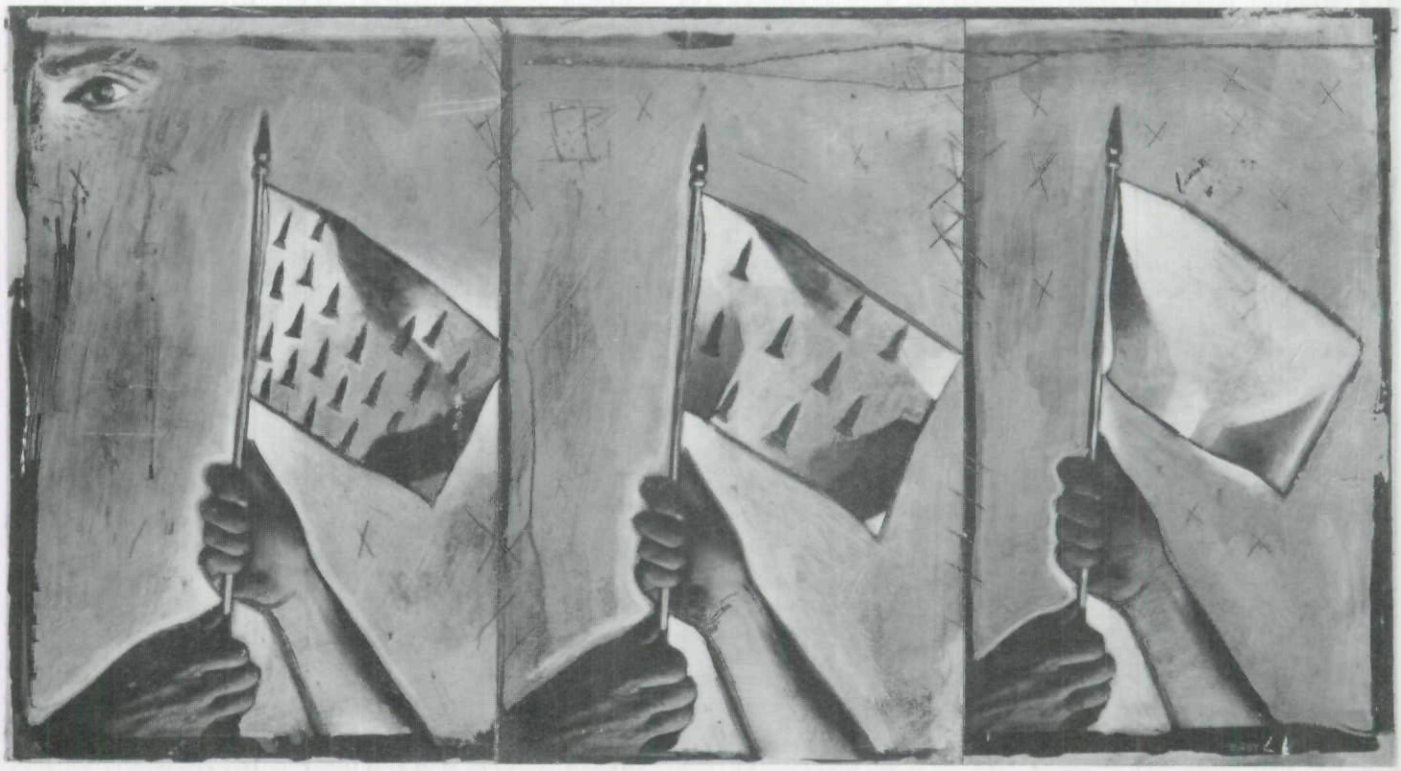


Larry Carroll, United States

Reducing U.S. and Soviet nuclear arsenals

A reduction of U.S. and Soviet nuclear arsenals to one-tenth their present sizes would maintain deterrent capabilities while exerting a stabilizing influence on the balance of terror.

by Harold A. Feiveson, Richard H. Ullman, and Frank von Hippel

THE ALMOST TOTAL absence of discussion of alternative futures that has characterized the nuclear weapons debate was first broken by the freeze movement and then by President Reagan's 1983 Strategic Defense Initiative ("Star Wars") proposal. Thus far six basically different alternative nuclear futures have been discussed:

- The abolitionist vision would completely eliminate nuclear weapons.
- The president's vision would effect a transition to a "defense-dominated" world in which increasingly effective defenses result in offensive systems' withering away.
- An arms race unconstrained by the 1972 Anti-Ballistic Missile (ABM) Treaty would maintain the mutual hostage relationship of the United States and the Soviet Union by virtue of the continuing dominance of offensive nuclear weapons systems.
- A constrained arms race would proceed more or less along current lines—constrained by the ABM Treaty and by modest SALT II-type limitations on some categories of offensive nuclear weapons.
- A tightened arms-control regime or freeze would take SALT II as its starting point to put stringent limits on the strategic arms competition, but would leave both superpowers with nuclear forces not much reduced in quantity or variety from those they now possess.
- Finite deterrence would couple very deep reductions in the superpower nuclear arsenals—but not enough to put in doubt their mutual hostage relationship—to severe constraints on the development and deployment of first-strike and ABM technologies.

Harold Feiveson is a research political scientist at Princeton University's Center for Energy and Environmental Studies. Richard Ullman, also a political scientist, and Frank von Hippel, a theoretical physicist, are both professors in Princeton's Woodrow Wilson School of Public and International Affairs.

The first two alternatives would represent radical departures from the current "balance of terror." The third would represent the breakdown that many fear is imminent in the current arms control regime. The last three represent attempts to rationalize the current situation.

Both radical alternatives will remain infeasible for the foreseeable future. Although we hope that abolition will ultimately be feasible, so many difficult issues would have to be dealt with that intermediate goals are required. The president's notion that nuclear weapons can be made "impotent and obsolete" by a unilateral U.S. technical fix is technologically impossible, and the effort to move toward a defense-dominated world will only lead to the third alternative: an all-out offense-defense arms race.

Of the proposals to rationalize the current situation, an interim freeze on new nuclear weapons would probably be an essential prerequisite to a comprehensive scheme of reductions. Beyond that, however, only the finite-deterrence alternative provides a rationale for reducing the current scale of the superpower arsenals. These arsenals, which contain tens of thousands of nuclear weapons, are completely out of correspondence with the reality of the world that nuclear weapons have created: they cannot be used without great risk of triggering the murder-suicide pact that binds East and West together.

The adoption of finite deterrence would make possible a 10-fold reduction of the superpower nuclear arsenals and the elimination of their most destabilizing and dangerous weapons. Thus, it could transform the relationship between the United States and the Soviet Union, reducing the dangerous fantasies and paranoia that feed and are fed by the arms race and making it much easier for them to build the foundations for a more satisfactory *modus vivendi*.[1]

THE IDEA OF FINITE or minimum deterrence goes back at least to the later years of the Eisenhower Administration, when it was advocated by the U.S. Navy. During the Kennedy Administration, Jerome Wiesner, the president's science adviser, argued that the United States required only a few hundred survivable nuclear weapons. And at about the same time the Soviet Union was offering disarmament proposals which were compatible with this approach.[2]

However, even as the Navy was arguing that 232 survivable Polaris missiles would be "sufficient to destroy all of Russia," the Strategic Air Command was putting on its target list 645 airfields from which Soviet strategic bombers might be launched, and thousands of tactical nuclear weapons were being deployed to Europe. By the mid-1960s, the U.S. arsenal contained approximately 30,000 nuclear weapons—slightly more than today's. The Soviet arsenal grew to comparable levels during the 1970s.

Neither the United States nor the Soviet Union seriously pursued a finite deterrence posture—on the U.S. side, principally on the grounds that nuclear weapons must be available for counterforce targeting, that is, for striking at military targets as a deterrent to Soviet aggression. Each side has also sought the ability to mount preemptive strikes to reduce the nuclear threat from the other.[3] Finite deterrence has also been criticized for resting upon "incredible" and "immoral" threats to destroy cities in order to deter attacks on other targets. Critics have also raised concerns that if nuclear arsenals were much smaller than those of today, they might be more vulnerable to neutralization by surprise attack or technological breakthrough. These concerns may best be addressed by discussing a concrete example.

THE ACCOMPANYING table shows an illustrative finite deterrence force and compares it with current superpower nuclear arsenals.[4] This may not be the best possible finite deterrence force. A strong argument can be made, for example, that the United States should take advantage of the relative invulnerability of its submarine-based forces and shift *all* of its ballistic missiles to sea. Furthermore, the superpowers might—for organizational or other reasons—choose very different mixes of nuclear weapons within overall arsenals of approximately equal size. (Such questions will be addressed in future studies by the Princeton Project on Finite Deterrence.)

The key changes in the transition from the current nuclear arsenals to the finite-deterrence force in the table are:

- Strategic warheads have been reduced by about 80 percent (from about 10,000 to 2,000), in large part by replacing multiple-warhead with single-warhead missiles.
- Intermediate-range nuclear weapons have been largely eliminated, although some land-based missiles might be located in Europe.
- Tactical nuclear weapons have been eliminated.

The resulting force is therefore quite similar to one that would be obtained by stripping the current force of its most destabilizing elements.

The destructive capacity of the finite-deterrence force is fixed by assuming that each of the warheads in the finite-deterrence arsenal has a yield of 100 kilotons. That yield is at the low end of the range of warhead yields in the current strategic arsenals of the superpowers, but it is approximately eight times larger than the yield of the bomb that destroyed Hiroshima. Such a warhead could destroy, by blast and fire, an area of about 50 square kilometers (20 square miles), containing, in a typical large urban area, about 100,000 people. Several such warheads in the illustrative arsenal could be targeted against *every* U.S. and Soviet city with a population of over 50,000.

Figure 1 shows the results of calculations done in 1967 for Secretary of Defense Robert McNamara of the percentage of the estimated 1972 Soviet urban population that could be killed and industrial capacity destroyed as a function of the "equivalent megatonnage" used.[5] The fatalities shown at a given level of equivalent megatonnage are significantly lower than *could* occur. Many effects—including those of radioactive fallout and the impacts of the destruction of the economy on the rural and surviving urban populations—appear to have been neglected. Only about 50 equivalent megatons would be required to destroy by blast and fire about one half of the urban area of the Soviet

U.S. and Soviet nuclear arsenals in 1985 and in an illustrative finite-deterrence (FD) regime

	Missiles or bombers			*Warheads*		
	United States	*Soviet Union*	*FD (each side)*	*United States*	*Soviet Union*	*FD (each side)*
Long- and intermediate-range						
ICBMs	1,023	1,398		2,126	6,420	
			500[a]			500[a]
Intermediate-range missiles (land-based ballistic and cruise)	104	534		104	1,362	
Submarine-launched ballistic	690	967	500	5,728	2,887	500
Long-range bombers	297	300	200	3,334	600	1,000
Subtotals	*2,114*	*3,199*	*1,200*	*11,292*	*11,269*	*2,000*
Other warheads						
Artillery shells				2,400	900	0
Antisubmarine warheads				2,000	600	0
Antiship cruise missile warheads				0	1,000	0
Battlefield ballistic missile warheads				300	1,600	0
Anti-aircraft missile warheads				200	300[b]	0
Anti-ballistic-missile warheads				0	32	0
Atomic demolition mines				600	some	0
Nonstrategic bombs				4,000	4,000	0
Overall total warheads[b]				*20,792*	*19,701*	*2,000*

[a] Some of the 500 land-based missiles in the finite-deterrence arsenal might be intermediate-range ballistic or ground-launched cruise missiles.
[b] Not including reloads

Sources: For strategic weapons: U.S. Department of Defense, *Soviet Military Power, 1984* (Washington, D.C.: Government Printing Office, 1984), pp. 24, 26; U.S. Department of Defense, *Report of the Secretary of Defense, Caspar W. Weinberger, to the Congress, 1986* (Washington, D.C.: Government Printing Office, 1985), Chart III.E.4 and Appendix C. For U.S. forces, we assume 10 warheads per Poseidon, eight per Trident I, eight bombs and short-range attack missiles on all 241 B-52G/Hs and six on each of the 56 FB-111s, and 12 air-launched cruise missiles on each of the 90 B-52G bombers. For Soviet forces, we assume four warheads per SS-17, 10 per SS-18, six per SS-19, seven per SS-N-18, nine per SS-N-20. We do not include Soviet bombers assigned to naval aviation, and we assume an average of two bombs and/or attack missiles per bomber, based on Senate Committee on Armed Forces, *Department of Defense Authorizations for Appropriations for FY 1985: Hearings,* 98th Cong., 2d sess., Feb. 1, 1984, p. 123.

For intermediate-range missiles: *New York Times,* April 14, 1985, p. E1.

For other nuclear weapons: Nuclear Weapons Databook Staff, in *World Armaments and Disarmament: SIPRI Yearbook, 1985* (London: Taylor and Francis, 1985).

Union or a comparable area in the United States.[6] Since a 100-kiloton warhead has approximately 0.2 equivalent megatons* destructive power, if each warhead in the 2,000-warhead illustrative finite-deterrence arsenal had a 100-kiloton yield, the arsenal's total destructive power would be almost 400 equivalent megatons.

This article addresses a series of questions about this finite-deterrence force: Would a commitment to finite deterrence brake the arms race dynamic? Is it moral? Would it deter? Would it be stable? Would it be adequately verifiable? And is it realistically achievable?

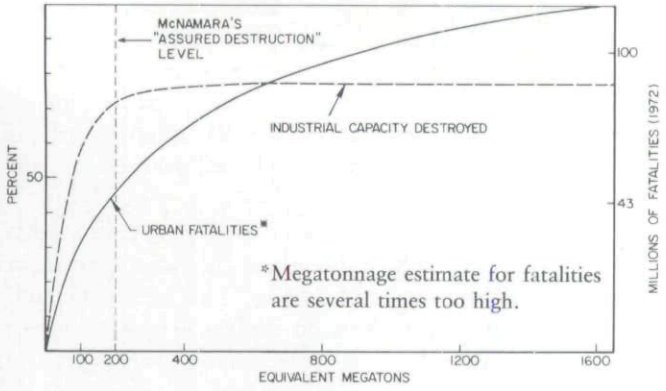
THE NUCLEAR ARMS race is driven largely by attempts to make nuclear weapons more "usable" and to develop combinations of first-strike and defensive capabilities that would make possible escape from the mutual hostage relationship. But no matter how technically sophisticated nuclear weapons systems have become, the mutual hostage relationship has made them unusable and that relationship itself has proved to be very robust.

Figure 2 illustrates this situation dramatically. Despite the recent U.S. scare about a "window of vulnerability," during a crisis neither superpower could reduce the other's strategic arsenal by more than about a half—far from the hundred-fold reduction required even to begin to loosen the grip of the mutual hostage relationship. Efforts to escape from hostage through defense appear similarly hopeless—so much so that the superpowers agreed in the 1972 ABM Treaty not even to try. And few independent analysts see any escape through new generations of counterforce weapons or the proposed Star Wars defenses.

Adoption of finite deterrence would require acceptance of the implications of the mutual hostage relationship and therefore a surrender of the illusions that drive the arms race. As Admiral Arleigh Burke, then chief of naval opera-

*The area that could be subjected to a certain level of blast overpressure varies as the two-thirds power of the yield (Y) of a nuclear weapon. This fact is captured by measuring the potential area-destructiveness of a nuclear warhead by its "equivalent megatonnage," $Y^{2/3}$. The equivalent megatonnage of a nuclear warhead with less than one-megaton yield is larger than its megatonnage. Above one megaton, the situation is reversed.

Figure 1. Potential consequences from blast alone in an all-out attack against Soviet cities



The fatality levels shown could result from a much lower level of equivalent megatonnage.

Sources: Robert S. McNamara, *The Fiscal Year 1969–73 Defense Program and the 1969 Defense Budget* (Washington, D.C.: Department of Defense, 1969). The fatality levels shown could result from a much lower level of equivalent megatonnage: see Frank von Hippel, "The Effects of Nuclear War," in David W. Hafemeister and Dietrich Schroeer, eds., *Physics, Technology and the Nuclear Arms Race* (New York: American Institute of Physics, 1983).

tions, argued almost three decades ago: if the superpowers abandoned the false hopes of "winning" through new counterforce or defensive systems, the rationale for new weapons would be greatly weakened.[7]

MUTUAL DETERRENCE depends fundamentally on the possibility that any large-scale direct confrontation between the United States and the Soviet Union could lead to untold destruction. This is true both for current nuclear arsenals and for the finite-deterrence arsenal proposed in the table. In terms of this immense destruction, the threats implicit in both postures must be viewed as immoral. Nevertheless, some have argued that a finite-deterrence posture would be particularly immoral because its smaller size implicitly emphasizes the threat to cities.

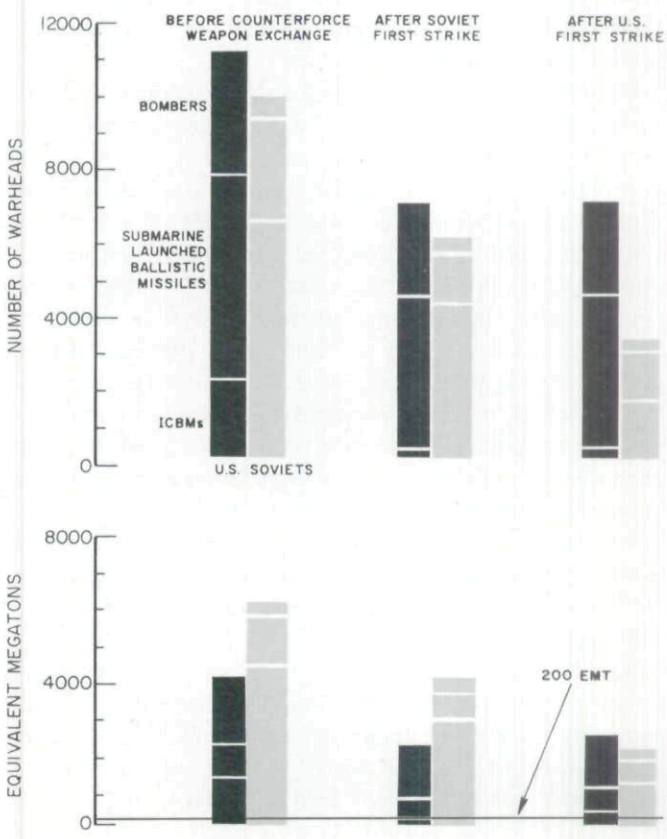
To acknowledge that threat, however, is not to insist that cities be targeted in the event of a nuclear war. Nothing in the configuration of the illustrative finite-deterrence arsenal would require the targeting of population centers rather than, for example, military installations. Nuclear strategists currently can fantasize that thousands of nuclear weapons could be so used, but by the time even hundreds of them had been used against, for example, military targets in Central Europe, civilian fatalities would number in the millions, command and control networks would be collapsing, and the chances of limiting the war would be rapidly vanishing.[8] Under these circumstances, the moral distinction between targeting military facilities and targeting cities would have become nearly irrelevant.

Therefore, adoption of a finite-deterrence posture would in no way reduce the superpowers' abilities—if they so wished—to avoid mass slaughter in a nuclear war. It would simply strip away the dangerous self-deception that a war could be fought with thousands of nuclear warheads without destroying civilization. This realization is a moral *advantage* of the finite-deterrence posture. Moreover, to the extent that a finite-deterrence posture would reduce the probability of accidental nuclear war and, in the event of all-out nuclear war, would inflict less overall destruction—especially on noncombatant nations—it also has a moral advantage. The superpower allies would be attacked by many fewer warheads, noncombatant nations would receive much less radioactive fallout, and the global environment would be less severely altered by the effects of ozone destruction and smoke. (Such advantages, however, must not be offset by increasing the average yield of the smaller number of warheads.)

Political leaders understand that the mere possibility of catastrophe inherent in the mutual hostage relationship—not the details of the arsenals or the plans for targeting

Figure 2. The futility of counterforce: calculated results of strategic counterforce exchanges, 1985 forces

These calculations assume that in a first strike the Soviet Union assigns two ICBM warheads to each U.S. Minuteman silo, that the United States assigns two Minuteman III warheads to each Soviet silo containing a MIRVed ICBM, and that 80 percent of the missiles so attacked are destroyed. It is also assumed that both sides are on generated alert with as many bombers on alert and ballistic-missile submarines at sea as possible. This figure is an update of one whose derivation is explained in greater detail in Harold A. Feiveson and Frank von Hippel, "The Freeze and the Counterforce Race," *Physics Today* (Jan. 1983), p. 36.



them—is what deters each superpower from threatening the vital interests of the other. McGeorge Bundy has termed this "existential deterrence."[9] As Bundy wrote during the great debate over anti-ballistic-missile systems in the late 1960s:

> Think-tank analysts can set levels of acceptable damage well up in the tens of millions of lives. They can assume that the loss of dozens of great cities is somehow a real choice for sane men. They are in an unreal world. In the real world of real political leaders—whether here or in the Soviet Union—a decision that would bring even one hydrogen bomb on one city of one's own country would be recognized in advance as a catastrophic blunder; ten bombs on ten cities would be a disaster beyond history; and a hundred bombs on a hundred cities are unthinkable.[10]

The destructive capacity in the illustrative superpower finite deterrence arsenal, although one-tenth the size of today's, is, nevertheless, many times greater than that required to accomplish even an "unthinkable" level of destruction.

Of course, existential deterrence would also exist for what has come to be termed "extended deterrence"—that is, not merely of nuclear attacks against the United States, but also of non-nuclear attacks against U.S. allies, particularly in Europe. For its entire history, NATO has relied upon the threat posed by U.S. nuclear weapons to make up for what has always appeared to be an imbalance of conventional forces in favor of the Warsaw Pact. Indeed, most of the U.S. nuclear arsenal is justified ultimately not by the need to protect the United States itself against nuclear attack, but as a deterrent to Soviet aggression in areas of U.S. vital interest.

Yet, ever since the Soviet Union achieved a secure second-strike capability in the early 1970s, extended deterrence has been largely a matter of doctrine and faith. Indeed, the desire to make plausible the U.S. willingness to risk American cities for the sake of the European allies has been a powerful motive in the constant search for additional credible "nuclear options" and more "usable" nuclear forces.

Despite the elaboration of nuclear options, however, extended deterrence seems no more (and, indeed, no less) plausible today than it did, say, two decades ago. Now, as then, extended deterrence depends not upon any imbalance in nuclear capabilities but upon perceptions of relative willingness to risk nuclear war. If Moscow is now deterred from launching a conventional war in Europe because of its inherent uncertainty about whether the West would attempt to stem the tide with nuclear weapons, there is demonstrable reason why the same deterrence would not apply if each side possessed 2,000 warheads.

The character and size of the illustrative superpower forces have been largely determined by the design requirement that the current degree of stability should exist after deep reductions. Despite the 90 percent reduction in the total number of warheads shown in the table, the number of U.S. "delivery vehicles" has only been reduced by about one-third. Assuming that Soviet nuclear forces would be reduced similarly, the U.S. finite-deterrence arsenal would be *less* vulnerable than the current arsenal because the Soviet Union would have available many fewer warheads per target for counterforce attacks. In addition, because of the deMIRVing, more than one ballistic missile warhead would be required to destroy one ICBM warhead on the other side.

Calculations such as those done for Figure 2 show that about half of the 2,000 warheads in the finite deterrence arsenal would survive a first strike. This result depends primarily on assumptions made about the percentages of bombers that would be on alert during a crisis and of ballistic missile submarines that would be at sea, not on the number of warheads used in the attack. Thus, even the great reductions envisioned here are not enough to destabilize the superpower strategic balance. That *would* occur if further reductions reached the point where such details as, for example, which side struck first or had more capable non-nuclear forces once again began to matter.

The survivability of the illustrative finite-deterrence arsenal could be further enhanced by making the single-warhead, land-based missiles mobile (if this could be done without making their numbers inadequately verifiable) and by distributing the single-warhead, submarine-launched missiles among a larger number of smaller submarines.

To discourage new threats to the stability of this situation, the establishment of a finite-deterrence regime should be accompanied by verifiable bans on the development of new types of weapons such as reentry vehicles that could "home in" on bombers in flight. Strict limitations on ballistic missile flight tests would severely hamper the development of such weapons and the pursuit of counterforce strategies more generally. Placing restrictions on the deployment of antisubmarine-warfare technologies would also be valuable.

Because the number of ballistic missile reentry vehicles that defenses would have to deal with would be greatly reduced, the importance of restraining defensive technologies would be increased. Therefore, the ABM Treaty should be strengthened in the gray areas where anti-tactical-ballistic missile and anti-aircraft defense capabilities overlap with anti-strategic-ballistic missile capabilities.

More worrisome than the vulnerability of nuclear weapons is the vulnerability of the superpower nuclear command-and-control systems. Even after completion of the current ambitious upgrade of the U.S.-command-and-control system, its designers believe that it could, at best, withstand an attack involving "a few hundred" nuclear warheads before losing positive control over the U.S. arsenal.[11] This mismatch between the number of weapons in the superpower nuclear arsenals and the survivability of the systems that direct them could raise pressures for preemptive use of the weapons before centralized control was lost, and would also encourage excessive decentralization of control during a crisis. "Decapitation" of either superpower's nuclear weapons system could well result in a globally catas-

trophic reflexive "spasm" attack. Deep reductions would not eliminate the vulnerability of command-and-control systems, but they would limit the number of warheads both that are available to attack them and that these fragile systems currently control.

Elimination of tactical nuclear weapons would also contribute to stability. The superpower armies and navies are now so thoroughly equipped with nuclear weapons for every purpose (about one nuclear warhead per one hundred military personnel on average) that there would be enormous risk of crossing the nuclear threshold in the event of any large-scale confrontation between the two militaries. This would derive from the myriad ambiguities and complexities inherent in the intermingling of conventional and nuclear forces on both sides, from the temptation to preemptively attack concentrations of nuclear arms, and from appeals from units about to be overcome to higher authorities to authorize use of their nuclear weapons.

The above discussion can be turned around to argue that the fragility of command and control and the nuclearization of tactical forces enhance deterrence by increasing the danger that any military confrontation between the United States and the Soviet Union might result in nuclear war. Such a prospect, no doubt, does help to instill caution on both sides. But beyond a certain point rationalizing brittleness in this way becomes the irresponsible advocacy of deterrence by an all-purpose doomsday machine.

ANOTHER KEY criterion for the illustrative finite-deterrence force was that no credible level of undetected cheating could allow either superpower to remove itself from hostage. If the forces are as large as those suggested and are adequately survivable, then even the secret doubling of the strategic weapons available to one side would not significantly alter the mutual hostage relationship.

It appears that the most critical changes in the transition to a finite-deterrence regime—reductions in the numbers of long-range bombers and replacement of large multiple-warhead missiles by smaller single-warhead missiles—could be verified by nonintrusive means such as satellites. A ban on testing MIRVed missiles would be verifiable by long-range monitoring techniques and would, over time, erode confidence in the usability of any hidden stockpile of MIRVed missiles, especially for a first strike.

Although a 100-kiloton limit on the yield of nuclear warheads may not be verifiable (in this range, each additional kilogram of warhead weight can result in an additional yield of about one kiloton[12]), a limit in the range of a few hundred kilotons—a typical yield for the individual warheads on current multiple-warhead ICBMs—ought to be enforceable. This could be done by limiting the throw-weights of the new single-warhead ballistic missiles and the sizes of cruise missiles.

Some aspects of a finite-deterrence regime, however, would be more difficult to verify and would probably require cooperative verification arrangements. For example, on-site monitoring will be necessary to verify the dismant-

ling of nuclear weapons and the "burning" of the recovered fissile material in nuclear power reactors and to ensure that nuclear power installations are not being used to produce fissile material for new warheads.

Small, mobile missiles could present serious verification problems since they would be much more difficult to count than current missiles which are relatively large and fixed in massive silos. This tradeoff has been left unresolved in the illustrative force. Sea-launched cruise missiles (SLCMs) pose a similar dilemma. Putting them on attack submarines would greatly increase the number of submarines armed with long-range nuclear delivery systems that would have to be destroyed in a disarming first strike. Their location and small size, however, would make them virtually impossible to count. As long as SLCMs are deployed, all attack-submarines and major surface ships will have to be assumed to be nuclear cruise-missile carriers.

The "denuclearization" of short-range systems such as fighter-bombers, sea-based and ground-launched cruise missiles, short-range ballistic missiles, and artillery would also be relatively difficult to verify. The systems themselves would still exist to fire conventional munitions, and the nuclear warheads, which are quite small, could be quickly delivered from secret stockpiles. Successful concealment of some nuclear warheads for short-range delivery systems would not, however, threaten the mutual hostage relationship.

A SUPERPOWER transition to a finite-deterrence regime would affect other nations. Indeed, it would be critical to make the transition in a way that did not disrupt international relationships. For example, withdrawal of nuclear weapons from Europe would have to be done in a way that would give maximum reassurance to the Europeans. In fact, the accompanying table allows for the possibility that some intermediate-range land-based missiles might be based in Europe.

Complications would also arise in dealing with the "medium" nuclear powers—France, the United Kingdom, and China. Although the superpower arsenals—measured by numbers of delivery vehicles—would still be an order of magnitude larger than those of the medium powers, if France and the United Kingdom completed MIRVing their submarine-launched ballistic missiles (SLBMs), the Soviets would find arrayed against them a number of warheads far exceeding their own. Even if 2,000 warheads are enough to pose an effective deterrent against all these forces, the political appearance of such an imbalance might be unacceptable. For that reason it would almost certainly be necessary to induce these medium nuclear powers to limit the size of their forces. The Chinese government has stated that it would consider constraints on its nuclear forces if the United States and the Soviet Union cut back their nuclear forces by 50 percent.[13]

Such difficulties and the tremendous inertia of the arms race would have to be overcome if drastic reductions of the superpower nuclear arsenals are to be achieved. As a result of the debates over the nuclear weapons freeze and Star Wars proposals, however, the political conditions for a radical change in the current postures may be more favorable than they have ever been. The finite-deterrence proposal would also represent a solution to the problems that are stalemating current U.S.-Soviet arms control negotiations. The United States has been insisting upon reductions in the numbers of Soviet MIRVed land-based missiles, and the Soviet Union has been insisting that the United States not proceed with its Star Wars program. The finite-deterrence proposal, by eliminating MIRVed missiles and maintaining stringent limitations on anti-ballistic-missile systems, would meet both of these concerns.

The arsenal described here should be about as effective and survivable a deterrent as the current superpower arsenals. It should therefore be *technically* possible for either superpower to adopt a finite-deterrence position unilaterally. This would seem unrealistic *politically,* but, given the superpowers' vast excess of available nuclear forces, many of the steps toward a finite-deterrence regime could be taken independently. For example, NATO could unilaterally denuclearize a large part of its artillery and short-range missiles. Since the military value of these area-destruction weapons is increasingly being seen as marginal in an era of precision-guided munitions, there is already broad support for such a move.

Therefore while a transition to a finite-deterrence regime would be difficult, it should not be impossible. The result would still be a balance of terror with the same caution-inducing characteristics as the current regime—but with some of its overkill and its dangerous and mind-twisting complexity stripped away. □

1. Richard H. Ullman, "Denuclearizing International Politics," *Ethics,* 95 (1985), pp. 567–88.
2. U.N. General Assembly, "Revised Draft Treaty on General and Complete Disarmament under Strict International Control," in *Documents on Disarmament, 1962.* p. 913.
3. Desmond Ball, *Targeting for Strategic Deterrence,* Adelphi Paper 185 (London: International Institute for Strategic Studies, 1983); David Holloway, *The Soviet Union and the Arms Race* (New Haven, Conn.: Yale University Press, 1983).
4. In a number of his talks, Richard L. Garwin has described finite-deterrence forces similar to the one discussed here.
5. Robert S. McNamara, *The Fiscal Year 1969–73 Defense Program and the 1969 Defense Budget* (Washington, D.C.: Department of Defense, 1968), pp. 50, 57.
6. Frank von Hippel, "The Effects of Nuclear War," in David W. Hafemeister and Dietrich Schroeer, eds., *Physics, Technology and the Nuclear Arms Race* (New York: American Institute of Physics, 1983), p. 1.
7. See, for example, David Alan Rosenberg, "The Origins of Overkill," *International Security* (Spring 1983), p. 3.
8. William M. Arkin, Frank von Hippel, and Barbara G. Levi, "The Consequences of a 'Limited' Nuclear War in East and West Germany," *Ambio* (June 1982), p. 163.
9. McGeorge Bundy, "Existential Deterrence and Its Consequences," in Douglas Maclean, ed., *The Security Gamble: Deterrence Dilemmas in the Nuclear Age* (Totowa, N.J.: Rowman and Allanheld, 1984), pp. 3–13.
10. McGeorge Bundy, "To Cap the Volcano," *Foreign Affairs* (Oct. 1969), p. 2.
11. Charles A. Zraket, "Strategic Command, Control, Communications, and Intelligence," *Science,* 224 (1984), p. 1306.
12. Thomas B. Cochran, William M. Arkin, and Milton M. Hoenig, *U.S. Nuclear Forces and Capabilities* (Cambridge, Mass.: Ballinger, 1984).
13. *New York Times,* June 22, 1983, p. 2.