retreat. Although anyone can buy a 40-channel CB radio and operate it over a range of three or four miles, a HAM can set up a local communications net using two-meter equipment, giving a working range over twenty miles and providing 800 channels to choose from. In addition, two-meter rigs are remarkably clear and interference free, qualities CB will never possess. The typical two-meter handi-talkies are about half the size of a comparable CB unit and usually have much greater battery life.

For longer range communication, HAMs routinely set up stations which reach around the world. It isn't unusual for a HAM to spend the evening chatting with a radio friend in New Zealand, Australia, or South Africa. If you were a survivor of a nuclear war, it would be helpful to be able to radio for medical advice or for news from a country not involved in the war. Of course, HAMs are also quite capable of reaching radio operators within the United States and Canada, too.

If you don't happen to know an amateur radio hobbyist, look in the yellow pages for a store carrying HAM equipment and ask the proprietor to put you in touch with the local club. In three or four months, you can be trained and get your own license. You will have to learn Morse code and some elementary theory, but the investment of time is well worth it.

If you can't afford a wide variety of sophisticated radio equipment, at least get a multi-band portable receiver so you can tune in emergency broadcasts in your area. I recommend the GE ten-band receiver (GE Model Number 7-2971 A). This radio is about the size of a lunchbox and receives AM, FM, CB, and short wave (6 to 21 MHz), as well as all public service, UHF, and weather frequencies. It operates on batteries or wall power. I have used mine intermittently for over a year, and the original batteries are still going strong.

You may find when you take your portable radio into a basement or fallout shelter that it doesn't work. Reinforced concrete and earth are excellent barriers to radio signals. Then you may find that the radio has no external antenna jack. What do you do then? If the radio has a whip antenna, you can rig an external antenna and clip it to the whip with some success, particularly with FM. Just take any kind of insulated wire, tie a rock to one end, heave the rock up into a tree, and run the other end down to the shelter. Wrap the wire around the whip antenna, and you are ready to go.

Unfortunately, many portable AM radios have internal ferrite rod antennas which are not easy to reach. You can disassemble the radio and connect your antenna directly to the circuit board through a capacitor if you know enough about electronics, but there are easier methods. One is to carefully coil ten or fifteen feet of the antenna around the outside of the radio (the rest of the antenna is outside in the tree as before). The external coil has to be coaxial with the coil around the ferrite rod in order to work, so a little experimentation will be necessary. But the simplest solution is to tie the radio to a long pole and set it outside on the ground. You can get normal reception that way while listening from within the shelter. If you have equipped the shelter with twelve-volt emergency electricity, you can prepare yourself with an automobile AM-FM radio and antenna. Set up the antenna outside, hook up the radio in theshelter, and you're all set.

An especially useful kind of radio for survivalists, is a weather alert radio with an automatic alarm. The government maintains many emergency weather information stations around the country, and if you are near one you can arrange to be instantly advised of any tornado, flood, hurricane, or atomic attack. I recommend the Electra Bearcat Alert BC W for retreat applications. This radio will run on alternating current or batteries, is designed for use with a roof antenna, and automatically turns itself on in the event of an emergency broadcast. The Electra Bearcat costs about 70 dollars. The Midland 13907 is my second choice (at 40 dollars), but it doesn't measure up to the Bearcat in terms of battery life or sensitivity.[4]

As for CB equipment, the golden rule is never to buy any unit that won't deliver the full five-watt maximum power. Even the five-watt units are disappointing unless they are attached to large base station antennas; a handi-talkie rated at less than five watts will frequently

Radios of use to survivalists. Left, the Realistic 200 handi-talkie with its optional microphone (available from Radio Shack). Center, the Genera) Electric ten-band portable. Right, a two-meter HAM unit made by Yaesu. Compared to the Realistic 200, the Yaesu has five times the battery life and ten times the range (used with a repeater station); the Yaesu has 800 channels. The roll of wire can be used as a makeshift antenna for the GE portable. (Yaesu unit courtesy of Harbor Electronic Marine Equipment Company (HEMEC), Santa Barbara, California.)

not operate any farther than you can shout. I tend to favor the Realistic 200 series of handi-talkies because of their versatility and convenient shape. These are five-watt units which can be obtained with six crystal-controlled channels or forty synthesized channels, external antennas, rechargeable batteries, alternating current adapters, auto adaptors, external microphones, earphones, and speakers. They can be operated on a low power setting to conserve batteries or to reduce the chance of being overheard, and they fit nicely into a surplus thirty-round magazine pouch for carrying on a pistol belt. One caution, however. Of my five handi-talkies, all have had to be returned for warranty service once. After that, they have operated very reliably. Be sure to "burn the unit in" well before the guarantee period is over.

Amateur radio equipment should be Heathkit manufactured for our applications because of the advantage of having the kit building manuals and troubleshooting guides that come with the radios.[5] You can buy a black box off the shelf if you want to, but it's nice to have a full set of manuals that tell you how to troubleshoot and repair your radio in case something goes wrong.

My last technical note about radios has to do with EMP, the electromagnetic pulse generated by a nuclear explosion, discussed in chapter 2. There is a very real possibility that the EMP from an explosion many, many miles away could destroy your electronic equipment if you don't protect it. I have seen comments in civil defense literature to the effect that disconnecting antennas and power leads during the attack will protect the equipment and that small radios won't be affected, but my contacts in the defense electronics industry tell me otherwise. If you want to protect your radio equipment from EMP, they say, you'll have to disconnect it and store it inside a closed metal cabinet which has been electrically grounded. Nothing else will do. My suggestion would be to store a few handi-talkies and portable radios in a metal footlocker and solder a conducting strap from the box to a water pipe.

The radio room should be located in some part of the shelter that can be isolated from the general living/sleeping area. The radios will have to be operating even when people need quiet for sleeping, and in the daytime the radio operator may need quiet in order to hear faint signals. Having the communications center in a separate room is best.

With the exception of routine checks with the security team, all activity in the radio shack should be logged, with detailed written notes of the time, radio frequency, and content of all messages in and out. It will be important to be able to follow the broadcasts of particular stations, and without written records, you will be unable to relocate many of them.

During the phase when your group members are entering the refuge, it might be a good idea for them to announce their arrival (probably over CB radio) before driving in. Your communications officer will need to monitor the pre-selected channel and let those arriving (and the security team) know that they are expected. This will be your opportunity to prepare a reception for any unexpected cars which may be tailing them.

Security

Most retreaters are naturally inclined to consider security a very important aspect of all phases of emergency planning. I was a little surprised to discover that the official shelter management text, too, devotes a lot of space to the subject of securing the shelter against unwanted outsiders. Once again, though, the official version quickly loses touch with reality. One of the suggested ways to deal with outsiders was to exchange people from the shelter with people from outside to "equalize" their exposure to radiation. I suspect that once inside, no one would agree to being rotated outside, and that the people outside would not agree to wait quietly until they could be rotated inside.

A retreat group of any size should have a well-organized security team. Typically, there is one member of each survivalist family who is security-conscious to the point of having some skill with firearms. A security team composed of one member of each family is a very democratic arrangement which leaves no one feeling left out or at the mercy of the people wearing the guns. If you can organize your team that way, it will be a good arrangement.

What are the duties of the security team? Actually, they are quite varied. For one thing, the security team meets and guides incoming retreat members, directing them to their quarters. The security team controls entrance to the shelter to be sure that everyone's exposure time to external radiation is properly logged and that incoming persons have been decontaminated. Food, water, and medical supplies should be constantly, but inconspicuously, kept under guard. During sleeping periods, one or two security team members patrol the shelter and keep watch over the sleepers, on guard against ventilation failure or fire. The team also checks on patients while the medical personnel are asleep.

As the group leader, you may be forced to call on the security team to deal with a destructive or dangerous member of the group, someone whose refusal to abide by the rules endangers everyone's survival. Your action in this case will have to depend on the seriousness of the offense. A very minor infringement of the rules which occurs only once can probably be ignored. Repeated minor offenses might be solved by a quiet talk with the offender or the offender's family—social pressure can usually bring people into line.

For the hard cases, there is no other resort other than arrest and confinement. Someone who insists on taking more than the allotted share of food or water and who cannot be reasoned with is threatening the survival of the group. Not only does this person deplete the survival stockpile, but the contention produced creates dissatisfaction and unrest. Arrest and confinement, placing the uncooperative individual under direct control, is the only thing you can do. Be sure that the survival rationale of the arrest is clear to the group.

Why confinement? Consider your other alternatives: You can't throw the offender out into the fallout because this individual is somebody's friend or relative. (He or she wouldn't be a member of your retreat group otherwise.) Even if the troublemaker is a stranger, it is a mistake to consider expulsion as a solution. As soon as you exile someone, the members of the group who disagree with your leadership will start to think you might do it to them. There goes your authority and group morale in one blow. Other actions will have equally serious consequences to morale. Don't even think about physical punishment, boot-camp harassment, mock jury trials, orwithholdingsurvival supplies. Just lock up the offender. When you let the troublemaker go again is up to you.

The most important duty of the security team is to form the nucleus of your defense in case of an attack by outsiders. You have the option of admitting strangers, of course, but if you decide not to allow anyone else into the refuge, the responsibility of turning the supplicants away will fall on the security team. The best approach will be to direct strangers to some other potential source of safety, such as the nearest town with a CD office. Many of the people who will arrive seeking help will really need only a minimum amount of advice, after which they will be able to save themselves. You may be able to prevent many desperate confrontations simply by having a few dozen sets of survival instructions ready to hand out to unprepared neighbors. If you tell them how to help themselves, many people will go away and leave you alone. If not, you can always fall back on the techniques discussed in chapter 7.

Medical Care

The first duty of your medical personnel will be to break out the medical supplies and familiarize themselves with the kind, quantity, and location of the materials at hand. They should also take a few moments to meet and briefly examine the arriving group members. Many incipient medical problems can be nipped in the bud right there.

You should set up a sick bay in an isolated corner of the shelter where the main part of your group will not be exposed to patients (and vice versa). There are very important reasons for this isolation, in addition to the obvious benefit to the recuperating patients. For one thing, in a restricted environment such as a basement or other typical fallout shelter, you will be in definite danger of an outbreak of respiratory disease. People with cold or flu symptoms must be isolated from the main group to slow down or prevent the spread of these diseases. You might have enough penicillin to treat one pneumonia victim, but without isolation you could wind up with twenty. Then what would you do?

Another reason to isolate patients has to do with the psychological effect on the healthy members of the group. If the members of your retreat group have been exposed to fallout on their way to the refuge (or fear that they have), the first person who vomits will terrify everyone. Since it is natural for people to become sick when confined in an enclosed space with the smell of vomit, one incident can trigger a rash of vomiting. It is not far from that to a panic over imaginary radiation sickness. Segregating people who feel sick can help prevent this. (Be sure everyone knows that radiation sickness is not contagious.)

If you have group members who have been injured by direct weapons effects, especially severe burns, isolating them from the rest of the group will help the group avoid the demoralizing shock of being constantly exposed to severely injured or disfigured patients. This is part of the reason for being a retreater in the first place—to avoid witnessing the human suffering that will be created by the attack. The leader's goal is to calm and reassure the people in the group, not to horrify and shock them. Isolate the badly injured.

Once you have set up your sick bay, you will need a second medical area in which to examine and treat your "outpatients." If you have segregated the truly ill and injured, it doesn't make much sense to parade the healthy ones through the sick bay just to give them aspirins. You might think of this second area as an "examination room." It will need good lighting and privacy. Your medical stores can be kept in this area.

The medical team should keep a detailed log of the condition, symptoms, and treatment of each patient, including a careful account of the medication issued. This will help you describe the patient's condition if you have to radio for medical advice, and it will give the on-duty medical attendant a complete record of everything that has happened since the last shift began. Incidentally, if you place the radio room next to the examination room, radio links to a remote doctor will be made easier.

What do you do if someone dies?The signs of death observed in the patient should be carefully described in the medical log and witnessed, signed, and dated by the medical team, the group leader, and the next of kin of the deceased. The next of kin should receive the personal effects of the deceased, except for those which could spread disease or which have been fouled or damaged by the patient's condition. The body should be covered, wrapped in its own bedding, and stored out of sight. If placed in a cool location, the body will keep for at least a day or two, until you have sufficient time to allow a brief burial expedition outside. The radiological defense team will have something to say about the timing and duration of any such foray. In most locations there will be very little problem in disposing of the dead.

It will also be the responsibility of the medical team to supervise the general living conditions within the shelter to prevent any possible threat to the health of the group. This means they will have the right to "prescribe" such non-medical measures as baths, de-lousing treatments, and changes in food preparation or storage methods if necessary. Any step the medical team can justify on the grounds of health relates directly to the survival potential of the group. That includes making Johnny wash behind his ears—and Johnny's father, too, if necessary.

One duty which could fall to your medical team is the grisly job of "triage." If your retreat plans go radically astray, you may be faced with treating many badly hurt group members. The medical personnel will have to decide who can be saved and will have to withhold the priceless medication from those who cannot be helped. Their decision is final—but be ready to have the security team back them up. Some of the relatives won't be inclined to agree with the medics.

Distribution of Food and Water

The group leader will find that water will be one of the greatest worries. Your people will be able to live without food for weeks, and without medical attention for possibly many years, but without water, your adventure will be over within a week.

By far the best situation is to have access to a deep well at your refuge. In that case, you can use all the water you want without imposing restrictions. If you have to rely on a limited supply, however, you will have to manage its use very carefully. Modern Americans use water like the ever-present resource it has always been to us; without strict rationing, your group could go through a six-month supply of drinking water in a week.

If your supply is limited, you should institute a basic ration of one-half gallon of drinking water per person per day, doled out in six servings of about ten ounces at snack and meal times. If water is in short supply, you can cut this ration down to one quart per day, but only if conditions are ideal. This means that the temperature is comfortable, that there is little physical exertion to be performed, and that the shelter diet is restricted to high carbohydrate foods. (Protein requires water for digestion.) Don't cut the ration any further than one quart per day. Having people die of thirst before the water runs out is inexcusable.

Make it clear to everyone that the medical team may prescribe water as a medicinal resource to persons performing hard physical labor or to members suffering from burns, injuries, or diarrhea. Be extremely careful to see that the distribution of the water ration is meticulously fair otherwise, because if it is not, you will soon have a tense situation on your hands. Everybody gets half a gallon a day. Period.

Of course, if your resources will stand it, your management problems will be made less difficult if you double this ration. A gallon a day is plenty to drink and leaves some extra for shaving, sponge baths, and perhaps a minimum of laundering. You might offer group members the choice of a rigid allowance or a more flexible arrangement in which they may use water at their own rates—as long as they don't exceed the daily limit. This approach allows individuals to "save up" extra water for personal uses, but it also requires that someone who is above reproach keep track of everybody's water allowance.

For sanitary purposes it is desirable that members of the group have their own water cups, and that water be poured into the cup, not the cup dipped into the water.

Contaminated water from outside the shelter (from a stream, lake or swimming pool) should not be used for drinking, cooking, or brushing teeth, but it is all right for utilitarian uses such as fallout decontamination, laundry, fire fighting, sanitation, and bathing. Just be sure that you strain it through cloth first to remove fallout grains. Remember that any water you devote to sanitation can first be used for washing dishes, clothes, diapers, or people. It will be safe to drink fallout contaminated water after two or three weeks, but it would still be best to treat it as described in chapter 5 first.

Advice about the preparation and serving of food is probably the area in which official shelter management policy is most noticeably lacking. Apparently, some bureaucrat discovered that if you starve people they will need less water, go to the toilet less frequently, and be too weak to cause trouble. From this discovery sprang the crackers-and-candy 700-calorie-per-day shelter diet. If you have any sense, you won't follow this example.

The preparation of food is probably the one area of shelter living which can be of the greatest aid to the group leader. By planning the retreat food stockpile to consist mainly of foods which require much preparation, you can keep people busy preparing, serving, and cleaning up after meals for four hours or more each day. Stocking your emergency larder with cans of heat-and-serve spaghetti is okay, but stocking dry spaghetti noodles and packets of dry sauce ingredients will help you keep people busy during times when activity will be a blessing. Keep the concept in mind while you are planning.

As is the case with water, food should be distributed with absolute equality, except in the case of individuals who clearly require more than their rightful shares. The medical team should have the authority to prescribe extra rations to their patients, pregnant women, lactating mothers, and persons who have been performing heavy labor on behalf of the group. (In some cases, teenaged boys might also be allowed a little extra to eat, too. They need it.)

There is one potentially disastrous calamity which can arise from group meal preparation under survival conditions. If your refrigeration is not good (or is non-existent), or if your cooking ware and eating utensils are not kept scrupulously clean, you may develop food poisoning. The medical team will have to be on the alert for this possibility at all times, and it will be their duty to inspect all kitchen equipment before and after each meal. Also, the shelter leader should see to it that at least one member of the medical team eats a selection of food that is completely different from the main menu at each meal. If the rest of you suddenly get sick, there will be at least one medic available.

Morale will be better if the food has variety and is not too unfamiliar. Small children are notorious for refusing novel food, and under tense circumstances even adults may lose their appetites—when confronted with whole wheat gruel, to name an example. There will be a natural tendency to eat the "good" food first and leave the bulk of the stockpile for later—when the monotony of canned carrots meal after meal will be unbearable. See that it doesn't happen.

Sleeping

The amount of time you allow for sleeping may have to vary somewhat for the first few days. At first, the members of your group will be feeling anxious and uncomfortable, and if they cannot sleep during the first or second night, you may be inclined to schedule ten hours of sleeping time later on to make up for what was lost. Be flexible.

As a well-prepared retreat group, you ought to have separate sleeping quarters for each family group to preserve privacy. If you are forced by circumstances to resort to community sleeping, your problems will be greatly increased. If you can't supply separate, enclosed sleeping areas for each family, at least screen off three areas to separate unmarried males, unmarried females, and family groups. Group morale will require some such arrangement.

As for equipment, every individual should have a complete set of sleeping gear (mattress, blanket, pillow, sleeping bag, etc.). There should be several extra sets, too, to provide changes of bedding for sick persons and small children.

If the group will have to spend an extended amount of time living in a crowded shelter, it may be wise to allow an outlet for sexual needs and other activities requiring privacy. A "private area" out of sight (and sound) of the main group is an adequate solution. Just be sure there is somewhere people can go to be absolutely alone if they really feel the need.

During the hours allotted for sleep, the members of your group should be strongly encouraged to respect one another's rights to quiet and darkness. Some fairly specific rules might be needed to define these rights, and the security team night patrol should quietly enforce them. Remember that the idea here is to give everybody the best possible chance to get a good night's sleep; this goal can be jeopardized by both over-enforcing and under-enforcing the rules.

One thing to think about in your preparation of the refuge is the fact that large utility storage shelves can be used to store supplies before the emergency, and can be quickly converted to bunk beds after occupancy begins. With a little ingenuity your storage shelves can be designed to double as Pullman berths, giving a measure of privacy to the sleepers and a place they can think of as their own. This also saves floor space.

If you do use bunk beds, be careful to check the radiation dose of the upper bunks. You may have to put everybody on the floor for the first day or two until it becomes safe to sleep that close to the ceiling of the shelter. (See figure 16 for an illustration of radiation levels in several basement areas.)

Training

The suggested shelter schedule advises that several time periods during the day be devoted to "training." What does this mean?

Persons in a retreat group about to emerge into the realities of a post-nuclear-war era will need to be taught how to survive in the new circumstances they will encounter. A well-prepared retreat group will assign a team of qualified people to lead training sessions in which the specialists systematically educate the rest of the group members in the skills they will need to exist, cope, and survive in their new way of life.

A training program also gives people something to do. Teachers will spend some of their off-duty time framing their lesson plans, and trainees will spend time discussing and reviewing after each class. Even if there is no actual benefit derived from the content of the classes, the activity produced is worth the effort.

At first, training should concentrate on two topics. The first is life within the shelter or refuge. What are the rules? What is the routine? Where are certain features of the shelter located? How do you operate a chemical toilet? How do you start the generator? How do you use a Coleman stove? A two-way radio? A survey meter?

The second topic concerns the real world effects of nuclear weapons. It will be important to advise the trainees about the factual implications of a nuclear war to dispel some of their fears. You might simply read out loud a few excerpts from chapter 2, chapter 4, and Appendix E of this book. Don't let your people sit and worry about the pseudo-dangers they have seen in the movies. That would certainly be damaging to morale.

Another important topic to cover immediately is firearms safety. If you intend to have a "ready rack" of loaded rifles and shotguns for defense, you will need to drill everyone in the fundamentals of gun safety. Ideally, a retreat group would consist entirely of skilled National Rifle Association members who have been handling weapons since they were pre-schoolers, but in real life you can expect that half of your group will be incompetent with guns. You must train them at least well enough to make it safe to leave guns and novices alone in the same room. (This is particularly true of children and pacifists.)

Later on, the emphasis in training can be shifted to the skills the trainees will need in order to survive outside the shelter. If you intend to live by farming and hunting, you will have to educate your people in the theory and skills they will need in order to "return to the land." Be sure that you teach at least a few people the more technical details (such as genetic breeding) in case your resident farmer has a fatal accident. You will also want to select a certain number of hunters and start teaching them the rudiments of good marksmanship using pellet guns.

Lastly, the education of children must go on. They must be taught to read at the very least; without the skill of reading, they will be unable to consult your technical library, notes, and medical manuals after you are gone. If your group is planning for long-term self-sufficiency, at least buy a set of phonic reading books, phonic flashcards, and an illustrated dictionary. You won't regret the expense.

Recreation and Special Activities

The official shelter management text makes life in a crowded fallout shelter sound like summer camp. Group reading, group singing, story telling, macrame, poster painting, mobile making .... A well-prepared retreat group can do a lot better.

You may already have thought of a reading library as a way to pass the time, and under the right circumstances a large selection of paperbacks could be a definite survival resource both for individual and group reading. Don't forget, however, that only about 10 percent of the American public reads for recreation. There may be people in your group whose eyesight is too poor for them to enjoy reading. Others may be too young to be able to read. Still others may just not like to read. You will need other forms of recreation for such people.

If your group has made careful preparations ahead of time, it should be possible for you to provide a wide variety of recreational resources. If you have a generator, you can use any kind of electronic entertainment you happen to like. An electronic television game (ping-pong, target shoot, tank battles, etc.) will keep children busy for hours. A videotape recorder/player and fifty cassettes of movies would be a tremendous recreational resource. One two-hour escapist-type movie each evening will make your days pass much more quickly. Just be sure that you exclude nuclear war horror stories from your tape library.

Recorded music can be a great morale booster if you use it correctly. Singing along with Mitch is out of vogue right now, but the sense of solidarity produced by group singing should not be overlooked. For whatever reason, it is a fact that group singing creates a spirit of unity that is difficult to produce any other way. Having a few musical instruments laid away is also a good idea.

The wrong way to use music is to "pipe it in" constantly, giving your shelter the air of a dentist's office. About half the people in your group will love it, but the other half will go crazy. Conflicts in taste can escalate to serious tensions if you aren't watching for them.

You will also find that a major source of recreation will be provided by the communications equipment. People will be unable to resist fiddling with the shortwave receiver in search of news from the outside world. You should purchase at least one portable shortwave radio that anyone in the group can use. Remember that you will have to restrict access to the radio shack to prevent potential accidents with the radio equipment.

Active games and exercise will help relieve some tension in the shelter, but you can only allow them if the ventilation team thinks it can handle the extra heat and humidity that will result. A week or two of inactivity will not hurt anybody, but if you intend to become hunters and farmers during the post-war period, you might feel the need for physical training. Have the medical team supervise the exercise sessions, and don't let the "coach" coerce or cajole the flabby people. Members should be encouraged to progress at their own speed, with the medical team keeping a sharp lookout for signs of over-exertion or heart disease. The signs to watch for are pulse rates greatly in excess of 160 beats per minute during active exercise and/ or pulse failing to return to normal within about five minutes.

You may find that some of the survival training sessions will quickly become recreational in nature. After you have begun to use a BB gun to teach marksmanship, you may find that it will also be in service during free-time periods. The toil of preparing meals may, if handled correctly, soon become a challenge to some of your group members. Your cooks may soon make it a point of pride to serve "impossible" foods such as doughnuts, cakes, meatloaf, and chops made of whole wheat flour, sugar, milk, and dried soup mixes. It can be done.

Religious services also fall into the category of "special activities." The religious behavior of your group is something you should take into account in advance. Unless you are all members of the same church, you will have to handle your religious differences with some tact. Non-denominational services or prayers (at mealtime, for example) can usually be accommodated without offending anyone, particularly if the duty is rotated among the different factions represented in the group. Services characteristic of a particular religion would be better conducted in private if that can be arranged.

Don't make the mistake of thinking that just because your group happens to be composed of atheists, agnostics and Sunday golfers that you will not need a Bible and prayer book. You may find that your group will feel an overwhelming need for the "proper" services if you have a death, or later on, a wedding.

Management after Emergence

At some point, the outside radiation will decay enough that group members will be able to safely leave the shelter for longer and longer periods each day. This is the period of "temporary emergence," when life within the shelter will be varied by brief trips outside. Living conditions will remain essentially the same, except that you may have access to abundant water from outside for laundry and bathing. Your primary and most difficult duty during this period will be to keep track of each individual's daily radiation exposure and to prevent overanxious group members from trying to leave the shelter too soon. You will also want to have the radiological defense team begin a detailed survey of local radiation levels on and around your property. You may find that there will be both "hot spots" and "cold spots," depending on where the fallout lodged when it fell. During this period of marginal safety, unsuspected hot spots could be very dangerous.

At this point, a peculiarity of radiation dose rate measurement must be considered. Dose rate is supposed to be measured at a height of thirty-six inches above the ground to give a "proper" reading. The reason for this is that radiation exposure from fallout particles on the ground diminishes rapidly with distance. Your feet get a much higher dose than your head as you walk across a contaminated area. Taking the measurement at a level of thirty-six inches gives you an average rate of exposure for an adult male. The body of an adult female is a little closer to the ground and receives 1.2 times the standard dose. That's not too alarming, but the picture changes rapidly as you get nearer the ground. A toddler three feet tall receives four times as much radiation as his or her father, even when they are standing side by side. And a crawling infant is exposed to sixty-four times the adult dose.

Clearly, a dose rate measurement for each individual should be taken at that person's midbody level. If the dose rate is barely safe for adults, don't expose children to it. If you must take them across such a contaminated area, you should carry them—a toddler sitting on an adult's shoulders receives only one-fourth of the standard adult dose.

One more thing—don't lie down out there. If you wait until the standard dose measurement reads 0.25 R per hour (the level which a person can tolerate indefinitely in a nuclear war context), you'll expect to receive only 6 R of exposure each day. But if, glad to be out of the shelter, you spread out your sleeping bag on contaminated ground and spend the night, you'll expose yourself to 128 R before morning. Four nights spent on the radioactive ground would certainly kill you, even though the survey meter (at thirty-six inches above the ground) says it's safe.

During this period you may want to keep your primary security team inside the shelter as much as possible. Their inclination will be to get out there and "patrol the perimeter," but it would be better to restrain them and send second-string defenders to be the lookouts. You must shield your best fighters from radiation exposure as a general policy because (1) you don't want to take any chances that they will develop radiation sickness, and (2) if worst comes to worst, they may have to expose themselves to outside radiation for dangerously long periods. Every hour you protect them during this period will be another hour that they will be able to safely spend outside in an emergency.

The time will eventually come when the radiation dose rate has fallen below 6 R per day. At that point, it will be possible to leave the shelter for as long as necessary, or even permanently, if you wish. It will be wise to at least sleep in the shelter, but you will be able to spread out to more roomy ground-level quarters in the daytime. This expansion into additional living space will simplify problems of privacy and overcrowding.

After permanent emergence, you will need to reorganize your teams and prepare to meet the new challenges of life outside. Your approach to post-war living will depend largely on your circumstances and on the preparations you have made in advance. Most full-fledged retreaters envision a future of complete self-sufficiency based on gardens, gathering, hunting, fishing, farming, and perhaps ranching. If this is your proposed course, you and your group will have to make some hard decisions about how it is to be done.

Shelter living is, by its very nature, a socialistic process. The survival of the group is the goal, and if your neighbor doesn't survive, then neither will you. Self-sufficient living, however, usually works best as a free enterprise activity. If you don't grow your own food, you don't eat. Trying to mix the two systems can be tricky, especially when the people who have to sweat in the sun all day plowing the fields start to feel bitter about the easy life the hunters are leading. (Remember Cain and Abel?)

When your group is on its feet and you are all living out in the open again, it will be inevitable that you will have dealings with other surviving groups in your area, including refugee groups and local residents. As a retreat group, you will be better equipped for the shift to self-sufficient living than most of your neighbors. It will be in your and their best interests if you make immediate attempts to offer your knowledge and skills to the local government as a gesture of community support. Remember that although you cannot share your food and supplies without jeopardizing your own long-term survival, you can share your knowledge of survival skills without endangering your position. The best possible way to avoid being attacked by starving neighbors is to see to it that they don't starve. Teach them.

Finally, you should be prepared for one staggering responsibility. When you attempt to contact the local government to offer your services, you may discover that, for all practical purposes, you are the local government. It could happen. As a large group of organized and well-trained survivalists in the midst of starving anarchy, you may be sucked into a power vacuum. If so, you will find that your security team has become the core of the local police department, your medical team has suddenly become the health department, and your food-and-water team has assumed the duties of county agents. The radiological defense team may be guiding decontamination efforts; your communications people may be setting up telephone, telegraph, or radio links to surrounding homesteads and communities; your training staff may be badly overworked teaching survival skills; and you, poor benighted soul, will be wondering how buying a few bags of wheat and a shotgun could have catapulted you into such a mess. Good luck.

Commentary

This is the final chapter of Life After Doomsday, and before closing I would like to discuss two subjects which didn't quite fit anywhere else in the book. The first is what I call the Leibowitz project; the second is the problem of finding a solution to the arms race.

There is a recurrent theme in survival fiction in which someone carefully selects and preserves an assortment of books intended to help civilization rebuild after the disaster. This theme appears in A Canticle for Leibowitz,[7] Lucifer's Hammer,[8] and The Time Machine,[9] to name only three examples. It is also an important theme in medieval history. We are familiar with the ancient Greek and Roman classics only because the books were deliberately preserved through the Dark Ages by monks and others who recognized their worth.

The Leibowitz. project is my informal attempt to see that the knowledge essential to civilization's recovery aftera nuclearwar will be available when it is needed. To this end I propose that you select three books as a legacy for the future. The first two books should be a reference book and a textbook relating to your profession; that way you can pass on the knowledge of the field you know best. The third book might be anything. It could be a book about history, art, religion, science, poetry, philosophy, or even fiction. When you have selected your three books, buy a new hardback copy of each. Treat each book with insecticide, wrap it in several layers of plastic and foil, and seal it airtight. Label the package well. Then store it in a safe place. Maybe, someday, we'll all be glad you did.

As for the arms race, I find each of the three typical "solutions" to be unacceptable. I think waiting passively to see what happens is suicidal; unfortunately it is a very common policy. As far as I can see, the result of disarming ourselves to avoid the war would be eventual capitulation. In my opinion, people who believe otherwise are being idealistic to the point of mental incompetence. The only other "solution" I have encountered is the Russian one: Get ready to fight the war and win it. That is a chilling alternative, and if we eventually decide to pursue it, decades will pass before we catch up to our opponents.

A fourth alternative, of course, is the one represented by this book; but I retain the hope that there must be some solution other than preparing for the worst. We must continue to seek another way out of the nuclear arms race, and not simply sit back on our supplies and watch the world drift gradually toward nuclear war. Having read Life After Doomsday, you are aware that personal survival of a nuclear attack is quite possible—but it requires a lot of effort. If you are willing to expend the effort getting ready for the war, why not make an effort to help prevent or avoid the war, too? Somewhere there must be a feasible course of action lying between the unacceptable alternatives of decimation and capitulation. A contribution of yours might help find it.

The largest single obstacle to finding such a solution is the fact that most Americans are abysmally ignorant about nuclear weapons. After reading this book, you no longer fall into that category. You could make a substantial contribution to the nuclear arms question by using your knowledge to educate your friends. The next time you hear people repeating the "no survivors"[10] myth, challenge them. Do they really know anything about the effects of nuclear weapons'? About fallout? About radiation protection? How about the size and structure of the Soviet and American arsenals? Are they aware of the variety of ways in which such a war might get started? Do they know the truth about the long-term effects of radiation exposure, or do they rely on nuclear superstitions? Do they have a realistic grasp of the number and distribution of nuclear targets in their area? What about ecological effects? You will find that most people are almost totally ignorant of even the most fundamental realities of nuclear war. You can help correct that.

I spent over a year writing this book to educate you about these topics. Do me the courtesy of spending ten minutes passing on some of the information to a friend. It will be time well spent.

Notes

1. Shelter Management Textbook, Office of Civil defense, SM-16.1, July 1971—Dl 19.8/8:16.1.
2. Cresson, Kearny, et al., A Homemade Fallout Meter, the KFM: How to Make and Use It (Oak Ridge, Tennessee: Oak Ridge National Laboratory, n.d.).
3. You can pay 120 dollars for this radio in a department store, but Unity Buying Service Company, Inc. offers it for about 75 dollars. Write Unity at PO Box 2000, Camarillo, California 93010.
4. For the location of weather alert stations, see figure 9 (in chapter 3). See also Consumer Reports, August 1978, pp. 459-61 for an excellent review of weather radios.
5. Information on the Heathkit models may be obtained from the Heath Company, Benton Harbor, Michigan 49022.
6. Jim McKeever has called my attention to an article in the MISL about the benefits of storing frozen food in a fallout shelter. The idea is that a small freezer filled with pre-cooked food, medicines, and flashlight batteries simplifies some of the problems of shelter living. Even without electricity, the food will take three or four days to thaw if the freezer is kept shut. Keep in mind, however, that some medicines can't successfully be frozen. Dry tablets, particularly, should not be frozen. (See table 14 in this regard.)
7. Walter M. Miller, Jr., A Canticle for Leibowitz. Bantam, 1961.
8. Larry Niven and Jerry Pournelle, Lucifer's Hammer (New York: Fawcett Crest Books, 1977).
9. H. G. Wells, The Time Machine. I refer to the motion picture, not the book by H. G. Wells.
10. Bruce D. Clayton, "Planning for the Day After Doomsday," The Bulletin of the Atomic Scientists, Sept. 1977, pp. 49-53.

APPENDIX A
Nuclear Target Areas within the United States

The following information was compiled from various publications of the Defense Civil Preparedness Agency (DCPA), the Strategic Air Command, the United States Senate, and the Library of Congress. All of the data were in the open literature; there are no government secrets revealed here. The primary source was High Risk Areas for Civil Preparedness Nuclear Defense Planning Purposes (DCPA, TR-82, April 1975). All high priority targets were double-checked against Analysis of Effects of Limited Nuclear Warfare (United States Senate Committee on Foreign Relations, September 1975).

Figure 35 shows the extent of areas of direct weapon effects in which an unprotected human would be in danger of injury. However, 300 tertiary targets not shown on this map are discussed in the text. Do not overlook these targets in your survival planning. In the list that follows, the radius of danger is assumed to be ten miles unless the target is marked with an asterisk (*). In that case, the danger radius is twenty miles. Note that some danger areas cross state boundaries.

, Primary targets are military bases, missile silos, and command posts which the Soviets may attack without warning in an effort to disarm us. These areas will certainly be hit in any nuclear exchange. Persons living near these targets will receive virtually no warning before the incoming warheads explode.

Secondary targets are military installations and cities which have high military value but which do not house strategic weapons. These areas might not be attacked in a first strike, but would be reserved for subsequent bomber or missile attacks with the object of reducing our ability to fight a prolonged conventional war.

Tertiary targets are non-military cities whose residents can be held hostage for purposes of nuclear blackmail. The object here would be to destroy cities one by one in every state until Congress was clamoring for peace at any price. If this course of action sounds unthinkable, remember that it is exactly what we did to the Japanese at the end of World War II.

The High Risk Areas manual designates 175 counties which could receive extremely high levels of fallout radiation. I have chosen not to reproduce this list here because, in my opinion, the information is very poor. The DCPA researchers made assumptions and used statistical techniques which have very little to do with reality; problems were compounded by inappropriate graphics and slopping printing practices. The results are misleading and potentially dangerous from the standpoint of survival planning. The fallout prediction method described in chapter 3 is much more reliable.

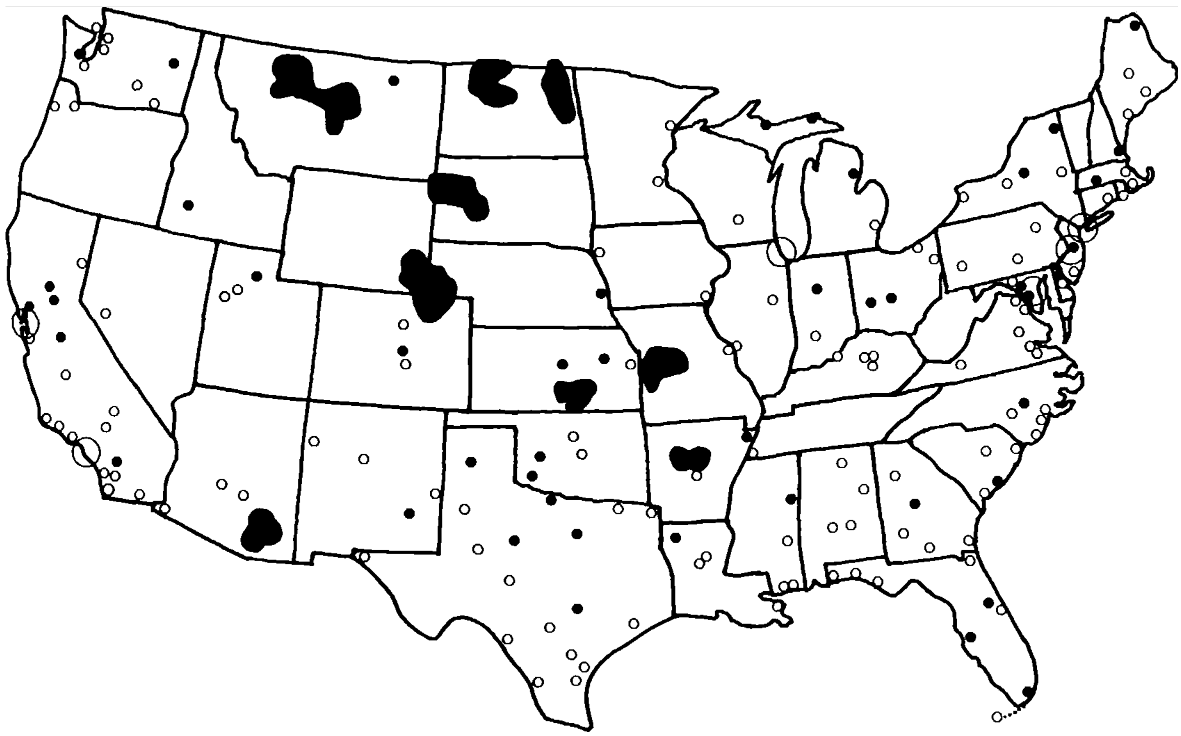


FIGURE 35: Military target areas within the United States. Solid black areas represent primary targets; open circles represent secondary targets. Refer to the text for exact target locations and for the location of tertiary targets which should not be overlooked in survival planning.

Note that the Air Force bases designated as stratotanker bases or heavy bomber bases involve an additional fan-shaped high-risk area extending about 50 miles north of each base. Medium bomber bases have an additional high-risk area extending 100 miles north of each base. Danger in these areas is caused by the possibility that the Soviets will attempt to knock down our bombers and ta'nkers shortly after they are launched. The danger areas represent a five-minute flying time radius from each base, within which nuclear air bursts might be expected during the first few minutes of the attack.

This list covers 1,108 primary targets (54 bases and 1,054 silos), 142 secondary targets (bases and industrial areas), and 300 tertiary targets (cities). That's 1,550 in total.

ALABAMA

Primary: None. Secondary: Anniston, Selma, Huntsville,* Montgomery. Tertiary: Muscle Shoals, Gadsden, Childersburg,* Tuscaloosa, Phenix City (Columbus, Georgia), Mobile.

ALASKA

Primary: None. Secondary: Adak Island, Anchorage, Fairbanks, Shermya Island (space radar), Clear (BMEWS radar). Tertiary: None.

ARIZONA

Primary: Davis-Monthan Air Force Base complex at Tucson (Titan missiles; including the entire area within a line connecting Nogales, Cochise, Mammoth, Eloy, south to the Mexican border). Secondary: Gilbert, Perryville, Yuma. Tertiary: Phoenix.

ARKANSAS

Primary: Little Rock Air Force Base complex (Titan missiles, including the entire area within a line connecting Shirley, Newport, Des Arc, Little Rock, Russellville, Nogo, and Shirley again), Blytheville Air Force Base (heavy bombers). Secondary: Pine Bluff, West Memphis (Memphis, Tennessee). Tertiary: Fort Smith, Texarkana, Little Rock.

CALIFORNIA

Primary: Travis Air Force Base at Fairfield (stratotankers). Castle Air Force Base at Merced (heavy bombers), Mather Air Force Base at Sacramento (heavy bombers), Beale Air Force Base at Marysville (heavy bombers and PAVE PAWS radar), March Air Force Base at San Bernardino (heavy bombers). Secondary: San Francisco area (including everything within a line connecting Pt. Reyes Station, St. Helena, Antioch, Palo Alto, Redwood City, and—up the coast—Pt. Reyes Station again), San Jose, El Centro, China Lake, Edwards Air Force Base (space camera), Lemoore, Portola, Los Angeles area (including everything within a line connecting Malibu, Camarillo, Lake Arrowhead, Perris, Laguna, and—up the coast—Malibu again), Oro Grande, Oceanside, San Diego,* Lathrope, Santa Barbara, Oxnard, Ventura, Thousand Oaks, Mt. Laguna (474N radar), Mill Valley (474N radar), Vandenberg Air Force Base (satellites). Tertiary: Milford, McClellan Air Force Base, Sacramento,* Santa Rosa, Modesto, Stockton, Salinas, Monterey, Fresno, Ridgecrest, Bakersfield, Mojave, Lancaster, Wrightwood, Barstow, Yermo, Victorville, Banning, Warner Springs, Gilroy.

COLORADO

Primary: Warren Air Force base complex (Minuteman missiles; including everything within a line connecting Grover, Briggsdale, Fort Morgan, Sedgwick, and—along the state line—Grover again), Colorado Springs (North American Air Defense Command Headquarters).* Secondary: Denver, Pueblo. Tertiary: Greeley, Boulder, Aurora, Cheraw, Pueblo-Boone area, Broomfield, Rocky Flats (target is ten miles west of Sedalia).

CONNECTICUT

Primary: None. Secondary: New London (submarine factory). Tertiary: Hartford,* Bristol,* New Haven,* Stamford, Norwalk, Bridgeport, Danbury.

DELAWARE

Primary: None. Secondary: Dover. Tertiary: Wilmington, Odessa, New Castle.

FLORIDA

Primary: Homestead Air Force Base, McDill Air Force Base at Tampa (474N radar), McCoy Air Force Base at Orlando. Secondary: Panama, Cocoa Beach, Jacksonville, Pensacola, Key West, Elgin Air Force Base at Ft. Walton Beach (FPS-85 radar, space radar). Tertiary: Port St. Joe, Tallahassee, Gainesville, Daytona Beach, Cape Canaveral, Titusville, Tampa,* Sarasota, Ft. Myers, Palm Beach, Miami, Boca Raton, Fort Lauderdale.*

GEORGIA

Primary: Warner-Robins Air Force Base at Macon (heavy bombers). Secondary: Atlanta,* Albany, Brunswick, Valdosta (target is ten miles northeast of Valdosta). Tertiary: Augusta, Columbus, Savannah,* Stockbridge, Marietta.

HAWAII

Primary: None. Secondary: Honolulu area (includes all of Oahu except the Waimea-Kahuku area and Makapuu Point). Tertiary: None.

IDAHO

Primary: Mountain Home Air Force Base. Secondary: None. Tertiary: Boise.

ILLINOIS

Primary: None. Secondary: Chicago,* Rantoul, East St. Louis.* Tertiary: Freeport, Rockford, Zion, Decatur, Moline (Davenport, Iowa), Peoria, Bloomington-Normal, Champaign, Springfield, East Dubuque (Dubuque, Iowa), Alton, Joliet,* Aurora, Elgin, Des Plaines.

INDIANA

Primary: Grissom Air Force Base (stratotankers, located about ten miles southwest of Peru). Secondary: Jeffersonville (Louisville, Kentucky), Crane. Tertiary: Gary,* South Bend, Elkhart, Fort Wayne, Lafayette, Muncie, Anderson, Indianapolis,* Terre Haute, Evansville,* New Albany.*

IOWA

Primary: None. Secondary: Burlington, Sioux City. Tertiary: Waterloo, Dubuque, Cedar Rapids, Des Moines, Davenport. Council Bluffs (Omaha, Nebraska).

KANSAS

Primary: McConnel Air Force Base complex at Wichita (stratotankersm Titan missiles; including the entire area within a line connecting Eureka, Arlington, Attica, Caldwell, Arkansas City, and Eureka again). Schilling Air Force Base at Salina, Forbes Air Force Base at Topeka. Secondary: Olathe. Tertiary: Elwood (St. Joseph, Missouri), Leavenworth, Manhattan, Topeka, Kansas City,* De Soto.

KENTUCKY

Primary: None. Secondary: Louisville,* Lexington (and another target ten miles east of Lexington), Richmond. Tertiary: Covington (Cincinnati, Ohio), Henderson (Evansville, Indiana), Owensboro, Paducah.

LOUISIANA

Primary: Barksdale Air Force Base at Shreveport (heavy bombers). Secondary: New Orleans,* Alexandria (and another target ten miles northeast of Alexandria). Tertiary: Baton Rouge,* Sterlington, Monroe, Lake Charles, Lafayette, New Iberia.

MAINE

Primary: Loring Air Force Base at Limestone (heavy bombers), Kittery (Pease Air Force Base at Portsmouth, New Hampshire). Secondary: Brunswick, Franklin (target is about five miles northwest of Franklin), Charleston (474N radar). Tertiary: Bangor, Auburn, Portland.

MARYLAND

Primary: Mt. Weather complex (Presidential survival command post located fifty miles northwest of Washington, DC on the Appalachian Trail), Washington, DC. Secondary: Patuxent, Fort Ritchie,* Baltimore-Washington area (including everything within a line connecting Gaithersburg, Reisterstown, Bel Air, Aberdeen, Rock Hall, Annapolis, La Plata, Riverside and the Virginia state line). Tertiary: Lexington Park.

MASSACHUSETTS

Primary: Westover Air Force Base, near Holyoke. Secondary: Otis Air Force Base (PAVE PAWS radar), Boston.* Tertiary: Springfield,* Worcester,* Fitchberg, Lowell,* Pawtucket (Providence, Rhode Island),* New Bedford, Nantucket.

MICHIGAN

Primary: Kincheloe Air Force Base at Kinross (heavy bombers), Wurtsmith Air Force Base at Oscoda (heavy bombers), K.I. Sawyer Air Force Base at Gwinn (heavy bombers). Secondary: Mount Clemens. Tertiary: Detroit area (including everything from a line connecting Pontiac, Ann Arbor, and Monroe, east to the state line), Escanaba, Sault St. Marie, Alpena, Midland, Saginaw, Bay City, Muskegan, Flint, Grand Rapids, Port Huron, St. Claire, Lansing, Benton Harbor, Kalamazoo, Battle Creek, Jackson.

MINNESOTA

Primary: None. Secondary: Minneapolis St. Paul,* Duluth. Tertiary: Rochester, Anoka, Forest Lake.

MISSISSIPPI

Primary: Columbus Air Force Base. Secondary: Biloxi, Gulfport, Meridian. Tertiary: Jackson, Pascagoula, Meridian Station.

MISSOURI

Primary: Whiteman Air Force Base complex (Minuteman missiles; including everything within a line connecting Freeman, Richmond, Arrow Rock, California, Gravois Mills, Osceola, Stockton, Sheldon, Rich Hill—west to the state line—and Freeman again). Secondary: St. Louis.* Tertiary: St. Joseph, Kansas City,* Columbia, Springfield.

MONTANA

Primary: Malmstrom Air Force Base complex (Minuteman missiles; including everything within a line connecting Devon, Highwood, a point ten miles north of Winifred, Winnett, Melville, Neihart, Wolf Creek, Augusta, Ethridge, and Devon again), Glascow Air Force Base. Secondary: None. Tertiary: Missoula, Helena, Butte, Billings.

NEBRASKA

Primary: Warren Air Force Base complex (Minuteman missiles; including the entire area southwest of a line connecting Henry, Oshkosh, and Chappell, to the state line), Omaha (Strategic Air Command Headquarters).* Secondary: None. Tertiary: Lincoln, Dakota City (Sioux City, Iowa).

NEVADA

Primary: None. Secondary: Hawthorne. Tertiary: Reno, Fallon, Las Vegas.

NEW HAMPSHIRE

Primary: Pease Air Force Base at Portsmouth (medium bombers). Secondary: Portsmouth harbor (submarine base). Tertiary: Manchester, Nashua (and all area within twenty miles of Lowell, Massachusetts).

NEW JERSEY

Primary: McGuire Air Force Base at Wrightstown. Secondary: Rockaway area (everything east of a line from Franklin to Somerville, to the state line), Trenton,* McKee City, Philadelphia area (includes everything within ten miles of the Delaware River from Pennsville to Cherry Hill, and within fifteen miles of the river from Cherry Hill to Trenton). Tertiary: Millville, Lakehurst, Scotch Plains,* Colt's Neck, Long Branch, Middletown.

NEW MEXICO

Primary: Roswell Air Force Base. Secondary: Albuquerque, Cannon Air Force Base at Clovis (and the area east to the state line), Gallup. Tertiary: Alamagordo, Las Cruces.

NEW YORK

Primary: Plattsburgh Air Force Base (medium bombers), Griffiss Air Force Base at Utica-Rome (heavy bombers).

Secondary; New York City area (includes everything south of Stony Point and west of Stony Brook to the state line), Watervliet, Buffalo, Syracuse.* Tertiary: Massena, Niagara Falls, Rochester (includes the area south to Henrietta), Albany, Troy, Schenectady, Binghamton, Brookhaven (within ten miles of Brookhaven National Laboratory).

NORTH CAROLINA

Primary: Seymour-Johnson Air Force Base at Goldsboro (heavy bombers). Secondary: Cherry Point, Fayetteville(Fort Bragg), Southport, Jacksonville-Midway Park area, Ft. Fisher (474N radar). Tertiary: Winston-Salem, Greensboro,* Graham, Durham, Morrisville, Raleigh, Asheville (south to Hendersonville), Charlotte, Wilmington, Carolina Beach.

NORTH DAKOTA

Primary: Grand Forks Air Force Base complex (Minuteman missiles, including the entire area within a line connecting Wahalla, Grand Forks, Tower City, Valley City, Devil's Lake, Sarles, and the Canadian border), also Minot Air Force Base complex (Minuteman missiles; including the entire area within a line connecting Westhope, Eckman, Minot, a point fifteen miles south of Towner, Harvey, Mercer, a point ten miles north of Beulah, Tioga, Portal, and the Canadian border. The danger zone extends about ten miles into Canada between Sarles and Wahalla, and between Portal and Westhope). Secondary: None. Tertiary: Grand Forks, Fargo.

OHIO

Primary: Wright-Patterson Air Force Base near Dayton (heavy bombers), Rickenbacker Air Force Base near Columbus (stratotankers); Rickenbacker is also called "Lockbourne Air Force Base" on some maps). Secondary: Cleveland, Youngstown-Warren area. Tertiary: Toledo (east-northeast from Delta to Lake Erie), Cleveland (everything within twenty miles of Lake Erie from Vermillion to Geneva), Windham, Mansfield, Lima, Steubenville, Bellaire (Wheeling, West Virginia), Middletown, Miamisberg, Dayton, Vandalia, Springfield, Canton, Akron,* Columbia.*

OKLAHOMA

Primary: Altus Air Force Base (stratotankers), Clinton-Sherman Air Force Base near Clinton. Secondary: Oklahoma City, Enid (Vance Air Force Base). Tertiary: Tulsa,* El Reno, Oklahoma City, Lawton, McAlester (target is ten miles southeast of McAlester).

OREGON

Primary: None. Secondary: Portland,* Mt. Hebo (474N radar). Tertiary: Canby, Salem, Eugene, Klamath Falls, Madras.

PENNSYLVANIA

Primary: None. Secondary: Pittsburgh,* Harrisburg, Scranton,* Willow Grove,* Philadelphia.* Tertiary: Natrona Heights,* York,* Waynesboro,* Chester, Erie, Beaver, Johnstown, Altoona, Harrisburg, Mechanicsburg, Lancaster, Reading, Allentown, Bethlehem.

RHODE ISLAND

Primary: None. Secondary: Newport, Quonset Point. Tertiary: Providence,* Westerly.

SOUTH CAROLINA

Primary: Charleston complex (submarine base; including everything east of Summerville between Goose Creek and Folly Beach). Secondary: Parris Island Marine Base at Beaufort, Myrtle Beach, Sumter. Tertiary: Greenville, Greer, Columbia (and a second target ten miles southwest of Columbia), Aiken (target is five miles northeast of Aiken), Hardeeville (everything within twenty miles of Savannah, Georgia), North Augusta.

SOUTH DAKOTA

Primary: Ellsworth Air Force Base complex (Minuteman missiles, heavy bombers; including the entire area within a line connecting Albion, Montana; a point ten miles north of Faith; Midland; a point ten miles south of Velvidere; Scenic; Sturgis; Spearfish; and—along the state line—and Albion again). Secondary: None. Tertiary: Sioux Falls, Rapid City.

TENNESSEE

Primary: None. Secondary: Memphis.* Tertiary: Nashville, Chattanooga, Signal Mountain, Knoxville, Alcoa, Bristol.*

TEXAS

Primary: Amarillo Air Force Base, Dyess Air Force Base at Abilene (heavy bombers), Bergstrom Air Force Base at Austin, Sheppard Air Force Base at Wichita Falls, Carswell Air Force Base at Fort Worth (heavy bombers). Secondary: Beeville, San Antonio, Texarkana, El Paso, Houston,* Sherman-Dennison, Big Spring, Kingsville, Lubbock, Corpus Christi,* San Angelo, Del Rio, Laredo. Tertiary: Dallas,* Tyler, Longview, Caddo Lake, Abilene, Odessa, Midland, Waco, Killeen, Bryan, Alice, McAllen, Harlington, Brownsville,* Freeport, Lake Jackson, Galveston,* Beaumont.*

UTAH

Primary: Hill Air Force Base at Ogden. Secondary: Tooele, Dugway (chemical warfare testing center). Tertiary:Salt Lake City,* Orem-Provo.

VERMONT

Primary: None. Secondary: None. Tertiary: Burlington.

VIRGINIA

Primary: None. Secondary: Washington, DC complex,* Richmond,* Norfolk-Portsmouth,* Newport News-Hampton,* Radford, Dulles Airport, Mt. Vernon. Tertiary:(Bristol, Tennessee),* Roanoke, Lynchberg, Hopewell, Petersburg, Blackstone, Yorktown, Chincoteague, Quantico, Manassas.

WASHINGTON

Primary: Fairchild Air Force Base at Spokane (heavy bombers), Bremerton (submarine base). Secondary:Oak Harbor, Tacoma,* Walla-Walla, Seattle,* Everett, Richland (the Hanford nuclear processing facilities northwest of Richland). Tertiary: Copalis Beach, Vancouver, (Portland, Oregon), Spokane.

WEST VIRGINA

Primary: None. Secondary: None. Tertiary: Wheeling area (everything north of Moundsville), Huntington, Charleston, Cedar Grove.

WISCONSIN

Primary: None. Secondary: Madison. Tertiary: Superior (Duluth, Minnesota), Eau Claire, Green Bay, Appleton,* Oshkosh, Onalaska, (Dubuque, Iowa), Mequon, Milwaukee,* Waukesha, Racine, Kenosha.

WYOMING

Primary: Warren Air Force Base complex (Minuteman missiles; including the entire area within a line connecting Cheyenne, Federal, a point ten miles northwest of Wheatland, Guernsey, and—along the state line—Cheyenne again). Secondary: None. Tertiary: Casper.

APPENDIX B
Fallout Pattern Data

Although it is true that any portion of the United States might receive fallout after a nuclear attack, it is also true that the winds do not blow in random directions. For a particular target, therefore, areas which probably will—or will not—receive fallout can be determined. The method of determining these areas is described in chapter 3. This appendix contains the data used in the predictions, compiled from User's Manual: Meteorological Data for Radiological Defense, Office of Civil Defense, July 1970—FG-E-5.6/1, and from raw wind-rose data supplied by representatives of the Defense Civil Preparedness Agency.

TABLE 16
Fallout Vectors from Selected Cities

LOCATION	WIND SPEED			
	20 mph	40 mph	60 mph	80 mph
Albuquerque, New Mexico*	25—175°	45—145°	55-105°	—
Bismark, North Dakota	15—185°	45-165°	75-115°	—
Boise, Idaho	5-195°	25—155°	85—115°	—
Boston, Massachusetts	25-175°	25- 145°	35—115°	—
Brownsville, Texas	35-125° 245-325°	45—115°	65- 75°	—
Buffalo, New York	35—165°	35—155°	55 — 115°	—
Burrwood, Louisiana	35—135° 225—295°	45—125°	55-105°	—
Caribou, Maine	345—175°	25-145°	55-115°	
Charleston, South Carolina	35—165° 235—265°	45-125°	55-115°	-
Columbia, Missouri	25-165°	35-145°	55-125°	
Dayton. Ohio	35—185°	35—145°	65-125°	
Denver, Colorado	25—195°	35—155°	65—125°	—
Detroit, Michigan	15-185°	45—145°	55—115°	—
Dodge City, Kansas	25—175°	35-155°	45-115°	—
Ely, Nevada	15-185°	25—155°	65- 95°	
Fort Worth, Texas	25-155°	35—125°	45-105°	-
Great Falls, Montana	5—175°	35-155°	65-135°	—
Green Bay, Wisconsin	15—185°	45—155°	65-125°	--
Jacksonville, Florida	45—155° 205—275°	55-125°	65 — 115°	-
International Falls, Minnesota	15-195°	45-165°	85—125°	
Lake Charles, Louisiana	35-145° 225—285°	35—125°	45-115°	---
Little Rock, Arkansas	35—165°	35—145°	55—115°	--
Long Beach, California	355-185°	45......155°	—	—
Medford. Oregon	5—205°	25-185°	55- 95°	—
Miami, Florida	45-135° 225—305°	55- 125°	85- 95°	—
Midland/Big Spring, Texas	25—145°	35—135°	55—95°	—
Montgomery, Alabama	45—165° 215-285°	45-125°	55-115°	
Nashville, Tennessee	35—175°	35-135°	45 125°	
New York, New York	25—175°	35-155°	45-115°	85- 95°
Norfolk, Virginia	25-165°	35—145°	55-115°	85 - 95°
Oakland, California	5 -195°	25—165°	—	
Omaha, Nebraska	5-175°	45 145°	65 -135°	
Pittsburgh, Pennsylvania	35-185°	35 -155°	55 -115°	85 95°
Rantoul, Illinois	25-185°	45-145°	55 -125°	85 95°
Rome, New York	15- 165°	25- 155°	55 115°	
Sault St. Marie. Michigan	25 205°	45- 165°	75 115°	
Seattle, Washington	355 185°	15—165°		-
St. Cloud, Minnesota	5 -185°	45-165°	85- 115°	—
Tucson, Arizona	5-175°	35 125°	55- 95°	
Washington DC	25 175°	35 -145°	55 125°	—

* Figures are given for areas with a 2 percent or more risk of fallout.

TABLE 17
Dimensions of Dose Contours (1 Megaton)

WIND SPEED mph	CUMULATIVE DOSE R	DOWNWIND DISTANCE miles	MAXIMUM WIDTH miles
10	150	95	30
10	500	50	16
10	1,500	25	9
10	5,000	5	3
20	150	140	20
20	500	70	11
20	1,500	25	6
20	5,000	(not likely to happen)	
40	150	265	13
40	500	105	7
40	1,500	25	4
40	5,000	(not likely to happen)	
60	150	310	10
60	500	110	6
60	1,500	7.5	1
60	5,000	(not likely to happen)	
80	150	340*	**
80	500	100*	**
80	1,500	(not likely to happen)	
80	5,000	(not likely to happen)	

Figures reflect measurements made at D+14 days. Those marked with an asterisk (*) indicate approximations by the author.

"Data not available.

TABLE 18
Dimensions of Dose Contours (10 Megaton)

WIND SPEED mph	CUMULATIVE DOSE R	DOWNWIND DISTANCE miles	MAXIMUM WIDTH miles
10	150	210	90
10	500	135	56
10	1,500	80	36
10	5,000	35	10
20	150	335	70
20	500	205	40
20	1,500	110	26
20	5,000	35	14
40	150	650	40
40	500	375	28
40	1,500	155	18
40	5,000	30	8
60	150	830	36
60	500	435	22
60	1,500	160	14
60	5,000	15	2
80	150	1,000*	**
80	500	480*	**
80	1,500	160*	**
80	5,000	10*	**

Figures reflect measurements made at D+14 days. Those marked with an asterisk (*) indicate approximations by the author.

**Data not available.

APPENDIX C
Expedient Shelter Construction

The following shelter-building instructions were adapted from Oak Ridge National Laboratory's Expedient Shelter Handbook (ORNL-4941), a manual written by G. A. Christy and Cresson Kearny. The Door-over-Trench shelter (figure 36) can be used by just about everyone; the Car-over-Trench shelter (figures 37, 38, and 39) is particularly appropriate to retreaters who plan to drive to a remote refuge in an emergency. Several other shelter plans were presented in this manual which I would have liked to include here, but space did not allow this.

The instructions for constructing these two shelters are basically so similar that 1 have taken the liberty of combining them into a single set of instructions. Each paragraph is preceded by a notation (CAR, DOOR, or BOTH) indicating to which shelter the instructions apply. Before starting, be sure to line out the paragraphs which do not apply to the shelter you wish to build. Study all the instructions carefully before beginning work, and then check off each step as you finish it.

Both types of shelter are intended for use in areas where a shortage of building materials exists and where the earth is sufficiently firm that the walls of the shelter will not cave in. A Car-over-Trench Shelter will provide fallout protection for four to six people, depending on the size of the car. A Door-over-Trench Shelter will provide fallout protection for one adult or older child for each door used and provides better fallout, blast, and fire protection than does a Car-over-Trench Shelter. A family evacuating a probable target area during a crisis can carry with them—provided they have a car with a roof rack, a station wagon, or a pickup truck—enough doors with the knobs removed to build this shelter.

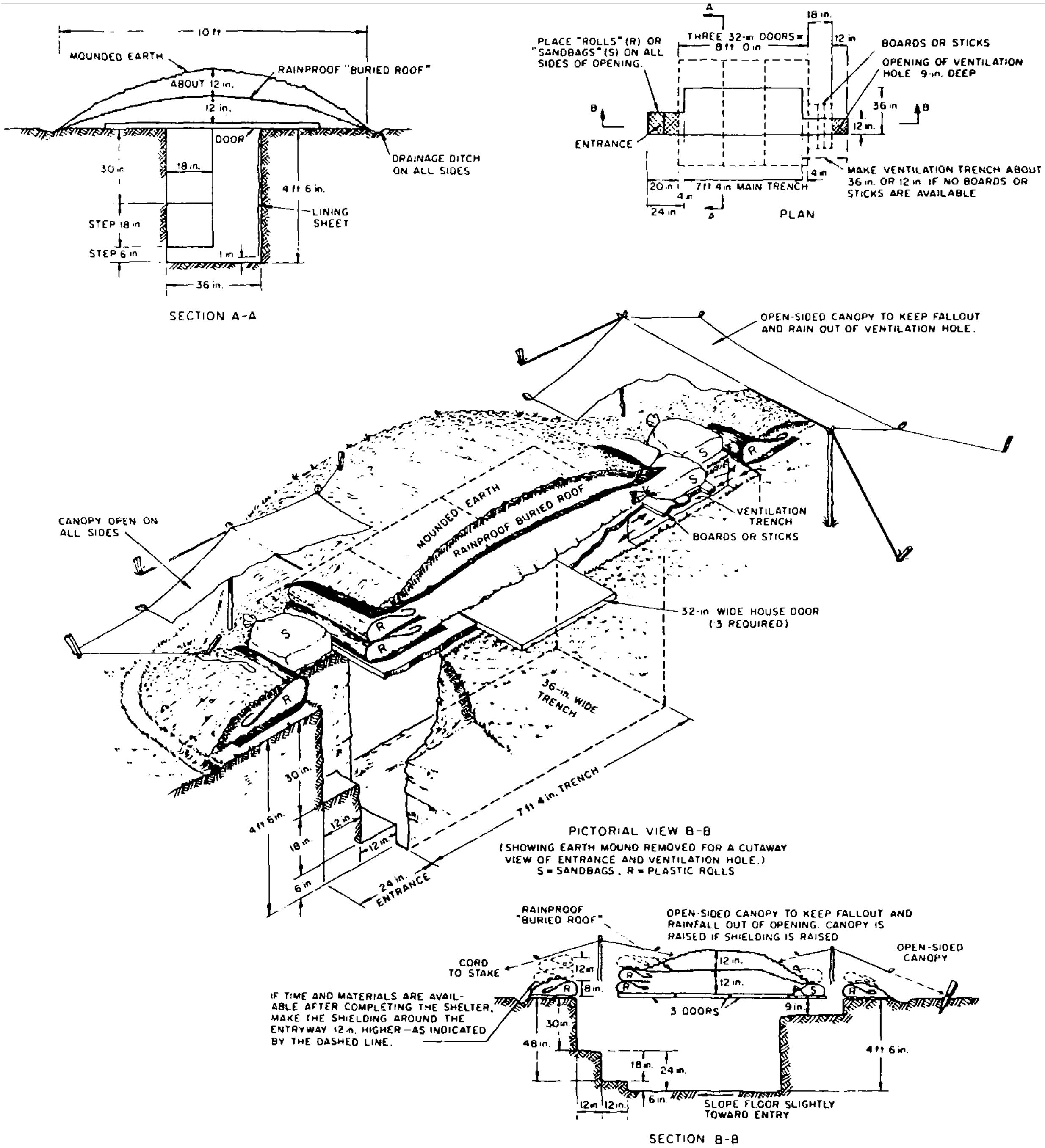
For either shelter, first determine whether the ground is firm enough to be safe. If the earth is very sandy, it is unlikely to be stable enough to keep the trench sidewalls from caving in. A quick test to determine whether or not earth is firm enough is given in step 7. Also before beginning, you should dig a test hole to make sure that the ground water table and the depth to solid rock is more than forty inches below the surface.

1. DOOR—Materials Required: One door for each adult, older child, or two younger children to be sheltered is necessary. Even hollow-core interior doors will serve.

   In addition to digging tools—preferably pick and shovel—the following rainproofing materials are required: (A) To make the buried roof, especially needed to keep rain or melting snow from dangerously weakening the earth-covered doors, at least twenty-five square feet per person of waterproof material such as canvas, plastic sheeting (four or more mils thick), shower curtain, or plastic tablecloth is needed. A family-sized tent might even be used. (B) For the two canopies over the shelter openings, a piece of rainproof material about six by six feet and a second piece about four by four feet are required. These canopies will keep fallout and/or rain from entering the shelter. Ordinary cloth will keep out fallout particles but not rain.

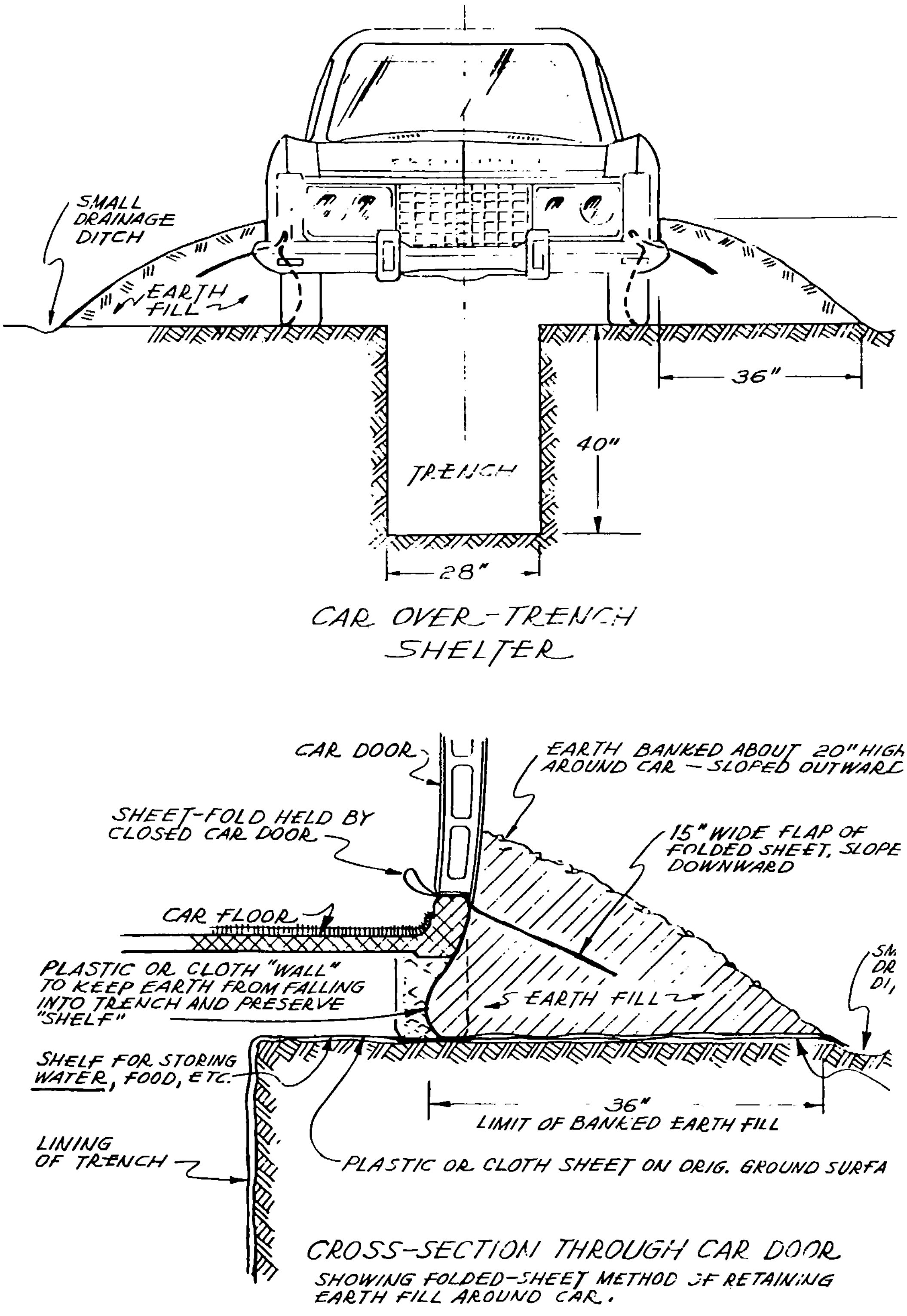
   Other materials are also useful: (A) An additional fifty square feet (about the area of a bedsheet) per person of plastic or cloth is needed to line the trench and to make "rolls" to raise and strengthen the entryway and ventilation hole openings (see figure 40). Plastic bedsheets, bedspreads, stout curtains, canvas, rugs, etc. will serve. (B) Two pillowcases per person, filled two-thirds with earth, will function as "sandbags." (C) String and/or cord, a knife, and a file for sharpening tools, as well as a measuring tape, yardstick, or ruler, will be indispensable. (D) Finally, four sticks or boards (each about four feet long) and eight stakes to support the awnings over the shelter openings are required. Poles and stakes from the family tent will work well.
2. CAR—Materials Required: In addition to digging tools—preferably pick and shovel—a car that can be parked over the trench is required. A four-wheel-drive pickup truck is ideal, but any car more than nine feet long will serve. The following materials are also needed: (A) To keep earth mounded around the car from falling into the trench and to provide a storage shelf on the surface around the trench, plastic sheeting (such as polyethylene film at least four mils thick, shower curtain, or plastic tablecloth) or cloth (bedsheets, bedspreads, etc.) are needed. (Ten to twelve bedsheets or the equivalent area of material will be required.) (B) Eight pillowcases, filled two-thirds with earth, will function as "sandbags." (C) String and/ or cord, a knife, and a file for sharpening tools as well as a measuring tape, yardstick, or ruler will be indispensable.
3. BOTH: If at all possible, wear gloves while building the shelter (including digging test holes) to avoid blisters. In this context, blisters could be fatal.
4. BOTH: Sharpen all tools before beginning work, and keep them sharp.
5. BOTH: Select reasonably level ground, accessible by car.
6. BOTH: Make sure that the earth is firm and stable enough so that the walls of the trench will not cave in. As a test, dig a small hole about eighteen inches deep. Remove all loose earth from the bottom of the hole. Then make a "thumb test" by pushing a bare thumb into the undisturbed earth in the bottom of the hole. If the thumb can be pushed into the earth no further than one inch, the earth should be suitable for this type of shelter. If the earth does not pass the "thumb test," move to another location and try the test again. Continue to relocate and repeat until suitable earth is found.

   To make doubly sure the earth is sufficiently stable and safe, make "heel tests" as the trench is deepened. To make a "heel test," first make an undisturbed, smooth earth step at least four inches wide, sixteen inches long, eighteen inches below the surface, and eight inches above whatever depth you have dug the trench. If the earth step does not break off when a 150-lb man stands on the outermost four inches of this step, placing all of his weight on one heel while raising his toe slightly, then the earth is stable enough to safely dig a vertical-walled trench at least eight inches deeper than this earth step (see figure 41).



Door-Over-Trench Shelter, Pictorial View.

FIGURE 36: Building plans for the Door-over-Trench expedient fallout shelter. This shelter is constructed entirely from items found in every home: pillowcases, sheets, shower curtains, and, of course, doors, (From G. A. Christy and Cresson Kearny, Expedient Shelter Handbook, Oak Ridge National Laboratory, ORNL-4941, August 1974.)



Car-Over-Trench Shelter, Front View and Cross Section.

FIGURE 37: Building plans for the Car-over-Trench expedient fallout shelter. Similar to the Door-over Trench version, this shelter provides about twice as much radiation protection as the average home fallout shelter. (From Expedient Shelter Handbook.)

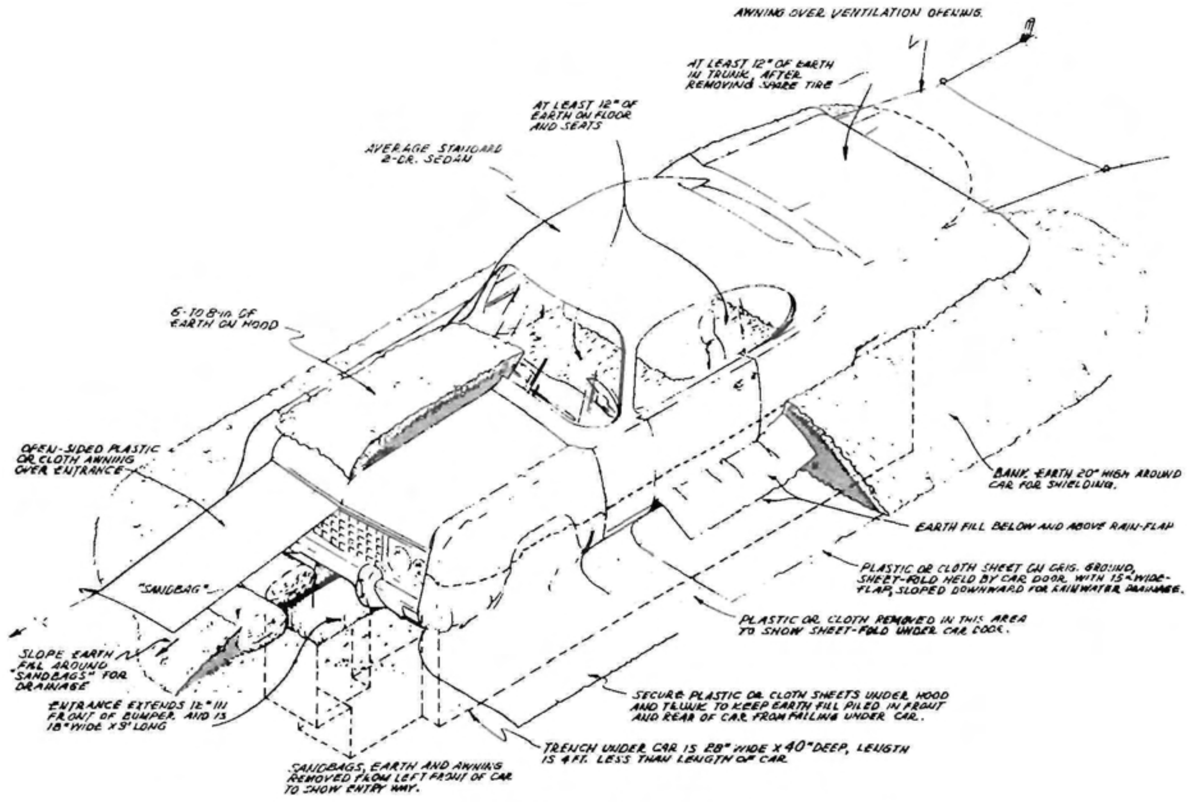


FIGURE 38: Pictorial view of the Car-over-Trench Shelter.

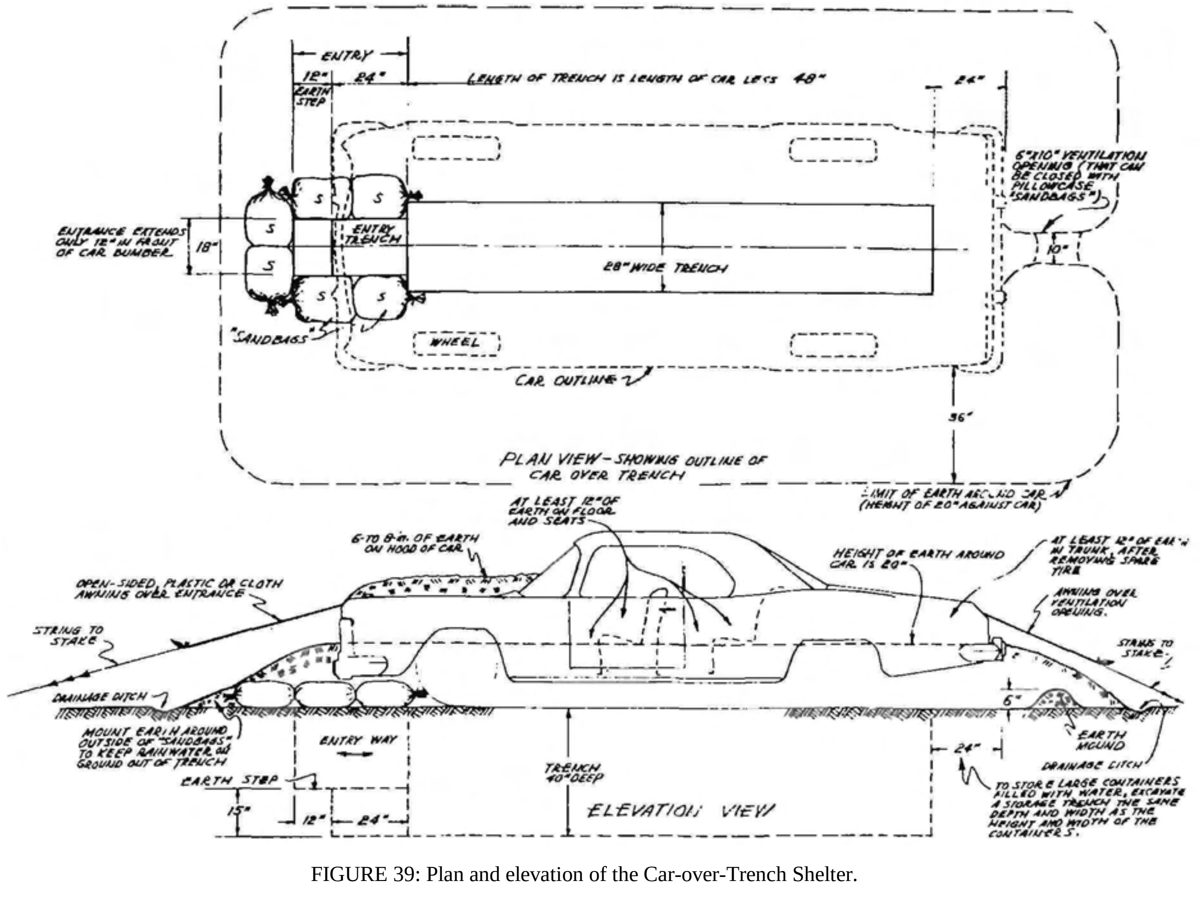


FIGURE 39: Plan and elevation of the Car-over-Trench Shelter.

7. DOOR: Prepare to dig a vertical-walled trench four and one-half feet deep and three feet wide. To determine the length of the trench, add together the widths of all the doors to be used for roofing it, and then subtract eight inches from this sum. (To avoid arithmetical errors, it is best to lay all the doors side by side on the ground.)
8. Stakeout a rectangular trench thirty-six inches wide and of the length previously determined. Also stake out the entrance at one end and the ventilation hole at the other.
9. CAR: Dig a trench twenty-eight inches wide and forty inches deep. To determine the length of the trench, measure the overall length of the car (front to rear bumper). Subtract forty-eight inches from this measurement and use this dimension as the length of the trench.
10. CAR: Stake out a rectangular trench twenty-eight inches wide and of the length determined previously. Also stake out the entrance
11. BOTH: Clear any brush, grass, or weeds that are more than a few inches high from the area where the trench will be dug, and from the ground around all sides of the trench to a distance of about eight feet from the sides and ends of the trench.
12. BOTH: Dig the main trench, the entryway trench, and the ventilation-hole trench. Place the excavated earth along both lengthwise sides of the trench so that no earth is piled nearer than three feet from the sides.
13. BOTH: To reduce the labor in removing hard earth with a pick, pick-mattock, or grubbing hoe: (A) Keep tools sharp. (B) After shoveling out and leveling the temporary bottom of the trench, start picking in the center of the trench, digging and then shoveling out a shallow hole across the entire width of the trench. (C) Then with the pick or mattock, break off row after row of small chunks of earth, breaking off each row across the width of the trench. A little experimentation may be necessary to determine the optimum size chunk which will break off with each pick stroke. Move forward as the work progresses (see figure 42). (D) Shovel out the loose earth until the trench floor is again about level. (E) Repeat.
14. DOOR: To keep each trench its full width as it is dug, cut sticks thirty-six, eighteen, and twelve inches long, and use them repeatedly as width measures. Keeping the trench its full width will save much work and time later.
15. CAR: Excavate both the main trench and the twenty-four-inch-long part of the entryway trench to a depth of forty inches. To save work, cut a stick twenty-eight inches long and use it repeatedly to help keep the main trench its full twenty-eight inches wide as it is dug down. To keep out radiation, do not make the entrance larger than illustrated unless a very large person must enter.
16. BOTH: If thes oil changes as the trench is being excavated, again make the same two soil tests—the "thumb test" and the "heel test"—used in the test hole. If the soil does not pass the tests, do not dig the trench any deeper.
17. DOOR: Carefully level and smooth the ground to a distance of two and one-half feet from the sides of the trench so that the doors will lie flat on the ground.
18. BOTH: If the supply of sheets, bedspreads, plastic, and/or other materials is plentiful, line the walls before covering the trench. The wall lining should reach the floor of the trench.

A trench with lined walls is more livable; the lining keeps the dirt from falling into eyes. Remove loose earth and rock from the edges and walls before placing the lining. H ang the lining from the edge of the trench by piling a little earth on it.

19. DOOR: To rainproof the shelter and to prevent the roofing doors from being dampened and weakened, use available waterproof materials as follows: If the earth is dry, the easiest and best way to make a rainproof roof is to place the doors directly on the ground, with each of the end doors overlapping an end of the main trench by four inches. Be sure to first level the ground surface so that doors touch the ground close to all edges of the trench. Mound dry earth over the doors until the mound is about twelve inches deep above the centerline of the trench and slopes to both sides, just covering the ends of the doors. Next, smooth off the earth mound, being careful to remove sharp stones and sticks that might puncture the rainproof material. Then place waterproof material over the smooth mound, making the illustrated "buried roof." Finally, carefully mound an additional six to twelve inches of earth on top of this roof.

If the earth is wet, place the waterproof material directly on top of the doors to keep them dry and strong. To keep water from collecting on the horizontal surface and leaking through, slope the doors toward one side of the trench by raising the other side of the trench by about three inches. One way to raise a side (while not increasing the distance the doors must span and thus decreasing the depth of earth that they will support) is to place an earth-filled "roll" of bedsheets or other material along one long edge of the trench. To keep the waterproof material used to cover the doors from sliding down the slope of the doors when earth is shoveled on, tuck the upper edge of the material under the higher ends of the doors. Finally, mound earth over the doors so that the mound is eighteen inches deep above the centerline of the roof and three or four inches deep over both ends of the doors.

If more waterproof material is available than is required to create a "buried roof," to cover the doors, and to make the two illustrated canopies over the shelter openings, use this excess material to cover the ground on which the doors are placed.

20. DOOR: In order to be able to place an adequately thick depth of shielding earth right up to and around the entryway and ventilation hole, before placing the earth cover on the roof, stack improvised "sandbags" around these two openings, or use cloth or plastic material to make "rolls" of earth, as illustrated in figure 40.
21. DOOR: Shovel earth around the "rolls" or "sandbags," used to raise the level of the earth around the two shelter openings. Slope this earth outward, and pack it so that rain water on the ground cannot run into the shelter.
22. CAR: After the trench has been dug and cleaned out to a depth of forty inches, or the excavation stopped because the soil has changed, drive the car carefully over the trench. Have someone guide the driver carefully.
23. CAR: To shield against radiation coming from above the trench shelter, remove the seats and put excavated earth into the car (on the front and rear floor, on the areas where the seats were, and inside the trunk) to an average depth of at least one foot. If you are using a pickup truck, fill the bed to a depth of one foot, too.
24. CAR: To keep earth that is to be banked around the car

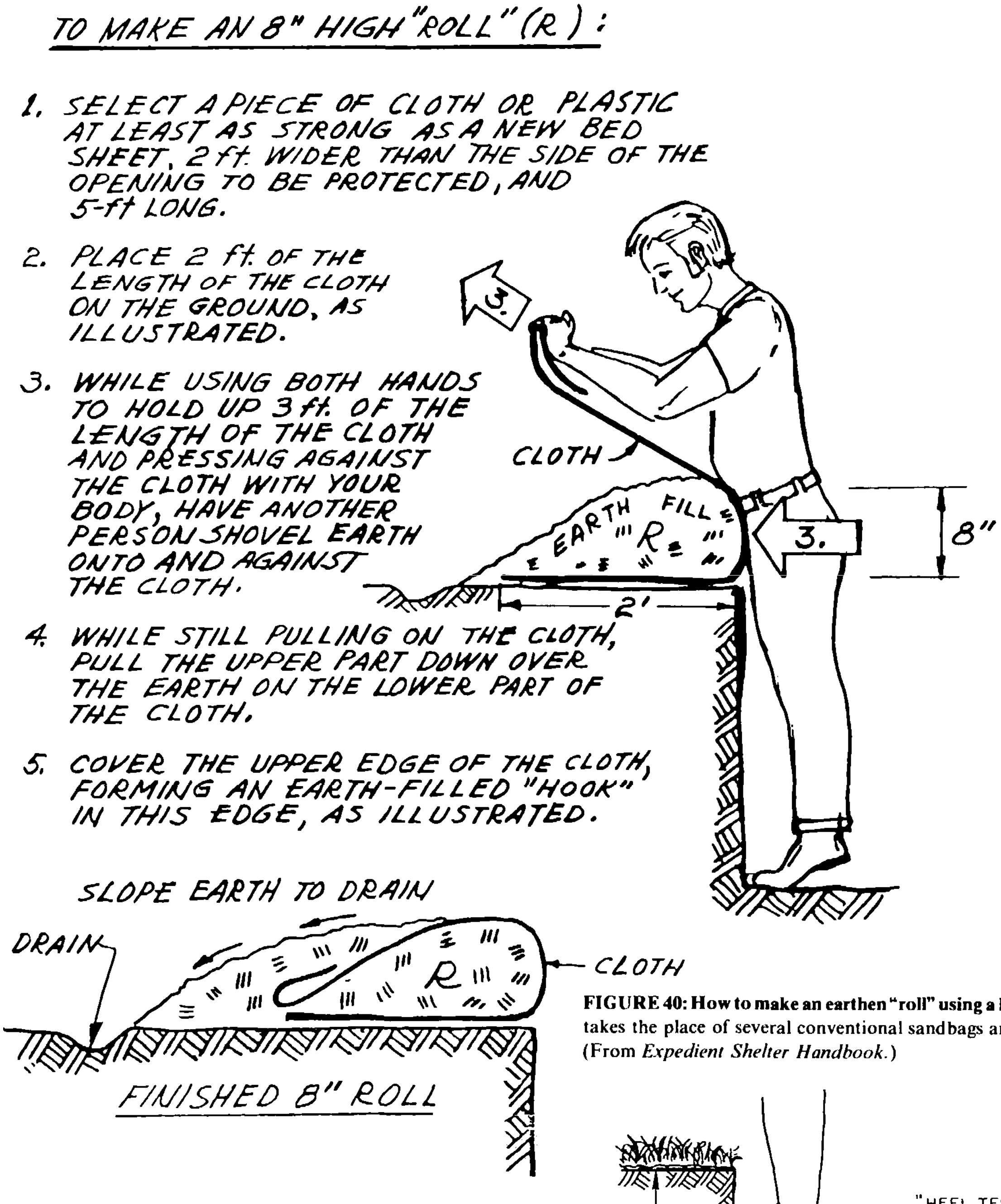
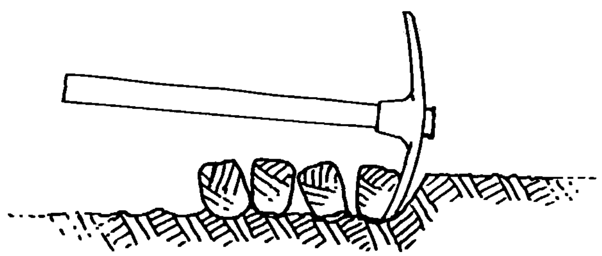


FIGURE 40: How to make an earthen "roll" using a bed sheet. The roll takes the place of several conventional sandbags and uses less cloth. (From *Expedient Shelter Handbook.*)



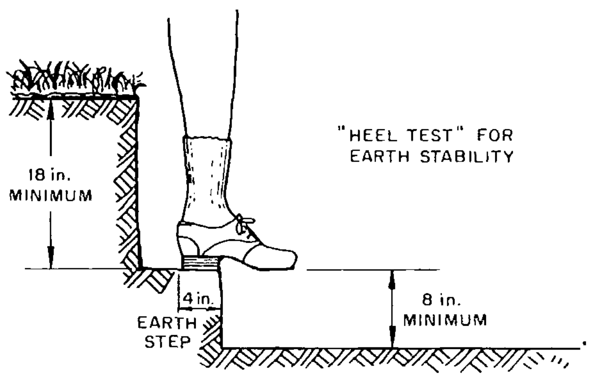


FIGURE 42: The proper way to use a pick or mattock. Work your way forward by breaking off chunks of the trench floor. Then shovel out the chunks. Don't try to do your primary digging with the shovel. (From Expedient Shelter Handbook.)

FIGURE 41: Making the "heel test" for earth stability. This test determines whether or not it will be safe to dig the trench any deeper. (From Expedient Shelter Handbook.)

from falling into the trench, use plastic sheets at least four mils thick, shower curtains, bed sheets, or other material—as illustrated in figures 37, 38, and 39. To do so, first fold a sheet about fifteen inches from one of its long edges. Then secure the folded edge of the sheet in the bottom of the door frame by closing the door on it. Place the longer part of the sheet on the gro'und in such a position that the line along which the cloth contacts the ground surface, when the cloth is pushed inward toward the trench, is an inch or two inside the line joining the inner sides of the front and rear wheels. Next, put some earth on the larger part of the sheet to hold it in place on the ground.

25. CAR: Shovel more earth on and against this held-in-position, larger part of the sheet, up to the height of the bottom of the car door. Meanwhile, keep the fifteen-inch-wide outer flap of the sheet above the banked earth until it can be placed on the outward-sloping side of the banked earth. So placed, this flap will help carry away from the shelter any rain or fallout that may run off the car. For added shielding, bank earth twenty inches high around the car.

26. CAR: Secure the folded material in the front door so that enough of it extends in front of the door to enable you to prop up this part of the fold under the front fender. Water that may run off the car roof from its drain channel then will not run under the car. Similarly, secure plastic or cloth sheets under the closed hood and car trunk to keep earth piled around the front and rear of the car from falling under the car.

27. BOTH: Dig small drainage ditches around the completed shelter to lead runoff water away.

28. BOTH: To keep rain and/or sand-like fallout particles from entering the shelter openings, build an open-sided canopy over each opening as illustrated in figures 38 and 39. Support each canopy on two sticks placed firmly in the ground; pull the corners of each canopy with cords tied to the bases of four stakes.

29. BOTH: For a place to sit inside the shelter, make a "bench" of water and food containers, bedding, etc., placed along the side of the trench that is farthest from the off-center shelter openings. If the trench floor is damp, it is best to cover it with waterproof material.

30. CAR: Place "sandbags" on the ground around three sides of the entrance. (A pillowcase about two-thirds full of earth, tied closed at its mouth, makes a quite satisfactory "sand-bag.") Mound earth around and almost as high as the sandbags to keep possible rainwater on the ground from running into the shelter trench. Study figure 40 closely in this regard.

31. CAR: To provide the essential ventilation—especially for enough cooling outdoor air in warm weather—build a ventilation opening at the rear of the car. Make this opening ten inches wide and at least six inches high. (This opening will need to be made larger if you plan to build a Kearny air pump to use in it—see Appendix D for plans of the pump.)

32. BOTH: In cold weather, restrict air flow through the shelter by hanging curtains or otherwise partially obstructing the two shelter openings. Always leave at least a few square inches open in each opening, however, to prevent a dangerous concentration of exhaled carbon dioxide. To keep exhaled water vapor from wetting clothing and bedding and reducing its insulating value, prop the ventilation openings as wide open as is practical to maintain tolerably warm shelter temperatures. When fallout is descending, ventilation openings should of course be closed more tightly.

33. CAR: After otherwise completing the shelter, put six to eight inches of earth on top of the car hood to increase the shielding provided by the engine and to prevent the sun from overheating the hood and thus the air inside the shelter.

34. CAR: To increase the radiation shielding of the entrance at times when temperatures inside the shelter permit most of the entrance to be closed, fill a car seat with earth. A shelter occupant can then pull the upside-down, earth-filled car seat over the entrance hole, as required. If the car lacks a hollow seat, use an earth-covered spare tire, or boards.

APPENDIX D
The Kearny Air Pump

The Kearny Air Pump (KAP) is a ventilation pump designed by Cresson H. Kearny at Oak Ridge National Laboratory to be used in expedient fallout shelters. It consists of a wooden frame about three feet square (the dimensions are variable) with a series of plastic flaps arranged across one face to allow air to pass through the frame in only one direction. When the frame is swung back and forth in a doorway or ventilation tunnel, the flaps act as valves, creating a flow of air. The formal instructions on how to build a KAP are lengthy, but this shortened version will provide a general overview of principles and design.

The frame can be made of any stiff material. Although small boards are pictured, even a few relatively straight sticks cut from bushes could be used. Note that the opening of the pump is crossed by many wires spaced about two thirds of an inch apart and that only every fifth or sixth wire carries a plastic flap. String pulled taut across the opening and stapled or tied in place can be used in place of wire. The flaps are cut from garbage bags or strong paper. A hem of flap material is wrapped around a wire and taped to itself (not to the wire). The drawings picture metal hinges being used to suspend the KAP in the doorway; you might take a set of hinges from a door in your house. In more primitive conditions, a hinge made of rope, wire, or fabric tape might be made to serve. See figures 43, 44, 45, and 46 for details of construction.

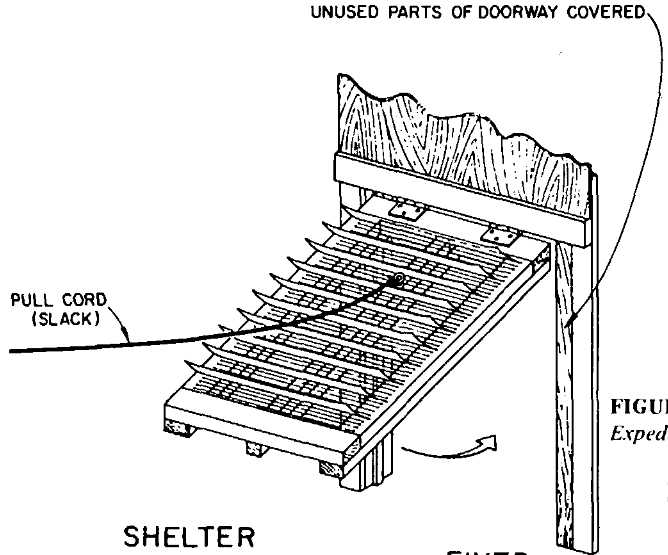


FIGURE 43: Perspective view of the Kearny Air Pump (KAP). (From *Expedient Shelter Handbook.*)

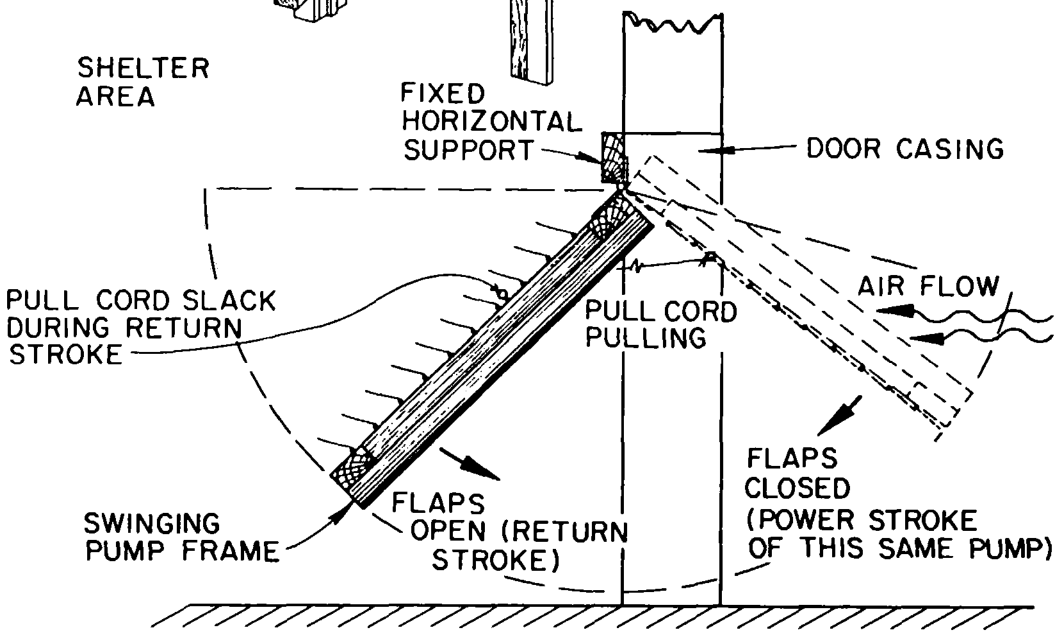


FIGURE 44: Detail of KAP construction. You can improvise materials to suit your circumstances. (From Expedient Shelter Handbook.)

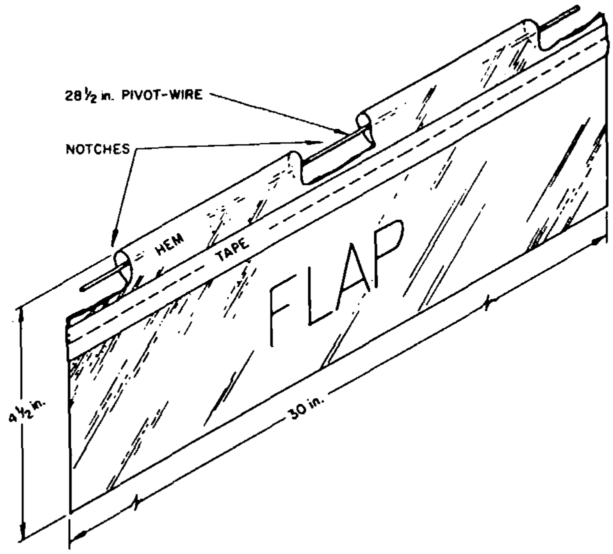


FIGURE 45: Detail of KAP valve flap construction.

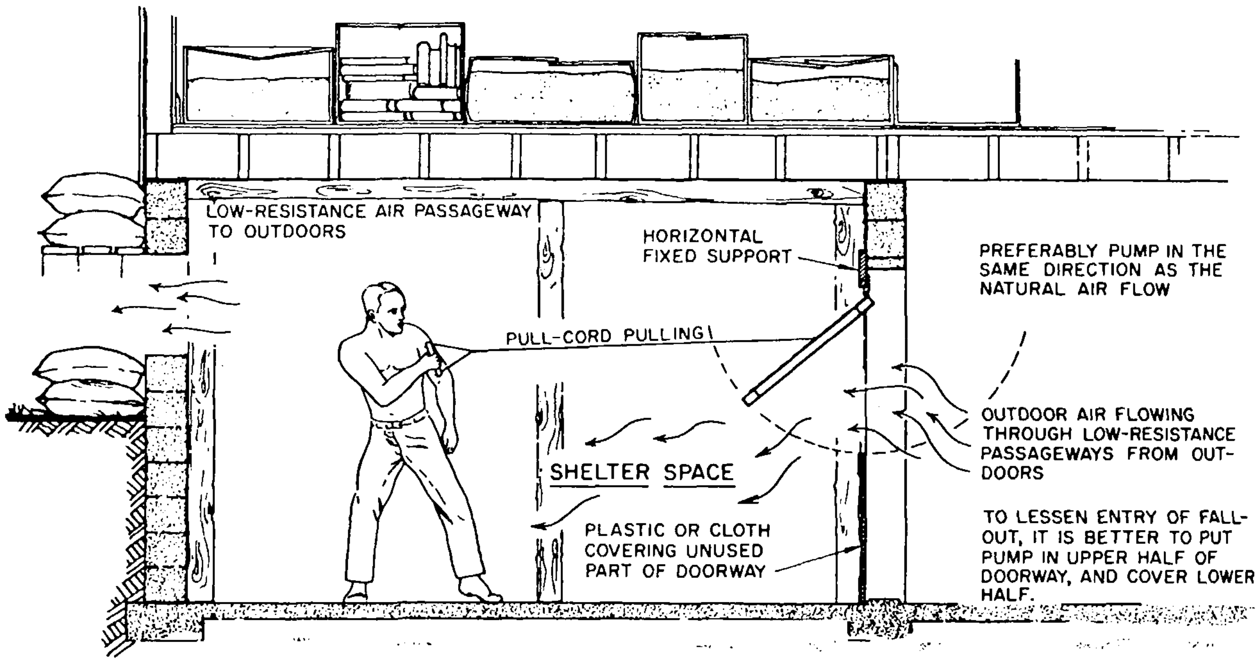


FIGURE 46: A KAP pictured in use in an improvised basement fallout shelter. The pump may also be operated comfortably from a seated or lying down position. (From Expedient Shelter Handbook.)

APPENDIX E
Supplementary Medical Information

This appendix contains technical information as reference material for a physician or paramedic unfamiliar with the characteristics of the special burns and radiation injuries associated with nuclear weapons effects. This material has been condensed from The Effects of Nuclear Weapons, edited by Samuel Glasstone.

Special Characteristics of Injuries

Sudden compression and decompression of the body in the blast wave results in damage at junctions between tissues and in air-containing organs. The lungs are particularly prone to hemorrhage and edema, and if the injury is severe air can enter the veins of the lungs, creating air embolic obstruction of the vessels of the heart and brain. Bodily activity in a person suffering primary blast injuries is extremely hazardous for this reason, and can produce death where recovery might otherwise have occurred. Damage to the brain is unlikely as a direct effect, but can result from arterial air emboli arising in the lung. Persons who spontaneously survive twenty-four to forty-eight hours without treatment, complications, or other injuries usually recover, showing little lung hemorrhage after seven to ten days.

Primary blast effects can cause temporary loss of consciousness and ruptured eardrums.

Indirect blast injuries from missiles striking the body can either be penetrating or nonpenetrating. Small glass fragments can cause penetrating wounds deep enough to enter the abdominal cavity in some cases, even if the fragments are very small (0.1 grams). Indirect injuries caused by the body being thrown through the air and striking a stationary object do not differ from normal impact injuries.

Burns. Nuclear weapons produce flame burns, flash burns, and sometimes burns due to contact with hot gas and dust from the explosion itself. Flame burns are identical to common burns caused by any fire. Flash burns are inflicted directly by the thermal heat pulse of the explosion and are usually restricted to those parts of the body not covered by clothing. Only the side of the body facing the fireball is injured. Flash burns through clothing usually occur where the fabric is thin and tightly pressed to the skin, such as at the elbows and shoulders.

Flash burns generally show a much smaller depth of penetration of the skin than flame burns. Depending on the distance from the explosion, the burns may vary from mild erythema to charring of the skin. Flash burns develop as depigmented lesions in cases of moderate exposure, but in cases of light exposure the initial erythema is followed by the development of a walnut coloration of the skin. (Note: This remark applies directly only to Orientals.)

Burns of moderate second degree (and milder) usually heal within four weeks, but third degree burns can easily become infected, especially because one of the effects of nuclear radiation injury is to decrease the body's resistance to infection. Infected second-degree burns can become third-degree burns due to the destruction of the remaining layer of skin.

Thick scar tissue (keloids) can be expected over healed burns if the healing is delayed by infection or malnutrition. Dark-skinned people (Orientals) produce keloids easily as a racial characteristic. The keloids subside gradually in the course of years.

Eye injuries. Nuclear explosions produce chorioretinal burns, flash blindness, and keratitis. Retinal spot burns occur in persons who have the fireball in their field of view at the instant of detonation. Impairment of visual acuity will depend on the part of the retina that is damaged.

Flash blindness is a temporary condition of dazzlement which may persist from a few seconds to several days. It is associated with image persistence, after-image formation, halo, etc.

Keratitis (inflammation of the cornea) may appear in nuclear explosion victims in some instances. The symptoms (sensitivity to light, foreign-body sensation, lachrymation, redness) last from a few hours to several days. The onset of most cases follows soon after the explosion, but delayed onset as much as a month later can occur when associated with nuclear radiation injury. Corneas usually do not suffer permanent damage in a nuclear flash injury of the eye (there is no delayed opacity).

Effects of acute radiation dosages. The unit of radiation dosage in normal use is the "rem" which stands for "roentgen equivalent mammal (or man)." The rem is a dose unit of "biological effect" and does not refer to the amount of radiation received but to the amount of damage done. For gamma rays, x-rays, and beta rays, the dose in rems is approximately equal to the amount of radiation received measured in roentgens.

Table 19 represents a summary of the clinical effects of acute ionizing radiation dosages (those received all at once or over a very short time). The information applies to whole-body exposures uncomplicated by other conditions.

Radiation injuries superimposed on other conditions aggravate shock. An irradiated person with burn injuries may develop earlier and more severe shock than the extent of the burns would indicate. Healing of wounds is retarded by the effects of radiation sickness due to a drop in natural resistance to secondary infections. Infections which would normally be dealt with by the body may prove fatal in radiation victims.

Acute doses of 25 to 200 rems produce little effect. Some patients will complain of vague discomfort or fatigue, others may have nausea and vomiting during the first day after exposure, and still others will show no symptoms at all. Detectable blood changes will be present in some people (see figure 47). The patients will recover and feel fine for up to two weeks or more, then suffer mild loss of appetite and malaise. In this latent period, changes in the character of the blood will be more definite. Essentially all patients will recover completely

Range	0 to 100 rems Subclinical range	100 to 1,000 rems Therapeutic range			Over 1,000 rems Lethal range	
		100 to 200 rems	200 to 600 rems	600 to 1,000 rems	1,000 to 5,000 rems	Over 5,000 rems
		Clinical surveillance	Therapy effective	Therapy promising	Therapy palliative	
Incidence of vomiting	None	100 rems: 5% 200 rems: 50%	300 rems: 100%	100%	100%	
Delay time	—	3 hours	2 hours	1 hour	30 minutes	
Leading organ	None	Hematopoietic tissue			Gastrointestinal tract	Central nervous system
Characteristic signs	None	Moderate leukopenia	Severe leukopenia; purpura; hemorrhage; infection. Epilation above 300 rems.		Diarrhea; fever; disturbance of electrolyte balance.	Convulsions; tremor; ataxia; lethargy.
Critical period post-exposure.	—	—	4 to 6 weeks		5 to 14 days	1 to 48 hours
Therapy	Reassurance	Reassurance; hematologic surveillance.	Blood transfusion; antibiotics.	Consider bone marrow transplantation.	Maintenance of electrolyte balance.	Sedatives
Prognosis	Excellent	Excellent	Good	Guarded	Hopeless	
Convalescent period	None	Several weeks	1 to 12 months	Long	—	
Incidence of death	None	None	0 to 80% (variable)	80 to 100% (variable)	90 to 100%	
Death occurs within	—	—	2 months		2 weeks	2 days
Cause of death	—	—	Hemorrhage; infection		Circulatory collapse	Respiratory failure; brain edema.

TABLE 19
Clinical Effects of Acute Ionizing Radiation Doses

in the absence of other injuries or infection. Adequate care and the use of antibiotics as needed will expedite recovery of more serious cases.

Acute doses of 200 to 1,000 rems will produce lethal effects in from 0 to 80 percent of the patients, depending on the dose. Probability of survival is good at the lower end of the range and poor at the upper end. Initial symptoms develop generally within twenty-four hours of exposure and consist of nausea, vomiting, diarrhea, loss of appetite, and malaise. The larger the dose, the sooner the symptoms will develop. Symptoms will disappear after a day or two, and for several days to two weeks the patient will feel relatively well. Subsequently there is a return of symptoms, including fever, diarrhea, and a step-like rise in temperature which may be due to accompanying infection. Commencing two to three weeks after exposure, there is a tendency to bleed spontaneously, and small hemorrhages (petechiae) form under the skin. This tendency may be marked. Spontaneous bleeding from the lining of the mouth, the intestinal tract, and the kidneys (blood in the urine) are very common. The bleeding is due to a lack of platelets in the blood. Epilation (loss of hair) begins at about two weeks in cases exposed to more than 300 rem. A loss of white blood cells occurs, leading to overwhelming infections. More serious cases exhibit severe emaciation and delirium, with death intervening in two to eight weeks. Patients who survive for three to

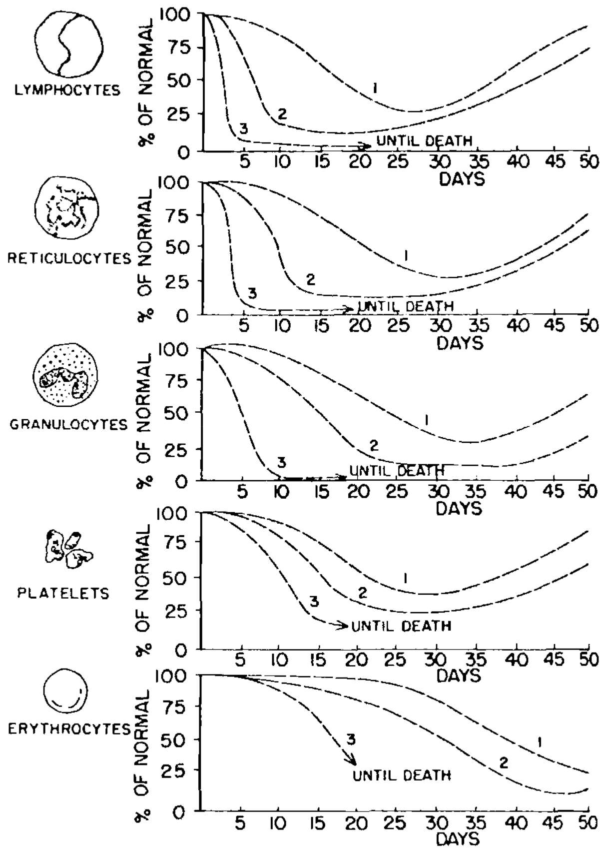


FIGURE 47: Typical blood cell response to whole blood irradiation. The curves marked / represent a response to a low exposure, approximately 200 rem. The curves marked 2 represent a midlethal dose (aboul 500 rem). Curves marked 3 correspond to a 95 to 100 percent lethal dose (about 1,000 rem). (Derived from the NATO handbook Emergency War Surgery, United States Defense Department, 1975—D l.6:Su7/975.)

four months and do not develop complications gradually recover. Loss of hair is not permanent, and blood composition returns to normal.

Acute doses greater than 1,000 rem are 90 percent lethal under the best of care. In the range of 1,000 to 5,000 rem, the gastrointestinal system shows the most severe effects. Vomiting and nausea are rapidly followed by prostration, diarrhea, anorexia (lack of appetite and dislike of food), and fever. The diarrhea may be frequent and severe, watery at first and becoming bloody later. With lower dosages, the patient may experience two or three (or more) days without symptoms after the initial discomfort passes. This period is followed by a return of the early symptoms with delirum or coma, terminating in death after a few days to two weeks. In doses over 5,000 rem there are prompt changes in the central nervous system. Symptoms are hyperexcitability, ataxia (lack of muscular coordination), respiratory distress, and intermittent stupor. There is almost immediate incapacitation, and death follows in all cases within a few hours to a week.

Emergency Handling of Radiation Victims

The following guidelines for handling radioactively contaminated patients were adapted from Physician's Emergency Handling of Radiation Accident Cases (Atomic Energy Commission, 1969—Y3.At7:2 Rl 1/20). Originally written with a nuclear power plant accident in mind, they have been adapted here for the nuclear war setting.

1. Check patient on stretcher for contamination, using a survey meter.
2. If seriously injured, give emergency lifesaving assistance immediately.
3. Handle contaminated patients as if carrying out a surgical procedure (use cap, mask, gown, gloves, etc.).
4. Collect and contain all potentially contaminated material, such as clothing, bedding, blood, urine, vomitus, and stool. When the patient is first removed from the contaminated environment, any or all of these could be radioactive and must be treated accordingly.
5. Decontaminate the patient's skin by washing with soap and warm water (as the medical condition permits). Pay particular attention to body orifices, folds of skin, and hair. Continue to use the survey meter to check the progress of the decontamination. Scrub the most contaminated parts first.
6. Wounds should be covered until the general decontamination bath is accomplished. Then they should be liberally irrigated with sterile water, and the run-off caught in a basin. This water will now contain radioactive material and must be handled with care.
7. In the case of a grossly contaminated wound containing fallout, dirt particles and crushed tissue, the emergency treatment is a simple wet debridement followed at a later date by more thorough surgical attention. The tissue and dirt removed from the wound will be radioactive and will require proper handling.

TABLE 20

Maximum Stay Time for Daily Excursions

DOSE RATE	STAY TIME
2.00 R/hr	3 hours/day
1.00 R/hr	6 hours/day
0.50 R/hr	12 hours/day
0.25 R/hr	24 hours/day

APPENDIX F
Special Radiological Information

This appendix contains the information you will need in order to measure the external radiation hazard, predict how long you will have to remain in the shelter, and estimate the exposure a person will receive by going out of the shelter for a specific amount of time during the dangerous period.

Rate of Decay Calculations

Figure 48 consists of two scales which you can cut apart and use as you would a slide rule. The upper scale shows various times after the nuclear explosion, ranging from one hour to forty days. The lower scale represents the radiation dose rate. By sliding the scales back and forth, you can match any measured dose rate with the time when it was measured. This gives you a means of predicting how rapidly the fallout radiation in your area will decay. Measure the radiation close rate outside the shelter, exactly three feet above the ground.

For example, the scales are positioned in figure 47 as if a measurement of 1,000 R per hour has been obtained a little less than three hours after the explosion. By comparing the scales to the right of this point, you can see that the dose rate will fall to 10 R per hour by the sixth day, and to 1 R per hour by the fortieth day. (You can cut the scales apart alongthedotted line and reposition them to fit your time and radiation reading.)

Note that the dose rate scale is in arbitrary units, which means that you can adjust it also to suit your needs. The scale as printed runs from I to 1,000 R per hour. You can adjust it to cover the range from 10 to 10,000 R per hour by multiplying the numbers on the scale by 10. You can adjust it to cover the range from 0.1 to 100 R per hour by dividing the numbers on the scale by 10. To cover the range from 0.01 to 10 R per hour divide the numbers on the scale by 100.

Stay-time Calculations

Suppose you have an emergency and you want to know how long you can stay outside without receiving a dangerous dose of radiation. Figures 49 and 50 will help.

First, you must determine the dose rate for one hour after the explosion (even if it took more than one hour for the fall-out to reach your location). Using figure 49, draw a straight line from a measured dose rate in the left scale(Exposure Rate at H+t) to the time when the dose rate was measured in the center scale (Time after Burst), and continue the line to intercept the right scale (Exposure Rate at H+l). The intercept point on the right scale gives you the theoretical dose rate at one hour, which you need for the next calculation.

Decide how much radiation you are willing to accept. This will depend on your previous exposure and how close you are to the 200 R lethal limit (see figure 50). Mark the maximum allowable dose in the left-hand scale (Total Exposure). Now mark the H+l dose rate in the scale second from the left (Exposure Rate—1 hour). Draw a line through these two points to intercept the center scale (E/ R 1). Mark the intercept point on the center scale.

Finally, mark the "entry time" (when you plan to go outside) on the right-hand scale. Now draw a straight line from the point on the center scale to the point on the right-hand scale. This line will cross the "Stay Time" scale. The intercept point will be the amount of time you can stay outside before acquiring your maximum safe dose of radiation.

For purposes of illustration, imagine that it is fifteen hours after the explosion and you have been in a well-shielded fallout shelter the whole time. You want to go outside to decontaminate the area around the shelter. You took a reading four hours after the explosion which indicated an exposure rate of 80 R per hour at that time. You are willing to accept 150 R of exposure if you have to. How long can you stay outside before you reach this level of exposure?

Consulting figure 49, you see that the dose rate was 80 R per hour (A) at four hours after the explosion (B). A line connecting A to B intersects the H+l scale at 400 R per hour (C).

Now turn to figure 50. You are willing to receive 150R of exposure (A). The H+1 dose rate was 400 R per hour (B). Draw a line from A to B and extend it to the center scale (C). You plan to go outside beginning fifteen hours after the explosion (D). A line drawn from C to D intercepts the "Stay Time" scale at twelve hours (E). This is the answer. Under these conditions, you can stay outside for twelve hours before acquiring a dose of 150 rem.

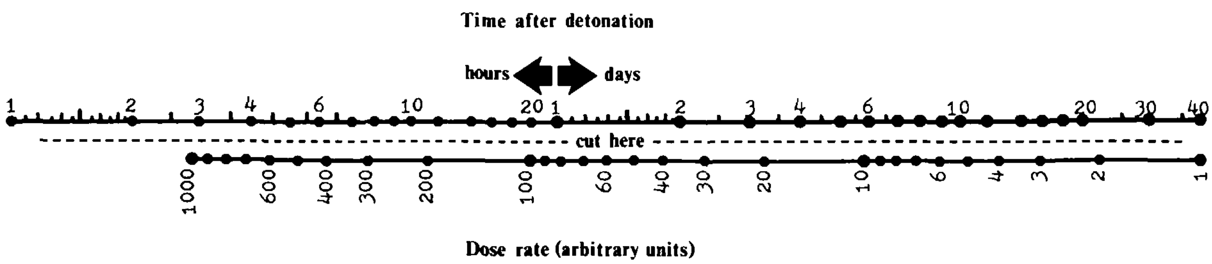


FIGURE 48: A slide-rule for predicting the rate of decay of fallout radiation.

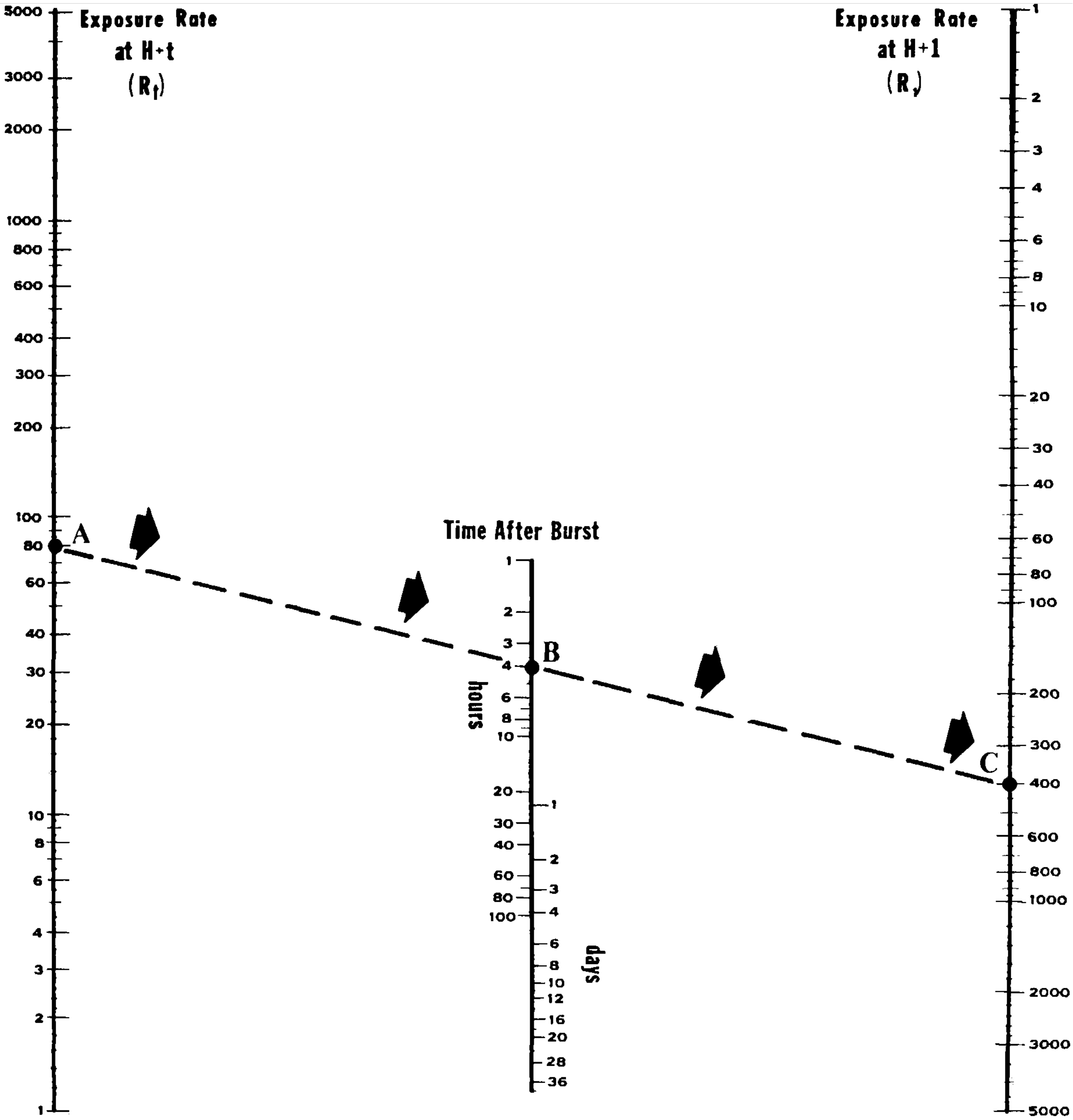


FIGURE 49: Together with figure 50, this chart can be used to estimate radiation exposure and the maximum safe exposure time under given circumstances. (From Radiological Defense Handbook, Defense Civil Preparedness Agency, June I974--SM-11.22.)

Final Emergence

After the external radiation dose rate has fallen to a point below 2 R per hour, you may begin to go outside on a regular basis. Your time outside the shelter must be limited, however, to avoid receiving over 6 R of exposure each day. When the external radiation dose rate decays to 0.25 R per hour, you may leave the shelter permanently. Table 20 is a summary of the amount of time you can safely spend outside for various dose rates between 2 R per hour and 0.25 R per hour.

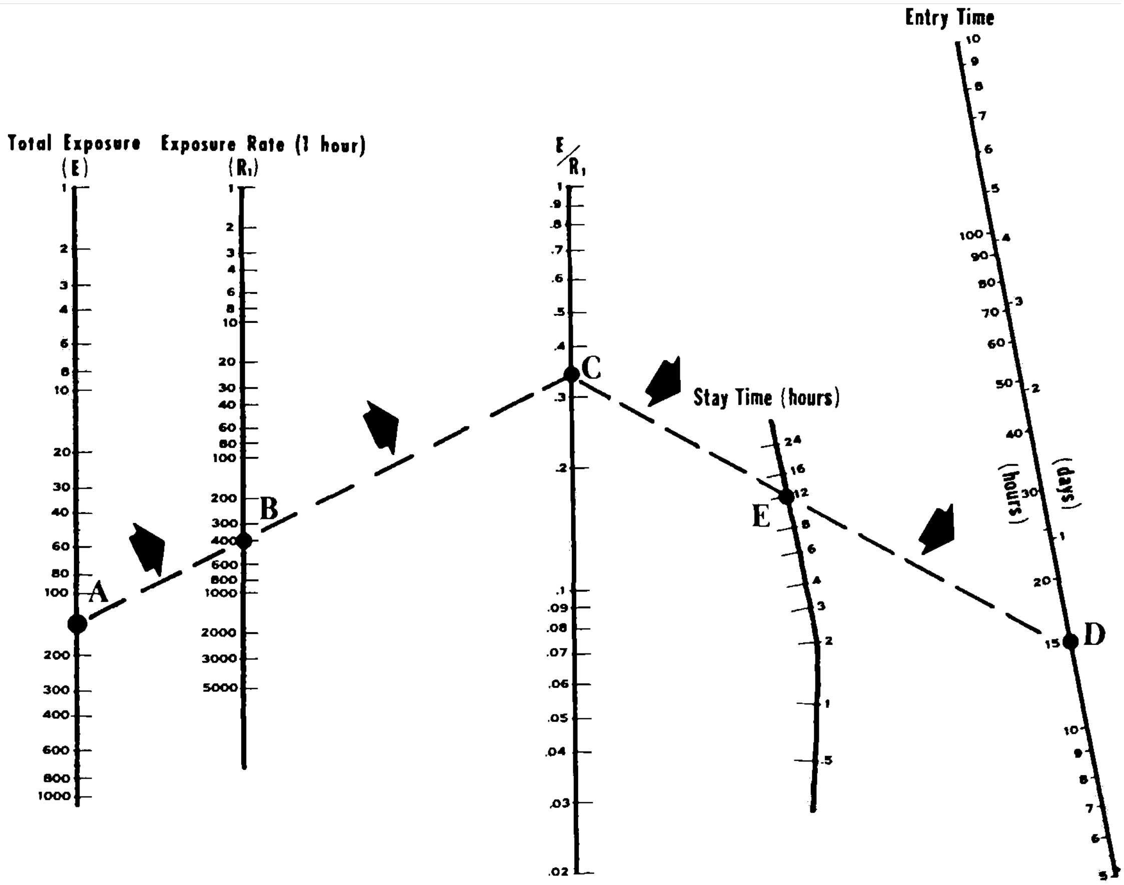


FIGURE 50: This chart is used with figure 49 to predict maximum safe stay-time in a radioactive environment. See text for discussion. (From Radiological Defense Handbook.)

TABLE 20
Maximum Stay Time for Daily Excursions

DOSE RATE	STAY TIME
2.00 R/hr	3 hours/day
1.00 R/hr	6 hours/day
0.50 R/hr	12 hours/day
0.25 R/hr	24 hours/day

APPENDIX G

The Kearny Fallout Meter

Reprinted from: The KFM, A Homemade Yet Accurate and Dependable Fallout Meter, ORNL-5040. Published by Oak Ridge National Laboratory. Available from National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161. Price $8.00.

1. The Need for Accurate and Dependable Fallout Meters

If a nuclear war ever strikes the United States, survivors of the blast and fire effects would need to have reliable means of knowing when the radiation in the environment around their shelters had dropped enough to let them venture safely outside. Civil defense teams could use broadcasts of surviving radio stations to give listeners a general idea of the fallout radiation in some broadcast areas. However, the fallout radiation would vary widely from point to point and the measurements would be made too far from most shelters to make them accurate enough to use safely. Therefore, each shelter should have some dependable method of measuring the changing radiation dangers in its own area.

During a possible nuclear crisis that was rapidly worsening, or after a nuclear attack, most unprepared Americans could not buy or otherwise obtain a fallout meter -- an instrument that would greatly improve their chances of surviving a nuclear war. The fact that the dangers from fallout radiation -- best expressed in terms of the radiation dose rate, roentgens per hour (R/hr) -- quite rapidly decrease during the first few days, and then decrease more and more slowly, makes it very important to have a fallout meter capable of accurately measuring the unseen, unfelt and changing fallout dangers. Occupants of a fallout shelter should be able to control the radiation doses they receive. In order to effectively control the radiation doses, a dependable measuring instrument is needed to determine the doses they receive while they are in the shelter and while they are outside for emergency tasks, such as going out to get badly needed water. Also, such an instrument would permit them to determine when it is safe to leave the shelter for good.

Untrained families, guided only by these written instructions and using only low cost materials and tools found in most homes, have been able to make a KFM by working 3 or 4 hours. By studying the operating sections of these instructions for about 1 1/2 hours, average untrained families have been able to successfully use this fallout meter to measure dose rates and to calculate radiation doses received, permissible times of exposure, etc.

The KFM (Kearny Fallout Meter) was developed at Oak Ridge National Laboratory. It is understandable, easily repairable, and as accurate as most civil defense fallout meters. In the United States in 1976 a commercially available ion chamber fallout meter that has as high a range as a KFM for gamma radiation dose-rate measurements retailed for $600,

Before a nuclear attack occurs is the best time to build, test and learn how to use a KFM. However, this instrument is so simple that it could be made even after fallout arrives provided that all the materials and tools needed (see lists given in Sections V, VI, and VII) and a copy of these instructions have been carried into the shelter.

II. Survival Work Priorities During a Crisis

Before building a KFM, persons expecting a nuclear attack within a few hours or days and already in the place where they intend to await attack should work with the following priorities: (1) build or improve a high-protection-factor shelter (if possible, a shelter covered with 2 or 3 feet of earth and separate from flammable buildings); (2) make and install a KAP (a homemade shelter-ventilating pump) -- if instructions and materials are available; (3) store at least 15 gallons of water for each shelter occupant — if containers are available; (4) assemble all materials for one or two KFM's; and (5) make and store the drying agent (by heating wallboard gypsum, as later described) for both the KFM and its dry-bucket.

III. How to Use These Instructions to Best Advantage

1. Read ALOUD all of these instructions through Section VII, "Tools Needed," before doing anything else.

2. Next assemble all of the needed materials and tools.

3. Then read ALOUD ALL of each section following Section VII before beginning to make the part described in that section.

A FAMILY THAT FAILS TO READ ALOUD ALL OF EACH SECTION DESCRIBING HOW TO MAKE A PART, BEFORE BEGINNING TO MAKE THAT PART, WILL MAKE AVOIDABLE MISTAKES AND WILL WASTE TIME.

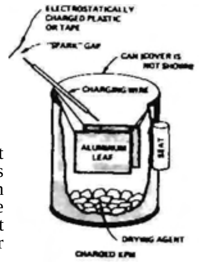
4. Have different workers, or pairs of workers, make the parts they are best qualified to make. For example, a less skilled worker should start making the drying agent (as described in Section VTU) before other workers start making other parts. The most skilled worker should make and install the aluminum-foil leaves (Sections X and XI).

5. Give workers the sections of the instructions covering the parts they are to build—so they can follow the step-by-step instructions, checking off with a pencil each step as it is completed.

6. Discuss the problems that arise. The head of the family often can give better answers if he first discusses the different possible interpretations of some instructions with other family members, including teenagers.

7. After completing one KFM and learning to use it, if time permits make a second KFM-that should be a better instrument.

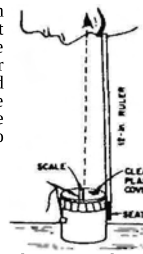
IV. What a KFM Is and How It Works



A KFM is a simple electroscope fallout meter with which fallout radiation can be measured accurately. To use a KFM, an electrostatic charge must first be placed on its two separate aluminum-foil leaves. These leaves are insulated by being suspended separately on clean, dry insulating threads.

To take accurate readings, the air inside a KFM must be kept very dry by means of drying agents such as dehydrated gypsum (easily made by heating gypsum wallboard, "sheetrock") or silica gel. (Do not use calcium chloride or other salt.) Pieces of drying agent are placed on the bottom of the ionization chamber (the housing can) of a KFM.

An electrostatic charge is transferred from a homemade electrostatic charging device to the two aluminum-foil leaves of a KFM by means of its charging-wire. The charging-wire extends out through the transparent plastic cover of the KFM.



When the two KFM leaves are charged electrostatically, their like charges (both positive or both negative) cause them to be forced apart. When fallout gamma radiation (that is similar to X rays but more energetic) strikes the air inside the ionization chamber of a KFM, it produces charged ions in this enclosed air. These charged ions cause part or all of the electrostatic charge on the aluminum-foil leaves to be discharged. As a result of losing charge, the two KFM leaves move closer together.

To read the separation of the lower edges of the two KFM leaves with one eye, look straight down on the leaves and the scale on the clear plastic cover. Keep the reading eye 12 inches above the SEAT. The KFM should be resting on a horizontal surface. To be sure the reading eye is always at this exact distance, place the lower end of a 12-inch ruler on the SEAT, while the upper end of the ruler touches the eyebrow above the reading eye. It is best to hold the KFM can with one hand and the ruler with the other. Using a flashlight makes the reading more accurate.

If a KFM is made with the specified dimensions and of the specified materials, its accuracy is automatically and permanently established. Unlike most radiation measuring instruments, a KFM never needs to be calibrated or tested with a radiation source, if made and maintained as specified and used with the following table that is based on numerous calibrations made at Oak Ridge National Laboratory.

The millimeter scale is cut out and attached (see photo illustrations on the following page) to the clear plastic cover of the KFM so that its zero mark is directly above the two leaves in their discharged position when the KFM is resting on a horizontal surface. A reading of the separation of the leaves is taken by noting the number of millimeters that the lower edge of one leaf appears to be on, on one side of the zero mark on the scale, and almost at the same time noting the number of millimeters the lower edge of the other leaf appears to be on, on the other side of the zero mark. The sum of these two apparent positions of the lower edges of the two leaves is called a KFM reading. The drawing appearing after the photo illustrations shows the lower edges of the leaves of a KFM appearing to be 9 mm on the right and zero and 10 on the left, giving a KFM reading of 19 mm. (Usually the lower edges of the leaves are not at the same distance from the zero mark.)

As will be fully explained later, the radiation dose rate is found by:

TABLE USED TO FIND DOSE RATES (R/HR) FROM KFM READINGS

*DIFFERENCE BETWEEN THE READING BEFORE EXPOSURE AND THE READING AFTER EXPOSURE (8-PLY STANDARD-FOIL LEAVES)

DIFF.* IN READ-INGS	TIME INTERVAL OF AN EXPOSURE 15 SEC. R/HR	1 MIN. R/HR	4 MIN. R/HR	16 MIN. R/HR	1 HR. R/HR
2 mm	6.2	1.6	0.4	0.1	0.03
4 mm	12.	3.1	0.8	0.2	0.06
6 mm	19.	4.6	1.2	0.3	0.08
8 mm	25.	6.2	1.6	0.4	0.10
10 mm	31.	7.7	2.0	0.5	0.13
12 mm	37.	9.2	2.3	0.6	0.15
14 mm	43.	11.	2.7	0.7	0.18

1. charging and reading the KFM before exposure;

2. exposing it to radiation for a specified time in the location where measurement of the dose rate is needed -- when outdoors, holding the KFM about 3 ft. above the ground;

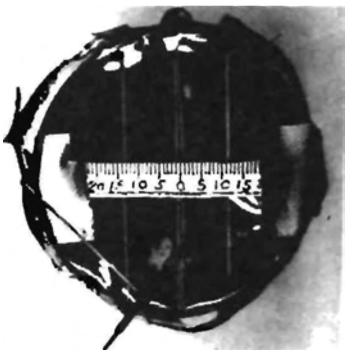
3. reading the KFM after its exposure;

4. calculating, by subtraction, the difference between the reading taken before exposure and the reading taken after exposure;

5. using this table to find what the dose rate was during the exposure -- as will be described later.

Instructions on how to use a KFM are given after those detailing how to make and charge this fallout meter.

To get a clearer idea of the construction and use of a KFM, look carefully at the following photos and read their captions.



A. An Uncharged KFM. The charging wire has been pulled to one side by its adjustment-thread. This photo was taken looking straight down at the upper edges of the two flat, 8-ply aluminum leaves. At this angle the leaves are barely visible, hanging vertically side by side directly under the zero mark, touching each other and with their ends even. Their suspension-threads insulate the leaves. These threads are almost parallel and touch (but do not cross) each other where they extend over the top of the rim of the can.

B. Charging a KFM by a Spark-Gap Discharge from a Tape That Has Been Electrostatically Charged by Being Unwound Quickly. Note that the charged tape is moved so that its surface is perpendicular to the charging-wire.

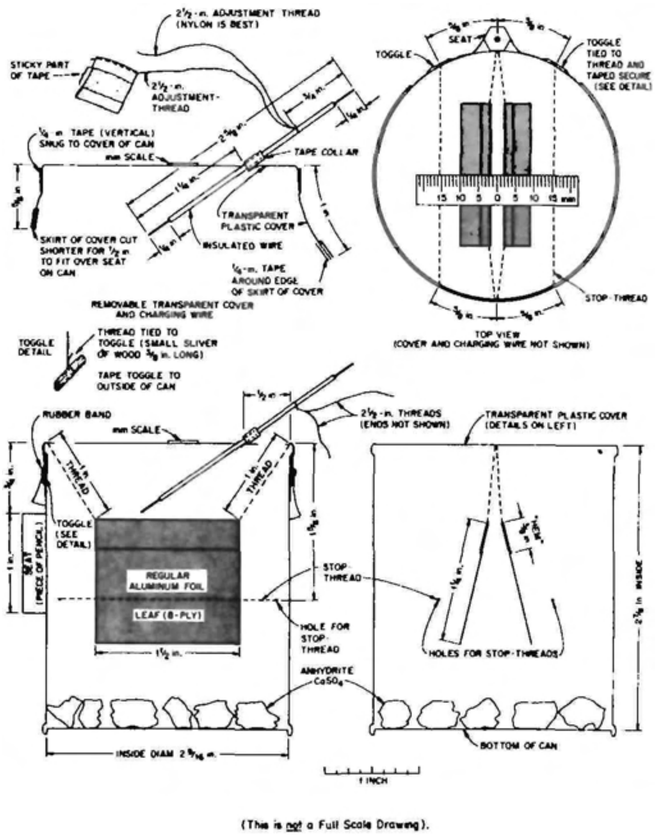
The high-voltage electrostatic charge on the unwound tape (that is an insulator) jumps the spark-gap between the tape and the upper end of the charging-wire, and then flows down the charging-wire to charge the insulated aluminum-foiJ leaves of the KFM. (Since the upper edges of the two leaves are 3/4 inch below the scale and this is a photo taken at an angle, both leaves appear to be under the right side of the scale.)

C. A Charged KFM. Note the separation of the upper edges of its two leaves. The charging-wire has been raised to an almost horizontal position so that its lower end is too far above the aluminum leaves to permit electrical leakage from the leaves back up the charging-wire and into the outside air.

Also note the SEAT, a piece of pencil taped to the right side of the can, opposite the charging wire.

D. Reading a KFM. A 12-inch ruler rests on the SEAT and is held vertical, while the reader's eyebrow touches the upper end of the ruler. The lower edge of the right leaf is under 8 on the scale and the lower edge of the left leaf is under 6 on the scale, giving a KFM reading of 14.

For accurate radiation measurements, a KFM should be placed on an approximately horizontal surface, but the charges on its two leaves and their displacements do not have to be equal.



V. Materials Needed

A. For the KFM: (In the following list, when more than one alternative material is given, the beet material is listed first.)

1. Any type metal can, approximately 2-9/16 inches in diameter inside and 2-7/8 inches high inside, washed clean with soap. (This is the size of a standard 8-ounce can. Since most soup cans, pop cans, and beer cans also are about 2-9/16 inches in diameter inside, the required size of can can also be made by cutting down the height of more widely available cans -- as described in Section IX of these instructions.)

2. Standard aluminum foil - 2 square feet. (In 1977, 2 square feet of a typical American aluminum foil weighed about 8.2 grams -- about 0,29 oz.) (If only "Heavy Duty" or "Extra Heavy Duty" aluminum foil is available, make S-ply leaves rather than 8-ply leaves of standard foil; the resultant fallout meter will be almost as accurate.)

3. Doorbell-wire, or other light insulated wire (preferably but not necessarily a single-strand wire inside the insulation) -- 6 inches.

4. Any type of lightweight thread (preferably but not necessarily nylon). (Best is twisted nylon thread; next best, unwaxed lightweight nylon dental floss; next best, silk; next best, polyester.) -- 3 feet. (Thread should be CLEAN, preferably not having been touched with fingers. Monofilament nylon is too difficult to see, handle, and mark.)

5. A piece of clear plastic - a 6 x 6 inch square. Strong polyethylene (4 mils thick) used for storm-proofing windows is best, but any reasonably stout and rather clear plastic will serve. The strong clear plastic used to wrap pieces of cheese, if washed with hot water and soap, is good. Do not use weak plastic or cellophane.

6. Cloth duct tape ("silver tape"), or masking tape, or freezer tape, or Scotch-type tape -- about 10 square inches. (Save at least 10 feet of Scotch Magic Transparent Tape for the charging device.)

7. Band-Aid tape, or masking tape, or freezer tape, or Scotch transparent tape, or other thin and very flexible tapes -- about 2 square inches.

8. Gypsum wallboard (sheetrock) - about 1/2 square foot, best about 1/2 inch thick. (To make the essential drying agent.)

9. Glue -- not essential, but useful to replace Band-Aid and other thin tapes. "One hour" epoxy is best. Model airplane cement is satisfactory.

10. An.ordinary wooden pencil and a small toothpick (or split a small sliver of wood).

11. Two strong rubber bands, or string.

B. For the Charging Devices:

1. Most hard plastic rubbed on dry paper. This is the best method.

a. Plexiglas and most other hard plastics, such as are used in drafts-men's triangles, common smooth plastic rulers, etc. - at least 6 inches long.

b. Dry paper - Smooth writing or typing paper. Tissue paper, news-paper, or facial tissue such as Kleenex, or toilet paper are satisfactory for charging, but not as durable.

2. Scotch Magic Transparent Tape (3/4 inch width is best), or Scotch Transparent Tape, or P.V.C, (Polyvinyl chloride) insulating electrical tapes, or a few of the other common brands of Scotch-type tapes. (Some plastic tapes do not develop sufficiently high-voltage electrostatic charges when unrolled quickly.) This method cannot be used for charging a KFM inside a dry-bucket, needed for charging when the air is very humid.

C. For Determining Dose Rates and Recording Doses Received:

1. A watch -- preferably with a second hand.

2. A flashlight or other light, for reading the KFM in a dark shelter or at night.

3. Pencil and paper - preferably a notebook.

D. For the Dry-Bucket: (A KFM must be charged inside a dry-bucket if the air is very humid, as it often is inside a crowded, long-occupied shelter lacking adequate forced vent-ilation.)

1- A large bucket, pot, or can, preferably with a top diameter of at least 11 inches.

2. Clear plastic (best is 4-mil-thick clear plastic used for storm windows). A square piece S inches wider on a side than the diameter of the bucket to be used.

3. Cloth duct tape, one inch wide and 8 feet long (or 4 ft., if 2 inches wide). Or 16 ft. of freezer tape one inch wide.

4. Two plastic bags 14 to 16 inches in circumference, such as ordinary plastic bread bags. The original length of these bags should be at least 5 inches greater than the height of the bucket.

5. About one square foot of wall board (sheetrock), to make anhydrite drying agent.

6. Two 1-quart Mason jars or other airtight containers, one in which to store anhydrite and another in which to keep dry the KFM charging devices.

7. Strong rubber bands - enough to make a loop around the bucket. Or string.

8. Four square feet of aluminum foil, to make a vapor-proof cover -- useful, but not essential.

VI. Useful but not Essential Materials
-Which Could be Obtained Before a Crisis-

1. An airtight container (such as a large peanut butter jar) with a mouth at least 4 inches wide, in which to keep a KFM, along with some drying agent, when it is not being used. Keeping a KFM very dry greatly extends the time during which the drying agent Inside the KFM remains effective.

2. Commercial anhydrite with a color indicator, such as the drying agent Drierite. This granular form of anhydrite remains light blue as long as it is effective as a drying agent. Obtainable from laboratory supply sources.

VII. Tools Needed

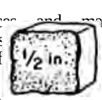
Small nail - sharpened
Stick, or a wooden tool handle
(best 2-2 1/2 inch diameter and at least 12 inches long)
Hammer
Pliers
Scissors
Needle - quite a large sewing needle, but less than 2 1/2 inches long
Knife with a small blade ~ sharp
Ruler (12 inches)

VIII. Make the Drying Agent
-- The Easiest Part to Make, but Time Consuming -

1. For a KFM to measure radiation accurately, the air inside its ionization chamber must be kept very dry. An excellent drying agent (anhydrite) can be made by heating the gypsum in ordinary gypsum wallboard (sheetrock). Do NOT use calcium chloride.

2. Take a piece of gypsum wallboard approximately 12 inches by 6 inches, and preferably with its gypsum about 3/8 inches thick. Cut off the paper and glue, easiest done by first wetting the paper. (Since water vapor from normal air penetrates the plastic cover of a KFM and can dampen the anhydrite and make it ineffective in as short a time as two days, fresh batches of anhydrite must be made before the attack and kept ready inside the shelter for replacement. The useful life of the drying agent inside a KFM can be greatly lengthened by keeping the KFM inside an airtight container (such as a peanut butter jar with a 4-inch-diameter mouth) with some drying agent, when the KFM is not being used.]

3. Break the white gypsum filling into small piec ake the largest no more than 1/2 in. across. (The tops larger than this may be too close to the aluminum f If the gypsum is dry, using a pair of pliers makes easier. Make the largest side of the largest pieces no bigger than this.



4. Dry gypsum is not a drying agent. To drive the water out of the gypsum molecules and produce the drying agent (anhydrite), heat the gypsum in an oven at its highest temperature (which should be above 400 degrees F) for one hour. Heat the gypsum after placing the small pieces no more than two pieces deep in a pan. Or heat the pieces over a fire for 20 minutes or more in a pan or can heated to a dull red.

5. If sufficient aluminum foil and time are available, it is best to heat the gypsum and store the anhydrite as follows:

a. So that the right amount of anhydrite can be taken quickly out of its storage jar, put enough pieces of gypsum in a can with the same diameter as the KFM, measuring out a batch of gypsum that almost covers the bottom of the can with a single layer.

b. Cut a piece of aluminum foil about 8 in. x 8 in. square, and fold up its edges to form a bowl-like container in which to heat one batch of gypsum pieces.

c. Measure out 10 or 12 such batches, and put each batch in its aluminum foil "bowl."

d. Heat all of these filled "bowls" of gypsum in hottest oven for one hour.

e. As soon as the aluminum foil is cool enough to touch, fold and crumple the edges of each aluminum foil "bowl" together, to make a rough aluminum-covered "ball" of each batch of anhydrite.

f. Promptly seal the batches in airtight jars or other airtight containers, and keep containers closed except when taking out an aluminum-covered "ball."

6. Since anhydrite absorbs water from the air very rapidly, quickly put it in a dry airtight container while it is still quite hot. A Mason jar is excellent.

7. To place anhydrite in a KFM, drop in the pieces one by one, being careful not to hit the leaves or the stop-threads. The pieces should almost cover the bottom of the can, with no piece on top of other pieces.

8. To remove anhydrite from a KFM, use a pair of scissors or tweezers as forceps, holding them in a vertical position and not touching the leaves.

IX. Make the Ionization Chamber of the KFM
(To Avoid Mistakes and Save Time,
Read All of This Section ALOUD Before Beginning Work.)

1. Remove the paper label (if any) from an ordinary 8-ounce can from which the top has been smoothly cut. Wash the can with soap and water and dry it. (An 8-ounce can has an inside diameter of about 2-9/16 inches and an inside height of about 2-7/8 inches.)

2. Skip to step 3 if an 8-ounce can is available. If an 8-ounce can is not available, reduce the height of any other can having an inside diameter of about 2-9/16 inches (such as most soup cans, most pop cans, or most beer cans). To cut off the top part of a can, first measure and mark the line on which to cut. Then to keep from bending the can while cutting, wrap newspaper tightly around a stick or a round wooden tool handle, so that the wood is covered with 20 to 30 thicknesses of paper and the diameter (ideally) is only slightly less than the diameter of the can.

   One person should hold the can over the paper-covered stick while a second person cuts the can little by little along the marked cutting line. If leather gloves are available, wear them. To cut the can off smoothly, use a file, or use a hacksaw drawn backwards along the cutting line. Or cut the can with a sharp, short blade of a pocketknife by: (1) repeatedly stabbing downward vertically through the can into the paper, and (2) repeatedly making a cut about 1/4 inch long by moving the knife into a sloping position, while keeping its point still pressed into the paper covering the stick.

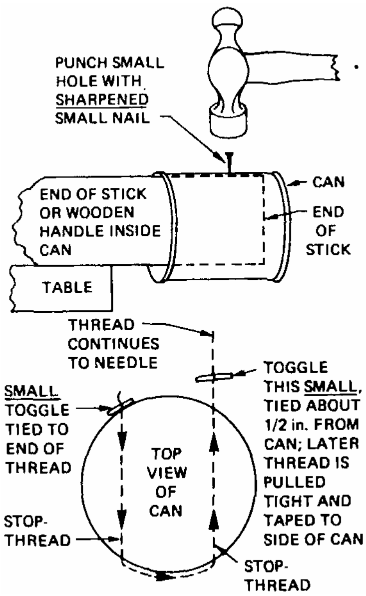
   Next, smooth the cut edge, and cover it with small pieces of freezer tape or other flexible tape.

3. Cut out the PAPER PATTERN TO WRAP AROUND KFM CAN. (Cut one pattern out of the following Pattern Page A.) Glue (or tape) this pattern to the can, starting with one of the two short sides of the pattern. Secure this starting short side directly over the side seam of the can. Wrap the pattern snugly around the can, gluing or taping it securely as it is being wrapped. (If the pattern is too wide to fit flat between the rims of the can, trim a little off its lower edge.)

4. Sharpen a small nail, by filing or rubbing on concrete, for use as a punch to make the four holes needed to install the stop-threads in the ionization chamber (the can). (The stop-threads are insulators that stop the charged aluminum leaves from touching the can and being discharged.)

5. Have one person hold the can over a horizontal stick or a round wooden tool-handle, that ideally has a diameter about as large as the diameter of the can. Then a second person can use the sharpened nail and a hammer to punch four very small holes through the sides of the can at the points shown by the four crosses on the pattern. Make these holes just large enough to run a needle through them, and then move the needle in the holes so as to bend back the obstructing points of metal.

6. The stop-threads can be installed by using a needle to thread a single thread through all four holes. Use a very clean thread,' preferably nylon, and do not touch the parts of this thread that will be inside the can and will serve as the insulating stop-threads. Soiled threads are poor insulators. (See illustrations.)

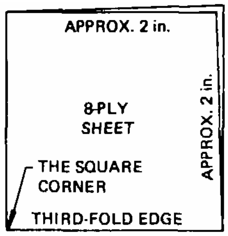


SINGLE THREAD THREADED THROUGH 4 HOLES TO MAKE 2 STOP-THREADS

Before threading the thread through the four holes, tic a small toggle (see the preceding sketch) to the long end of the thread. (This toggle can easily be made of a very small sliver of wood cut about 3/8 in. long.) After the thread has been pulled through the four holes, attach a second toggle to the thread, about 1/2 inch from the part of the thread that comes out of the fourth hole. Then the thread can be pulled tightly down the side of the can and the second small toggle can be taped securely in place to the side of the can. (If the thread is taped down without a toggle, it is likely to move under the tape.)

The first toggle and all of the four holes also should be covered with tape, to prevent air from leaking into the can after it has been covered and is being used as an ionization chamber.

X. Make Two Separate 3-P1y Leaves of Standard [Not Heavy Duty*] Aluminum Foil



Proceed as follows to make each leaf:

1. Cut out a piece of standard aluminum foil approximately 4 inches by 8 inches.

2. Fold the aluminum foil to make a 2-ply (= 2 thicknesses) sheet approximately 4 inches by 4 inches.

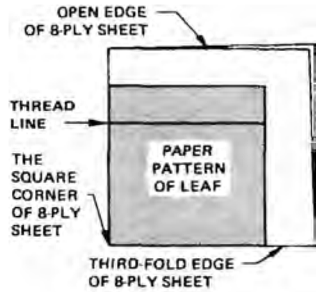
3. Fold this 2-ply sheet to make a 4-ply sheet approximately 2 inches by 4 inches.

4. Fold this 4-ply sheet to make an 8-ply sheet (8 sheets thick) approximately 2 inches by 2 inches, being sure that the two halves of the second-fold edge are exactly together. This third folding makes an 8-ply aluminum foil sheet with one corner exactly square.

5. Cut out the FINISHED-LEAF PATTERN, found on the following Pattern Page B. Note that this pattern is NOT a square and that it is smaller than the 8-ply sheet. Flatten the 8 thicknesses of aluminum foil with the fingers until they appear to be a single thin, flat sheet.

6. Hold the FINISHED-LEAF PATTERN on top of the 8-ply aluminum foil sheet, with the pattern's THIRD-FOLD EDGE on top of the third-fold edge of the 8-ply aluminum sheet. Be sure that one lower corner of the FINISHED-LEAF PATTERN is on top of the exactly square corner of the 8-ply aluminum sheet.

7. White holding a straight edge along the THREAD LINE of the pattern, press with a sharp pencil so as to make a shallow groove for the THREAD LINE on the 8-ply aluminum sheet. Also using a sharp pencil, trace around the top and side of the pattern, so as to indent (groove) the 8-ply foil.



8. Remove the pattern, and cut out the 8-ply aluminum foil leaf.

9. While holding a straight edge along the indented THREAD LINE, lift up the OPEN EDGE of the 8-ply sheet (keeping all 8 plies together) until this edge is vertical, as illustrated. Remove the straight edge, and fold the 8-ply aluminum along the THREAD LINE so as to make a flat-folded hem.

10. Open the flat-folded hem of the finished leaf until the 8-ply leaf is almost flat again, as shown by the pattern, from which the FINISHED-LEAF PATTERN has already been cut.

11. Prepare to attach the aluminum-foil leaf to the thread that will suspend it inside the KFM.

*If only heavy duty aluminum foil (sometimes called "extra heavy duty") is available, make 5-ply leaves of the same size, and use the table for the 8-ply KFM to determine radiation dose rates. To make a 5-ply leaf, start by cutting out a piece of foil approximately 4 inches by 4 inches. Fold it to make a 4-ply sheet approximately 2 inches by 2 inches, with one corner exactly square. Next from a single thickness of foil cut a square approximately 2 inches by 2 inches. Slip this square into a 4-ply sheet, thus making a 5-ply sheet. Then make the 5-ply leaf, using the FINISHED-LEAF PATTERN, etc. as described for making an 8-ply leaf.

If no epoxy glue* is available to hold down the hem and prevent the thread from slipping in the hem, cut two pieces of tape (Band-Aid tape is best; next best is masking or freezer tape; next best, Scotch tape). After first peeling off the paper backing of Band-Aid tape, cut each piece of tape 1/8 inch by 1 inch long. Attach these two pieces of tape to the finished 8-ply aluminum leaf with the sticky sides up, except for their ends. As shown by the pattern on the following pattern page, secure 1/8 inch of one end of a tape strip near one corner of the 8-ply aluminum foil leaf by first turning under this l/8-inch end; that is, with this end's sticky side down. Then turn under the other 1/8-inch-long end, and attach this end below the THREAD LINE. Slant each tape strip as illustrated on Pattern (C).

Be sure you have read through step 18 before you do anything else.

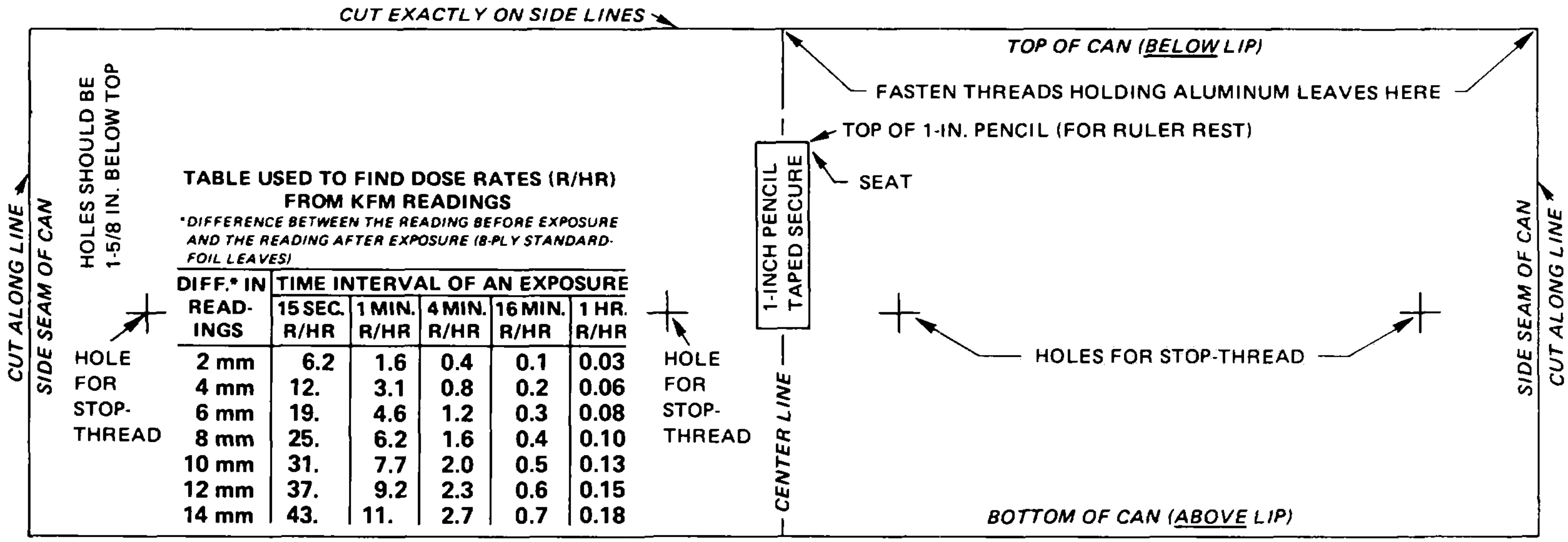


TABLE USED TO FIND DOSE RATES (R/HR) FROM KFM READINGS

**DIFFERENCE BETWEEN THE READING BEFORE EXPOSURE AND THE READING AFTER EXPOSURE (8-PLY STANDARD-FOIL LEAVES)*

DIFF.* IN	TIME INTERVAL OF AN EXPOSURE				
READ-INGS	15 SEC. R/HR	1 MIN. R/HR	4 MIN. R/HR	16 MIN. R/HR	1 HR. R/HR
2 mm	6.2	1.6	0.4	0.1	0.03
4 mm	12.	3.1	0.8	0.2	0.06
6 mm	19.	4.6	1.2	0.3	0.08
8 mm	25.	6.2	1.6	0.4	0.10
10 mm	31.	7.7	2.0	0.5	0.13
12 mm	37.	9.2	2.3	0.6	0.15
14 mm	43.	11.	2.7	0.7	0.18

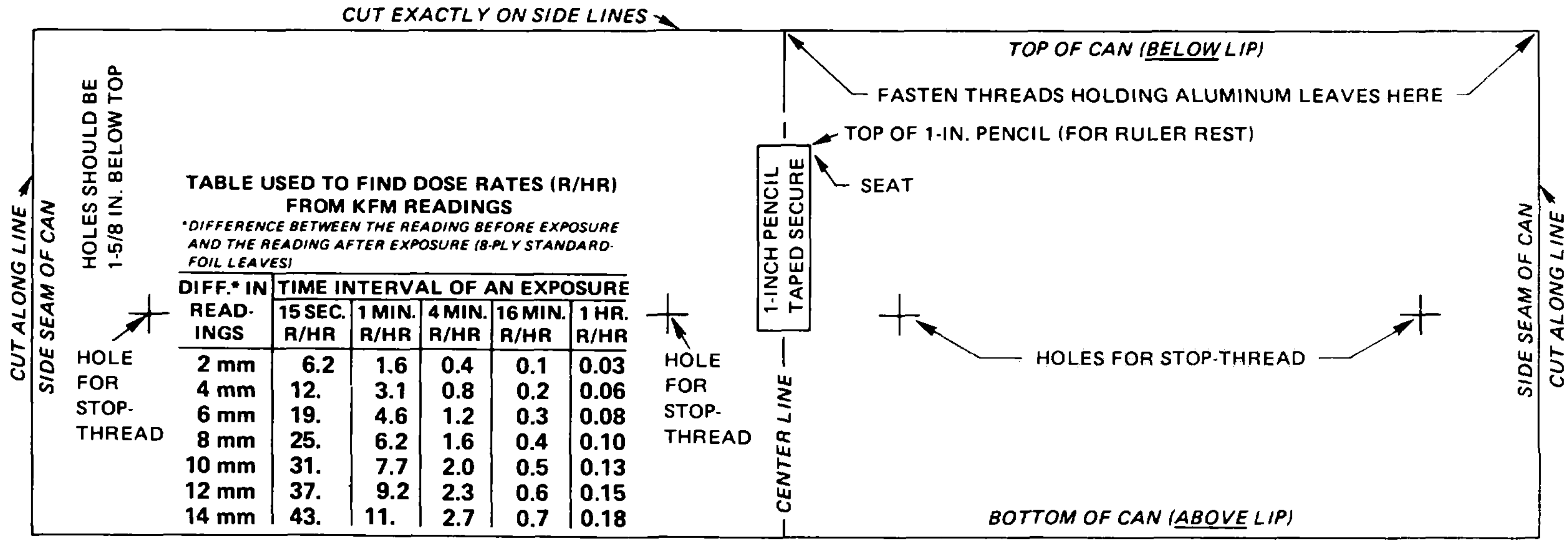


TABLE USED TO FIND DOSE RATES (R/HR) FROM KFM READINGS

**DIFFERENCE BETWEEN THE READING BEFORE EXPOSURE AND THE READING AFTER EXPOSURE (8-PLY STANDARD-FOIL LEAVES)*

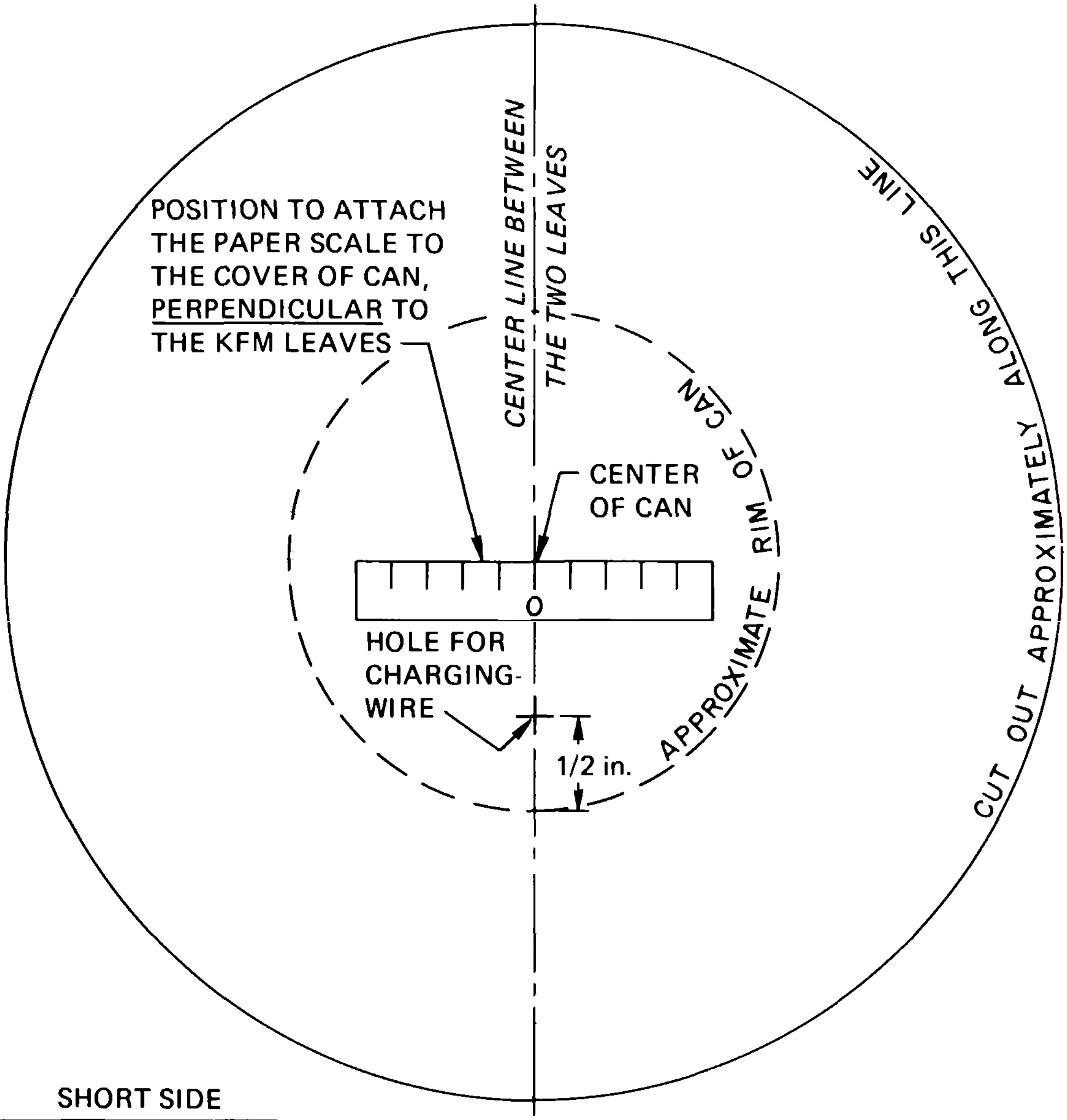
DIFF.* IN	TIME INTERVAL OF AN EXPOSURE				
READ-INGS	15 SEC. R/HR	1 MIN. R/HR	4 MIN. R/HR	16 MIN. R/HR	1 HR. R/HR
2 mm	6.2	1.6	0.4	0.1	0.03
4 mm	12.	3.1	0.8	0.2	0.06
6 mm	19.	4.6	1.2	0.3	0.08
8 mm	25.	6.2	1.6	0.4	0.10
10 mm	31.	7.7	2.0	0.5	0.13
12 mm	37.	9.2	2.3	0.6	0.15
14 mm	43.	11.	2.7	0.7	0.18

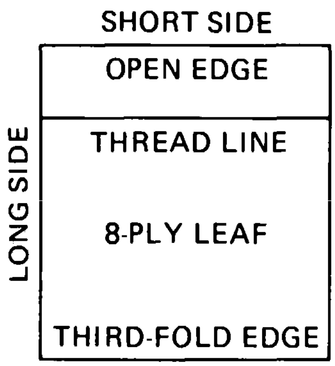
PAPER PATTERN TO WRAP AROUND KFM CAN (GLUE OR TAPE SECURELY TO CAN)

PATTERN PAGE (A)

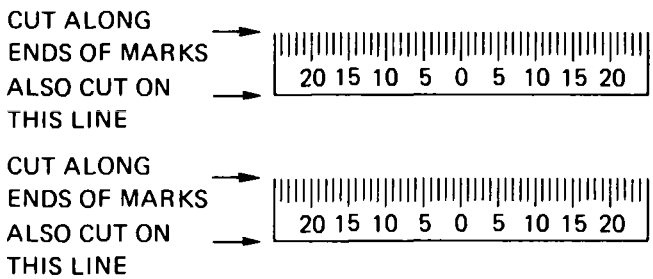
CUT OUT THESE PATTERNS, EACH OF WHICH IS THE EXACT SIZE FOR A KFM.
CAUTION: XEROX COPIES OF THESE PATTERNS WILL BE TOO LARGE.

PATTERN FOR CLEAR-PLASTIC COVER FOR KFM CAN





FINISHED-LEAF PATTERN
(CUT OUT EXACTLY ON SIDE LINES)



PAPER SCALE (TO BE CUT OUT)

PATTERN PAGE (B)

CAUTION: XEROX COPIES OF THE FINISHED-LEAF AND THE SCALE PATTERNS WILL BE SLIGHTLY TOO LARGE.

12. Cut an 8-l/2-inch piece of fine, unwaxed. very clean thread. (Nylon twisted thread, unwaxed extra-fine nylon dental floss, or silk thread are best in this order. Nylon monofilament "invisible" thread is an excellent insulator but is too difficult for most people to handle.)

Cut out Pattern (C), the guide sheet used when attaching a leaf to its suspending thread. Then tape Pattern (C) to the top of a work table. Cover the two "TAPE HERE" rectangles on Pattern (C) with pieces of tape, each piece the size of the rectangle. Then cut two other pieces of tape each the same size and use them to tape the thread ONTO the guide sheet, on top of the "TAPE HERE" rectangles.

Be very careful not to touch the two 1-inch parts of the thread next to the outline of the finished leaf, since oil and dirt even on clean fingers will reduce the electrical insulating value of the thread between the leaf and the top rim of the can.

13. With the thread still taped to the paper pattern and while slightly lifting the thread with a knife tip held under the center of the thread, slip the finished leaf under the thread and into position exactly on the top of the leaf outlined on the pattern page. Hold the leaf in this position with two fingers.

14. While keeping the thread straight between its two taped-down ends, lower the thread so that it sticks to the two plastic strips. Then press the thread against the plastic strips.

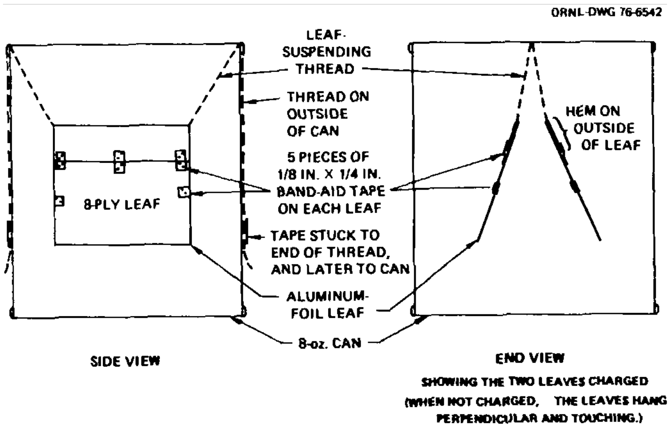
15. With the point of the knife, hold down the center of the thread against the center of the THREAD LINE of the leaf. Then, with two fingers, carefully fold over the hem and press it almost flat. Be sure that the thread comes out of the corners of the hem. Remove the knife, and press the hem down completely flat against the rest of the leaf.

16. Make small marks on the thread at the two points shown on the pattern page. Use a ballpoint pen if available.

17. Loosen the second two small pieces of tape from the partem paper, but leave these tapes stuck to the thread.

18. Cut 5 pieces of Band-Aid tape, each approximately 1/8 inch by 1/4 inch, this small.

Use 3 of these pieces of tape to secure the centers of the side edges of the leaf. Place the 5 pieces as illustrated in the SIDE VIEW sketch below.



*If using epoxy or other glue, use only a very little to hold down the hem, to attach the thread securely to the leaf and to glue together any open edges of the plied foil. Most convenient is "one hour" epoxy, applied with a toothpick. Model airplane cement requires hours to harden when applied between sheets of aluminum foil. To make sure no glue stiffens the free thread beyond the upper comers of the finished leaf, put no glue within 1 /4 inch of a point where thread will go out from the folded hem of the leaf.

The instructions in step 11 are for persons lacking "one hour" epoxy or the time required to dry other types of glue. Persons using glue instead of tape to attach the leaf to its thread should make appropriate use of the pattern on the following page and of some of the procedures detailed in steps 12 through 18.

XI. Install the Aluminum-Foil Leaves

1. Use the two small pieces of tape stuck to the ends of a leaf-suspending thread to attach the thread to the outside of the can. Attach the tapes on opposite sides of the can, so as to suspend the leaf inside the can. See END VIEW sketch. Each of the two marks on the attached thread MUST rest exactly on the top of the rim of the can, preferably in two very small notches filed in the top of the rim of the can. Each of these two marks on a thread should be positioned exactly above one of the two points shown on the pattern wrapped around the can. Be sure that the hem-side of each of the two leaves faces outward. Sec END VIEW sketch.

2. Next, the suspending thread of the first leaf should be taped to the top of the rim. Use a piece of Band-Aid only about 1/8 in. x 1/4 in., sticking it to the rim of the can so as barely to cover the thread on the side where the second leaf will be suspended. Make sure no parts of the tapes are inside the can.

3. Position and secure the second leaf, being sure that:

   a. The smooth sides of the two leaves are smooth (not bent) and face each other and are flush (= "right together") when not charged. See END VIEW sketch and study the first photo illustration, "An Uncharged KFM".

   b. The upper edges of the two leaves are suspended side by side and at the same distance below the top of the can.

   c. The leaf-suspending threads are taped with Band-Aid to the top of the rim of the can (so that putting the cover on will not move the threads).

   d. No parts of the leaf-suspending threads inside the can are taped down to the can or otherwise restricted.

   e. The leaf-suspending parts of the threads inside the can do not cross over, entangle or restrict each other.

   f. The threads come together on the top of the rim of the can, and that the leaves are fiat and hang together as shown in the first photo illustration, "An Uncharged KFM,"

   g. If the leaves do not look like these photographed leaves, make new, better leaves and install them.

4. Cover with tape the parts of the threads that extend down the outside of the can, and also cover with more tape the small pieces of tape near the ends of the threads on the outside of the can.

5. To make the SEAT, cut a piece of a wooden pencil, or a stick, about one inch long and tape it securely to the side of the can along the center line marked SEAT on the pattern. Be sure the upper end of this piece of pencil is at the same position as the top of the location for the SEAT outlined on the pattern. The top of the SEAT is 3/4 inch below the top of the can. Be sure not to cover or make illegible any part of the table printed on the paper pattern.

6. Cut out one of the "Reminders for Operators" and glue and/or tape it to the unused side of the KFM. Then it is best to cover all the sides of the finished KFM with clear plastic tape or vamish. This will keep sticky-tape on the end of an adjustment thread or moisture from damaging the "Reminders" or the table.

XII. Make the Plastic Cover

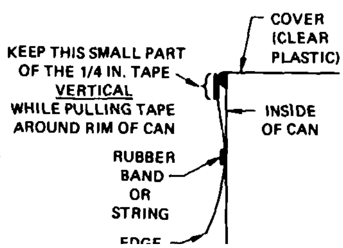
1. Cut out the paper pattern for the cover from the Pattern Page (B).

2. From a piece of clear, strong plastic, cut a circle approximately the same size as the paper pattern. (Storm-window polyethylene plastic, 4 mils thick, is best.)

3. Stretch the center of this circular piece of clear plastic over the open end of the can, and pull it down close to the sides of the can, making small tucks in the "skirt," so that there are no wrinkles in the top cover. Hold the lower part of the "skirt" in place with a strong rubber band or piece of string. (If another can having the same diameter as the KFM can is available, use it to make the cover - to avoid the possibility of disturbing the leaf-suspending threads.)

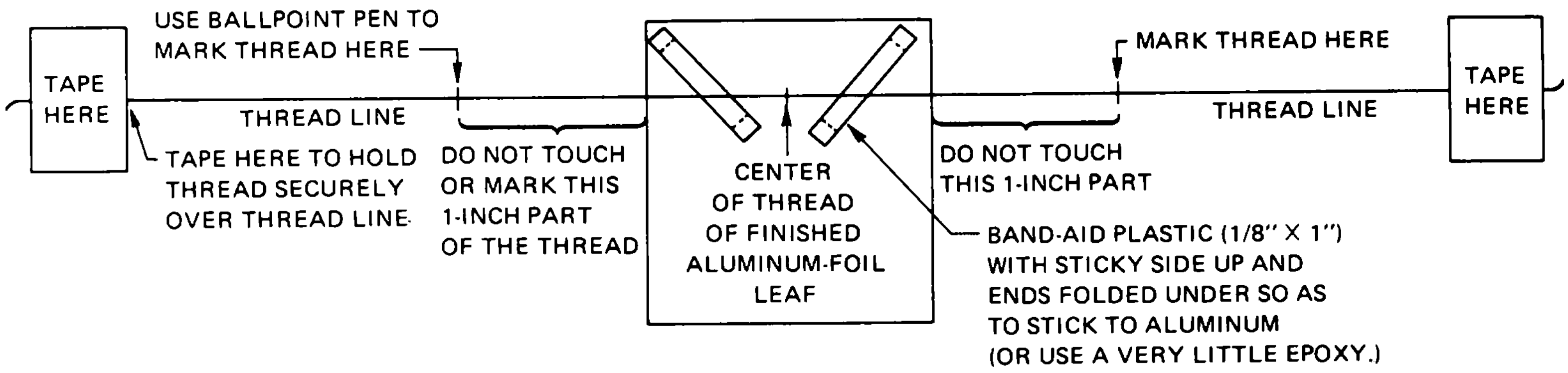
4. Make the cover so it fits snugly, but can be taken off and replaced readily.

Just below the top of the rim of the can, bind the covering plastic in place with a J/4-inch-wide piece of strong tape. (Cloth duct tape is best. If only freezer or masking tape is available, use two thicknesses.)



Keep vertical the small part of the tape that presses against the rim of the can while pulling the length of the tape horizontally around the can so as to bind the top of the plastic cover snugly to the rim. If this small part of the tape is kept vertical, the lower edge of the tape will not squeeze the plastic below the rim of the can to such a small circumference as to prevent the cover from being removed quite easily.

COVER THE TWO "TAPE HERE" RECTANGLES WITH SAME-SIZED PIECES OF TAPE, IN ORDER TO KEEP FROM TEARING THIS PAPER WHEN REMOVING TWO ADDITIONAL PIECES OF TAPE. THEN, BY PUTTING TWO OTHER PIECES OF TAPE THIS SAME SIZE ON TOP OF THE FIRST TWO PIECES, TAPE THE THREAD ONTO THIS GUIDE SHEET, AND LATER ATTACH A LEAF TO THE TAPED-DOWN THREAD.



PATTERN (C)
(Cut out this guide along its border lines and tape to the top of a work table.)

WARNING: The parts of the thread that will be inside the can and on which the leaf will be suspended must serve to insulate the high-voltage electrical charges to be placed on the leaf. Therefore, the suspended parts of the thread must be kept very clean.

REMINDERS FOR OPERATORS

THE DRYING AGENT INSIDE A KFM IS O.K. IF, WHEN THE CHARGED KFM IS NOT EXPOSED TO RADIATION, ITS READINGS DECREASE BY 1 MM OR LESS IN 3 HOURS.

READING: WITH THE READING EYE 12 INCHES VERTICALLY ABOVE THE SEAT, NOTE ON THE MM SCALE THE SEPARATION OF THE LOWER EDGES OF THE LEAVES. IF THE RIGHT LEAF IS AT 10 MM AND THE LEFT LEAF IS AT 7 MM, THE KFM READS 17 MM. NEVER TAKE A READING WHILE A LEAF IS TOUCHING A STOP-THREAD. NEVER USE A KFM READING THAT IS LESS THAN 5MM.

FINDING A DOSE RATE: IF BEFORE EXPOSURE A KFM READS 17 MM AND IF AFTER A 1-MINUTE EXPOSURE IT READS 5 MM, THE DIFFERENCE IN READINGS IS 12 MM, THE ATTACHED TABLE SHOWS THE DOSE RATE WAS 9.6 R/HR DURING THE EXPOSURE.

FINDING A DOSE: IF A PERSON WORKS OUTSIDE FOR 3 HOURS WHERE THE DOSE RATE IS 2 R/HR, WHAT IS HIS RADIATION DOSE? ANSWER: 3 HR x 2 R/HR = 6 R.

FINDING HOW LONG IT TAKES TO GET A CERTAIN R DOSE: IF THE DOSE RATE IS 1.6 R/HR OUTSIDE AND A PERSON IS WILLING TO TAKE A 6 R DOSE, HOW LONG CAN HE REMAIN OUTSIDE? ANSWER: 6 R ÷ 1.6 R/HR = 3.75 HR = 3 HOURS AND 45 MINUTES.

FALLOUT RADIATION GUIDES FOR A HEALTHY PERSON NOT PREVIOUSLY EXPOSED TO A TOTAL RADIATION DOSE OF MORE THAN 100 R DURING A 2-WEEK PERIOD:

6 R PER DAY CAN BE TOLERATED FOR UP TO TWO MONTHS WITHOUT LOSING THE ABILITY TO WORK.

100 R IN A WEEK OR LESS IS NOT LIKELY TO SERIOUSLY SICKEN.

350 R IN A FEW DAYS IS LIKELY TO PROVE FATAL UNDER POST-ATTACK CONDITIONS.

600 R IN A WEEK OR LESS IS ALMOST CERTAIN TO CAUSE DEATH WITHIN A FEW WEEKS.

5. With scissors, cut off the "skirt" of the plastic cover until it extends only about one inch below the top of the rim of the can.

6. Make a notch in the "skirt," about one inch wide, where it fits over the pencil SEAT attached to the can. The "skirt" in this notched area should be only about 5/8 of an inch long, measured down from the top of the rim of the can.

7. Remove the plastic cover, and then tape the lower edges of the "skirt," inside and out, using short lengths of 1/4-inch-wide tape. Before securing each short piece of tape, slightly open the tucks that are being taped shut on their edges, so that the "skirt" flares slightly outward and the cover can be readily removed.

8. Put the plastic cover on the KFM can. From the Pattern Page (B) cut out the SCALE. Then tape the SCALE to the top of the plastic cover, in the position shown on the pattern for the cover, and also by the drawings. Preferably use transparent tape.

   Be careful not to cover with tape any of the division lines on the SCALE between 20 on the right and 20 on the left of 0.

9. Make the charging-wire by following the pattern given below which is exactly the right size.

   Doorbell wire with an outside diameter of about 1/16 inch is best, but any lightweight insulated wire, such as part of a lightweight two-wire extension cord split in half, will serve. The illustrated wire is much thicker than bell wire. To stop tape from possibly slipping up or down the wire, use a very little glue.

   If a very thin plastic has been used for the cover, a sticky piece of tape may need to be attached to the end of the bare-ended adjustment thread, so both threads can be used to hold the charging wire in a desired position.

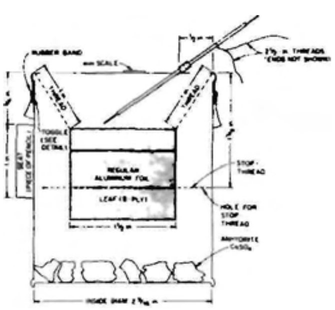
   The best tape to attach to an end of one of the adjustment-threads is cloth duct tape, A square piece 3/4 inch by 3/4 inch is the sticky base. To keep this tape sticky (free of paper fibers), the paper on the can should be covered with transparent tape or varnish. A piece about 1/8 inch by 3/4 inch serves to stick under one end of the sticky base, to hold the adjustment-thread. A 3/4 inch by 1-1/4 inch rectangular piece of tape is used to make the finger hold - important for making adjustments inside a dry-bucket.

   With a needle or pin, make a hole in the plastic cover 1/2 inch from the rim of the can and directly above the upper end of the CENTER LINE between the two leaves. The CENTER LINE is marked on the pattern wrapped around the can. Carefully push the CHARGING-WIRE through this hole (thus stretching the hole) until all of the CHARGING-WIRE below its Band-Aid-tape stop is inside the can.

XIII. Two Ways to Charge a KFM

1. Charging a KFM with Hard Plastic Rubbed on Dry Paper.

   a. Adjust the charging-wire so that its lower end is about 1/16 inch above the upper edges of the aluminum-foil leaves. Use the sticky-tape at the end of one adjustment-thread to hold the charging-wire in this position. Stick this tape approximately in line with the threads suspending the leaves, either on the side of the can or on top of the plastic cover. (If the charging-wire is held loosely by the cover, it may be necessary to put a piece of sticky-tape on the end of each adjustment-thread in order to adjust the charging-wire securely. If a charging-wire is not secure, its lower end may be forced up by the like charge on the leaves before the leaves can be fully charged.)



   b. Select a piece of Plexiglas, a draftsman's plastic triangle, a smooth plastic ruler, or other piece of hard, smooth plastic. (Unfortunately, not all types of hard plastic can be used to generate a sufficient electrostatic charge.) Be sure the plastic is dry.

   For charging a KFM inside a dry-bucket, cut a rectangular piece of hard plastic about 1-1/2 by S inches. Sharp corners and edges can be smoothed by rubbing on concrete. To avoid contaminating the charging end with sweaty, oily fingers, it is best to mark the other end with a piece of tape.

   c. Fold DRY paper (typing paper, writing paper, or other smooth, clean paper) to make an approximate square about 4 inches on a side and about 20 sheets thick. (This many sheets of paper lessens leakage to the fingers of the electrostatic charges to be generated on the hard plastic and on the rubbed paper.)

   d. Fold the square of paper in the middle, and move the hard plastic rapidly back and forth so that it is rubbed vigorously on the paper in the middle of this folded square — while the outside of this folded square of paper is squeezed firmly between thumb and the ends of two fingers. To avoid discharging the charge on the plastic to the fingers, keep them away from the edges of the paper. See photo.

   e. Move the electrostatically charged part of the rubbed plastic rather slowly past the upper end of the charging-wire, while looking straight down on the KFM. Keep the hard plastic approximately perpendicular to the charging-wire and about 1/4 to 1/2 inch away from its upper end. The charge jumps the spark gaps and charges the leaves of the KFM.

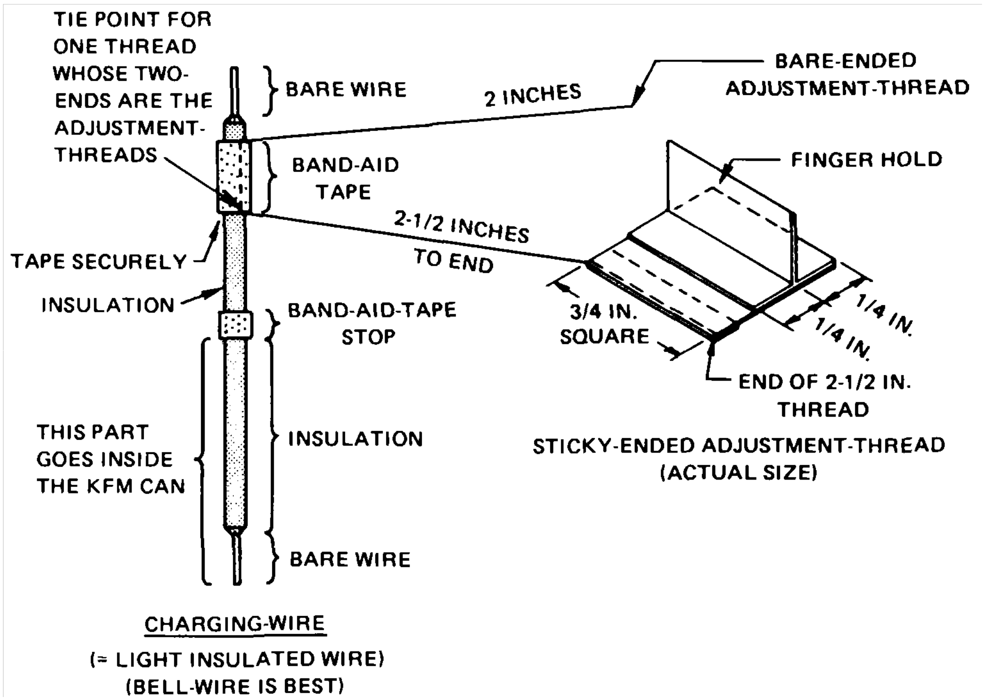
   f. Pull down on an insulating adjustment-thread to raise the lower end of the charging-wire. (If the charging-wire has been held in its charging position by its sticky-ended adjustment-thread being stuck to the top of the clear plastic cover, to avoid possibly damaging the threads: (1) pull down a little on the bare-ended adjustment-thread; and (2) detach, pull down on, and secure the sticky-ended adjustment-thread to the side of the can, so as to raise and keep the lower end of the charging-wire close to the underside of the clear plastic cover.) Do not touch the charging-wire.

   g. Put the charging paper and the hard plastic in a container where they will be kept dry -- as in a Mason jar with some drying agent.

2. Charging a KFM from a Quickly Unwound Roll of Tape. (Quick unwinding produces a harmless charge of several thousand volts on the tape.)

   a. Adjust the charging-wire so that its lower end is about 1/16 inch above the upper edges of the aluminum-foil leaves. Use the sticky-tape at the end of one adjustment-thread to hold the charging-wire in this position. Stick this tape approximately in line with the leaves, either on the side of the can or on the plastic cover. (If the plastic cover is weak, it may be necessary to put a piece of sticky-tape on the end of each adjustment-thread, in order to hold the charging-wire securely. If a charging-wire is not secure, its lower end may be forced up by the like charge on the leaves before the leaves can be fully charged.)

EXACT SIZE

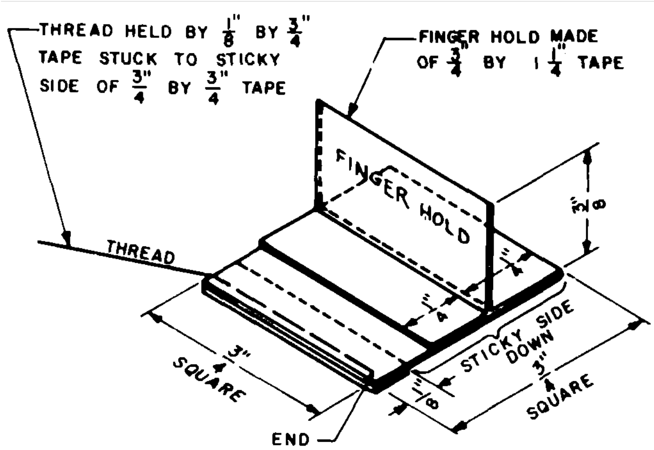


STICKY-ENDED ADJUSTMENT-THREAD (ACTUAL SIZE)

CHARGING-WIRE

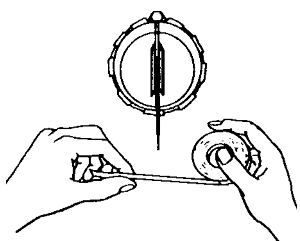
(= LIGHT INSULATED WIRE) (BELL-WIRE IS BEST)

STICKY-ENDED ADJUSTMENT-THREAD (OVERSIZED DRAWING)



b. The sketch shows the "GET SET" position, preparatory to unrolling the Scotch Magic Transparent Tape, P.V.C electrical tape, or other tape. Be sure to first remove the roll from its dispenser. Some of the other kinds of tape will not produce a high enough voltage.

c. QUICKLY unroll 10 to 12 inches of tape by pulling its end with the left hand, while the right hand allows the roll to unwind while remaining in about the same "GET SET" position only an inch or two away from the KFM.



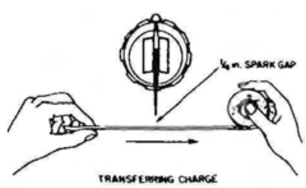
"GET SET" POSITION

d. While holding the unwound tape tight, about perpendicular to the charging-wire, and about 1/4 inch away from the end of the charging-wire, promptly move both hands and the tape to the right rather slowly - taking about 2 seconds to move about 8 inches. The electrostatic charge on the unwound tape "jumps" the spark gaps from the tape to the upper end of the charging-wire and from the lower end of the charging-wire to the aluminum leaves, and charges the aluminum leaves.

Be sure neither leaf is touching a stop-thread.

Try to charge the leaves enough to spread them far enough apart to give a reading of at least 15 mm.

Pull down on an insulating adjustment-thread to raise the lower end of the charging-wire. If the charging-wire has been held in charging position by its sticky-ended adjustment-thread being stuck to the top of the clear plastic cover, it is best first to pull down a little on the bare-ended adjustment-thread, and then to move, pull down on, and secure the sticky-ended adjustment-thread to the side of the can so that the lower part of the charging-wire is close to the underside of the clear plastic cover.



TRANSFERRING CHARGE

Do not touch the charging-wire.

Rewind the tape tight on its roil, for future use when other tape may not be available.

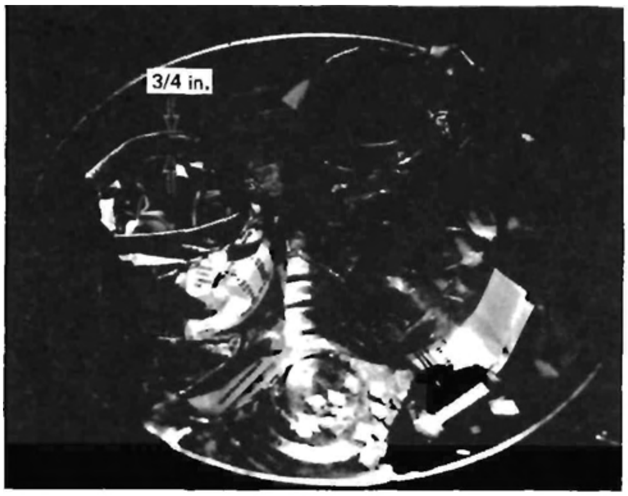
By charging a KFM while it is inside a dry-bucket with a transparent plastic cover (see illustration), this fallout meter can be charged and used even if the relative humidity is 100% outside the dry-bucket. The air inside the dry-bucket is kept very dry by a drying agent placed on its bottom. About a cupful of anhydrite serves very well. The pieces of this dehydrated gypsum need not be as uniform in size as is best for use inside a KFM, but do not use powdered anhydrite.

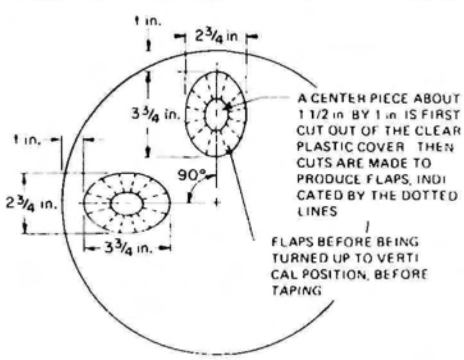
A dry-bucket can be readily made in about an hour by proceeding as follows:

1. Remove the handle of a large bucket, pot, or can preferably with a top diameter of at least 11 inches. A 4-gallon bucket having a top diameter of about 14 inches is ideal. If the handle-supports interfere with stretching a piece of clear plastic film across the top of the bucket, remove them, being sure no sharp points remain.

2. Cut out a circular piece of clear plastic with a diameter about 5 inches larger than the diameter of the top of the bucket. Clear polyethylene 4 mils thick, used for storm windows, etc., is best. Stretch the plastic smooth across the top of the bucket, and tie it in place, preferably with strong rubber bands looped together to form a circle.

3. Make a plastic top that fits snugly but is easily removable, by taping over and around the plastic just below the top of the bucket. One-inch-wide cloth duct tape, or one-inch-wide glass-reinforced strapping tape, serves well. When taping, do not permit the lower edge of the tape to be pulled inward below the rim of the bucket.





4. Cut two small holes (about 1 inch by 2 inches) in the plastic cover, as illustrated. Then make the radial cuts (shown by dotted lines) outward from the small holes, out to the solid-line outlines of the 3 inch by 4 inch hand-holes, so as to form small flaps.

5. Fold the small flaps upward, so they are vertical. Then tape them on their outer sides, so they form a vertical "wall" about 3/4 inch high around each hand-hole.

6. Reduce the length of two ordinary plastic bread bags (or similar plastic bags) to a length that is 5 inches greater than the height of the bucket. (Do not use rubber gloves in place of bags; gloves so used result in much more humid outside air being unintentionally pumped into a dry-bucket when it is being used while charging a KFM inside it.)

7. Insert a plastic bag into each hand-hole, and fold the edge of the plastic bag about 1/2 inch over the taped vertical "wall" around each hand-hole.

8. Strengthen the upper parts of the plastic bags by folding 2-inch pieces of tape over the top of the "wall" around each hand-hole.

9. Make about a quart of anhydrite by heating small pieces of wall-board gypsum, and keep this anhydrite dry in a Mason jar or other airtight container with a rubber or plastic sealer.

10. Make a circular aluminum-foil cover to place over the plastic cover when the dry-bucket is not being used for minutes to hours. Make this cover with a diameter about 4 inches greater than the diameter of the top of the bucket, and make it fit more snugly with an encircling loop of rubber bands, or with string. Although not essential, an aluminum-foil cover reduces the amount of water vapor that can reach and pass through the plastic cover, thus extending the life of the drying agent.

11. Charge a KFM inside a dry-bucket by:

    a. Taking off wrist watch and sharp-pointed rings that might tear the plastic bags.

    b. Placing inside the dry-bucket:

        (1) About a cup of anhydrite or silica gel;
        (2) the KFM, with its charging-wire adjusted in its charging position; and
        (3) dry, folded paper and the electrostatic charging device, best a 5-inch-long piece of Plexiglas with smoothed edges, to be rubbed between dry paper folded about 4 inches square and about 20 sheets thick. (Unrolling a roll of tape inside a dry-bucket is an impractical charging method.)

    c. Replacing the plastic cover, that is best held in place with a loop of rubber bands.

    d. Charging the KFM with your hands inside the plastic bags, operating the charging device. Have another person illuminate the KFM with a flashlight. When adjusting the charging-wire, move your hands very slowly. See the dry-bucket photos.

12. Expose the KFM to fallout radiation either by:

    a. Leaving the KFM inside the dry-bucket while exposing it to fallout radiation for one of the listed time intervals, and reading the KFM before and after the exposure while it remains inside the dry-bucket. (The reading eye should be a measured 12 inches above the SEAT of the KFM, and a flashlight or other light should be used.)

    b. Taking the charged KFM out of the dry-bucket to read it, expose it, and read it after the exposure. (If this is done repeatedly, especially in a humid shelter, the drying agent will not be effective for many KFM chargings, and will have to be replaced.)

XV. How to Use a KFM after a Nuclear Attack

A. Background Information

If during a rapidly worsening crisis threatening nuclear war you are in the place where you plan to take shelter, postpone studying the instructions following this sentence until after you have:

(1) built or improved a high-protection-factor shelter (if possible, a shelter covered with 2 or 3 ft of earth and separate from flammable buildings), and

(2) made a KAP (homemade shelter-ventilating pump) if you have the instructions and materials, and

(3) stored at least 15 gallons of water for each shelter occupant if you can obtain containers.

Having a KFM or any other dependable fallout meter and knowing how to operate it will enable you to minimize radiation injuries and possible fatalities, especially by skillfully using a high-protection-factor fallout shelter to control and limit exposures to radiation. By studying this section you first will learn how to measure radiation dose rales (roentgens per hour = R/hr), how to calculate doses [R] received in different time intervals, and how to determine time Intervale (hours and/or minutes) in which specified doses would be received. Then this section lists the sizes Of doses (number of R) that the average person can tolerate without being sickened, that he is likely to survive, and that he is likely to be killed by.

Most fortunately for the future of all living things, the decay of radioactivity causes the sandlike fallout particles to become less and less dangerous with the passage of time. Each fallout particle acts much like a tiny X ray machine would if it were made so that its rays, shooting out from it like invisible light, became weaker and weaker with time.

Contrary to exaggerated accounts of fallout dangers, the radiation does rate from fallout particles when they reach the ground in the areas of the heaviest fallout will decrease quite rapidly. For example, consider the decay of fallout from a relatively nearby, large surface burst, at a place where the fallout particles are deposited on the ground one hour after the explosion. At this time one hour after the explosion, assume that the radiation dose rate (the best measure of radiation danger at a particular time) measures 2,000 roentgens per hour (2,000 R/hr) outdoors. Seven hours later the dose rate is reduced to 200 R/hr by normal radioactive decay. Two days after the explosion, the dose rate outdoors is reduced by radioactive decay to 20 R/hr. After two weeks, the dose rate is less than 2 R/hr. When the dose rate is 2 R/hr, people can go out of a good shelter and work outdoors for 3 hours a day, receiving a daily dose of 6 roentgens, without being sickened.

In places where fallout arrives several hours after the explosion, the radioactivity of the fallout will have gone through its time period of most rapid decay while the fallout particles were still airborne. If you are in a location so distant from the explosion that fallout arrives 8 hours after the explosion, two days must pass before the initial dose rate measured at your location will decay to 1/10 its initial intensity.

B. Finding the Dose Rale

1. Reread Section IV, "What a KFM Is and How It Works." Also reread Section XIII, "Two Ways to Charge a KFM," and actually do each step immediately after reading it.

2. Charge the KFM, raise the lower end of its charging-wire and read the apparent separation of the lower edges of its leaves while the KFM rests on an approximately horizontal surface. Never take a reading while a leaf is touching a stop-thread.

3. Expose the KFM to fallout radiation for one of the time intervals shown in the vertical columns of the table attached to the KFM. (Study the following table.) If the dose rate is not known even approximately, first expose the fully charged KFM for one minute. For dependable measurements outdoors, expose the charged KFM about three feet above the ground. For most exposures, connect the KFM to a stick or pole (best done with two rubber bands), and expose it about three feet above the ground. Be careful not to tilt the KFM too much.

4. Read the KFM after the exposure, while the KFM rests on an approximately horizontal surface.

5. Find the time interval that gives a dependable reading - by exposing the fully charged KFM for one or more of the listed time intervals until the reading after the exposure la:

   (a) Not less than 5 mm.

   (b) At least 2 mm less than the reading before the exposure.

6. Calculate by simple subtraction the difference in the apparent separation of the lower edges of the leaves before the exposure and after the exposure. An example: If the reading before the exposure is 18 mm and the reading after the exposure is 6 mm, the difference in readings is 18mm - 6 mm = 12 mm.

7. If an exposure results in a difference in readings of less than 2 mm, recharge the KFM and expose it again for one of the longer time intervals listed. (If there appears to be no difference in the readings taken before and after an exposure for one minute, this does not prove there is absolutely no fallout danger.)

8. If an exposure results in the reading after the exposure being less than 5 mm, recharge the KFM and expose it again for one of the shorter time intervals listed.

9. Use the table attached to the KFM to find the dose rale (R/hr) during the time of exposure. The dose rate (R/hr) is found at the intersection of the vertical column of numbers under the time interval used and of the horizontal line of numbers that lists the calculated difference in readings at its left end.

TABLE USED TO FIND DOSE RATES (R/HR FROM KFM READINGS

*DIFFERENCE BETWEEN THE READING BEFORE EXPOSURE AND THE READING AFTER EXPOSURE (8 PLY STANDARD FOIL LEAVES)

DIFF.* IN READINGS	TIME INTERVAL OF AN EXPOSURE 15 SEC. R/HR	1 MIN. R/HR	4 MIN. R/HR	16 MIN. R/HR	1 HR. R/HR
2 mm	6.2	1.6	0.4	0.1	0.03
4 mm	12.	3.1	0.8	0.2	0.06
6 mm	19.	4.6	1.2	0.3	0.08
8 mm	25.	6.2	1.6	0.4	0.10
10 mm	31.	7.7	2.0	0.5	0.13
12 mm	37.	9.2	2.3	0.6	0.15
14 mm	43.	11.	2.7	0.7	0.18

An example: If the time interval of the exposure was 1 MIN. and the difference in readings was 12 an, the the table shows that the dose rale during the time interval of the exposure was 9.2 R/HR (9.2 roentgens per hour).

Another example: If the time interval of the exposure was 15 SEC. and the difference in readings was 11 mm, the table shows that the dose rate during the exposure was halfway between 31 R/HR and 37 R/HR that is, the dose rale was 34 R/hr.

10. Note in the table that if an exposure for one of the listed time intervals causes the difference in readings to be 2 mm or 3 mm, then an exposure 4 times as long reveals the same dose rate. An example: If a 1-min exposure results in a difference in readings of 2 mm, the table shows the dose rate was 1.6 R/hr; then if the KFM is exposed for 4 minutes at this same dose rate of 1.6 R/hr, the table shows that the resultant difference in readings is 8 mm.

    The longer exposure results in a more accurate determination of the dose rate.

11. If the dose rate is found to be greater than 0.2 R/hr and time is available, recharge the KFM and repeat the dose-rate measurement -- to avoid possible mistakes.

C. Calculating the Dose Received

The dose of fallout radiation -- that is, the amount of fallout radiation received -- determines the harmful effects on men and animals. Being exposed to a high dose rale is not always dangerous -- provided the exposure is short enough to result in only a small dose being received. For example, if the dose rate outside an excellent fallout shelter is 1200 R/hr and a shelter occupant goes outside for 30 seconds, he would be exposed for 1/2 of 1 minute, or 1/2 of 1/60 of an hour, which equals 1/120 hour. Therefore, since the dose he would receive if he stayed outside for 1 hour would be 1200 R, in 30 seconds he would receive 1/120 of 1200, which equals 10 R (1200 R divided by 120 = 10 R). A total dally dose of 10 R (10 roentgens) will not cause any symptoms if it is not repeated day after day for a week or more.

In contrast, if the average dose rate of an area were found to be 12 R/hr and if a person remained exposed in that particular area for 24 hours, he would receive a dose of 288 R (12 R/hr x 24 hr = 288 R). Even assuming that this person had been exposed previously to very little radiation, there would still be a serious risk that this 288 R dose would be fatal under the difficult conditions that would follow a heavy nuclear attack.

Another example: Assume that three days after an attack the occupants of a dry, hot cave giving almost complete protection against fallout are in desperate need of water. The dose rate outside is found to be 20 R/hr. To backpack water from a source 3 miles away is estimated to take 2-1/2 hours. The cave occupants estimate that the water backpackers will receive a dose in 2-1/2 hours of 50 R (2.5 hr x 20 R/hr - 50 R). A dose of 50 R will cause only mild symptoms (nausea in about 10% of persons receiving a 50 R dose) for persons who previously have received only very small doses. Therefore, one of the cave occupants makes a rapid radiation survey for about 1-1/2 miles along the proposed route, stopping to charge and read a KFM about every quarter of a mile. He finds no dose rates much higher than 20 R/hr.

So, the cave occupants decide the risk is small enough to justify some of them leaving shelter for about 2-1/2 hours to get water.

D. Estimating the Dangers from Different Radiation Doses

Fortunately, the human body — if given enough time -- can repair most of the damage caused by radiation. An historic example: A healthy man accidently received a daily dose of 9.3 R (or somewhat more) of fallout-type radiation each day for a period of 106 days. His total accumulated dose was at least 1000 R, A dose of one thousand roentgens, if received in a few days, is almost three times the dose likely to kill the average man if he receives the whole dose in a few days and after a nuclear attack cannot get medical treatment, adequate rest, etc. However, the only symptom this man noted was serious fatigue.

The occupants of a high-protection-factor shelter (such as a trench shelter covered with 2 or 3 feet of earth and having crawlway entrances) would receive less than 1/200 of the radiation dose they would receive outside. Even in most areas of very heavy fallout, persons who remain continously in such a shelter would receive a total accumulated dose of less than 25 R in the first day after the attack, and less than 100 R in the first two weeks. At the end of the first two weeks, such shelter occupants could start working outside for an increasing length of time each day, receiving a daily dose of no more than 6 R for up to two months without being sickened.

To control radiation exposure in this way, each shelter must have a fallout meter, and a daily record must be kept of the approximate total dose received each day by every shelter occupant, both while inside and outside the shelter. The long-term penalty which would result from a dose of 100 R received within a few weeks is much less than many Americans fear. If 100 average persons received an external dose of 100 R during and shortly after a nuclear attack, the studies of the Japanese A-bomb survivors indicate that no more than one of them is likely to die during the following 30 years as a result of this 100 R radiation dose. These delayed radiation deaths would be due to leukemia and other cancers. In the desperate crisis period following a major nuclear attack, such a relatively small shortening of life expectancy during the following 30 years should not keep people from starting recovery work to save themselves and their fellow citizens from death due to lack of food and other essentials.

A healthy person who previously has received a total accumulated dose of no more than 100 R distributed over a 2-week period should realize that:

100 R, even if all received in a day or less, is unlikely to require medical care-provided during the next 2 weeks a total additional dose of no more than a few R is received.

350 R received in a few days or less is likely to prove fatal after a large nuclear attack when few survivors could get medical care, sanitary surroundings, a well-balanced diet, or adequate rest.

600 R received in a few days or less is almost certain to cause death within a few days.

E, Using a KFM to Reduce the Doses Received Inside a Shelter

Inside most shelters, the dose received by an occupant varies considerably, depending on the occupant's location. For example, inside an expedient covered-trench shelter the dose rate is higher near the entrance than in the middle of the trench. In a typical basement shelter the best protection is found in one corner. Especially during the first several hours after the arrival of fallout, when the dose rates and doses received are highest, shelter occupants should use their fallout meters to determine where to place themselves to minimize the doses they receive. They should use available tools and materials to reduce the doses they receive, especially during the first day, by digging deeper (if practical) and reducing the size of openings by partially blocking them with earth, water containers, etc. -- while maintaining adequate ventilation. To greatly reduce the danger from fallout particles entering the body through nose or mouth, shelter occupants should at least cover their nose and mouth with a towel or other cloth while the fallout is being deposited outside their shelter.

The air inside an occupied shelter often becomes very humid. If a good flow of outdoor air is flowing into a shelter - especially if pumped by briefly operating a KAP or other ventilating pump -- a KFM usually can be charged at the air intake of the shelter room without putting it inside a dry-bucket. However, if the air to which a KFM is exposed has a relative humidity of 90% or higher, the instrument cannot be charged, even by quickly unrolling a roll of tape.

In extensive areas of heavy fallout, the occupants of most home basements, that provide inadequate shielding against heavy fallout radiation, would be in deadly danger. By using a dependable fallout meter, occupants would find that persons lying on the floor in certain locations would receive the smallest doses, and that, if they improvise additional shielding in these locations, the doses received could be greatly reduced. Additional shielding can be provided by placing a double layer of doors, positioned about two feet above the floor and strongly supported near their ends, and by putting books, containers full of water and other heavy objects on top of these doors. Or, if tools are available, breaking through the basement floor and digging a shelter trench will greatly increase available protection against radiation. If a second expedient ventilating pump, a KAP, is made and used as a fan, such an extremely cramped shelter inside a shelter usually can be occupied by several times as many persons.

END OF INSTRUCTIONS