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Limited Nuclear War

The U.S. may be committing itself to preparing for a war limited to attacks on military bases, with relatively few civilian casualties. Would the casualties really be few, and could the war stay limited?

by Sidney D. Drell and Frank von Hippel

For more than a decade U.S. strategic policy has been dominated by the recognition and acceptance of a few simple facts: We and the Russians are each other's nuclear hostages; in the event of nuclear war neither this country nor the U.S.S.R. would be able to defend itself against virtual annihilation; even if one side were to initiate the war with a massive preemptive attack, the other would retain an "assured destruction" capability, the ability to devastate the attacker. In one form or another this recognition has underlain most of the past quarter century of mutual deterrence.

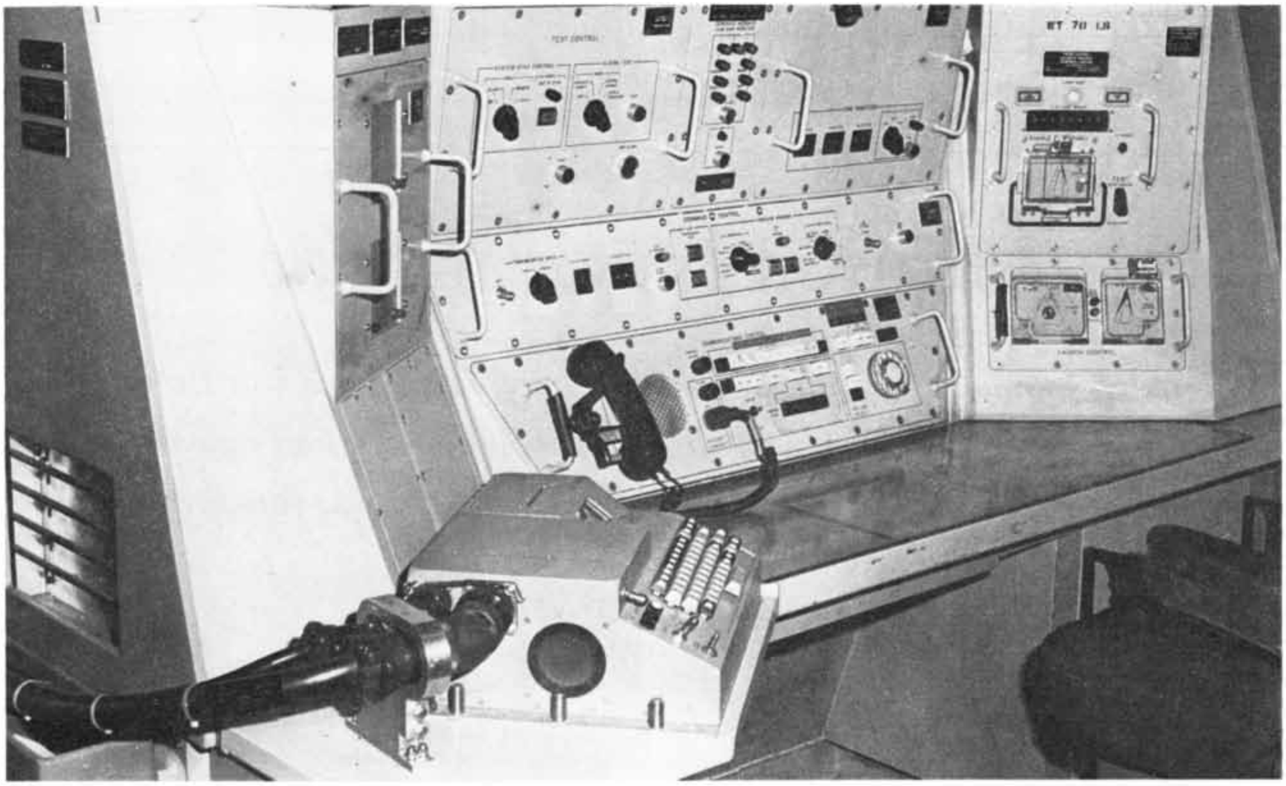
It has also been recognized, however, that nuclear weapons might be launched with restraint on both sides, with less than devastating results. President Nixon emphasized in 1970 the importance of having options other than "massive retaliation" for replying to a small (and possibly accidental) attack. That formulation of flexible response was nothing new. U.S. leaders have for many years had the option of launching a limited nuclear attack rather than an all-out one. The requirements of flexible response were expanded, however, by former Secretary of Defense James R. Schlesinger in Congressional testimony on March 4, 1974. According to his formulation, the U.S. should include in its flexible-response repertory the possibility of replying to a limited nuclear attack with selected strikes, notably "counterforce" strikes targeted against enemy military installations. Schlesinger argued that such strikes would be qualitatively different from intentional attacks on population centers, reducing the probability that a limited nuclear war would escalate into a massive exchange resulting in large civilian casualties, and that a flexible capability would make the possibility of a U.S. nuclear attack more credible and would thus increase the leverage provided by U.S. nuclear forces in international confrontations.

Since 1974 Schlesinger and other defense spokesmen have emphasized what they now seem to regard as two necessary new ingredients of a flexible-response strategy. One is the development of intercontinental ballistic missiles (ICBM's) capable of destroying "hardened" Russian military targets, such as missiles emplaced in blast-resistant underground silos. The other is a major expansion of the civil defense program, which has been largely inactive since the early 1960's. The purpose of the civil defense program would be to improve the credibility of the U.S. limited-nuclear-war posture by protecting the civilian population from the effects of limited Russian nuclear attacks. The new emphases give more weight to achieving a capability for fighting and "winning" a limited nuclear war.

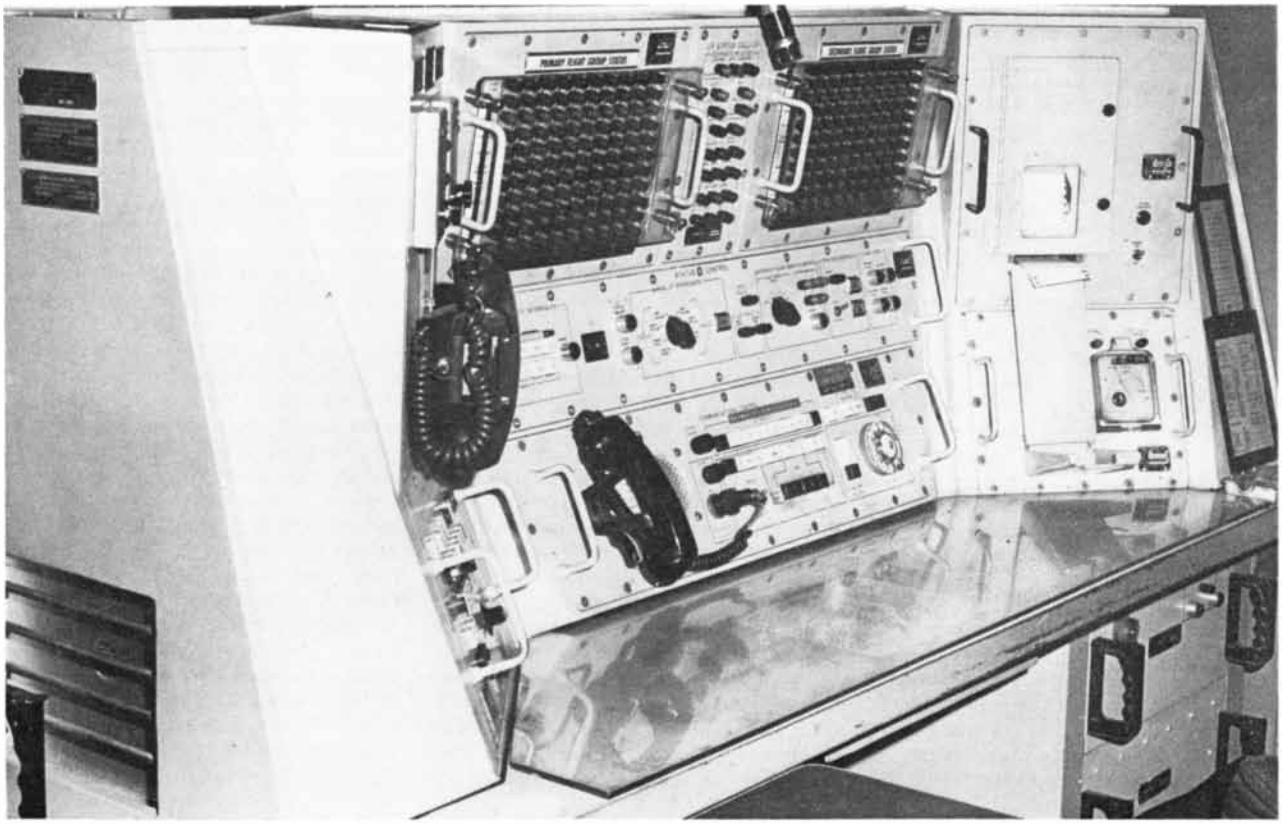
This proposed shift in strategy and the weapons-development and civil defense measures being sought to support it have come under attack on two broad grounds. First, detailed calculations based on the properties of nuclear weapons of the coming decade suggest that the casualties from any militarily significant nuclear counterforce strike would be so devastatingly high that this concept of limited nuclear war loses meaning. Second, a counterforce strategy founded on the ability to destroy enemy ICBM's increases the chances of nuclear war.

In his testimony before a subcommittee of the Senate Committee on Foreign Relations in March, 1974, Schlesinger supported his advocacy of such a counterforce capability by suggesting that a counterforce strike against the U.S. might result in "hundreds of thousands" of civilian casualties "as opposed to tens and hundreds of millions," which could result from an all-out nuclear exchange. Several senators were skeptical that a militarily significant strike could cause so few casualties; Senator Clifford P. Case of New Jersey in particular asked that the basis for the casualty calculations be further explained. In September, Schlesinger returned with Department of Defense computer calculations on the consequences of limited nuclear war. The figures indicated that if extensive civil defense protection were available and taken advantage of, a Russian attack on all 1,054 Minuteman and Titan ICBM's, with one one-megaton warhead targeted on each silo, would cause about 800,000 civilian deaths. Schlesinger concluded from this that "the likelihood of limited nuclear attacks cannot be challenged on the assumption that massive civilian fatalities and injuries would result."

Some senators were still skeptical, and the Congressional Office of Technology Assessment (OTA) was asked to review the Defense Department calculations. An expert panel including one of the present authors (Drell) reported back in February, 1975, that "the casualties calculated were substantially too low for the attacks in question as a result of a lack of attention to intermediate and long-term effects" of the nuclear explosions. Pointing out that the Russian strike postulated by the Defense Department was "evidently not designed to maximize destruction of U.S. ICBM's," the panel insisted that a real Russian effort to cause maximum damage to U.S.



MINUTEMAN III missile combat-crew commander's console controls the launching of a flight of 10 missiles. The keyboard (*foreground*) is that of the Command Data Buffer system, which makes possible the resetting of targets in on-board computers in 36 minutes.



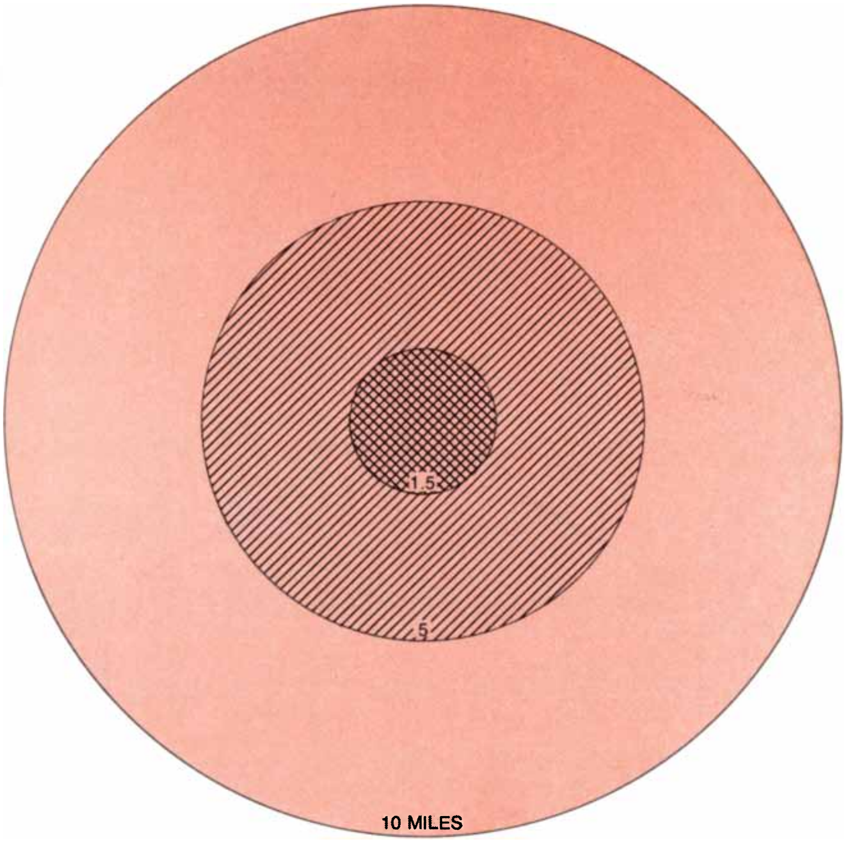
MINUTEMAN II console shown here is that of the deputy combat-crew commander. The consoles are in underground launch-control centers. The U.S. has 450 Minuteman II's and 550 Minuteman III's, the latter with multiple independently targetable reentry vehicles.

strategic forces with weapons currently deployed or under development would in fact "inflict massive damage on U.S. society." The panel raised specific questions about some of the assumptions underlying the Defense Department's calculations, and it also asked for estimates of the probable degree of damage to U.S. military targets for postulated attacks. This is a critical point, since it would be specious and misleading to calculate a low casualty figure for some imagined trivial—and therefore unlikely—counterforce attack.

In response to the panel's critique Defense Department analysts tested the sensitivity of their calculations to the assumptions challenged by the panel and estimated the effectiveness of various possible Russian strikes. In what follows we shall consider these issues and some of the underlying technical factors. We shall draw in part on the Defense Department's results, which were reported in July, 1975, and also on an independent analysis, produced by Henry C. Kelly of the staff of the Office of Technology Assessment in collaboration with Richard L. Garwin and one of us (von Hippel), presented to the Committee on Foreign Relations that September. What emerges is this: Strikes causing relatively few casualties would be militarily insignificant; strikes inflicting appreciable damage on U.S. strategic forces would cause very large civilian casualties; even the most comprehensive counterforce attack that was postulated would leave the U.S. with such massive retaliatory capability as to make the counterforce strategy appear to be ineffective from the Russian point of view.

We begin by examining the techniques for calculating the civilian casualties resulting from a nuclear attack. Casualty levels depend sensitively on many factors, such as the nature of the attack, weather conditions and civil defense protection. The basic physics of warhead effects, however, is fairly well established and widely known; it is set forth most comprehensively in *The Effects of Nuclear Weapons,* a publication of the Department of Defense and the Atomic Energy Commission, edited by Samuel Glasstone, that was published originally in 1957 and in revised form in 1962.

For a low-altitude nuclear explosion releasing the energy equivalent of a million tons (one megaton) of TNT the immediate effects of blast, heat and nuclear radiation would extend over an area around ground zero with a radius of about 10 miles. At military targets near populated places, such as naval shipyards, missile-submarine bases and some command centers, the Defense Department calculated that blast fatalities alone would be between 50,000 and 100,000 per one-megaton warhead exploded high enough so that local radioactive fallout would not be a hazard. For military targets in places with a low population density, casualties from these immediate effects would be much lower. For such targets it is radioactive fallout that would account for most of the civilian casualties, and the fallout from a Russian attack on a Minuteman base could be lethal many hundreds of miles downwind. Considering the weapons that are deployed today or are likely

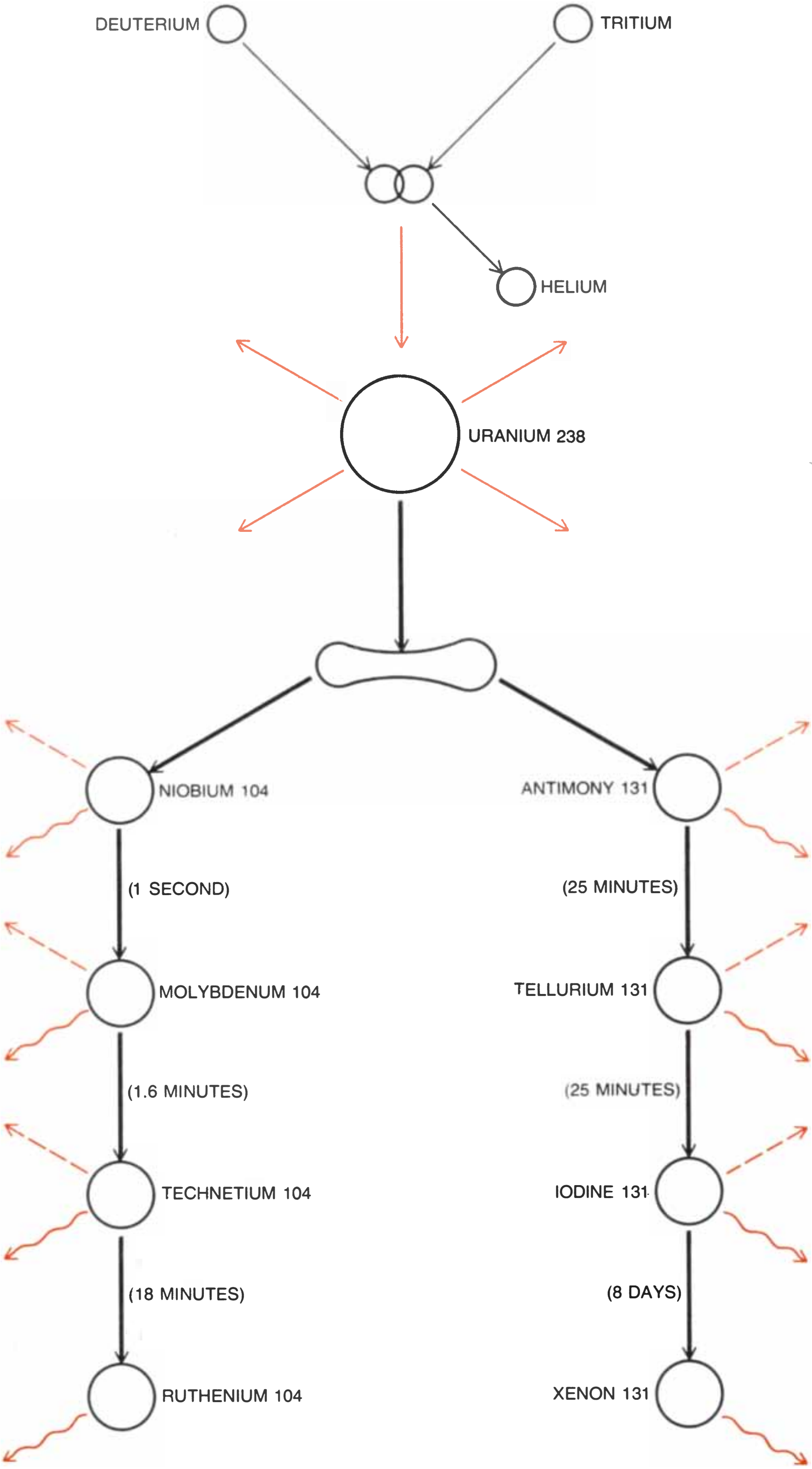


CAUSE		EFFECT
	THERMAL RADIATION	BURNS AND FIRES, POSSIBLE FIRESTORM
	BLAST	CASUALTIES FROM BUILDING COLLAPSE AND FLYING GLASS
	NUCLEAR RADIATION	RADIATION DEATHS

IMMEDIATE EFFECTS of a nuclear explosion are due to the initial nuclear radiation, the air blast and the thermal radiation. The approximate radii at which the various effects would be significant are given here for a one-megaton nuclear warhead exploded near the surface.

DOSE (IN REMS)		EFFECT
IF DELIVERED OVER ONE WEEK	IF DELIVERED OVER ONE MONTH	
150	200	THRESHOLD FOR RADIATION ILLNESS
250	350	5 PERCENT MAY DIE
450	600	50 PERCENT MAY DIE

BIOLOGICAL EFFECTS of nuclear radiation vary with the rate at which a dose is delivered. The dose unit, the rem, takes into account the relative effectiveness of the type of radiation.



FISSION PRODUCTS, the source of fallout radiation, are produced in the chain of events following a nuclear explosion, in this case a typical fission-fusion-fission explosion. Heated by an initial fission explosion, the hydrogen isotopes deuterium and tritium fuse to form helium, releasing an energetic neutron (*colored arrow*). The neutron enters the nucleus of a uranium-238 atom, making it unstable; it fissions, releasing four neutrons and two radioactive daughter nuclei, or fission products. The fission products emit beta rays, or electrons (*broken arrows*), and gamma rays (*wavy arrows*), thus decaying to form new products. Each decay chain ultimately terminates in a stable isotope. For each transition there is a characteristic half-life, which tends to become longer as the stable stage is approached. Other decay chains, not illustrated here, produce the important long-lived radioisotopes strontium 90 and cesium 137.

to become available in the next decade. such an attack might be delivered by one megaton or two megatons of nuclear explosive fuzed to detonate near the surface at each of the 150 or 200 hardened ICBM silos at the base.

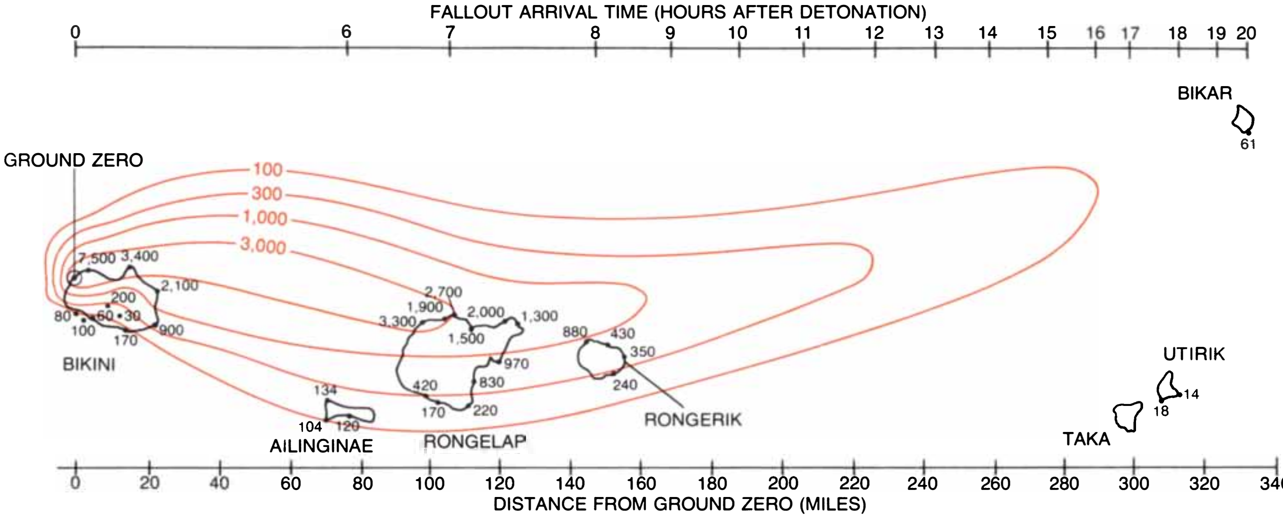
Radioactive fallout originates with the thousands of tons of soil, rock and other material that would be melted or vaporized by the heat of each explosion and mixed with its radioactive by-products. This debris would be carried to a height of some eight miles with the rising fireball. In the stratosphere the fireball would cool and the larger particles would descend to the ground within a day or so, over an area extending some hundreds of miles downwind, as "local" fallout. The smaller particles would drift great distances and eventually descend as global fallout.

The hazards of local fallout were dramatized by the events that followed the first U.S. test of a fission-fusion-fission bomb (with a yield of 15 megatons) at Bikini Atoll on March 1, 1954 [*see illustration on opposite page*]. Fishermen 80 miles downwind received radiation doses that ultimately killed one of them. At the south end of Rongelap Atoll, 100 miles downwind, people suffered severe short-term and long-term radiation effects. If they had been living at the north end of the atoll, the higher radiation levels there would almost surely have killed them.

If people in the local-fallout zone did not (as the residents of Rongelap did) ingest contaminated food and water, the principal hazard would be external radiation from radioactive particles. (Most of the particles in local fallout would be too large for inhalation into the lungs.) If people did not stay outdoors and come into direct contact with fallout, thereby sustaining burns caused by beta particles (the short-range electrons emitted by radioactive nuclei), the major hazard would be the more penetrating gamma radiation.

In order to determine the distribution and consequences of local fallout one needs to know the fission yield and height of burst of each warhead, the biological effects of a given absorbed radiation dose, the dependence of the fallout pattern on weather conditions, the degree to which the population is sheltered and the geographic distribution and total megatonnage of the attack. Predictions of fatalities and injuries are sensitive to the assumptions one makes about each of these factors, which we shall consider in turn.

The radioactivity in the fallout would come mostly from fission. A "thermonuclear" weapon is typically a fission-fusion-fission device. A "small" fission explosive (one of the chain-reacting isotopes uranium 235 or plutonium 239)



HAZARDS OF LOCAL FALLOUT downwind from a thermonuclear explosion were dramatized by the U.S. test of a 15-megaton fission-fusion-fission bomb on Bikini Atoll on March 1, 1954. The measurements (*black numbers*) give the total dose, in rems, that had accumulated 96 hours after the explosion. Contour lines calculated on the basis of those measurements outline the fallout pattern.

triggers a fusion explosion involving, for example, the hydrogen isotopes deuterium and tritium. The high-energy neutrons emitted by the fusion reactions then fission the nuclei of a large amount of the non-chain-reacting isotope uranium 238, releasing more fission energy [*see illustration on opposite page*]. In the Defense Department calculations 50 percent of the energy release was assumed to be due to fission, and that is a representative fraction.

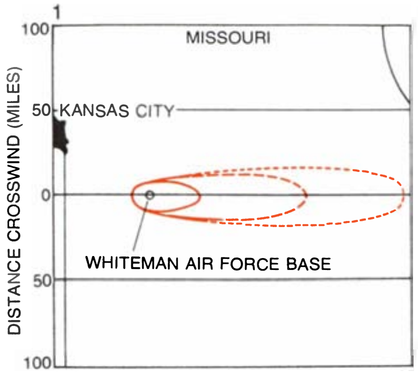
The biological consequences of gamma radiation depend on the total dose received and the time period over which it is delivered. The median lethal radiation dose was taken by Defense Department analysts to be 450 rems for doses received within a few days. (The rem, standing for "roentgen equivalent man," is a unit of the biological effect of radiation.) For doses delivered over a longer time the lethal dose was taken to be somewhat higher because, given time, a biological system can repair a considerable amount of radiation damage. The effective dose suffered by the exposed population when the rate of repair just balances the rate of damage being done by the decaying ambient field of radiation would be the "maximum biological dose" and would determine the lethality of the exposure.

Death from radiation sickness would be neither quick nor painless. As described in the Glasstone book, "the initial symptoms are . . . nausea, vomiting, diarrhea, loss of appetite and malaise." Beginning two or three weeks after the exposure "there is a tendency to bleed into various organs, and small hemorrhages under the skin . . . are observed." Spontaneous bleeding from the mouth and intestinal tract is common. "Loss of hair . . . also starts after about two weeks. . . . Ulceration about the lips may . . . spread from the mouth through the entire gastrointestinal tract." Eventually "the decrease in the white cells of the blood and injury to other immune mechanisms of the body . . . allow an overwhelming infection to develop." One has only to multiply that description by the millions to get a partial picture of the possible consequences of "limited" nuclear attacks on the U.S. and the U.S.S.R.

If the fresh fission products from one megaton of fission were spread uniformly over a perfectly flat area of 1,000 square miles, the gamma-ray dose rate one meter above the ground would be about 250 rems per hour after 10 hours. For human beings the median lethal dose at such a high dose rate is about 450 rems. The gamma-ray dose rate would decrease about sixteenfold for every tenfold increase in time for the first six months after the explosion and more rapidly thereafter. In our example the radiation intensity would be down to about 15 rems per hour after four days and about one rem per hour after 40 days. For a person remaining in the radiation zone, however, the cumulative dose would continue to rise significantly for quite a long time. Consider the local fallout beginning about 10 hours after an explosion, which is a typical time for the fallout to reach ground level. A full 40 percent of the dose accumulating after that time would remain to be delivered after four days, and 25 percent of it would still remain to be delivered after 40 days.

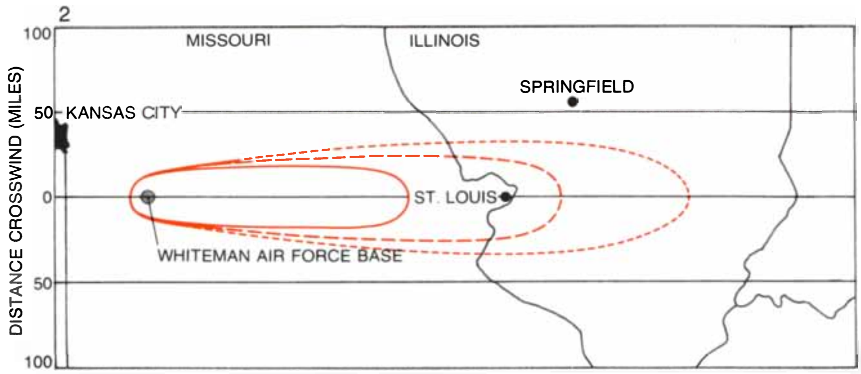
The height of burst of the warheads, which has an important influence on the amount of fallout deposited downwind, would be affected by the choice of target. In the counterforce attacks envisioned by the Defense Department most of the megatonnage would be directed against underground Minuteman silos. The Department reported that the Minuteman-killing effectiveness of surface bursts and of airbursts at the "optimum height of burst" would be about equal. (The optimum height of burst is the height that, for a given yield, provides a blast pressure exceeding a certain value over the largest area; for a one-megaton yield and an overpressure of 1,000 pounds per square inch it would be about 1,000 feet.) The attacker would thus be faced with a trade-off. On the one hand a surface burst does not have to be as precisely placed as an airburst (an important consideration, since attacks on hardened targets put a high priority on accuracy). On the other hand, Defense Department calculations show that, other things being equal, for an attack on the U.S. ICBM's fallout fatalities could be four times higher for surface bursts than for airbursts.

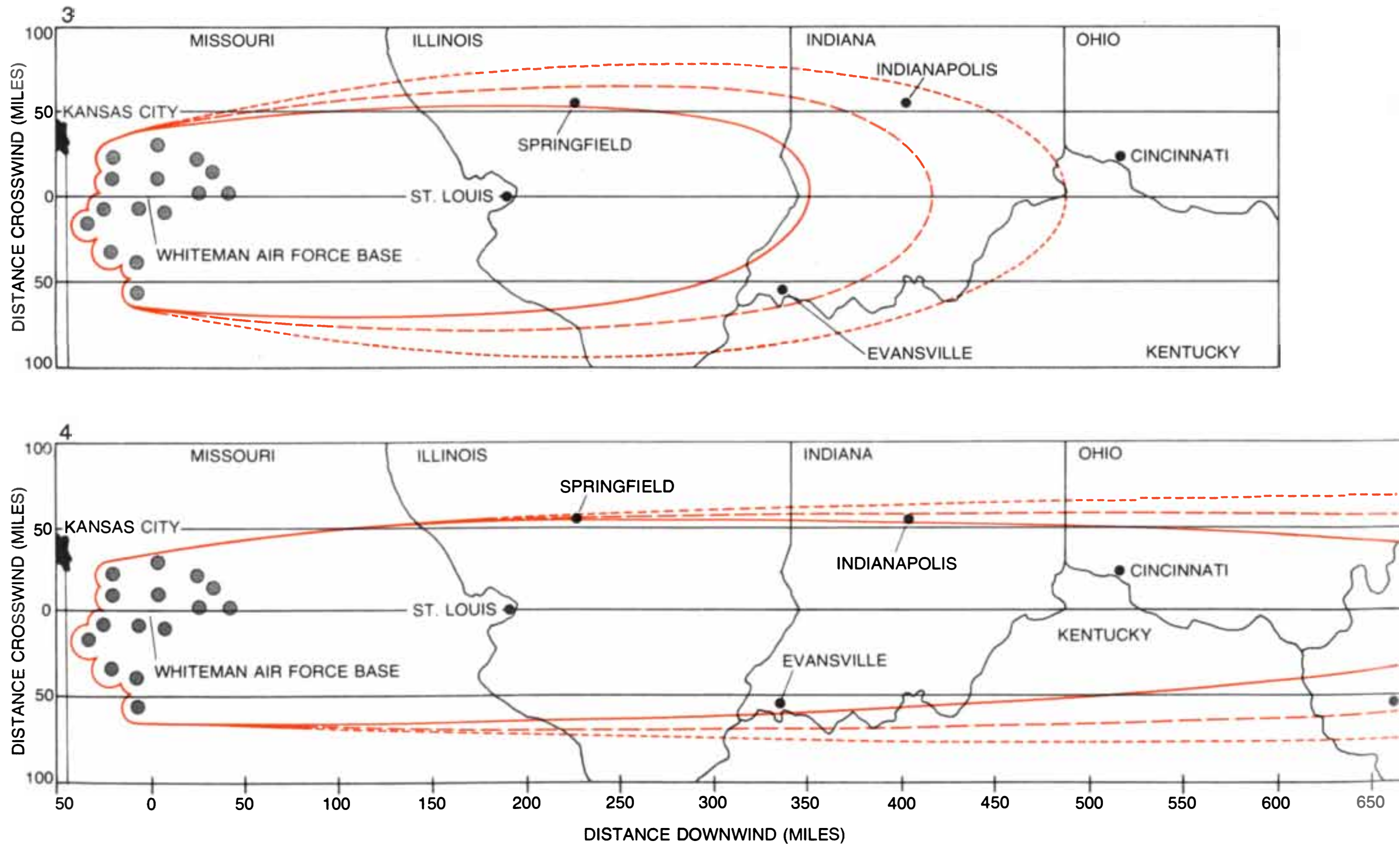
The fireball from a one-megaton nuclear explosion and the fission products it contains rise rapidly until the top of the cooling fireball cloud enters the stratosphere, about six miles above sea level at middle latitudes. At a height of about eight miles the cloud stabilizes, with its fission products spread over an area about four miles in diameter. An average settling time for the local fallout from a one-megaton explosion might be about eight hours. The settling time and the average speed of the winds between the top of the fireball cloud and the ground determine how far the particles drift downwind. For a typical aver-



age wind velocity of 20 miles per hour the average drifting distance would be 160 miles. (The settling time also determines the extent to which short-lived radioactive isotopes decay harmlessly before reaching the surface.) The width of the fallout pattern is determined primarily by the differences in the speed and direction of the winds to which particles are subjected at various heights in the cloud. For a typical wind shear of one mile per hour per mile of height and an average wind speed of 20 miles per hour, the pattern of fallout 100 miles downwind from ground zero would be about 25 miles wide.

Clearly the number of casualties depends to a considerable degree on what weather conditions are assumed. In the Defense Department calculations the total casualties from one postulated attack were three times higher with typical March winds blowing than they were with typical June winds. Such variations are largely due to changes in wind direction and wind speed that cause the fallout pattern to cover certain densely populated areas or miss them. Consider the fallout pattern downwind from the Minuteman wing at Whiteman Air Force Base in central Missouri after a Russian attack by two one-megaton surface bursts (with 50 percent of the yield from fission) on each of the base's 150 silos. With an average wind velocity of 20 miles per hour the lethal fallout zone for people indoors would stretch to the Illinois-Indiana border; with an average wind velocity of 60 miles per hour (which is not an unusual speed high in the troposphere, where the fallout would be for most of the time before it





FALLOUT PATTERNS are shown for attacks by one-megaton warheads (with 50 percent of their explosive yield from fission) exploded at the surface on ICBM's at Whiteman Air Force Base in Missouri. The contours correspond to maximum biological doses of 1,350 rems outdoors, or 450 rems (50 percent fatalities) inside an average residence (*solid line*); 450 rems outdoors (*broken line*), and 150 rems outdoors (*dotted line*), the approximate threshold for fatalities. The four patterns are for a single warhead (*1*), for one warhead

settled to the ground) it would stretch all the way to the Virginia border [*see illustration on these two pages*]. The area within the lethal-dose contour would be very large: about 2 percent of the land area of the continental U.S.

There are six Minuteman bases from which comparably massive fields of lethal radiation would extend, and three 18-missile Titan bases as well. Hence in the event of a counterforce strike against U.S. missiles a substantial portion of the U.S. would be covered by the downwind radiation patterns from the thousands of nuclear explosions. And a significant fraction of the population, including the residents of many major Middle Western cities, would be in the zones of lethal radiation [*see illustration on next page*]. Presumably a map of the U.S.S.R. would show a similar pattern for a U.S. counterforce attack on that country.

The consequences of being caught in the fallout pattern downwind from a low-altitude or surface fission explosion would depend, of course, not only on the level of ground contamination but also on where one took refuge. Currently the U.S. civil defense program requires that for a shelter space to be identified as such it must shield against all but 1 to 2 percent of the fallout gamma radiation. The degree of protection a given shelter provides is characterized by its "protection factor," which is the reciprocal of the fraction of radiation that penetrates it. The current requirement is therefore a protection factor of 50 to 100. That degree of shielding can be provided by cover of approximately two feet of dirt or 16 inches of concrete. Those parts of a single-story residence that are above ground level have a protection factor of 3. The basement of the residence may have a protection factor of 20 to 40 if it is completely below ground level and therefore receives gamma radiation almost entirely from fallout that lands on the roof of the building.

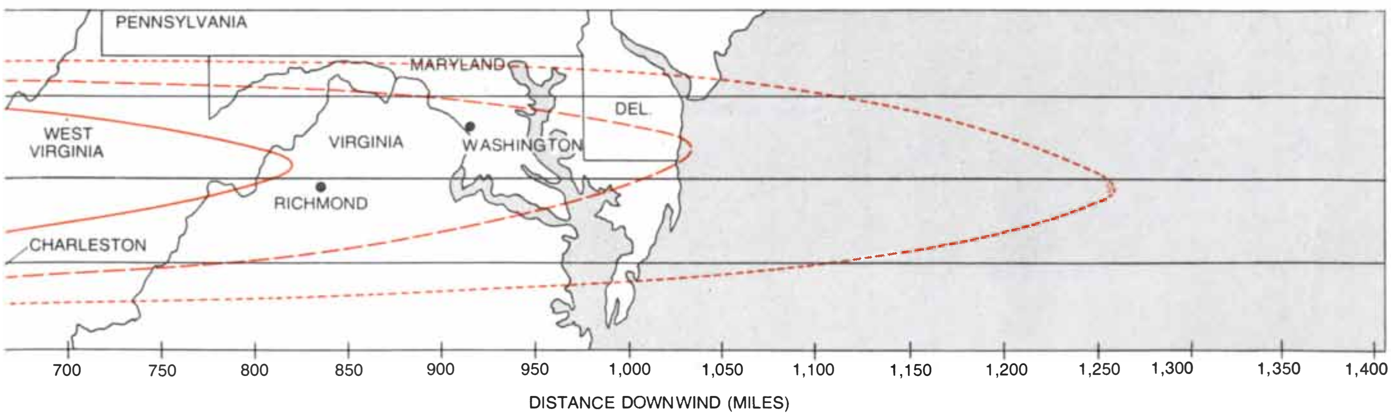
In the Defense Department calculations the postulated distribution of protection factors corresponds to assuming that about 60 percent of the people in the U.S. would seek and reach the best shelter available in their area [*see top illustration on page 35*]. The 40 percent who did not seek shelter or for whom shelter was not available were assigned a protection factor of 3, that of an average residence. It was found that halving the protection factors increased the number of deaths by more than 50 percent.

It is important to note that the Defense Department analysts assumed that people would remain sheltered for 30 days. At the current level of civil defense preparation it is highly unlikely that the population could remain so well sheltered for such a length of time. For a limited nuclear war to be taken seriously as a policy option—as a realistic threat in a confrontation with the U.S.S.R.—it would be necessary to make much better shelter arrangements. In other words, the U.S. would have to embark on a greatly enlarged civil defense program.

Indeed, the development of civil defense procedures requiring the massive evacuation and relocation of populations during crises has recently been proposed in the annual U.S. defense budget request as a necessary adjunct to the new strategy. The preparations required for such mass movements and for the support of the population for long periods away from home would have a major impact on U.S. peacetime society. Identified shelter spaces and evacuation plans by themselves would not constitute an effective civil defense program; a total system would have to be organized and woven into civilian life through training programs, rehearsals and volunteer activities.

An idea of the magnitude of a civil defense program that could achieve high shelter occupancy and maintain it for several weeks or longer can be gained from the system envisioned by the 1962 U.S. civil defense guide. The plans, which were never implemented, contemplated that for every shelter accommodating 100 civilians there should be an operating cadre of 25, of whom 10 or 12 would need training. That is, 10 percent of the sheltered population, or 20 percent of the adult population, would have to be trained. To recruit such a large cadre the Government would have to look beyond existing community safety personnel such as policemen, firemen and National Guard units.

One task of these trained people would be to operate communication systems over substantial distances in order to deal with any local shortage of food, water or medical supplies. They would also have to know how to use radiation dosimeters, because in the immediate postattack period the fallout levels could vary greatly from one place to another. (Like snow, radioactive debris accumulates where it is driven, depending on the wind, the weather and the topography, including buildings. There could be pockets of relative safety in the midst of areas with lethal levels of radiation.) The trained cadre would have to provide leadership in the long period of extreme social duress after the attack and reestablish services for a so-



on each of the 10 silos in a flight (*gray circle*) of Minutemen (*2*) and for two warheads on each of the 150 silos in Whiteman's 15 flights (*3 and 4*). The large difference between the bottom two patterns is the result of a change in the assumed wind speed. In all four cases the wind is assumed to blow toward the east. In the first three examples the wind speed is assumed to be constant at 20 miles per hour. In the bottom example the wind speed is assumed to be 60 miles per hour (averaged at altitudes between the surface and the stratosphere).

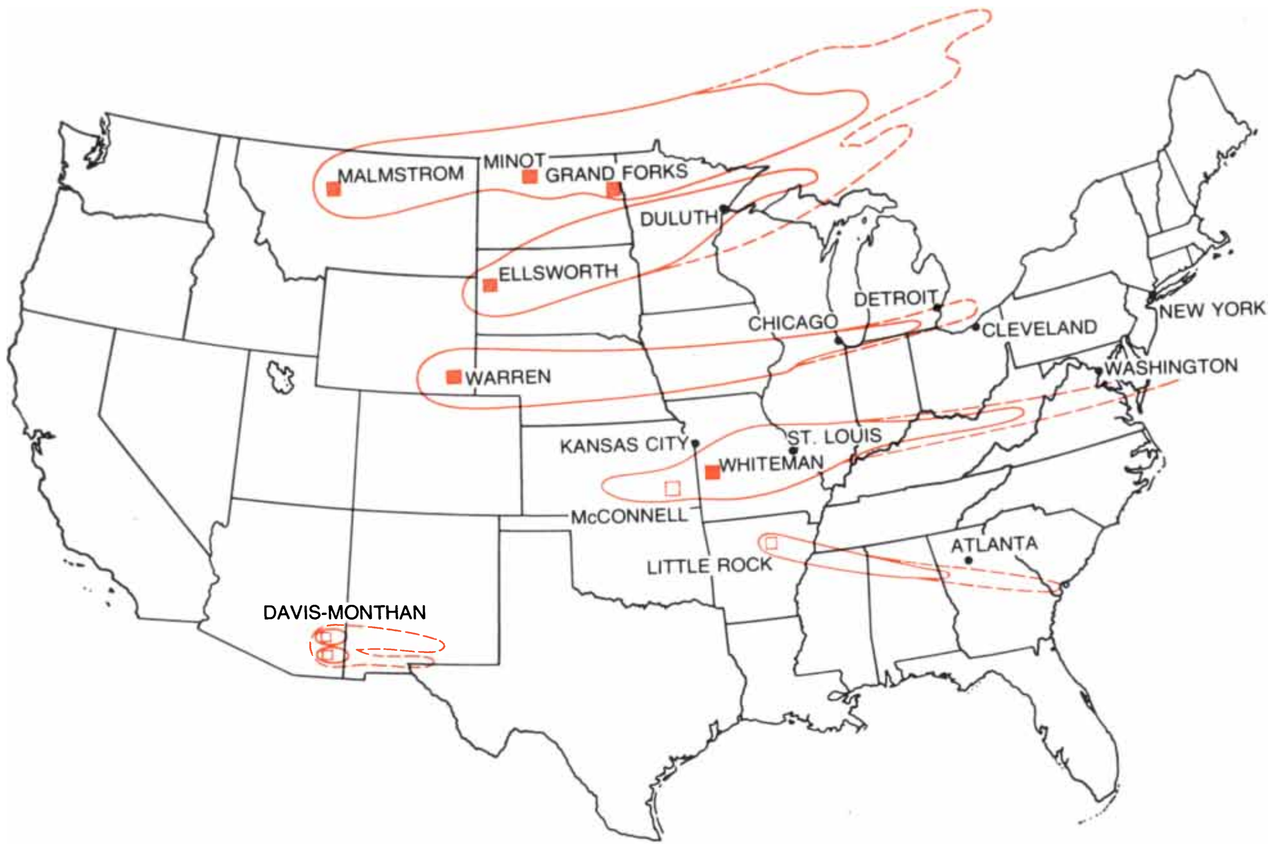
ciety with a large population of sick, injured and dying citizens. It should be noted that Defense Department calculations of the consequences of limited nuclear war are almost certainly serious underestimates. For example, the calculations omit any estimate of what may be one of the gravest consequences of all: the disruption of the intensely interdependent components that enable a modern society to function. The difficulties imposed on a society trying to recover with totally unprecedented levels of mortality and morbidity, with insufficient medical care and with profound dislocations in the supply of food and water are simply ignored. Moreover, the calculations omit any consideration of long-term consequences such as the millions of genetic defects and cases of cancer that would occur worldwide in the decades after the postulated nuclear attack.

A higher level of public awareness and concern and a willingness to participate in repeated civil defense exercises would be required if the U.S. intended to develop a viable system for a massive evacuation and shelter. In the absence of sustained preparation chaos and panic would surely ensue at the time of an attack. It is difficult to see how commitment to such plans could be obtained without a deliberate and sustained intensification of public apprehension concerning a nuclear war. One of the lessons of the relatively ineffective civil defense program of 1961 and 1962 was that the large expenditures for civil defense and the inconveniences of a major shelter program could only be made plausible to the American public by exaggerating the probability of nuclear war.

Today we are again hearing allegations that the U.S.S.R. is developing and rehearsing civil defense plans involving the evacuation and relocation of large populations, along with the dispersal and hardening of industry. These programs are cited to indicate that the U.S. may be losing its deterrent and to spur a renewed U.S. civil defense effort. What evidence is there in support of these allegations?

The Russians have written much on the subject and have given their people more intensive exposure to civil defense than Americans have received. Apparently they have also spent much more money on plans and organizations and have involved in exercises small numbers of individuals with key skills. In view of the unprecedentedly large scale of the nationwide disaster being considered, however, an effective civil defense program would surely have to include among its essential components full-scale rehearsals and survival-living exercises involving the population. If there had been any such rehearsals, we would have heard about them. They would be very difficult to conceal, and many people who would have participated in them or would have had knowledge of them have now left the U.S.S.R. and would have called attention to them. Yet no evidence of such exercises has been presented. The editor of the U.S. Government translation of the official Russian civil defense manual for 1974 comments that "the Soviet Union has not conducted mass shelter living experiments or even simulated ones as has been done in the U.S." Plans and manuals are very different from an effective operating system.

The Defense Department's response of July, 1975, presented new casualty figures and also estimates of the military effectiveness of the postulated attacks. According to the new calculations, a strike with two 550-kiloton warheads, one a surface burst and the other an airburst, against each of the 1,054



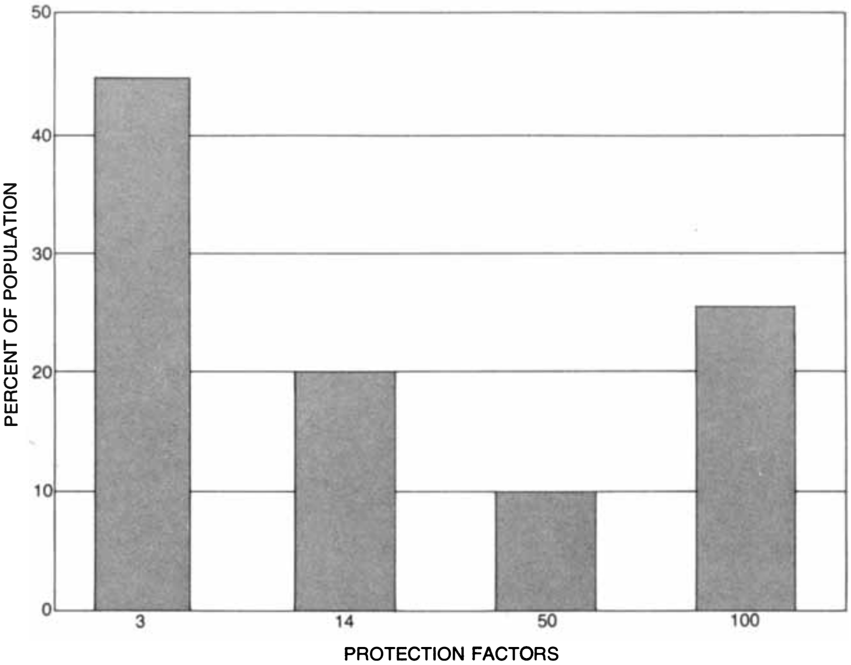
COUNTERFORCE ATTACK on all Titan (*white squares*) and Minuteman (*color squares*) ICBM bases, with two one-megaton surface bursts (50 percent fission yield) per silo, could produce these patterns. Each inner contour delimits a 450-rem dose indoors (50 percent fatalities) and each outer contour a 200-rem dose indoors (50 percent hospitalized). Typical March wind speeds are assumed.

U.S. ICBM silos would cause 5.6 million fatalities (assuming a 25 percent reduction of the population-protection factors given above) and destroy only 42 percent of the silos. A heavier strike with two three-megaton warheads, one a surface burst and the other an airburst, directed at each silo would cause 18.3 million fatalities and destroy 80 percent of the silos. A "comprehensive" attack, with two one-megaton surface bursts on each ICBM silo and strikes against the 46 Strategic Air Command (SAC) bases and the two bases for ballistic-missile submarines, would cause 16.3 million fatalities and destroy 57 percent of the ICBM's, 60 percent of the bombers caught on the ground and 90 percent of the missile submarines in port [*see bottom illustration at right*].

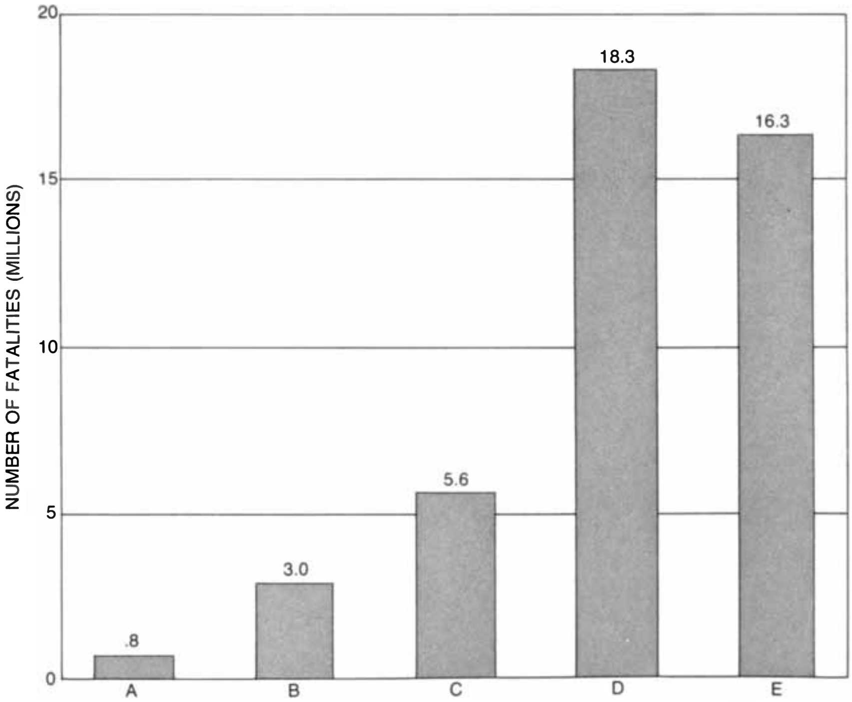
The effectiveness of all these attacks would be somewhat higher if one assumed that the incoming missiles were more accurate and would be somewhat lower if one assumed that the attacking force was less than 100 percent reliable. An additional factor in a massive attack involving many warheads arriving at about the same time in the same area is "fratricide" among the incoming missiles. In a concentrated attack the atmospheric disturbances created by the first warheads to arrive must necessarily destroy, disable or deflect many of the warheads that arrive later. Only the almost perfect synchronization of the arrival of warheads that are aimed at the same silo or nearby silos can avoid this effect.

In any case it is clear that even with a massive attack resulting in enormous devastation, including the direct death of 20 million Americans, the U.S.S.R. would have accomplished little of strategic military value. After the heaviest of the anti-ICBM strikes considered by the Defense Department, more than 200 ICBM's would survive: an overwhelming retaliatory force even if one ignores the SAC bombers, the missile submarines and the thousands of U.S. tactical nuclear weapons deployed overseas and on aircraft carriers. It is therefore at least misleading to suggest that a successful and strategically effective counterforce attack could be carried out with low civilian casualties.

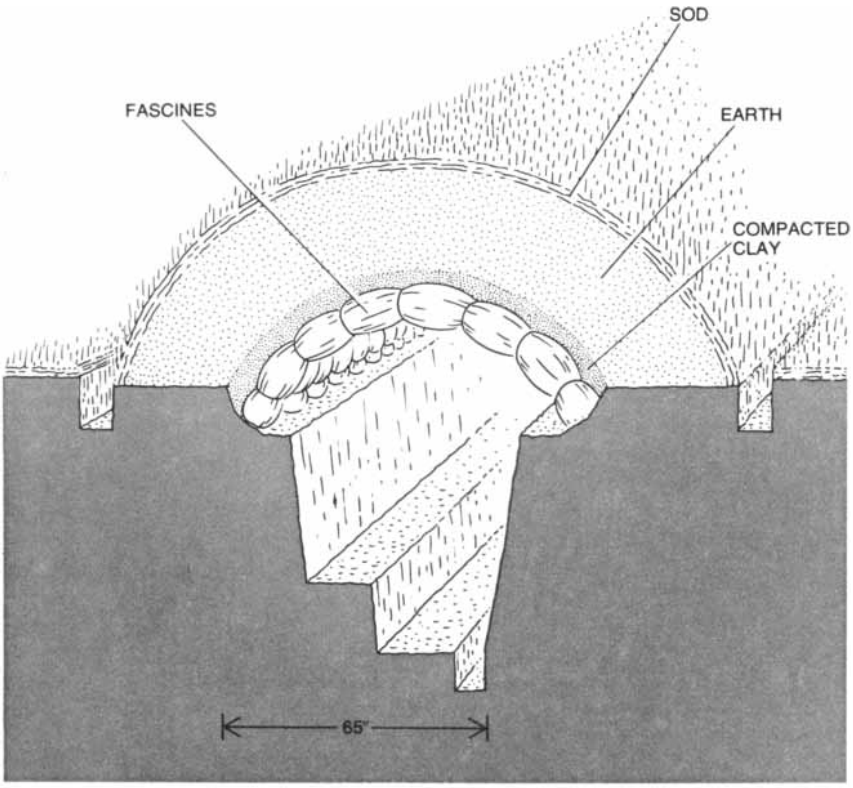
A major danger associated with a policy reorientation that emphasizes preparations for actually waging a limited counterforce war is that it would tend to undermine the stability of the strategic balance. Flexibility is one thing and an efficient hard-target kill capability is another. Flexibility is inherent in the wide range of U.S. strategic weapons, which are targeted on a variety of urban, industrial and military objectives. Any one or any 100 of these weapons could be launched selectively. Furthermore, each missile or bomber has multiple tar-

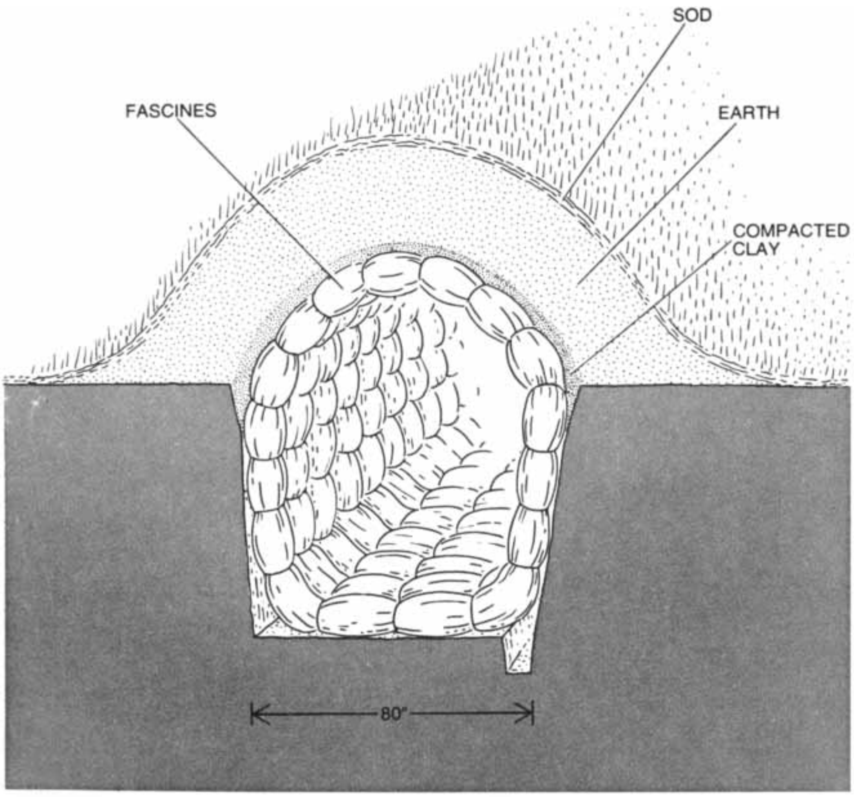


"SHELTER POSTURE" assumed in Department of Defense calculations is given by bars showing what percent of the population is in shelters that have given "protection factors" (the inverse of the proportion of outside gamma radiation penetrating the shelter). A protection factor of 3 is roughly that provided on the ground floor of a one-story residence; the basement of a one-story frame house could provide a factor of 15 to 20, that of a two-story brick house as much as 50. A trench covered by two feet of earth provides a protection factor of about 100.



FATALITIES estimated for five postulated Russian counterforce attacks are shown: one one-megaton airburst on each U.S. ICBM silo (*A*); the same attack with surface bursts (*B*); two 550-kiloton warheads per silo, one airburst and one surface burst (*C*); two three-megaton warheads per silo, one airburst and one surface burst (*D*); a "comprehensive" attack, with two one-megaton surface bursts per silo and with airbursts over all 46 Strategic Air Command bases and the two ballistic-missile submarine bases (*E*). In the last three cases the shelter posture shown in the illustration at the top of the page is "degraded" by 25 percent and March winds are assumed instead of August winds. Also in the last three cases Defense Department evaluated effectiveness of attack: 42 percent of the ICBM's destroyed (*C*); 80 percent destroyed (*D*); 57 percent of the ICBM's destroyed as well as heavy damage to aircraft on ground or flying within eight miles of a base and to submarines in port and base facilities (*E*).





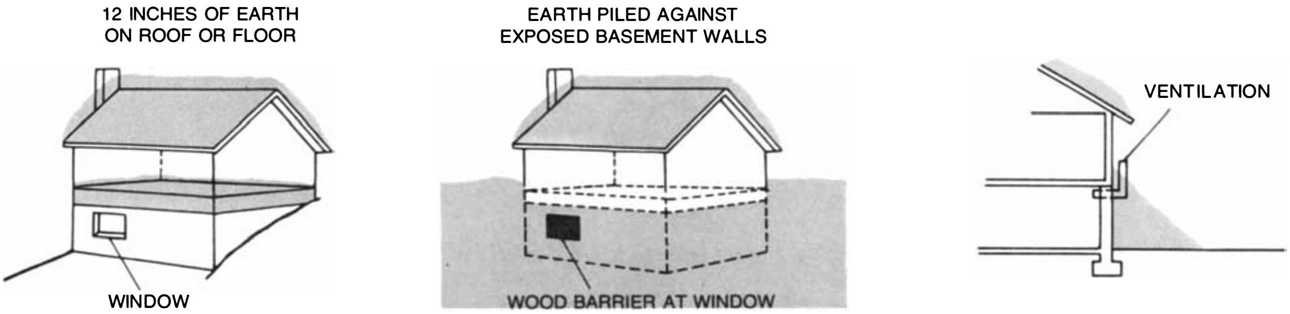
RUSSIAN SHELTER DESIGNS, from a 1970 U.S.S.R. handbook, are for simple structures to be built by people "using available materials and their own labor." A dugout (*top*) in firm clay soil is roofed by rows of fascines (bundles of brushwood, canes or reeds) covered with compacted clay and 30 inches of soil. Rings of fascines are required in looser soil (*bottom*).

get options. The new Command Data Buffer system currently nearing completion makes possible the remote resetting of targets in the on-board computers of Minuteman III missiles from launch-control centers in 36 minutes.

As a result of all this flexibility the U.S. also already has a substantial counterforce capability even without highly accurate warheads. There are, for example, "soft" military targets such as airfields and submarine bases that could be selectively destroyed with a few warheads. Even hard missile silos could be destroyed by hitting each one with a number of Minuteman missiles. The Defense Department nonetheless wants more: the ability to deliver counterforce strikes efficiently and with high confidence against hardened Russian ICBM silos. As Schlesinger put it in his 1976 appropriation request: "I believe we should improve our hard-target kill capability so as to have higher confidence of executing limited hard-target attacks." Indeed, the U.S. is currently progressing toward that goal with funded programs.

These developments clash directly with the need for strategic stability. A U.S. missile force with multiple independently targetable reentry vehicles (MIRV's) or with the maneuverable reentry vehicles (MARV's) now being developed, and with a demonstrated combination of very high reliability, very accurate guidance and high-yield warheads would suggest to Russian leaders the possibility of a U.S. preemptive strike against their ICBM silos. It would further suggest to them that in a time of confrontation they should not be caught with their missiles in their silos, that at such a time they should either strike first or adopt a "hair trigger," or launch-on-warning, policy. The same arguments apply with the U.S. and Russian roles reversed. The current national debate indicates that there is widespread concern, as there should be, about the possibility that the U.S.S.R. might be developing a hard-target counterforce capability, particularly in view of the larger size of the Russian ICBM's.

To be sure, it is impossible to envision a disarming first strike that would really threaten the retaliatory capacity of the U.S.S.R. (or of the U.S.), if only because missile submarines at sea and bombers in the air or on alert are not subject to destruction in a preemptive attack. In order to maintain a stable strategic environment such as the one that now exists for the two superpowers, however, there should be neither a real nor a "perceived" vulnerability of any major component of the strategic deterrent forces on either side. (From the Russian point of view this is true in particular of the land-based ICBM component, since it constitutes a much larger fraction of



U.S. SHELTER DESIGN, redrawn from an illustration published by the Defense Civil Preparedness Agency, is for an "expedient shelter" intended primarily to accommodate evacuated populations. In order to provide adequate fallout protection in a basement that is only partially below ground level it is necessary to put a 12-inch layer of earth overhead and to pile earth against exposed basement walls.

their deterrent power: roughly 75 percent compared with 25 percent for the U.S.) The deployment of missiles with hard-target capability would therefore create tension, because each side would fear that such deployment might lead to the possibility of an effective first-strike threat against its force of silo-based ICBM's. The fact that formidable technical and operational difficulties, such as the fratricide problem, lead many people to challenge the feasibility of achieving such a capability is almost beside the point; there would still be serious concern about the ability of land-based ICBM's to survive a preemptive first strike.

U.S. officials recognize the danger of seeming to threaten Russian retaliatory capacity, and so they couple proposals for an improved hard-target kill capability with announcements that deployment of new offensive weapons would be limited, at least for the time being. But can one acquire just a little hard-target counterforce without bringing on the ill effects of a lot? After all, it is no more than the fear of a possible future Russian ICBM counterforce threat against U.S. Minutemen that has been cited in support of the ongoing programs for improving U.S. missiles. It has been argued that we must be able to respond in kind against each and every perceived potential threat. Schlesinger said that there should be "no perceived asymmetries in levels or capabilities of force—conventional or nuclear."

The danger in this logic is that we will almost inevitably find our own development program triggering a Russian commitment to the very program we fear (and vice versa, of course). All precedents, including in particular the history of MIRV deployment on both sides, indicate that once the technology has been developed and tested for attacking hardened counterforce targets with high confidence, the dynamics of the nuclear arms race will take over and make it difficult if not impossible for the U.S. to refrain from deploying the new weapons extensively and for the U.S.S.R. to refrain from responding in kind.

Neither side has yet developed weapons designed specifically as hard-target killers: weapons that have a high probability of destroying a hardened military target, such as an underground silo, with a single warhead. Research-and-development programs directed toward that goal are, however, funded in this year's U.S. defense budget. Before both countries are committed further and perhaps irrevocably to reciprocally stimulated and mutually reinforcing programs for developing such weapons, the hard questions should therefore be faced up to. Do we really want or need them? What is the value of being able to destroy an enemy silo (which may be empty by the time our warhead arrives) in response to an attack on our own silo? If a small response is wanted, will not an air base or a naval base or a military storage depot do as a target? Is not our current broad flexibility adequate? Will hard-target counterforce weapons make a compelling military contribution to national security or does their justification rest solely on ephemeral politico-strategic argument?

We have argued that such weapons would complicate the problem of maintaining strategic stability. It would therefore seem that it would serve the security of both the U.S. and the U.S.S.R. to avoid their development and deployment. A significant precedent for restraining new weapons in the interest of stability is the treaty, negotiated in the first round of the strategic-arms limitation talks, stringently limiting anti-ballistic-missile defenses. Now again the U.S. and the U.S.S.R. each have a critically important opportunity to limit their traditional technological arms competition by restraining the testing and deployment of new weapons designed to destroy hardened ICBM silos.

In the three decades since Hiroshima and Nagasaki there have been many crises involving the two superpowers, and the U.S. has fought two major land wars in Asia. Yet the armed nuclear truce has persisted. Why has neither side launched a single one of the thousands of nuclear warheads that each has had deployed? Surely it is because of the overwhelming fear of political leaders and citizens on both sides that once a nuclear weapon is detonated there will be an answering detonation, with subsequent exchanges escalating until both nations are destroyed and hundreds of millions of people are dead and dying. The issue created by the new emphasis on a selective, hard-target counterforce strategy accompanied by intensive civil defense efforts is whether or not there is any real prospect of escaping this "balance of terror." Should the assumption that a general nuclear war is prevented by the certainty of mutual destruction be abandoned in favor of the objective of fighting, winning and "surviving" a limited nuclear war when the evidence indicates that even a limited war would cause many millions of fatalities?

In the 1960's the U.S. adopted a strategic policy giving top priority to the prevention of nuclear war through deterrence rather than to preparation for fighting nuclear wars if deterrence should fail. Since then weapons technology has progressed, so that new and more sophisticated kinds of limited counterforce strikes, including attacks on hardened military targets, can be seriously considered. The political reality of deterrence, however, remains unchanged. New technology and new strategy do not significantly reduce the risk of all-out nuclear war breaking out once the first nuclear weapon has been fired.

It is important to recognize that once the nuclear firebreak has been crossed the decision to keep a war limited is no longer in the hands of one side alone; it has to be made by both—or all—participants in the conflict. As Secretary of State Henry A. Kissinger wrote in 1965: "No one knows how governments or people will react to a nuclear explosion under conditions where both sides possess vast arsenals."