# Tenfold Reductions in the U.S. and Soviet Nuclear Arsenals: Why and How[1]

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Let me start by telling you a story:

A few years ago, the members of an arms control seminar to which I belong were invited by the Commander of the US Strategic Air Command to fly to one his airbases, look inside a nuclear bomber, visit an underground nuclear missile launch control center and then come to his headquarters outside Omaha and listen to some of his officers give the U.S. Air Force's perspective on nuclear weapons policy.

We went. The visit to the air base was very interesting. But the visit to Strategic Air Command's headquarters was not. All they wanted to talk to us about was how much the Air Force needed the MX.
[Figure 1. Test of MX]

For those of you unfamiliar with it, the MX is the United States' newest intercontinental missile. It has 10 warheads -- each of which can explode within about 100 meters of its target with the force of almost one half a million tons of chemical explosive. The Soviet Union already has had such a missile for several years -- although it is not quite so accurate as the MX.

In any case, we were being told that the U.S. needed this missile "for deterrence." I did not understand this so, finally, I asked:

> "Don't you think that the British, the French and the Chinese, who have forces only a few percent as large as the U.S., nevertheless have a deterrent?"

The answer was:

> "Of course they do, but they have only a <u>finite</u> deterrent!"

[Figure 2. The nuclear debate.]

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1. Opening talk of the International Forum of Scientists on Drastic Reductions and Final Elimination of Nuclear Weapons, Moscow, Feb. 14, 1987 AM.

## The Nuclear Debate

My question and the Air Force answer reflect the two main positions in the debate over nuclear weapons. In Figure 1, I describe it as the debate between the "new thinking" and the "old thinking." This is a debate that goes on inside us as well as between us.

The reality that almost everyone agrees on today is that nuclear weapons are so destructive, so small and so numerous that the most powerful nation on earth is defenseless against nuclear attack and can be completely destroyed within a short time. All nations have therefore become the hostages of the nuclear weapons states and the nuclear weapons states have become each other's hostages.

The new thinking accepts this situation. It sees nuclear weapons as having made war between the industrialized countries unthinkable. The main danger in the current situation is seen to be accidental war. In the short term, the principal task is therefore seen to make the situation as stable as possible. In the longer term, it is hoped to gradually reduce the level of threats that we make toward each other.

The old thinking is not so optimistic. In this view, the mere existence of nuclear weapons has not tamed man's aggressive instincts and the old Roman dictum is still valid: "If you want peace, prepare for war." In particular, many in the West believe that we must be prepared to use nuclear weapons if necessary to defend Western Europe. This means that we must obtain nuclear weapons that are usable. Such thinking drives the nuclear arms race.

This debate shows that it is important not to consider the nuclear arms race in isolation from its causes -- one of which is the confrontation in Europe. This is why our discussion this afternoon on "Nuclear Disarmament and the Security of Europe" is so important.
[Figure 3. Outline of talk]

In this session, however, we <u>are</u> considering the nuclear confrontation by itself. In the time that remains to me therefore, I will discuss the scale of the current nuclear arsenals, why their size reflects old thinking, how they might be reduced, and how scientists can contribute to laying the analytical basis for reductions.
[Figure 4. Maximum-Casualty Attacks on US and Soviet cities.]

## Overkill

We often hear that the United States and Soviet Union can destroy each other tens of times over. This has been true for a long time. Twenty years ago, US Secretary of Defense Robert McNamara, in an effort to convince the US Congress that US nuclear forces were -- if anything -- too large, had US Department of Defense analysts calculate how many weapons would be required to destroy certain fractions of the Soviet economy and people.

McNamara concluded that less than 200 equivalent megatons -- 5 percent of the 4000 Mt that could be delivered to the Soviet Union by a U.S. attack today -- could result in what the "assured destruction" of the Soviet Union as a modern society.

McNamara was an optimist. As we have understood more about the effects of nuclear weapons, we have learned that both the U.S. and Soviet Union could be destroyed by many fewer nuclear weapons than he suggested. At Princeton, for example, we estimate that, as a result of the tremendous fires that would be caused by large nuclear explosions, 70 1-Mt explosion could kill as many people as McNamara's analysts estimated for 200 Mt. In reality, the casualties would be still much higher, since we did not even attempt to estimate the additional hundreds of millions who would die as a result of the destruction of the United States and Soviet Union as modern societies.

The current U.S. and Soviet nuclear arsenals are therefore one to two orders of magnitude larger than required to maintain their mutual-hostage relationship.

## Nuclear Warfighting

Why do we have such large nuclear forces? The reason is that military men do not want to slaughter millions of innocent people. They want to be able to defeat the military forces of the other side. And the best way to destroy a nuclear weapon is with a nuclear weapon. The nuclear arsenals are so large because their highest priority targets are each other! And they represent a much larger number of targets than the cities.
[Figure 5. Fallout patterns from a hypothetical Soviet counterforce attack on United States strategic-nuclear forces.]

For example, United States and the Soviet Union each have more than one thousand widely-separated reinforced-concrete underground shelters -- each housing only one intercontinental missile. An attack having the objective of destroying just this part of the strategic forces on either side would today target about one million tons of explosive power on each of these shelters.

This figure shows an approximate map -- given typical February winds -- of the areas of lethal fallout which would result from such an attack on strategic nuclear forces of the United States. The large areas are downwind

from the six "fields" of U.S. missile shelters. The smaller areas correspond to the locations of bomber bases, naval bases, nuclear-weapons storage depots, the underground command posts from which attack orders would be issued and the radio and satellite antennas through which those orders would be transmitted.
[Figure 6. Fallout patterns from a hypothetical United States attack on Soviet strategic nuclear forces.]

This figure shows the corresponding map for the Soviet Union. The fallout patterns look smaller primarily because the Soviet Union is larger and has placed fewer missiles in each of a larger number of bases.

Civilian Casualties. Although the purpose of such attacks would be to destroy weapons not people, tens of millions of people would nevertheless be killed. We estimate at Princeton that up to 30 million people would be killed on each side by the direct effects of such attacks. Many more would die later as a result of the economic and social effects. To think of such attacks as more humane than attacks against cities is clearly a dangerous illusion.
[Figure 7. The futility of first strikes.]

Military Ineffectiveness. Such attacks on either the U.S. of Soviet nuclear forces would also be militarily ineffective. Even if the attacks on the missile shelters were perfectly successful, both sides have many nuclear weapons hidden in submarines beneath the surface of the oceans and many of their nuclear bombers could escape from their bases in the time between warning of an attack and its arrival.

As a result, about one half of the nuclear destructive power of either the Soviet Union or the US would survive a surprise attack. Given that the attack would have resulted in tens of millions of deaths, it is hard to imagine that some of these surviving forces would not be used for a terrible response.
[Figure 8. Nuclear warfighting and crisis instability.]

Destabilizing Effects. The military have not abandoned ideas of nuclear warfighting, however. The accuracy of the warheads on Soviet multiple-warhead missiles, for example, has been steadily improved to the point where they could in theory destroy most of the shelters housing U.S. land-based missiles. And the U.S. is now obtaining even more accurate multiple-warhead missiles in order to be able to similarly threaten Soviet missile shelters and underground command posts. The dangerous result has been increased incentives to use nuclear forces before they can be destroyed.

It is widely believed within the expert community, for example, that both the United States and Soviet Union may already have adopted "launch-on-warning" doctrines. Such a doctrine would irreversibly launch the nuclear forces once the U.S. or Soviet leadership became convinced that the other side had launched some of its missiles in an attack. Since the time available for such a decision would be very short (ten minutes or even less), this is a very worrisome development.

The military leaderships don't like the launch-on-warning doctrine. Their preferred alternative is even more dangerous, however. It is to anticipate attack by the other side and then attack first -- a "preemptive attack." In a crisis, this could result in the fear of nuclear attack being self-fulfilling. Each military would watch the activities of the other looking for signs of preparations for an attack. And it would itself prepare for an even more rapid attack. The other side would see such preparations, be alarmed and heighten the level of readiness of its own forces. Many experts are concerned that this spiral of alarm and preparations could lead to nuclear war even though originally neither side intended to attack.
[Figure 9. The nuclear arsenals today.]

## Stabilizing Reductions

Perhaps the most important task today is to redesign our nuclear forces so as to prevent this instability. This can be done in part through reductions.

Our group in Princeton has been investigating the possibility of a ten-fold or 90 percent reduction of the total number of nuclear weapons in the Soviet and U.S. nuclear arsenals. This reduction would be carried out principally be eliminating nuclear-warfighting weapons.

Battlefield or Tactical Nuclear Weapons. First, we could cut the arsenals approximately in half by simply eliminating so-called "battlefield" or "tactical" nuclear weapons. Currently, the US and Soviet Union each have approximately 10,000 short- and medium-range nuclear weapon -- approximately one for each 100 soldiers in their armies and each 100 sailors in their surface navies. On the U.S. side, for example, every artillery unit can fire nuclear shells and all but the smallest Naval surface ships are equipped with nuclear weapons of various types.

This means that nuclear weapons would be involved in even the smallest battle between U.S. and Soviet forces. Desperate commanders could be asking permission to use them from the earliest stages of the conflict -- and, in some cases, might do so without permission. And military leaders would be concerned that nuclear weapons in the battle area were being destroyed or captured. The resulting pressures are described by the U.S. military as "use them or lose them."

Elimination of short-range nuclear weapons would not eliminate the danger of nuclear war -- or even the possibility of using some longer-range nuclear weapons against troops or ships -- but it would make the decision a more deliberate one made under centralized control. Their elimination would also reduce the two arsenals to about one half of their present sizes.

Multiple-Warhead Ballistic Missiles. The remaining halves of the U.S. and Soviet nuclear arsenals are carried by long-range "strategic" delivery vehicles. Some missiles carry up to 14 nuclear warheads and some US bombers carry up to 24. If only multiple-warhead ballistic missiles were replaced

by single-warhead missiles and the number of nuclear weapons per U.S. bomber were reduced to five, the number of long-range nuclear weapon on each side would be reduced from approximately 10,000 to about 3500.

It would be wise to eliminate multiple-warhead ballistic missiles because their existence encourages ideas of first strikes. If used first, one of these missiles could destroy more than one on the other side. [Figure 10. Stabilizing Reductions]

Even more important to stability -- and to concerns about verifiability -- however, would be to ensure that the forces remained invulnerable to surpise attack even if one side secretly retained a large number of multiple-warhead missiles. This is of great concern to the U.S. military, which was traumatized by the Japanese surprise attack on our naval forces in Hawaii at the beginning of World War II. Today, the U.S. keeps about one half of its nuclear submarines at sea and about one third of U.S. nuclear bombers are prepared to take to the air within ten minutes notice. In the case of land-based missiles, there is considerable pressure from the Congress to deploy more-difficult-to-target mobile missiles.

To further reduce the number of warheads in the U.S. and Soviet nuclear arsenals below 3500, one would have to reduce the number of launchers. We believe that a reduction to 2000 warhead should be quite feasible. Even if all the warheads being carried had 100-kt yield -- one tenth the power of the warheads traditionally carried by single-warhead missiles -- they would still carry the destructive power of more than 10,000 Hiroshima weapons -- many times more than required to maintain the mutual-hostage relationship.

Such reductions would not achieve their full benefit in increasing stability, however, if they were not accompanied by an abandonment of interest in preemptive nuclear attacks.

Bruce Blair, who is here, has suggested that the fear of surprise attacks and therefore interest in preemptive attacks could be reduced if the military knew that even after a first strike, a command staff would survive -- perhaps on a submarine -- and that this command staff be able to communicate with other surviving forces and governmental groups. Then it would be known by both sides that it would be possible for the people linked together by this communications network to take time to think through what had happened and what the appropriate response should be. Morton Halperin has suggested that all nuclear weapons be placed under the control of a separate service which would have no other function than that of surviving and providing the capability for nuclear retaliation if required.

Another essential requirement for stability and for reductions is to preserve and strengthen the Treaty Limiting Anti-Ballistic Missile Systems. The alternative to this Treaty is a dangerous offense-defense arms race. This is why we will have a special session on this subject tomorrow morning. [Figure 11. What scientists can do.]

## What Scientists Can Do

I have outlined the case for drastic reductions and how they might be carried out. The details are missing, however -- especially the details about verification.

It is true that there are specialists in some of these matters -- especially in the intelligence agencies with their satellites and other means for monitoring activities on the other side of the world.

However, these specialists are not being asked (at least yet) by their political leaderships to examine how drastic reductions might be implemented and, in any case, they like to keep their capabilities secret. They are therefore of little help when one needs to answer the questions of sceptics who are worried that agreements to make drastic reductions might make us vulnerable because the other side might cheat.

Fortunately, it is not necessary for us to know all the secrets of the intelligence agencies in order to answer most of these questions. For example, the seismologists have already shown in a public way how it could be possible to detect even concealed underground explosions down to very low yields. In a similar way we could, for example, use basic physics and publicly-available information to estimate the capabilities of radars and satellites for verifying a ban on the testing of multiple-warhead missiles.

As another example, we could devise nonintrusive systems to ensure that missile factories do not produce more than an agreed number of single-warhead missiles And we could propose ways in which it would be possible for each side to confirm that the other side has destroyed a certain number of specific warheads and converted the nuclear materials that they contain to peaceful purposes under international control.

Conversely, we could explain on the basis of basic physical principals why we expect that submarines at sea will remain relatively safe from detection and therefore destruction for the forseeable future.

We could also explain to the public why we can tolerate a great deal of uncertainty in verification: once one has more than a certain small number of invulnerable nuclear weapons, the mutual-hostage relationship is established even if the other side has two or even ten times as many.

Finally, we could begin to discuss the possibility of even deeper reductions than I have discussed here. Here, I hope that the fifth session of this forum -- on open science projects -- will be helpful.

FIGURES

## Ten MX Reentry Vehicles Hit Target Area at Kwajalein

Ten unarmed Mk. 21 MX intercontinental ballistic missile reentry vehicles hit a target area within the Kwajalein Missile Test Range in the Pacific Ocean during the 12th flight test of the advanced ICBM. The missile was launched from Vandenberg AFB, Calif., May 21 and flew 4,000 mi. to the target area during the 30-min. flight—the first flight in which the MX carried 10 Mk. 21 reentry vehicles. Missile crewmembers from F. E. Warren AFB, Wyo., participated in the launch as part of the transition to an operational MX missile system. Initial operational capability with 10 missiles at Warren is scheduled for this December.

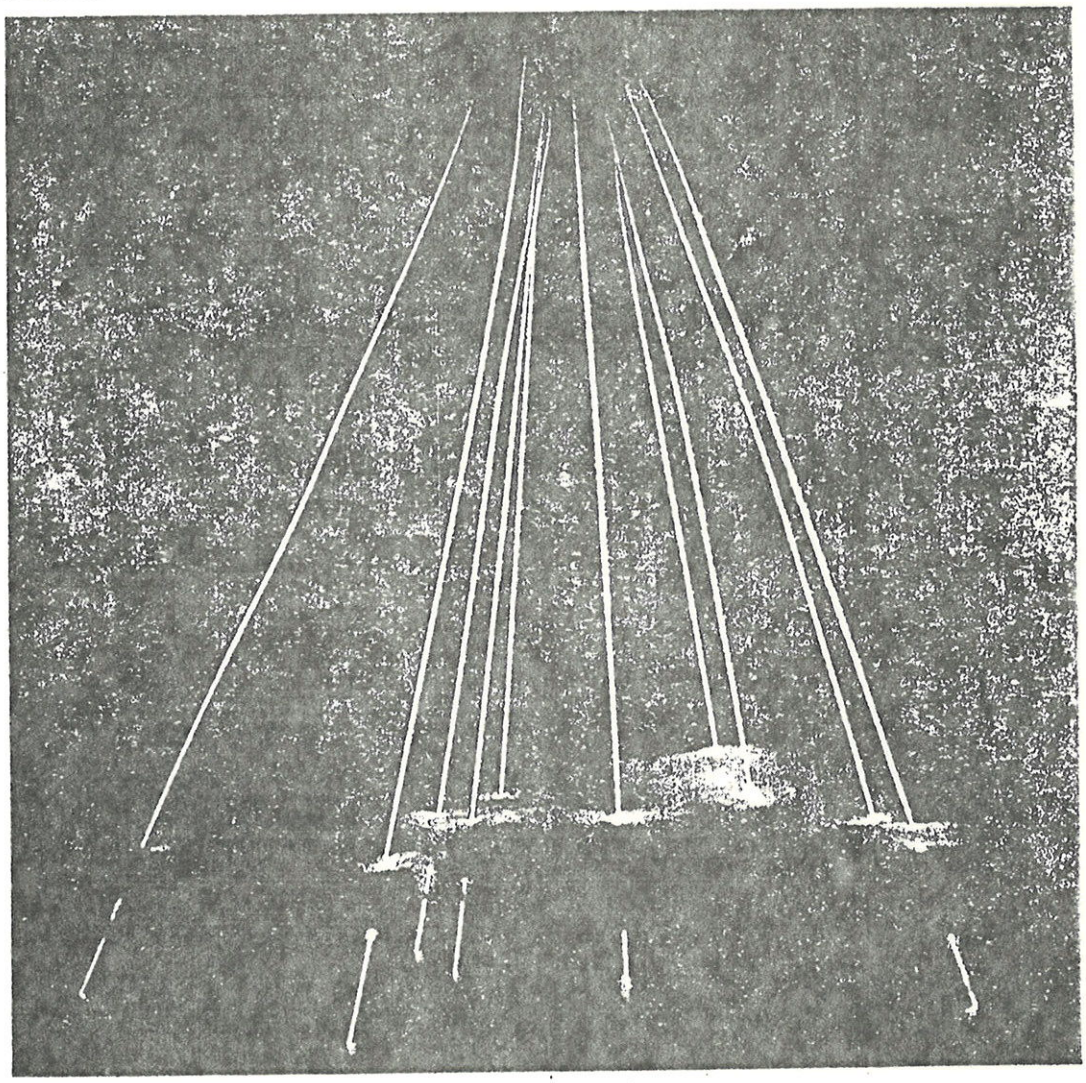


Figure 1

Figure 2

THE NUCLEAR DEBATE

NEW THINKING: WE ARE EACH OTHER'S MUTUAL NUCLEAR HOSTAGES.

NUCLEAR WEAPONS HAVE MADE WAR OBSOLETE.

WE MUST MAKE THE MUTUAL NUCLEAR HOSTAGE RELATIOHSHIP STABLE AND THEN GRADUALLY REDUCE.

OLD THINKING: NUCLEAR WEAPONS HAVE NOT MADE WAR OBSOLETE.

IF YOU WANT PEACE, YOU MUST PREPARE FOR WAR.

--(IN THE WEST): WE MUST BE ABLE TO USE NUCLEAR WEAPONS TO PROTECT WESTERN EUROPE.

Figure 3

OUTLINE OF TALK

OVERKILL

NUCLEAR WARFIGHTING WEAPONS

STABILIZING REDUCTIONS

HOW SCIENTISTS CAN CONTRIBUTE

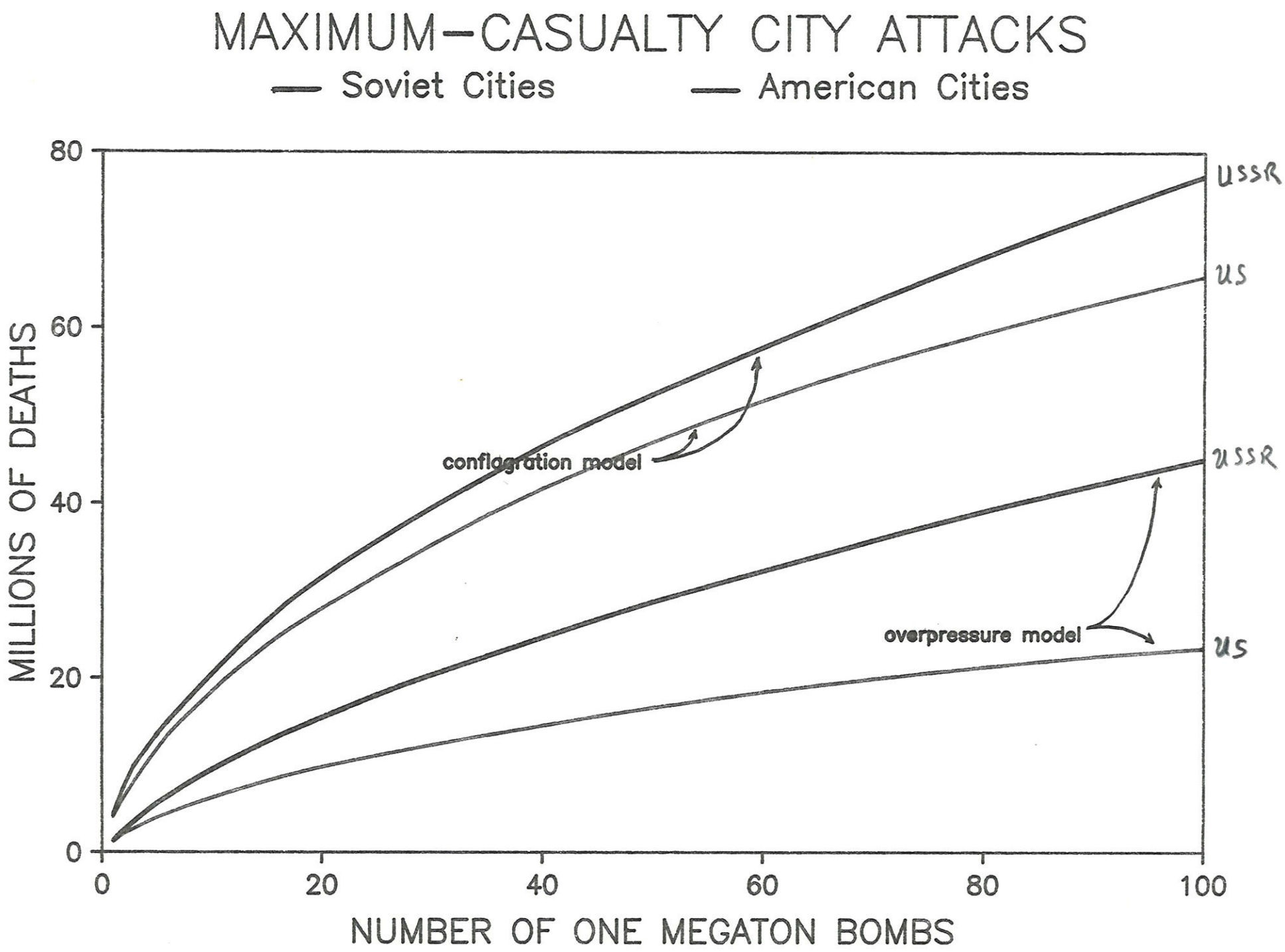
Figure 8

NUCLEAR WARFIGHTING AND CRISIS INSTABILITY

LAUNCH-ON-WARNING DOCTRINES PROVIDE TOO SHORT A DECISION TIME

PREEMPTIVE ATTACK DOCTRINES PROVOKE SELF-FULFILLING FEARS OF NUCLEAR WAR

Figure 4


MAXIMUM–CASUALTY CITY ATTACKS
— Soviet Cities
— American Cities
MILLIONS OF DEATHS
0
20
40
60
80
0
20
40
60
80
100
NUMBER OF ONE MEGATON BOMBS
conflagration model
overpressure model
USSR
US
USSR
US

FALLOUT PATTERN
FEBRUARY ATTACK ON US STRATEGIC NUCLEAR TARGETS

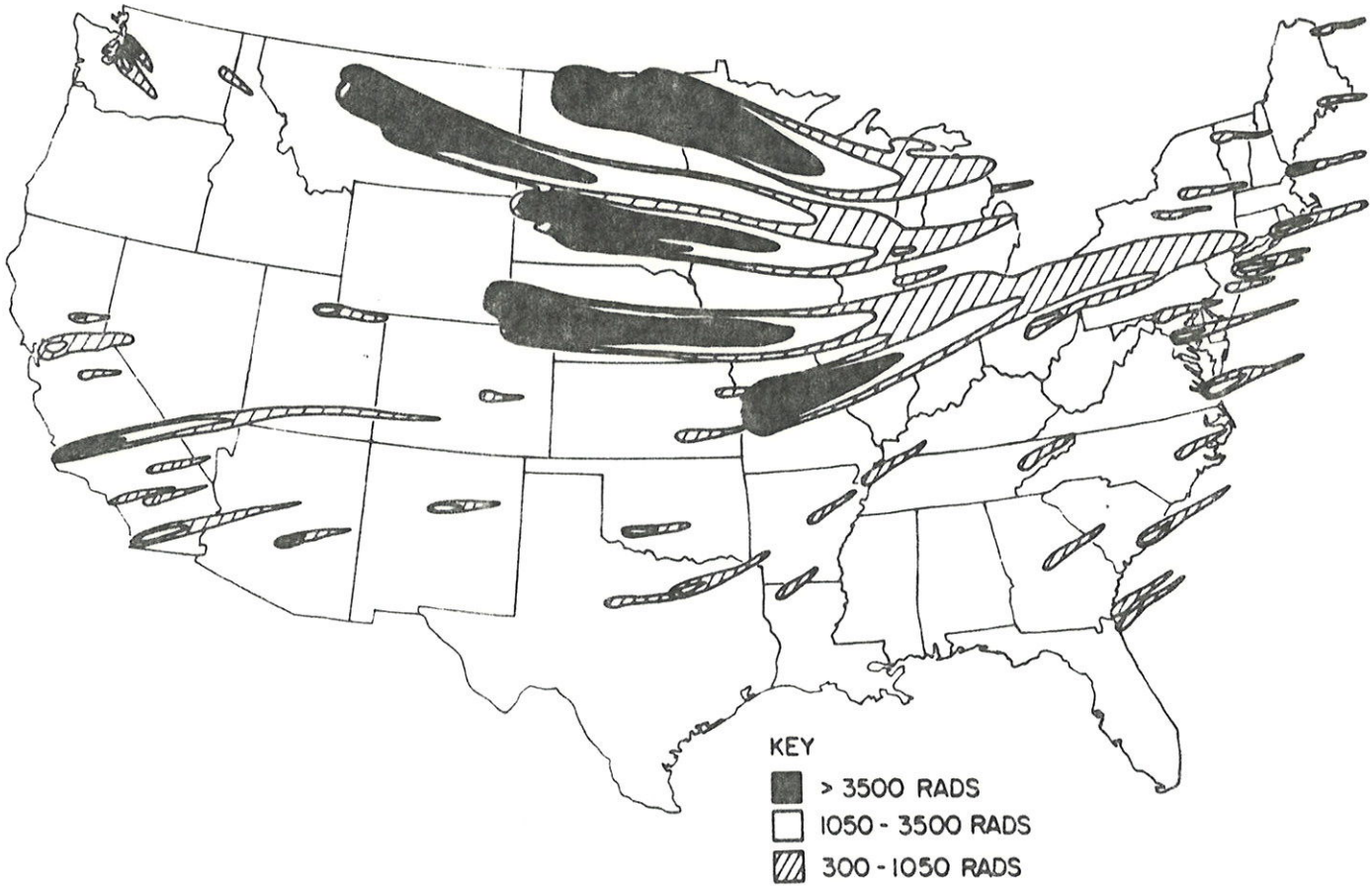



Figure 5

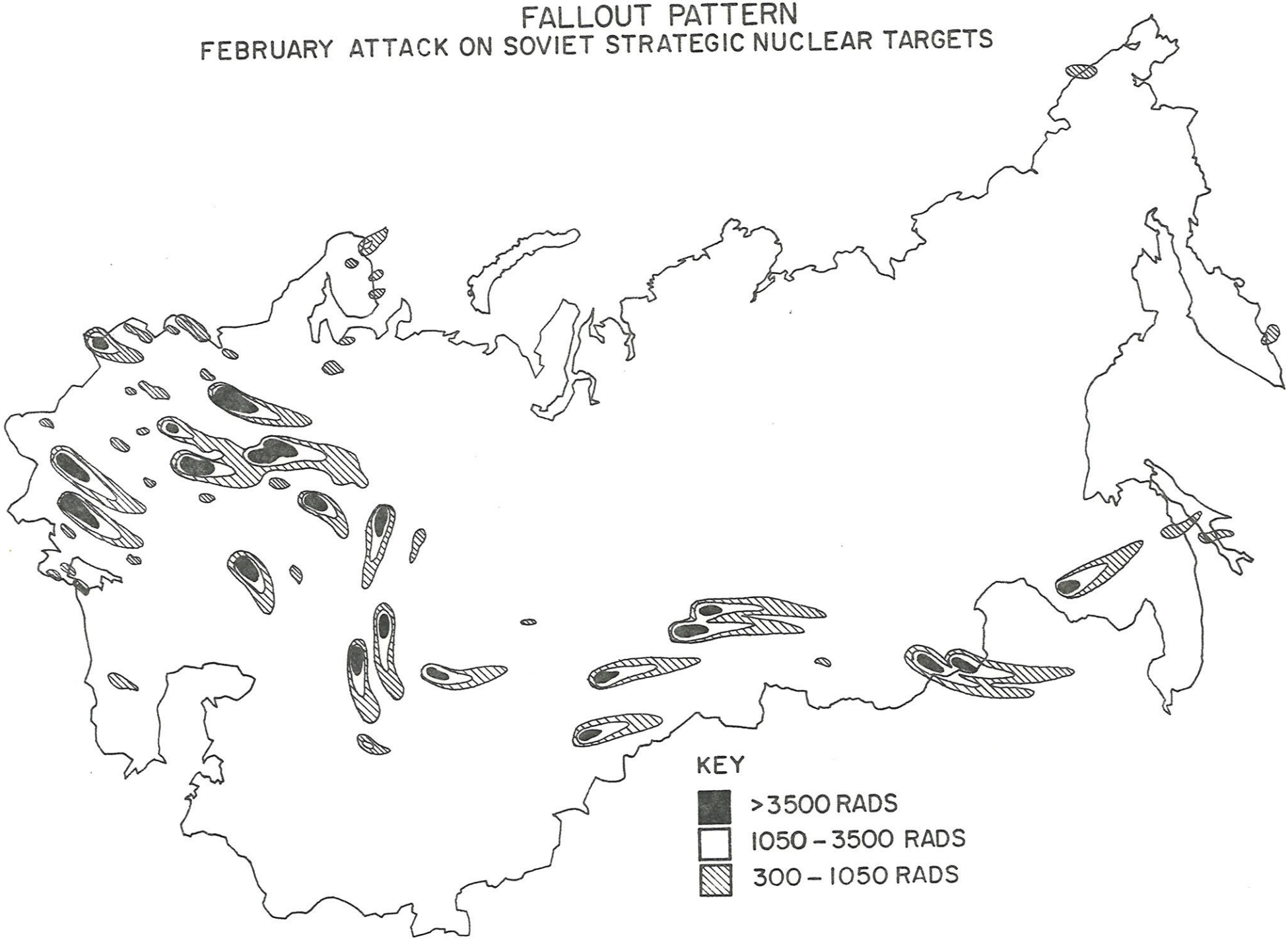

FALLOUT PATTERN
FEBRUARY ATTACK ON SOVIET STRATEGIC NUCLEAR TARGETS
KEY
>3500 RADS
1050 – 3500 RADS
300 – 1050 RADS

Figure 6

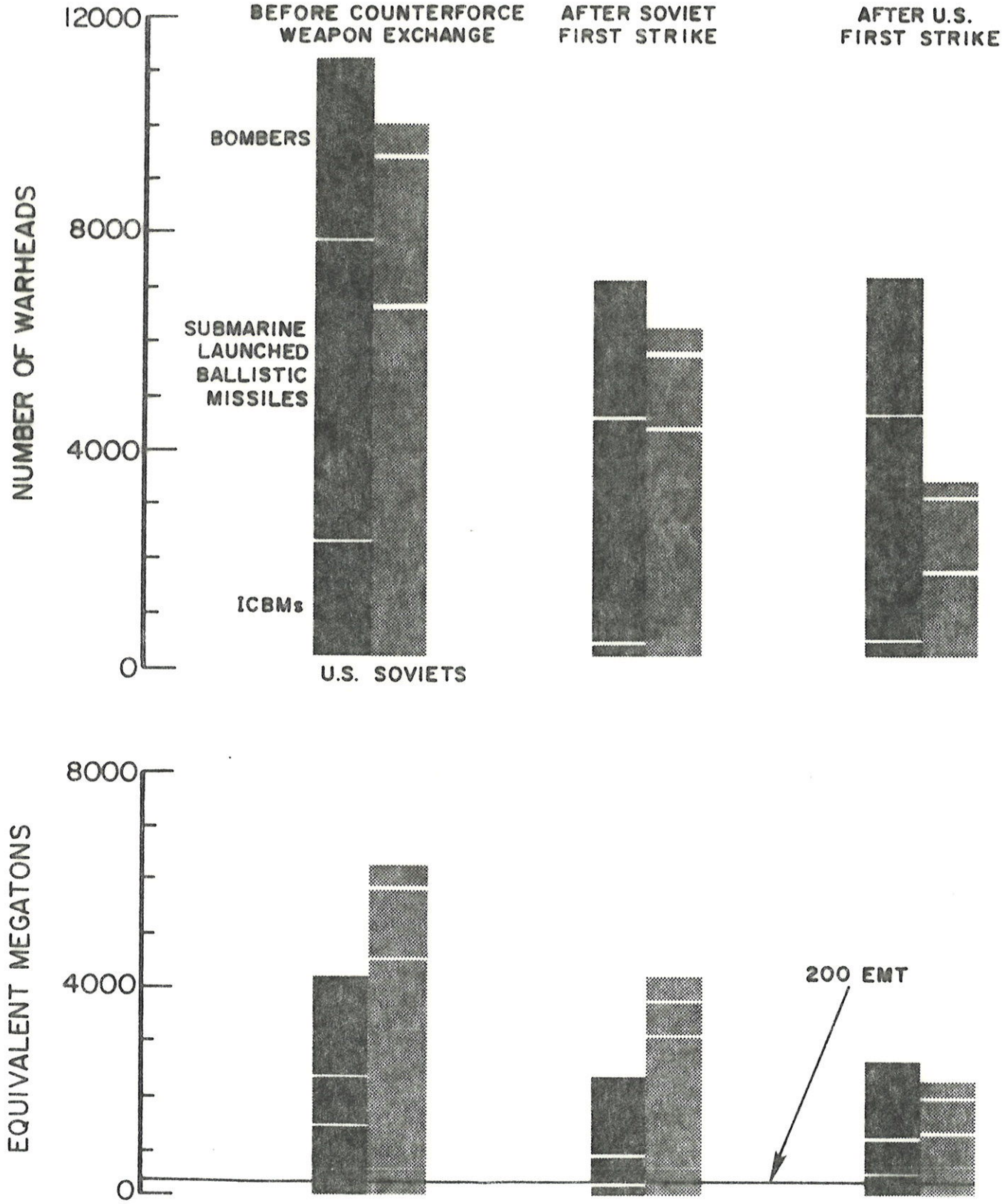



Figure 7

The Futility of First Strikes

(Figure 8 is on Figure 2 & 3)

Figure 9

US, USSR, AND FINITE DETERRENCE NUCLEAR ARSENALS

| | MISSILES OR BOMBERS | | | WARHEADS | | |
|---|---|---|---|---|---|---|
| | US | USSR | FD | US | USSR | FD |
| ICBMs | 1026 | 1398 | 500 | 2126 | 6420 | 500 |
| IRMs | 104 | 534 | | 104 | 1362 | |
| SLBMs | 690 | 967 | 500 | 5728 | 2887 | 500 |
| BOMBERS | 297 | 300 | 200 | 3336 | 600 | 1000 |
| SUBTOT | 2117 | 3199 | 1200 | 11000 | 11000 | 2000 |
| ARTILLERY SHELLS | | | | 2400 | 900 | 0 |
| ANTI-SUBMARINE | | | | 2000 | 600 | 0 |
| ANTI-SHIP CRUISE | | | | 0 | 1000 | 0 |
| BATTLEFIELD BALLISTIC MISSILES | | | | 300 | 1600 | 0 |
| ANTI-AIRCRAFT MISSILES | | | | 200 | 300+ | 0 |
| ANTI-BALLISTIC MISSILES | | | | 0 | 32 | 0 |
| ATOMIC DEMOLITION MINES | | | | 600 | some | 0 |
| NON-STRATEGIC BOMBS | | | | 4000 | 4000 | 0 |
| OVERALL TOTAL* | | | | 21000 | 20000+ | 2000 |

* Not including reloads.

## STABILIZING REDUCTIONS

1) ELIMINATE "TACTICAL" (SHORT- AND MEDIUM-RANGE) NUCLEAR WEAPONS.

--THIS WOULD RAISE THE THRESHOLD BETWEEN NONNUCLEAR AND NUCLEAR WAR.

2) REPLACE MULTIPLE-WARHEAD BALLISTIC MISSILES WITH A SMALLER NUMBER OF SINGLE-WARHEAD MISSILES

--THIS WOULD REDUCE THE NUMBER OF WARHEADS AVAILABLE FOR FIRST STRIKES MUCH MORE THAN THEIR TARGETS

3) REDUCE MAXIMUM WEAPONS PER BOMBERS TO 5.

| | RESULT | |
|---|---|---|
| | 1985 | REDUCED |
| U.S. WARHEADS | | |
| -- TACTICAL: | 10,000 ---> | 0 |
| -- ON MISSILES: | 8,000 ---> | 1,800 |
| -- ON BOMBERS: | 3,000 ---> | 1,500 |
| SOVIET WARHEADS | | |
| -- TACTICAL | 10,000 ---> | 0 |
| -- ON MISSILES | 11,000 ---> | 2,900 |
| -- ON BOMBERS | 600 ---> | 600 |

Figure 10

WHAT SCIENTISTS CAN DO

ASSESS, USING PUBLIC INFORMATION AND BASIC PHYSICAL PRINCIPLES:

1) VERIFIABILITY BY NATIONAL TECHNICAL MEANS OF REDUCTIONS, TESTING LIMITATIONS, ETC.

2) POSSIBILITIES FOR NONINTRUSIVE COOPERATIVE MEANS OF VERIFICATION WHERE REQUIRED

3) VULNERABILITY OF SUBMARINES, MOBILE MISSILES..

4) STABILITY OF FINITE DETERRENCE POSTURES TO CHEATING, BREAKOUT FROM LIMITATIONS, ETC.

5) POSSIBILITIES FOR FURTHER REDUCTIONS.

Figure 11