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Identifies five meanings currently given to the term nuclear threshold, analyzes the nuclear threshold concept and related concepts, and makes recommendations on terminology. Discusses the origin of the nuclear threshold concept, the reasons for its development, and the factors that may recently have made the concept less clear and useful. Concludes that if limitation of conflict is sought, continued respect for the boundary between nonnuclear and nuclear weapons appears to be desirable in the absence of strong evidence that it is no longer serviceable.

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ANALYTIC RESEARCH ON

STRATEGIC, TACTICAL AND DOCTRINAL

MILITARY CONCEPTS

The Nuclear Threshold Concept

A paper prepared for the Defense Nuclear Agency
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HISTORICAL EVALUATION AND RESEARCH ORGANIZATION

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THE NUCLEAR THRESHOLD CONCEPT

EXECUTIVE SUMMARY

The nuclear threshold concept, like the concept of deterrence, represents an effort to deal in a rational way with the overwhelming destructiveness of nuclear weapons -- to construct a rationale that makes their power available for use in the nation's interest without bringing about cataclysmic devastation. The concept centers on the difference between nonnuclear weapons and nuclear weapons, the line separating one from the other. The concept seeks to use this dividing line as a means of limiting war.

There are currently two basic problems connected with the meaningful use of the nuclear threshold concept. One is the problem of definition of terms: The term nuclear threshold is used in so many different ways that real discourse about the concept is difficult. The second is the question of whether the distinction between nuclear weapons and nonnuclear weapons has been made obsolete by technological changes, shifts in the balance of military strength, changed perceptions of Soviet strategy, and the spread of nuclear weapons to additional countries.

DEFINITION OF TERMS

The report identifies five senses in which the term nuclear threshold is currently used:

- The scientific line that separates nuclear weapons from conventional weapons, with regard to their physical nature.
- An alleged sharp increase in destructiveness and lethality between conventional weapons and nuclear weapons. This may also be expressed as a gap between the lethality of the most lethal conventional weapon and the lethality of the least lethal nuclear weapon.
- The line between not possessing nuclear weapons and possessing nuclear weapons.
- The operational line that separates nonuse of nuclear weapons from use of nuclear weapons.
- The point at which firing of nuclear weapons would be resorted to, or the provocation for which nuclear weapons would be considered the appropriate response.

After exploring the validity and usefulness of these concepts, and of applying the term nuclear threshold to them, the report makes the following recommendations on terminology:

- The term should not be used for the dividing line between not possessing nuclear weapons and possessing nuclear weapons (as in, "India has crossed the nuclear threshold.")
- The term should not be used for a gap in lethality between the most lethal conventional weapons and the least lethal nuclear weapons. ("The deadliest [conventional] weapons are now more powerful than the smaller nuclear weapons [and thus] the nuclear threshold has been breached.") The nuclear threshold concept does not depend on such a lethality gap, whether or not it exists.
- The term nuclear scientific line appears to be a clear and useful term for the line that separates conventional weapons from nuclear weapons, on the basis of their scientific nature.
- The term nuclear boundary appears to be a clear and useful term for the operational line between the nonuse of nuclear weapons and the use of nuclear weapons. The nuclear boundary, in this sense, is the line on a spectrum of conflict that separates nonnuclear weapons from nuclear weapons.
- The term nuclear threshold appears to be best applied to the point on a spectrum of provocation, or military necessity, at which nuclear weapons would be resorted to. The nuclear threshold can be raised or lowered; the nuclear boundary does not move.
- A firebreak, in strategic discourse, is a clearly discernible boundary line on the spectrum of conflict that is respected as a stopping point and crossed only under great provocation or extreme military necessity. The nuclear firebreak is a firebreak at the nuclear boundary.
- The nuclear taboo is a strong reluctance to use nuclear weapons that is reinforced by tradition and feelings of moral prohibition.

Figures 1, 2, and 3, copies of which are attached to this executive summary, should further clarify these definitions.

CONTINUED VALIDITY OF THE CONCEPTS

The report discusses a number of recent developments that may appear to have blurred the scientific nuclear line and the nuclear boundary, and/or undermined the validity of the nuclear threshold concept in limiting war. The following tentative conclusions are reached:

- The scientific nuclear line has not been blurred or threatened by the development of new, more destructive conventional weapons or new, less destructive nuclear weapons.

- Because of the existence of new weapons, there is some question as to whether the difference, in combat use, between conventional and nuclear weapons will still be clear in all cases. If it is not clear, the nuclear boundary would be threatened, as would the validity of the nuclear threshold concept. Further investigation, with the assistance of weapons specialists, is needed on this matter.
- Proliferation of nuclear weapons should not invalidate the nuclear boundary and nuclear threshold concepts.
- There is some question as to whether probable Soviet war strategies threaten or invalidate the nuclear boundary and nuclear threshold.
- There appears to be no other boundary line within the spectrum of conflict with anything approaching the clarity of the nuclear boundary. If limitation of conflict is sought, continued respect for the nuclear boundary firebreak appears to be desirable, in the absence of strong evidence that it is no longer serviceable.

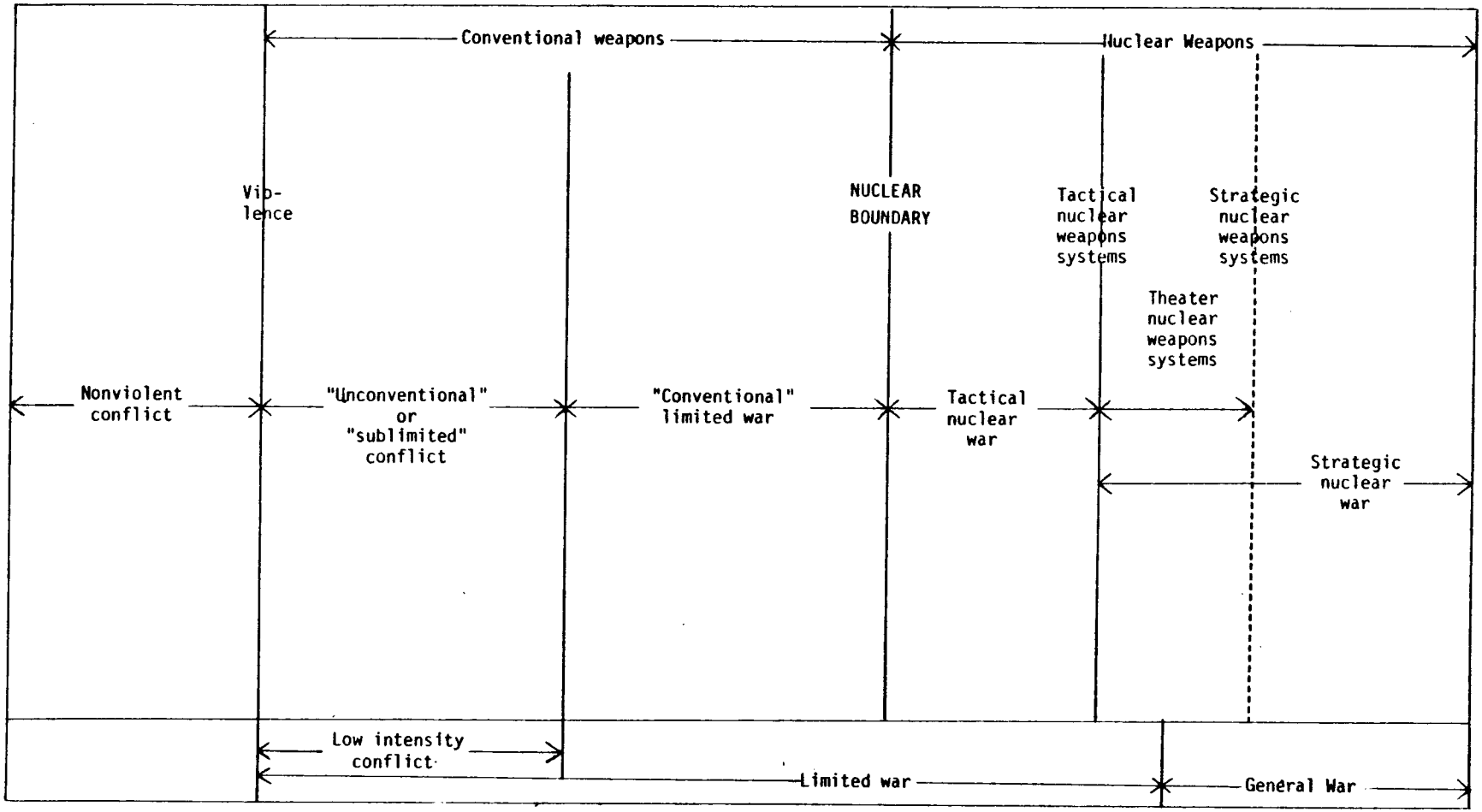

Figure 1: Spectrum of conflict, showing nuclear boundry

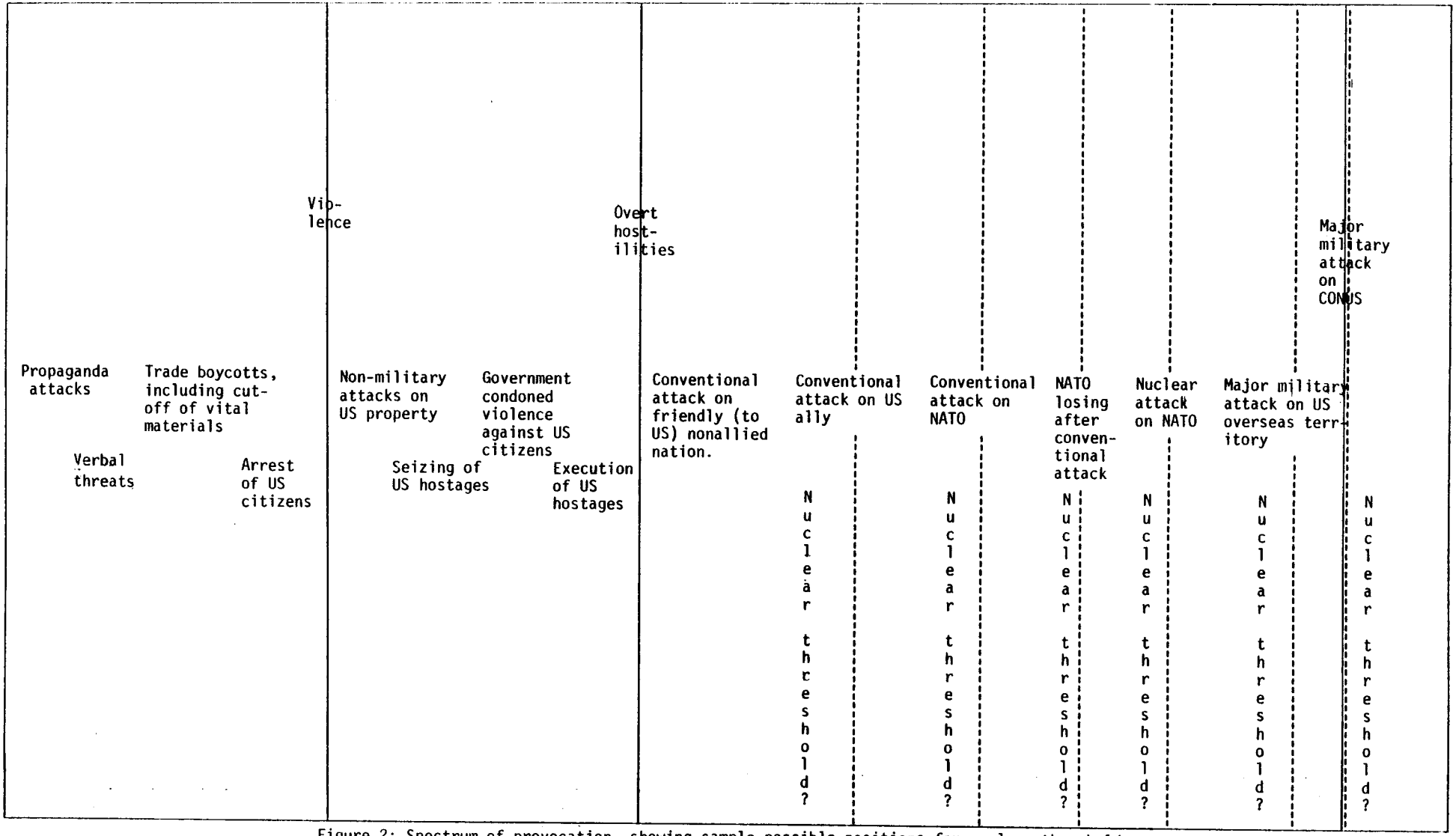

Figure 2: Spectrum of provocation, showing sample possible positions for nuclear threshold

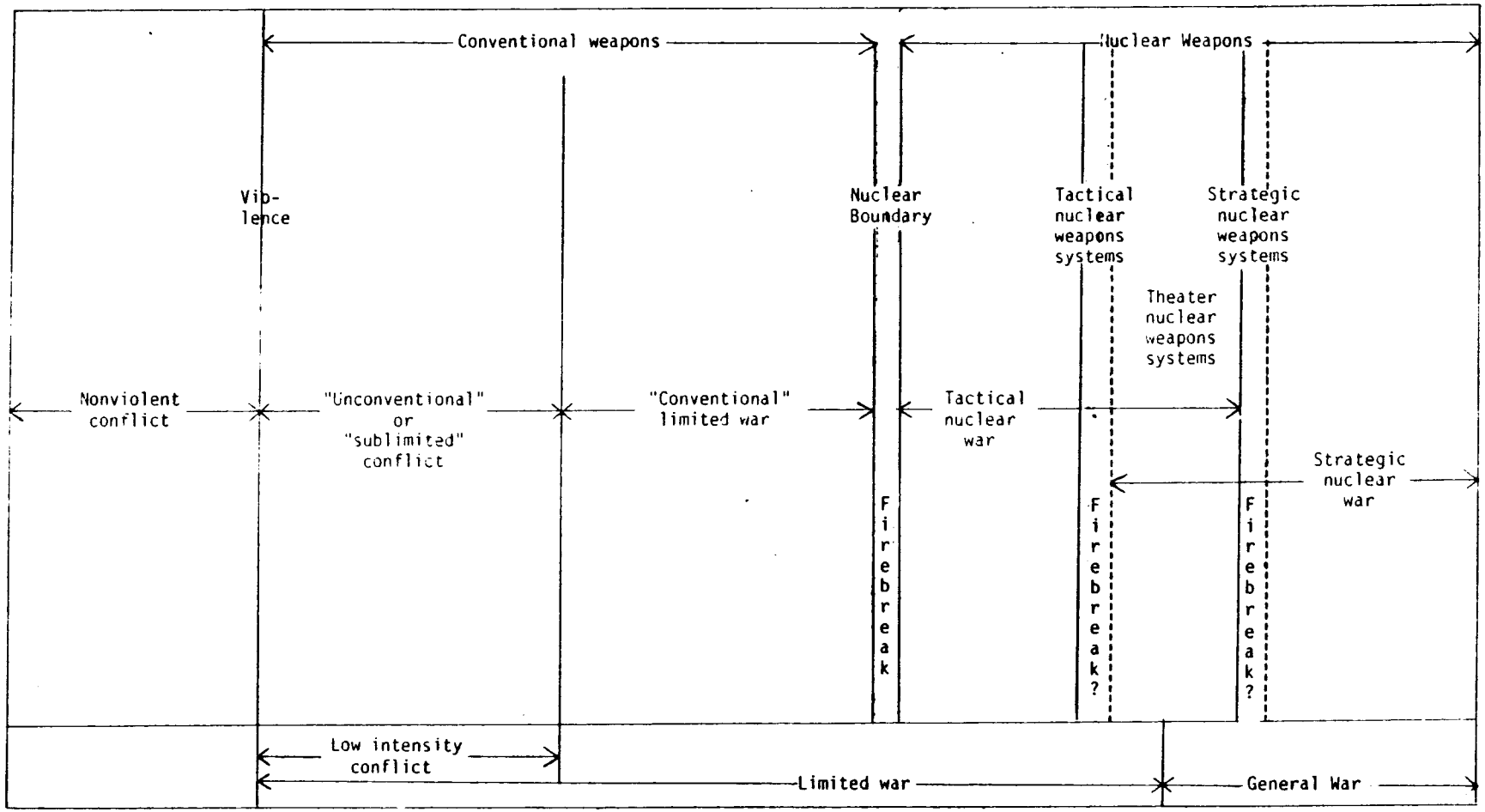

Figure 3: Spectrum of conflict, showing firebreak

THE NUCLEAR THRESHOLD CONCEPT

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THE NUCLEAR THRESHOLD CONCEPT

The concept of a nuclear threshold, like the concept of deterrence, represents, fundamentally, an effort to deal in a rational way with the overwhelming destructiveness of nuclear weapons. The first nuclear weapons burst upon the world in 1945 with tremendous power, figuratively as well as literally. These explosions were different in kind, not just in degree, from all previous explosions on this planet, and were immediately perceived as such. Their extraordinary destructiveness was exaggerated in the press and public opinion even beyond its real dimensions. Many concerned persons felt that nuclear weapons made war impossible or made world government necessary if the destruction of the world was to be avoided.

Responsible statesmen and analysts, seeing that utopia was not likely to arrive immediately and that the reality of nuclear weapons had to be dealt with, responded with the deterrence concept -- briefly, the use of nuclear weapons to prevent the firing of nuclear weapons, through the careful structuring and deployment of one's nuclear forces -- and with a number of related concepts, including that of the nuclear threshold.

The several meanings with which the term nuclear threshold is used will be discussed below, as will such related terms as firebreak and nuclear taboo. More precise terminology will be recommended in some cases. At the outset, however, it seems necessary to describe the central idea of the nuclear threshold. Basically, this is the idea that nuclear weapons are different in kind as well as degree from other weapons, that the extraordinary destructiveness of the highest-yield nuclear weapons (those with the force of millions of tons of TNT) means that extraordinary efforts should be made to avoid using them, and that for this reason and others, including the emotional connotations of differentness and horror that have attached themselves to nuclear weapons, the line between nuclear and nonnuclear weapons is an extremely important line, and the first use of nuclear weapons in conflict (since 1945) is an extremely important step to take. This nuclear threshold idea has thus become an important obstacle for those who believe that the United States must be ready to use various types of nuclear weapons freely in those situations where purely military considerations would dictate their use. The weight of public opinion, including the press and influential opinion, still seems to support the importance of the nuclear threshold idea.

Critical and objective examination of the concept, or concepts, involved seems called for.

There are currently two basic problems connected with the meaningful use of the phrase nuclear threshold. One is the problem of definition of terms: Nuclear threshold is used in so many different ways that real discourse about the concepts involved is difficult. The second is the question of whether the distinction between nuclear weapons and nonnuclear weapons has been made obsolete by technological changes, proliferation of nuclear weapons, Soviet attitudes toward nuclear weapons, and shifts in the balance of military strength.

DEFINITION OF TERMS

Unlike the case with the concept of deterrence, there is almost no literature dealing specifically with the nuclear threshold concept. A search by the Library of Congress computer found no book on the subject, and hardly an article could be found in which the nuclear threshold was the central theme. A careful search through likely literature had to be made for mentions, definitions, and passages dealing with the concept. Often there was no specific mention of the term nuclear threshold in a passage that implied the concept's existence in discussing, for example, the dangers of escalation from the use of tactical nuclear weapons. The author formed the impression that the term and the concept -- or concepts -- to which it refers are used at least as much in oral discussion in the defense community as in analytic literature. Under these circumstances, an exploration and clarification of terminology seemed a particularly appropriate place to begin a study of the subject.

Following are the chief meanings for the term nuclear threshold that have been found in the literature -- either explicitly stated or implied -- during the preparation of this report:

1. The scientific line that separates nuclear weapons from conventional weapons, with regard to their physical nature. Conventional explosive weapons produce their explosive effect through a chemical reaction, one product of which is large amounts of energy. In this chemical reaction and the consequent explosion, only the electrons orbiting the inner nucleus of the individual atom are involved; the nucleus itself is not. In a nuclear explosion, the nucleus is changed, the tremendous force that holds it together is freed, and amounts of energy greater by orders of magnitude than those of a chemical-reaction explosion are released. In a nuclear fission chain reaction, the force released is 20 million times greater per atom than

than that of the most powerful conventional explosion.*

This dividing line between conventional and nuclear weapons is not explicitly referred to as a nuclear threshold in any of the literature examined, but it is included here because it is a relevant nuclear/nonnuclear dividing line, or threshold, and because all the other concepts to which the term nuclear threshold is applied depend fundamentally on this scientific distinction.

2. A sharp increase in destructiveness and lethality between conventional weapons and nuclear weapons, which may also be expressed as a gap between the lethality of the most lethal conventional weapon and the lethality of the least lethal nuclear weapon. This is the sense in which the term was used in a Washington Post interview by Bernard Nossiter with a British scientist, J.P. Perry Robinson, in 1978. Nossiter reported Robinson's findings as follows:

> The killing power of modern conventional weapons has increased so rapidly that the deadliest are now more powerful than the smaller nuclear weapons.
>
> This means that the nuclear threshold has been breached and technology has made obsolete a key argument over whether or not to deploy the neutron bomb. [Emphasis added.]**

3. The line between not possessing nuclear weapons and possessing nuclear weapons, which may include carrying out test detonations. "Nations in the second tier of the global order are reaching the nuclear threshold (in the case of India, that threshold has been crossed).***

4. The operational line that separates nonuse of nuclear weapons from use of nuclear weapons. This meaning refers to the nuclear threshold as a stopping point, a boundary, on the spectrum of conflict that stretches from the first minimal use

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* Victor F. Weisskopf, "A Peril and a Hope," Physics Today, July 1978, p. 30. The JCS Dictionary (1974) definition of a nuclear weapon is "A device in which the explosion results from the energy released by reactions involving atomic nuclei, either fission or fusion, or both.

** July 1, 1978, p. F1.

*** Richard E. Bissel, "The Many Faces of Nuclear Policy," Orbis 22:279 (1978)

of force to an all-out nuclear conflict. Nuclear threshold in this sense is best explained, to the current author's knowledge, by Thomas Schelling (1966). (See bibliography annotation.) Schelling discusses several possible "thresholds" between minimal force and general nuclear war, and concludes that the nuclear-conventional distinction is the clearest, and thus the most useful. This concept of nuclear threshold as a clear operational boundary line within the spectrum of conflict is based on the scientific difference between nonnuclear and nuclear weapons, but it is not identical with it. One is a difference in scientific nature, the other a dividing line between two kinds of military action.

5. The point at which the firing of nuclear weapons would be resorted to, or the provocation for which nuclear weapons would be considered the appropriate response. This is the meaning intended when a writer speaks of "raising the nuclear threshold." The nuclear threshold, in this meaning of the term, can be raised in at least two ways: by developing and deploying "sophisticated" nonnuclear weapons that can accomplish the same missions nuclear weapons would earlier have been assigned; and by making a policy decision that certain provocations that earlier were considered to call for response with nuclear weapons do not in fact require such a response. Thus, precision-guided munitions (PGMs) have recently been said to raise the nuclear threshood, and the shift from a declared "massive retaliation" policy to a "flexible response" policy, which began soon after the former policy was enunciated (1954), was also a raising of the nuclear threshold. Raymond Aron described the function of nuclear threshold in this sense (he actually used the term "atomic threshold") by saying that it has "meant simply that a border incident or act of local aggression would not be answered by atomizing a city." (Aron 1964:46).

If the United States had a no-first-use policy for nuclear weapons, then the nuclear threshold would lie at the point where an enemy used nuclear weapons against the United States. If the US nuclear umbrella over NATO is interpreted as meaning that any attack on Europe would mean a nuclear response, whether strategic, theater, or tactical, then the nuclear threshold lies at the point where NATO is attacked. Some would urge that a conventional attack should be met with conventional defense forces and that nuclear weapons should be used only if NATO forces face imminent defeat. If this approach is followed, the nuclear threshold lies at the point at which an invaded Europe is facing imminent defeat. Some analysts now favor "lowering the nuclear threshold," by readily using newer tactical nuclear weapons with carefully tailored characteristics for any combat situation for which they fit the military requirements.

The difference between this meaning of the term nuclear threshold and the meaning described above as 4. may appear oversubtle, but it is real and is important for a rigorous clarification of the concepts involved. Meaning 4. is the line between use and nonuse of nuclear weapons. It lies on a continuum of violence stretching from minimal force to all-out nuclear war. Meaning 5. is the occasion calling for use of nuclear weapons. It lies on a continuum of provocations and military necessities stretching from, say, minor border incidents that involve US interests only indirectly to direct nuclear attack on the United States. It can be shifted up and down that continuum by policy decisions that change the gravity with which various provocations or military necessities are regarded, in relation to the gravity of using nuclear weapons. It can also be shifted up and down by decisions as to the effectiveness of conventional weapons for carrying out given military tasks. Finally, it can be shifted up or down by decisions as to the importance of respecting the boundary line between use and nonuse of nuclear weapons; the existence of very low-yield nuclear weapons could well bring about a shift downward in the nuclear threshold. (See Figures 1, 2, and 3.)

Related Terms

Two other, related terms, firebreak and nuclear taboo, should also be noted at this point.

The term firebreak, which originated in the early 1960s, is a metaphor taken from firefighting, where it means a strip of cleared ground that acts as a barrier to the uncontrolled spread of a forest fire. In strategic discourse, it means a boundary line, or threshold, on the spectrum of conflict that is respected as a stopping point and only crossed under great provocation or extreme military necessity.* The nuclear threshold (in sense 4.) has been the firebreak generally favored by analysts and policy makers, and when the term "firebreak" is used, it is generally understood to mean a firebreak at the nuclear threshold. However, the terms nuclear threshold and firebreak are not necessarily synonymous. Some analysts would like to move the firebreak, setting it between tactical and strategic nuclear weapons or tactical and theater nuclear weapons.**

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* Raymond E. Bell, who made useful contributions to this paper, has identified a corresponding term, and similar metaphor, in the German-language literature of the subject -- atomare feuermauer (atomic firewall). Franz Freistetter, "Konfrontationen -- Konflikte -- Kriege," Osterreichische Militarische Zeitschrift, Heft 2/1977.

** This latter is the choice of Major John Rose, an Army specialist on tactical nuclear weapons and doctrine. Personal communication, August 10, 1979.

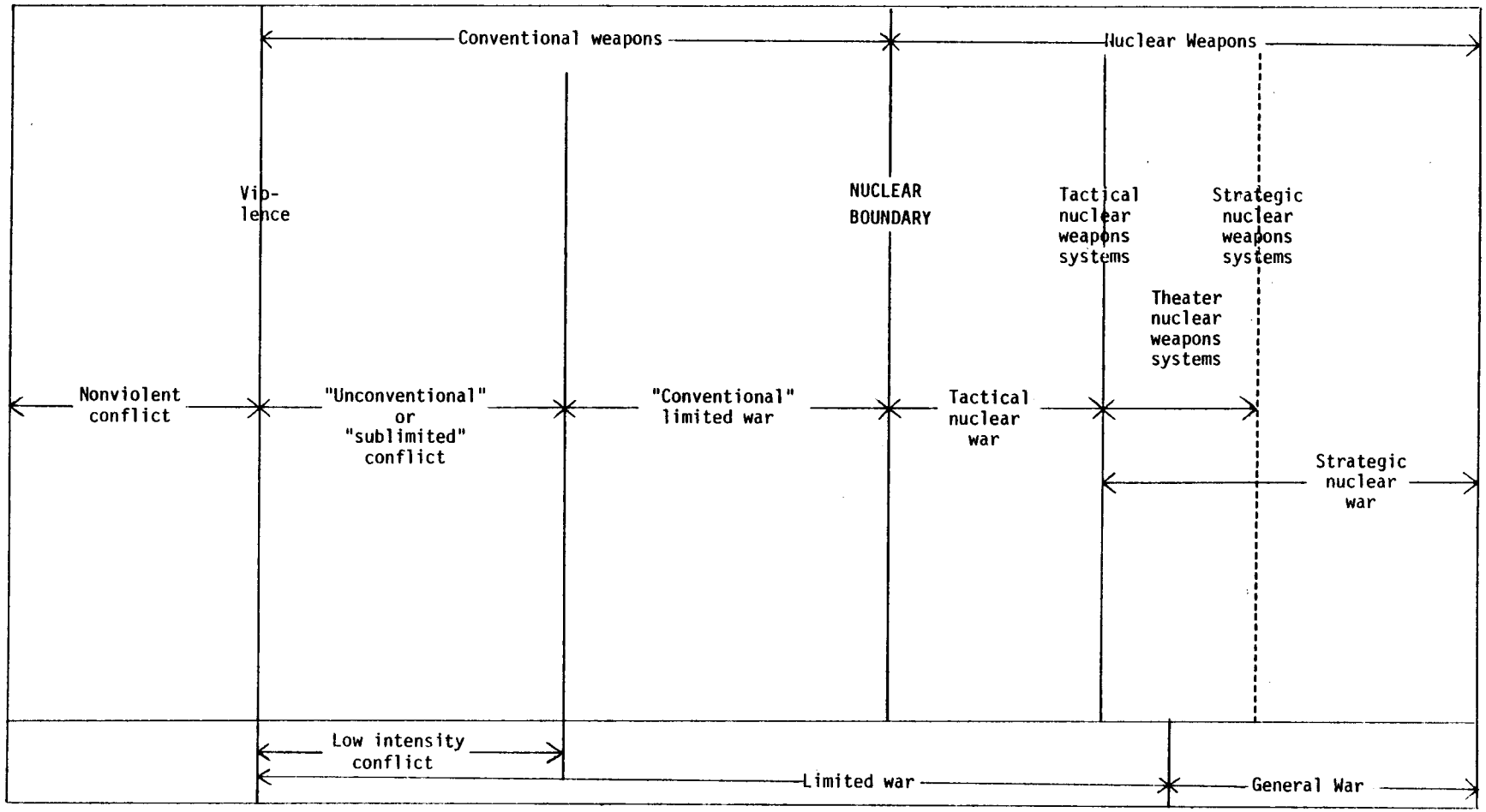

Figure 1: Spectrum of conflict, showing nuclear boundry

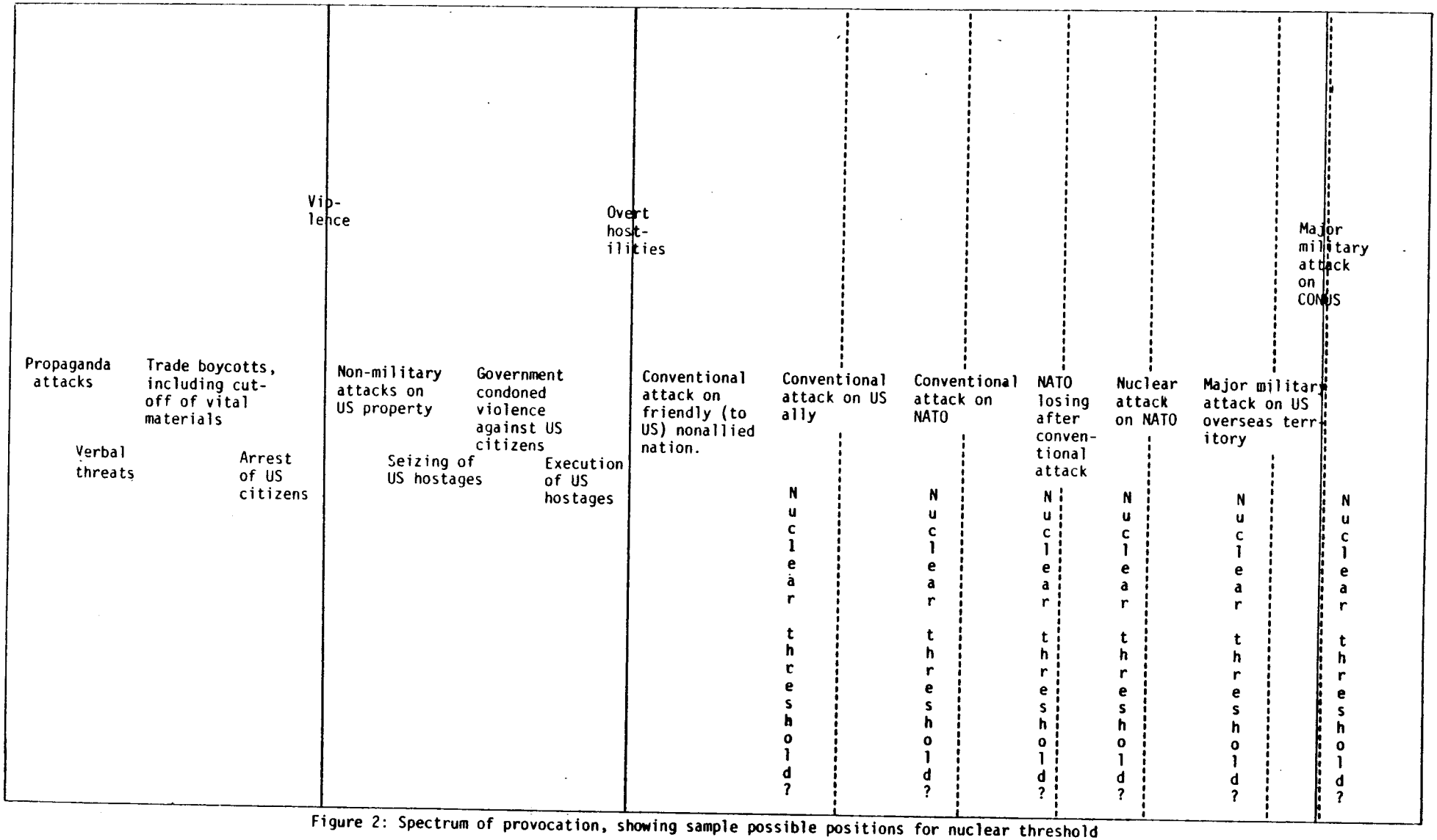

Figure 2: Spectrum of provocation, showing sample possible positions for nuclear threshold

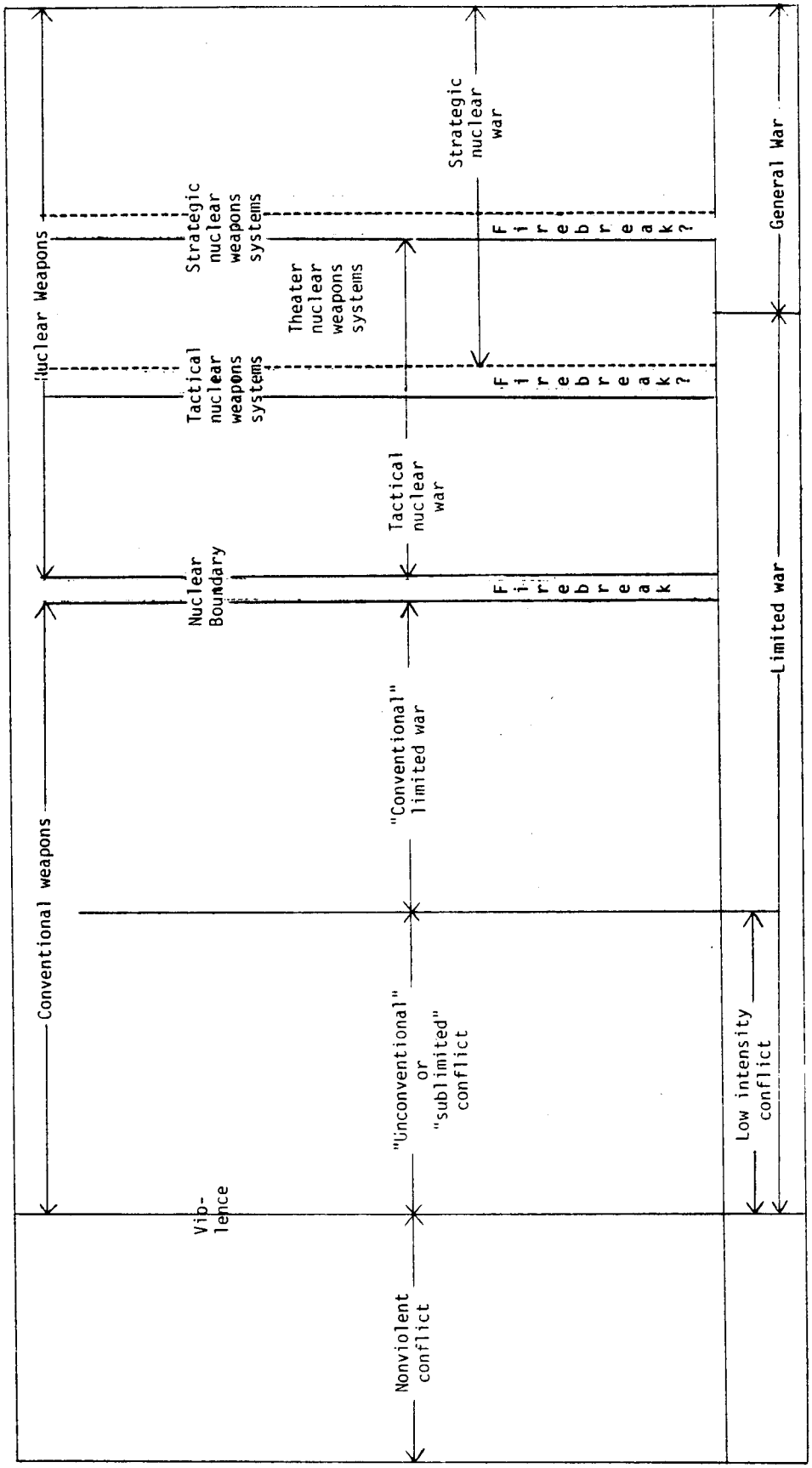

Figure 3: Spectrum of conflict, showing firebreak

The nuclear taboo may be defined as a strong reluctance to use nuclear weapons that is reinforced by tradition and feelings of moral prohibition. To explore the origins and development of the nuclear taboo would require a separate and extensive research effort. However, its existence and relation to the nuclear threshold must be mentioned.

In addition to the realistic, scientific difference in kind between conventional and nuclear weapons, and the realistic recognition of the much greater devastation that can be wreaked by nuclear weapons, there is undoubtedly a widespread and strong socio-psychological distinction drawn by both elites and mass publics between the two categories of weapons. Feelings of horror are associated with nuclear weapons that are probably out of proportion to their greater lethality and destructiveness, except in the case of multimegaton thermonuclear weapons. The invisibility of the subatomic particles causing radiation effects; the widespread and uncontrollable dispersion, and delayed and long-lasting effects, of some of these particles; their effects on the reproductive system and thus on future generations; the fact that the first use of the weapons was against populations who had no warning and no protection and thus were especially severely damaged -- these are among the reasons for the special feelings of horror that reinforce the nuclear taboo. If the line between nonnuclear and nuclear weapons is significant, the nuclear taboo has value in enhancing it. If the firebreak concept has value, the nuclear taboo adds to the claims of the nuclear threshold, or nuclear boundary, to be the firebreak line. If the nuclear threshold idea is properly considered obsolete, then the nuclear taboo is a powerful hindrance to doing away with it.

Recommendations

How can some order be brought out of the various meanings with which the term nuclear threshold is used? Perhaps the best place to begin is with the clearing away of some underbrush of the less useful meanings.

It would seem wise to eliminate immediately meaning 3., the line between nonpossession and possession of weapons. This use only breeds confusion. It is most unfortunate to have the same phrase -- "crossing the nuclear threshold" -- used to mean either acquiring nuclear weapons or firing them for the first time (since 1945) in conflict. This is a recent use of the term and should be relatively easy to eradicate. One can thus wholeheartedly urge members of the defense and academic communities not to use the term nuclear threshold in this way.

The next unfortunate use is 2., the sharp increase in destructiveness between conventional and nuclear weapons. Although certainly the extraordinary destructiveness and lethality of the most destructive nuclear weapons are the heart of the whole nuclear threshold question, no informed person has ever claimed that any nuclear weapon system was necessarily more lethal or

destructive than any conventional weapons system. Even in 1945, the "conventional" bombing of Tokyo on March 9 killed and injured many more people than the nuclear bombing of Hiroshima on August 6.* At that time it was not possible to make a "small" nuclear explosion, and it required huge numbers of conventional bombs, delivered within a few hours, to equal and exceed the effect produced by one nuclear bomb in one minute. Soon, however, low-yield nuclear weapons were developed. Did this erase the line between conventional and nuclear weapons? No, it could not erase a line based on the clear difference in the scientific nature of the two kinds of explosions. Alain Enthoven, one of the early writers on the nuclear threshold and firebreak concepts, stated the matter clearly in 1963:

> There has been in recent years the development of small nuclear weapons having yields equivalent to a few thousand tons of TNT or less. The day will come, if it has not come already, when there will be nuclear weapons of smaller yield than the largest high explosive weapons. When that day comes, will there no longer be a distinction between nuclear and conventional weapons? Some have argued to that effect. But they are mistaken. There is and will remain an important distinction, a "firebreak" if you like, between nuclear and non-nuclear war, a recognizable qualitative distinction that both combatants can recognize and agree upon, if they want to agree upon one. And, in the nuclear age, they will have a very powerful incentive to agree upon this distinction and limitation, because if they do not, there does not appear to be another easily recognizable limitation on weapons -- no other obvious "firebreak" -- all the way up the destructive spectrum to large scale thermonuclear war.**

Since nothing but mischievous confusion can arise from using the term "crossing the nuclear threshold" to mean both firing nuclear weapons in combat and creating new, very destructive conventional weapons or new, very low-yield nuclear

---

* Tokyo: 97,000 killed, 125,000 injured, 1,200,000 homeless: Hiroshima: 75,000 killed, 75,000 injured. Dupuy 1978:25-26.

** Enthoven 1963:123-24. Bernard Brodie (1965) states that Enthoven was, so far as he knows, the first person to use the term firebreak; Brodie cites the passage quoted above.

weapons, it is easy to decide to recommend that their use (2., above) be completely avoided.

The question remains whether it is important to distinguish in terminology between the other three meanings listed above: the scientific line between nonnuclear and nuclear weapons (meaning 1.), the operational line between the nonuse and use of nuclear weapons (meaning 4.), and the point on a spectrum of provocations and military necessities at which nuclear weapons would be resorted to (meaning 5.). The answer is not obvious, and several alternative courses of action will be suggested.

First, however, on the assumption that it may be desirable to distinguish between the three concepts, separate terms for each will be suggested. The first concept, the scientific line between nonnuclear and nuclear weapons is seldom referred to as the nuclear threshold, and in fact, as indicated above, is seldom mentioned specifically in the literature. However, it is a very important concept, because it is on this factual scientific difference in the nature of the weapons that the nuclear threshold concept ultimately rests. Clarity may be furthered by calling this line the scientific nuclear line, rather than the nuclear threshold.

It is more difficult to decide on terms for the other two concepts, and especially on the question of which of them to designate nuclear threshold. In the classic literature of the 1960s, specifically Kahn 1965 and Schelling 1966, the general term threshold was used as the boundary line between two readily distinguishable activities on the spectrum of conflict -- between not attacking targets in the enemy homeland and attacking such targets; between avoiding striking cities and striking cities; between avoiding conflict with troops of the major adversary (attacking only troops of his allies and clients) and attacking such troops; and between not using nuclear weapons and using them. This last threshold was referred to as the nuclear threshold -- meaning 4., above.

A less well known work of this period, the HERO 1966 report listed in the bibliography of the current report, included a detailed discussion of the spectrum of conflict, with an illustrative diagram. The HERO report saw three major thresholds (meaning 4.) -- the threshold of violence, the threshold of overt hostilities, and the nuclear threshold. It saw many gradations of violence, but no clear threshold between the nuclear threshold and unlimited nuclear exchange (HERO 1966:155), and it placed a firebreak at the nuclear threshold.

Thus nuclear threshold is meaning 4. carries the weight of time and authority. It also fits many of the cases in which

the concept may usefully be referred to, for example: Should the firebreak be placed at the nuclear threshold? Do new nuclear and conventional weapons make the nuclear threshold less easy to recognize?

On the other hand, Aron (1964), a distinguished thinker, although not one who focused his attention on the threshold concept, used the term atomic threshold (which may be considered identical with nuclear threshold) in sense 5. Also, and of major importance, it is probably in this sense that the term is most often used today, as in the phrase "raise the nuclear threshold," or "NATO's nuclear threshold, the point at which NATO must resort to nuclear weapons rather than accept defeat by Pact conventional forces . . . ." (Vernon 1979:60).

Three possible, alternative approaches to the terminology problem seem feasible. In all three, the term scientific nuclear line would be used to refer to the line between conventional weapons and nuclear weapons, the dividing line based on the scientific nature of their explosions. In other respects, the approaches would differ as follows:

1. Nuclear threshold would be used for meanings 4. and 5., on the grounds that the term is now used for both concepts, that establishing new terminology would probably be difficult; and that the difference between the uses is subtle.

2. Nuclear threshold would be used for meaning 4. and another term, perhaps nuclear use point or nuclear decision point would be used for meaning 5.

3. Nuclear threshold would be used for meaning 5. and another term, perhaps nuclear boundary, would be used for meaning 4.

Since in this paper maximum precision and clarity are being sought, separate terms for the two meanings will be used here. The third approach will be followed for the remainder of this paper, with nuclear boundary used to refer to the operational line on the spectrum of conflict that separates nonuse of nuclear weapons from use of nuclear weapons, and nuclear threshold used to refer to the point on a spectrum of provocations and military necessities at which the firing of nuclear weapons would be resorted to.

Crossing the Nuclear Threshold

What, then, does the familiar phrase "cross the nuclear threshold" mean, in the context of this analysis? Crossing the nuclear threshold in the sense of the nuclear boundary is

to pass from nonuse of nuclear weapons to use of nuclear weapons in armed conflict. Therefore, when a nation first fires a nuclear weapon of any kind in armed conflict -- not as a test, not by accident -- that nation has crossed the nuclear threshold, or in the language of this paper, crossed the nuclear boundary.

Crossing the nuclear theshold in meaning 5., the meaning of this paper, means that the point on the spectrum of provocation and military necessity has been reached at which it has been previously decided that nuclear weapons will be used. As a result, the decision is made, the weapons are released for use, and the nuclear boundary is crossed. If the nuclear boundary is not crossed, then a last-minute decision must have been made to raise the nuclear threshold.

From the point of view of a hypothetical objective observer, what happens when the nuclear boundary is crossed and what happens when the nuclear threshold is crossed are exactly the same thing -- nuclear weapons are fired.

WHAT IS THE VALUE OF THE CONCEPTS?

With the terms involved in discourse about nuclear threshold examined and somewhat clarified, it should be possible to move to the other basic problem -- a consideration of their current validity. However, it may be well first to summarize briefly what value has been implicity claimed in the past for the concepts of the scientific nuclear line, the nuclear boundary, a firebreak at the nuclear boundary, and the nuclear threshold.

The basic premise is the extraordinary destructiveness of the thermonuclear weapons at the upper end of the spectrum of nuclear weapons. It does not seem necessary to give statistics here on this destructiveness. While informed opinion recognizes that nuclear war would not mean "the destruction of the world" or "the end of life as we know it," no one claims that a multimegaton warhead is "just another weapon." Thoughtful analysts and policy makers have tried since the beginning of the atomic age, and especially since the advent of fusion weapons and ICBMs, to avoid having these weapons used by anyone. Yet armed conflict has also been recognized as an unavoidable fact of international relations, and it has been recognized that no confidence could be put in any outright banning of the most destructive weapons, given the nature of the international system. Means of limiting war were therefore sought.

Theorists of the 1960s

As has been mentioned, a good deal of attention was focused in the 1960s on a model of conflict that saw conflict as a

spectrum stretching from minor incidents of small arms fire to all-out nuclear war, or as an escalation ladder with rungs from subcrisis maneuvering to spasm or insensate war. Stopping points were then sought on these continuums, clear lines that could be recognized readily by both sides to a conflict, so that if one side stopped just short of the line the other side would be aware that restraint was being exercised and could follow suit if it chose. Conflict might escalate to mutual devastation, but it would not do so just because no one knew where to stop. What was sought was a line comparable to the geographical line of a river. As Schelling pointed out (1966), if one country bombs many targets, but none beyond a given river, its enemy can look at a map and see a pattern -- no bombing beyond the river -- and can perceive restraint. The same bombing strikes without the river line would not be seen as a pattern and would not communicate restraint.

The line between tactical and strategic nuclear weapons has been repeatedly considered as a possible choice for a clear line short of all-out nuclear war. Henry Kissinger, in his first major work, favored a strategy of limited nuclear war as the best way of avoiding all-out nuclear war. (1957:176). However, Enthoven (1963), Kahn (1965), Schelling (1966), and others made a strong case for the unique clarity and, therefore, value of the nuclear boundary as a firebreak.

Enthoven, in the passage quoted above (p. 18), pointed out the scientific basis for the nonnuclear/nuclear distinction. He then stated that hostile powers had "a very powerful incentive" to agree on this distinction and, by implication, not to cross the line: "There does not appear to be another easily recognizable limitation on weapons -- no other obvious "firebreak" -- all the way up the destructive spectrum to large-scale thermonuclear war." (Enthoven 1963:124)

Kahn (1965) saw conflict in an escalation model, proceeding up a ladder of increasing violence, and looked for stopping points on that ladder. He called these stopping points "thresholds," but they will here be called boundaries, following the recommended terminology of this paper. Kahn identified six such boundaries on an escalation ladder rising from disagreement to uncontrolled, "spasm" nuclear war, and wrote at length (94-133) on the nuclear boundary, calling it "the most salient, the most widely acknowledged, and quite possibly the most likely to be observed." (94) He felt that although there were other easily recognized limitations, "it remains true that once war has started no other line of demarcation is at once so clear, so sanctified by convention, so ratified by emotion, so low on the scale of violence, and -- perhaps most important of all -- so easily defined and understood as the line between not using and using nuclear weapons." (95)

Kahn considered a number of arguments against preserving the nuclear boundary and concluded that it was probably in the interest of the United States to make strong efforts to preserve it. In addition to the reasons cited just above, he was influenced by a belief that using nuclear weapons would greatly accelerate proliferation of these weapons, and that this was not in US interests. Although Kahn recognized that in the near future newly nuclear nations would have only small and crude arsenals, he felt that in the long run nuclear weapons would act as equalizers of power, and that in a world of many nuclear powers the United States would eventually see its strategic advantages of wealth, population, and geography neutralized. (132)*

Schelling (1966) sought to identify the characteristics of effective limitations on conflict, and this effort brought him to the matter of boundaries, and specifically the nuclear boundary. "Evidently the most powerful limitations, the most appealing ones, the ones most likely to be observable in wartime, are those that have a conspicuousness and simplicity, that are qualitative and not a matter of degree, that provide recognizable boundaries. . . . A main argument in favor of any stopping place is the question . . .'If not here, where?'" (1966:164) There is little value, said Schelling, in an undifferentiated scale, a continuous spectrum with no clear stopping points.

> To insist that the use of nuclear weapons can as readily be limited at fifty as at zero, or that Hitler could have used just a little gas [in warfare], or that two Chinese divisions in South Vietnam would have been analyzed for their quantitative significance alone and not with regard to the drama of their nationality, undermines the most important potential limitations. There might be a dramatic threshold [boundary] separating cities from no cities; and to argue that one can as readily stop after the third city, or the thirteenth, or the thirtieth, detracts from the more promising boundary of zero.(1966:164)

Schelling examined the desirability of a cities/no cities boundary, then much in the minds of analysts because Secretary of Defense Robert McNamara had declared a "no cities" policy in 1962, in case war should escalate to the level of attacks on the Soviet homeland. Schelling also discussed the boundary line between war that would not involve Soviet and US forces

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* Interestingly, Kahn specifically mentioned newly nuclear nations' acquiring "cheap, small fusion weapons -- the 'poor man's bombs' of the future," and said they would probably be attainable within a decade or two. (1965:132) News reports of March 1980 suggested that the explosion detected off South Africa in fall 1979 may have been the test detonation of just such a small fusion (neutron) warhead by Israel.

attacking each other and war that would, and the boundary between attacks on the Soviet or US homelands and war without such attacks.

Schelling returned to the nuclear boundary as the dividing line that best fulfilled the requirements of conspicuousness, simplicity, and qualitative distinction. "We shall probably know it, and the enemy too, when a nuclear weapon is next used in warfare, whether the initial use is by the United States, by the Soviet Union, or by any other country. But the line separating "cities" from all other localities, and the recognition that a city has in fact been deliberately destroyed, are unlikely to be so clear." (1966:165)*

The Nuclear Boundary as Firebreak

During the 1960s the nuclear boundary as firebreak became generally accepted by the defense community. The nonuse of nuclear weapons in Korea and the failure to use them in aid of the French in Indochina in 1954 had already done much to strengthen the nuclear taboo, and thus to reinforce the nuclear boundary. The nonuse of nuclear weapons in Vietnam further strengthened the boundary.

The other boundaries that have been considered lack the clarity of the nuclear boundary. As Schelling pointed out, the line between attacking only military targets and attacking cities is obviously not at all clear in practice, and experience in Vietnam has underlined this fact -- even with careful targeting and precision-guided bombs, there were enough civilian casualties to make US restraint far from universally apparent. (This lack of clarity does not, of course, mean that such restraint should not be practiced or that it will never be recognized.) The line between avoiding the enemy's homeland and attacking the enemy's homeland is a poor one for the United States, since establishing such a firebreak would mean that a Soviet attack on Europe would be below the firebreak, while a US retaliatory strike on the Soviet Union in response to such an attack would mean crossing the firebreak. The line between tactical and theater nuclear weapons, on the one hand, and strategic nuclear weapons, on the other, is not hard to set in kilotons, but it is an arbitrary line, and it would appear much more difficult to recognize such a line in practice than to recognize the line between conventional weapons and nuclear weapons. The line between tactical and theater nuclear weapons,

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* The entire passage on boundaries from Schelling 1966, pp. 153-66, should be read by anyone interested in the nuclear threshold concept, as should the passage cited from Kahn 1965, pp. 94-133.

usually drawn at the 10-kiloton level, with most of the tactical weapons actually falling below one kiloton, would also appear hard for all sides to recognize in practice.* Furthermore, and perhaps most important, these arbitrary boundaries lack the solid scientific foundation of the nuclear firebreak, which is based on the scientific nuclear line, the qualitative difference between conventional and nuclear weapons. A final possible line, that between fission and fusion nuclear weapons is not useful, because, although the most destructive nuclear weapons are fusion weapons, so also are some of the most clearly tactical weapons -- the enhanced radiation warheads.

ARE THE CONCEPTS STILL VALID?

To determine the current validity of the concepts defined and discussed above, these are the questions that need to be answered:

- Have new weapons blurred the scientific nuclear line?
- Have these new weapons made the nuclear boundary so hard to recognize that the nuclear threshold is meaningless?
- Does the fact that many more nations will probably soon have nuclear weapons make their use inevitable, and does this make the nuclear threshold meaningless?
- Does the model of conflict that envisions progressive step-by-step escalation of violence -- the model in which the nuclear threshold concept developed -- still have validity? If not, what effect does this change have on the validity of the nuclear threshold concept?
- Would the Soviet Union be likely to initiate a war in a way that would allow the nuclear threshold a meaningful role?

Has the Scientific Nuclear Line Been Blurred?

Some writers have recently suggested that the narrowing, or erasing, of the gap in lethality between the most destructive

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* For yield limits of tactical nuclear weapons, Rose, personal communication, August 10, 1979.

conventional weapons and the least destructive nuclear weapons means that there is no longer a meaningful distinction between the two classes of weapons. (Barnaby 1978; Robinson 1978)* There are at least two comments that should be made on this position. The first is that it is not valid. The collapsed gap in lethality (or destructiveness) between least-destructive nuclear and most-destructive conventional weapons is nothing new, and it does not affect the basis of the scientific nuclear line. In 1957, Gordon Dean, chairman of the Atomic Energy Commission, wrote, "This spectrum [of weapons] is continuous. The destructive power of some atomic weapons is less than that of some conventional high-explosive weapons. The destructive power of some thermonuclear weapons is less than the destructive power of some of our fission weapons." (Kissinger 1957:ix) Enthoven, in the 1963 passage quoted above (p. 18), acknowledged the arguments of those who said that the loss of the lethality gap would remove the line between nuclear and nonnuclear weapons, and rejected it, basing the boundary/firebreak on the "recognizable qualitative distinction" between the two classes of weapons. The scientific nuclear line has never rested on the amount of explosive force of any given weapon that employed the principle of nuclear fission or nuclear fusion, but rather on the nature of the explosion -- that the nucleus of the atom is altered to cause it.

The second comment that may be made on this position is that its advocates, who write from an arms-control point of view, are on dangerous ground in pressing their point. Robinson would like to see highly lethal conventional weapons brought under arms control consideration in the same way that nuclear weapons are, and it is apparently to this end that he is striving to erase the line between conventional and nuclear weapons. But if the line should be erased, the question would then arise, how can restraint in conflict be practically exercised? What recognizable firebreaks are there? Attempting to build a case that all weapons are the same is a dubious course for arms-control advocates.

Something should be said about the scientific nature of the weapons that are claimed to threaten the scientific nuclear line. In speaking of the diminished or vanished lethality gap, Robinson and Barnaby use the neutron bomb as the prime example of the low-lethality, low-explosive-power nuclear weapon and fuel air explosive (FAE) weapons as the prime example of the high-lethality, high explosive-power conventional weapon. The FAE achieves its explosive effect by the combustion of highly volatile, highly explosive gases which have dispersed to form a cloud of gas before ignition. The explosion is the result

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* Barnaby stresses the erased gap in explosive power, Robinson in lethality.

of chemical reactions, and despite its great destructiveness, especially when clusters of the FAE explosives are used, is clearly on the conventional side of the scientific nuclear line.

Other nonnuclear weapons might also appear to threaten the scientific nuclear line. Particle-beam weapons, now in the research stage, make use, as do nuclear weapons, of the physics of complex processes, rather than of simple chemical reactions. The principle is the propelling of atomic particles, which may be electrons or may be atoms "shaved" of some of their electrons, in high-energy streams toward a target. However, despite their sophisticated technology, these possible future weapons are clearly on the nonnuclear side of the scientific nuclear line. They are not explosive in nature (although they could detonate an explosion if aimed at an explosive target), and, of key importance, their weapons effects do not use the extraordinary energies associated with the cohesive forces of the nucleus -- the interior of the nucleus is not involved.

Other classes of weapons close to the nuclear scientific line should be mentioned here. Chemical, biological, and radiological (CBR) weapons have always posed something of a problem with regard to the line. By definition, they are not "conventional" weapons. There are international agreements (for chemical and biological weapons) and psychological-moral taboos limiting or forbidding their use, taboos similar to those affecting nuclear weapons. They do not produce their weapons effects by means of chemical-reaction explosions. There are de facto firebreaks between conventional weapons and chemical weapons, conventional weapons and biological weapons, and conventional weapons and radiological weapons. If one of those firebreaks was crossed, would this event weaken the nuclear firebreak? Probably it would, but this is a separate problem from that of the nuclear scientific line. That line, as defined here, is between nuclear weapons and conventional weapons. It is not affected by the existence of other kinds of unconventional weapons.

Radiological weapons do pose a special problem with regard to the scientific nuclear line. These weapons would produce their weapons effects through changes in the nuclei of atoms that resulted in the giving off of lethal radiation, and this involvement of the nucleus links radiological weapons with nuclear weapons. Some newer nuclear weapons are especially closely related to radiological weapons. The enhanced radiation warhead, or "neutron bomb," is an explosive device which produces more short-term radiation in relation to blast and heat than other nuclear weapons. It aims to kill mainly by radiation, in strong contrast to the first nuclear weapons, which were designed to kill and destroy by the explosive release of huge amounts of energy in the form of blast and heat,

with radiation effects a secondary accompaniment.

Recognizing that radiological weapons and nuclear weapons are both on the nuclear side of the nuclear scientific line, is there a clear distinction between these two kinds of weapons? For the clarity and usefulness of the entire nuclear threshold idea, it is probably desirable, although not necessary, that there should be such a clear distinction between nuclear weapons and any other class of weapons. The nuclear-radiological distinction lies in the high-energy explosive effect that is characteristic of nuclear weapons and would not be characteristic of radiological weapons. The JCS Dictionary definition of nuclear weapons clearly indicates that these weapons must have an explosive effect, an effect caused by energy released from atomic nuclei. (See p. 11n.) The distinction appears to be clear in practice. Even such a high-radiation nuclear weapon as a one-kiloton enhanced radiation warhead ("neutron bomb") destroys all buildings within a radius of 500 meters,* and no one witnessing its use could doubt that an explosion had taken place.

This assessment of threats to the scientific nuclear line from recent weapons developments and from various nonconventional weapons may be summarized as follows: The line between conventional weapons and nuclear weapons, here termed the scientific nuclear line, is clear, and is not threatened by new weapons or known prospective new weapons. The line between nuclear weapons and radiological weapons is not so clear, although the basic explosive nature of even the smallest nuclear weapons and those with the least explosive force in relation to radiation seems to mark a line that is conceptually adequate and that would be clear in operations.

Is The Nuclear Boundary Still Recognizable?

This brings the discussion to the matter of clarity in operations. Whatever the clarity of the scientific distinction between conventional weapons and nuclear weapons, if the two classes of weapons cannot be readily distinguished from each other in use -- distinguished by enemies, allies, and neutrals -- restraint is not signalled, and an important reason for respecting the nuclear boundary and firebreak is lost.

The physical effects of conventional and nuclear explosions are different. In a nuclear explosion, not only are heat, light,

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* Barnaby 1978:151. This is not the best way of expressing damage estimates, but it is adequate for the present purpose.

and blast effects greater by orders of magnitude than those of a conventional chemical-reaction explosion for a similar mass of explosive material, but a nuclear explosion also produces radiation, both immediate and residual. At least in the past, the extraordinary light, heat, and blast, the mushroom-shaped cloud, and the characteristic signs of radiation death and sickness in unprotected persons were stigmata that left no doubt that a nuclear device had been detonated.

There is no doubt that the recognizable difference in operations between conventional weapons and nuclear weapons is less clear now than it was in 1945, and it is probably somewhat less clear than it was in the 1960s, when the nuclear boundary/firebreak/threshold concept was developed. There are nuclear weapons that do not produce mushroom clouds, and there are conventional weapons, the FAEs, that produce an orange fireball which may, at relatively close range, have a blinding effect comparable to that of a nuclear explosion. The intense heat of the FAE can also start firestorms.

Is there a clear operational line? All nuclear weapons produce an explosion and radiation. Radiation is readily detectable by monitoring devices with which all modern military units are equipped. There should be no problem in readily determining that a nuclear weapon has been used, even if it is a low-yield weapon that lacks many of the classic stigmata of nuclear weapons. However, there can be no doubt that the operational boundary line is not so clear as one would like it to be for firebreak purposes.*

Will Proliferation Make the Nuclear Threshold Meaningless?

There is considerable agreement that possession of nuclear weapons by many more countries, perhaps six to twelve more, is probable during the next decade, and that by the 1990s most countries can have nuclear weapons within a short time if they

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* It appears that further examination of the readily apparent operational effects of various conventional, nuclear, and CBR, expecially radiological, weapons would be useful. Such examination, by weapons specialists, devoting special attention to possible characteristics that would distinguish categories of weapons from each other, should make possible a decision, on firm factual grounds, on whether or not the nuclear boundary is still a readily recognizable operational line.

choose to. This is true largely because the spread of nuclear power has made weapons-grade fuel readily available, and the spread of the necessary technology has made use of the fuel to create weapons relatively easy -- although still a major and expensive undertaking at this time. The question arises as to whether the new countries that may be expected to have nuclear weapons will recognize and respect the nuclear firebreak. On the basis of probability alone, the chances for use of a nuclear weapon should greatly increase, and once several countries have used the weapons in conflict, even though the nuclear boundary might still be clear, with the nuclear taboo violated, the firebreak would presumably appear much less potent, and the concept of nuclear threshold, whose value is intimately involved with the idea that nuclear weapons are used only in response to the most serious provocations or necessities, might lose its meaning.

Certainly the nuclear firebreak is likely to be harder to maintain than it was when there were only three, or four, or five nuclear powers. However, it should be remembered that few of the newly nuclear countries will have delivery means for their weapons, and that none will be likely to have high-yield thermonuclear weapons soon. The weapons they do have are not likely to be used lightly in conflicts with present nuclear powers. There is no reason to think that, in the minds of the new nuclear owners, the weapons will not be considered weapons for deterrence, rather than conflict, just as those of the present nuclear powers have been -- deterrence of hostile regional rivals or threatening great powers. If, on the other hand, a small country, such as Israel, should actually fire a weapon, and do so to avoid national destruction, it would be observing no lower a nuclear threshold than the United States would observe, and there should logically be no damage inflicted on the nuclear threshold concept.

Is the Escalation Model Obsolete? If So, What are the Implications for the Nuclear Threshold?

The escalation model of the 1960s (Kahn 1965), visualized conflict on a ladder of increasing violence, with prudent national leaders deliberately moving up the ladder, generally one rung at a time, or choosing not to, or choosing to de-escalate, in response to threats to national interest, or -- in the case of revolutionary or revisionist powers -- in response to opportunities for national enhancement. Stopping places on the ladder, which Kahn called "thresholds" (boundaries in this paper's terminology), were to be respected and crossed only for grave reasons. To cross such a boundary, and especially the nuclear boundary, signalled to the adversary that the interest at stake was of extraordinary importance. Each step up the

ladder, in fact, was a signal, as well as a diplomatic or military measure.

It seems fair to say that the Vietnam War was conducted with the escalation model present in the minds of US decision makers, and that it strongly influenced the course taken by the United States in the war. A systematic analysis of the entire war as an escalation scenario would be of interest, and may well have been undertaken. Without access to such an analysis or time to conduct one, it seems safe to say only that it appeared at the end of the war that the escalation model had not proved a useful guide to the war. Controlled escalation by the United States had not resulted in de-escalation by the enemy. Signals had not been responded to by measures of restraint, but rather by determined continuation of the struggle. Each new increment of US commitment was met by enough new enemy commitment to contain it. The question was bound to arise as to whether an initial all-out US effort, either nuclear or all-out subnuclear, might have been more effective than a step-by-step response.

This is far too complex a question to be more than touched on here, but one fact, in any case, seems clear: the escalation model has gone out of fashion in discussing and dealing with crises and conflict.* Does this mean that the nuclear boundary and nuclear threshold concepts are no longer valid?

Logically, it would not appear to. Whether or not controlled escalation has worked effectively, multimegaton nuclear weapons remain, and the need for restraint in conflict remains. Potential conflict still lies in a spectrum from minimal violence or subviolence to use of the multimegaton weapons. A clear line may still be strongly argued to be the best aid to restraint. No convincing case has been made, or seems likely to be made, for the existence of a clear line beyond the nuclear boundary.

In a War With the Soviet Union, Would the Nuclear Threshold Have a Chance?

The basic fact about the scientific nuclear line is that it is a clear line, readily recognizable to anyone with rudimentary scientific knowledge about the nature of nuclear and

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* Since this report was prepared, the Iran hostage crisis of 1979-80 has brought a renewed use of the escalation model.

conventional explosions. The basic facts about the nuclear boundary are that (1) it is based on the scientific nuclear line and (2) it has been readily recongizable by both sides under operational conditions. To the extent that it may be less readily recognizable, its value is reduced. Two basic assumptions about the nuclear boundary are (1) that not to cross it communicates restraint to the adversary (as well as to all others) and (2) that to cross it communicates to the adversary (and to others) that interests are at stake that are so vital that the most important boundary, and the accepted firebreak, on the spectrum of conflict has to be crossed. Assuming that one wishes to avoid all-out nuclear war, and to maintain the nuclear firebreak, to that end one places the nuclear threshold as high as possible, fortifying it with highly effective conventional weapons and strategies below the nuclear boundary.

The effectiveness of all these facts, concepts, and assumptions rests on their being recognized by both sides in a confrontation. It was generally believed in the 1960s that the Soviet leaders, although they did not at first seem to recognize the unique nature and power of nuclear weapons, and their qualitative difference from conventional weapons, would come to this realization as they built their own arsenal and lived with the reality of the weapons. The Soviet attitude that the nuclear bomb was "just another weapon" would be replaced by an attitude of respect for the nuclear taboo and the nuclear firebreak. Although there have been Soviet statements indicating both these attitudes, some US analysts have suggested recently that the weight of the evidence indicates that the Soviet Union would use nuclear weapons from the outset in any conflict with the United States. Greatly increased Soviet nulcear and conventional strength, to -- and perhaps beyond -- parity with the United States, have made the matter of Soviet attitudes on nuclear use increasingly significant.

In a widely read 1977 article, Richard Pipes suggested that a Soviet initiation of war, if it came, would be a "preemptive" strategic counterforce attack on the United States, followed by a combined-arms invasion of Western Europe designed to seize it with a minimum of damage to cities and industries. The submarine-rich Soviet Navy would "have the task of cleaning the seas of US ships," cutting supply lines between the United States and its allies, and the Soviet Union, having accepted the huge losses caused by the US strategic retaliatory strike, would be prepared to win the war of attrition that would follow the initial exchanges. (Pipes 1977:33). Graham Vernon, a recently retired Army specialist on Soviet forces, has argued convincely that in any conflict in Central Europe the Soviets would be likely to use nuclear weapons immediately. (Vernon 1979:16-17). Joseph Douglass and Amoretta Hoeber, in a 1979

monograph based entirely on Soviet materials intended for higher-level Soviet military and political officers, present strong evidence that if the Soviet Union should initiate a war against the United States, it would make every effort to achieve initial surprise, and would fight a war in which nuclear and conventional weapons -- and "strategic" and "tactical" (in US terms) forces -- were fully integrated.

None of these authors suggests that the Soviet Union would seek a war against NATO or the United States. Vernon stresses the lack of appeal such a course of action would have for the Soviet Union. But if vital Soviet interests were involved, if national survival appeared threatened or attack by the United States appeared likely, and if the Soviet leadership decided that war was inevitable, these authors see a conflict that is nuclear from the beginning.*

If these arguments are valid, then, as far as conflict with the Soviet Union is concerned, the nuclear boundary would be crossed by the enemy in the first moments of conflict, the US nuclear threshold would consequently be crossed at the same moment, and the nuclear threshold would have no real operational significance. Since war with the Soviet Union as the result of a Soviet invasion of NATO is the context for much, perhaps most, of the discussion of nuclear threshold, such a war strategy by the Soviet Union would appear to diminish seriously the value of the nuclear boundary and nuclear threshold concepts.

It should be noted, however, that war with the Soviet Union, either in Europe or through a strategic nuclear exchange, although the most important possible armed conflict the United States faces, is far from the most likely one. For all other conflict, the issues of keeping conflict limited and communicating restraint may still be best met by respecting the firebreak at the nuclear boundary and keeping the nuclear threshold high. It could nevertheless be argued that the best way to limit conflict with Third-World entities, and thus limit the risk of Soviet involvement, is to use the most effective and militarily appropriate weapons in the US arsenal promptly. If

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* It should be stressed that Vernon, in the publication cited, deals only with war initiated in Central Europe, not with strategic nuclear exchanges. A provocative recent article from a point of view similar to Pipes's is Colin S. Gray, "Nuclear Strategy: The Case for a Theory of Victory," International Security 4:45-87.

one adopts this point of view, the establishment and reinforcement through time of the nuclear taboo have been unfortunate, in making it hard to use the best weapons available and in signaling that an event of importance disproportionate to the force used has taken place, if low-yield nuclear weapons should be used.*

CONCLUSIONS

The following conclusions may be drawn from this preliminary investigation of the nuclear threshold concept:

1. For ease and clarity of discourse about the several related concepts involved, the following terminology is recommended:

   a. The scientific nuclear line is the line between conventional weapons and nuclear weapons, based on the difference in their scientific nature.
   b. The nuclear boundary is the operational line between nonuse of nuclear weapons and use of nuclear weapons.
   c. The nuclear threshold is the point on a continuum of provocation at which nuclear weapons would be resorted to.
   d. A firebreak, in strategic discourse, is a clearly discernible boundary line on the spectrum of conflict that is respected as a stopping point and crossed only under great provocation or extreme military necessity. The nuclear firebreak is a firebreak at the nuclear boundary.
   e. The nuclear taboo is a strong reluctance to use nuclear weapons that is reinforced by tradition and feelings of moral prohibition.

2. The scientific nuclear line has not been blurred or threatened by the development of new, more destructive conventional weapons or new, less destructive nuclear weapons.

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* There is a brief discussion of this point of view in Colin Gray, "Soviet American Strategic Interaction in a Proliferated World," in Lewis A. Dunn, US Defense Planning for a More Proliferated World, Hudson Institute: Croton-on-Hudson, N.Y., 1979, p. 164.

3. Because of the existence of new weapons, there is some question as to whether the difference, in combat use, between conventional and nuclear weapons will still be clear in all cases. If it is not clear, the nuclear boundary would be threatened, as would the validity of the nuclear threshold concept. Further investigation, with the assistance of weapons specialists, is needed on this matter.

4. Proliferation of nuclear weapons should not invalidate the nuclear boundary and nuclear threshold concepts.

5. There is some question as to whether probable Soviet war strategies threaten or invalidate the nuclear boundary and nuclear threshold concepts. Further investigation and thought are needed on this matter.

6. There appears to be no other boundary line within the spectrum of conflict with anything approaching the clarity of the nuclear boundary. If limitation of conflict is sought, continued respect for the nuclear boundary firebreak appears to be desirable, in the absense of strong evidence that it is no longer serviceable.

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[Barnaby uses the term in his title to mean the gap between the destructive power of conventional and nuclear weapons: "The deployment of enhanced-radiation weapons may considerably narrow the current gap -- often called the nuclear threshold -- between the minimum yield of deployed nuclear weapons and the maximum explosive power of conventional weapons." The brief paper includes clear explanations of the neutron warhead and of fuel air explosive (FAE) conventional weapons, which use the ignition of gases to produce great destructive effects, and also includes a diagram of the effects of the neutron warhead. Director of the Stockholm International Peace Research Institute, Barnaby believes that both the neutron warhead and FAE weapons should be banned.]

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[Beecher, New York Times military correspondent, summarizes characteristics of the new tactical nuclear weapons, including those employing enhanced radiation, suppressed radiation, and induced radiation. Writing at the time these weapons were being planned, Beecher states that the Kennedy and Johnson administrations resisted development of the weapons out of concern that more usable weapons would be more likely to be used, risking escalation to strategic nuclear war. Some officials of the Nixon administration, he says, also adhered to what he calls the "firebreak school," but he suggests that in 1972 there was a shift toward development and deployment of the new tactical weapons. He summarizes the reasons: strategic parity and strategic arms limitations seemed to call for strengthening conventional and tactical nuclear capabilities in Europe if deterrence was to continue effectively.]

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partly through preaching its merits to the unconverted both at home and abroad." (62) He suggests we will run less danger of escalation to strategic nuclear weapons by using tactical nuclear weapons where appropriate. He feels we should not make our nuclear superiority (of that period) impotent by broadcasting so clearly the idea that we will use it under almost no circumstances.]

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New York: Frederick A. Praeger, 1965
Address delivered at Loyola University, February 10, 1963. Also reprinted in Survival 5:94-101 (May-June 1963)

[This address includes the best brief statement of the nuclear threshold concept found in this survey of literature. It is quoted in full in the body of this report. The address also includes a clear explication and defense of the flexible response approach to strategic nuclear targeting and a useful discussion of the just-war concept and the ethical issues involved in planning for nuclear war.]

FIALKA, John J.

1978 "Particle Beam 'Instant Kill' Weapons Studied"
Washington Star, December 15, 1978, p. 1

[Provides explanation for layman of particle beam weapons as extremely dense, fast-moving subatomic particles. Does not deal with implications for nuclear threshold.]

GALLOIS, Pierre M.

1979 "The Future of France's Force de Disuasion"
Strategic Review 7:34 ff. (summer 1979)
Reprinted in US Air Force, Current News, Main Edition, August 10, 1979, pp. 7-F - 12-F

[Stresses the importance of France's mobile, submarine-launched nuclear deterrent, given new, highly accurate Soviet missiles targeted on Europe. Implications for nuclear threshold: New, highly accurate Soviet missiles targeted on Europe mean that a surprise Soviet attack by selectively targeted nuclear-

armed missiles would be far less destructive than a conventional war in Europe. Also, only the Soviet Union would initiate war in Europe; it would have to do so with its own forces, not proxies; therefore, it would not initiate such a war without assuming assured success; and, therefore, it would use nuclear forces from the beginning, including surprise long-range missile strikes. If these assumptions and reasonings are correct, it does not seem sensible for NATO to plan for a conventional war in Europe and to try not to cross the nuclear threshold.]

GLASSTONE, Samuel, and Philip J. Dolan, comps. and eds.

1977 The Effects of Nuclear Weapons
Prepared and published by the US Department of Defense and the US Department of Energy; 3rd ed.

[The standard unclassified reference. Clearly presented for the layman, with separate, more detailed, sections of each chapter for readers with scientific background. Explains the nature of fission and fusion nuclear explosions. Describes effects at various distances of nuclear explosions of various yields taking place at various heights. Does not deal with the effects of specific categories of weapons, such as the newer tactical weapons or other nuclear weapons in which some effects have been enhanced and others reduced.]

HERO (Historical Evaluation and Research Organization)

1966 National Strategic Concepts and the Changing Nature of Modern War
Report prepared for the US Air Force Office of Scientific Research
Trevor N. Dupuy, HERO Executive Director; Gay M. Hammerman, Study Coordinator
HERO: Washington, D.C.

[Chapter VIII, "The Nature of Contemporary Conflict," Vol. 1, pp. 153-69, includes an extensive discussion of the spectrum of conflict, with a graphic representation of the spectrum, and some discussion of the nuclear threshold concept.]

IKLE, Fred Charles

1980 "NATO's 'First Nuclear Use': A Deepening Trap?"
Strategic Review 8:18-23

[Deals with threat of "first use" -- the threat to introduce nuclear weapons into a conventional battle -- which the author says has "long played a reassuring role in Western Europe, especially in the Federal Republic of Germany." Does not deal directly with the nuclear threshold concept, or use the term, but includes considerable good discussion on probabilities of escalation, psychological aspects of nuclear weapons use, and other topics closely related to nuclear threshold.]

KAHN, Herman

1965 On Escalation: Metaphors and Scenarios
Frederick A. Praeger: New York

[Chapter VI, "The Nuclear Threshold," pp. 94-133, discusses fully the arguments against respecting the nuclear-nonnuclear line as a firebreak, explores the various possible results of tactical use of nuclear weapons, and concludes that, on balance, the tradition of nuclear nonuse is worth preserving. On Escalation also discusses "thresholds", and Kahn believes that the only threshold beyond the nuclear threshold that has clarity and value approaching those of the nuclear threshold is the "central sanctuary threshold," the line just short of attacks on the enemy homeland. (142-43)]

KISSINGER, Henry A.

1957 Nuclear Weapons and Foreign Policy
Harper & Brothers: New York

[Kissinger, in this early work, considers the arguments against any use of nuclear weapons and rejects them, concluding that limited nuclear war is "a strategy which will utilize our special skills to best advantage, and . . . may be less likely to become all-out than conventional war." (176) The threshold and firebreak concepts had not yet appeared at this time, but Kissinger, implicitly, would place the firebreak between tactical nuclear and strategic nuclear weapons, rather than between conventional and nuclear weapons.]

ROBINSON, J.P. Perry

1978 "Neutron Bomb and Conventional Weapons of Mass Destruction"
Bulletin of the Atomic Scientists, March 1978, pp. 42-45

[Robinson's thesis is that the new, highly lethal, and highly destructive conventional weapons, together with the low-collateral-damage neutron warhead, have erased the lethality gap between conventional and nuclear weapons, and made the nuclear threshold concept obsolete. He sees the nuclear threshold as having been used largely as an argument for deploying more effective conventional weapons and thus fewer tactical nuclear weapons. Writing from an arms control point of view, Perry is making an argument for the control of highly destructive conventional weapons.]

ROSE, John P.

1979a "Battlefield Employment of Nuclear Weapons: Concept for a Doctrine"
Unpublished manuscript, August 1979
The author, a major in the US Army, is on the faculty of the US Military Academy, West Point, N.Y.

[Proposes a new concept for US employment of tactical and theater nuclear weapons that stresses flexibility, authority for commanders down to battalion level to use nuclear weapons on their own authority upon release by the theater commander (release which would be given once war commences), establishment of tactical doctrine for all types of combat operations in a nuclear environment, making nuclear fire planning a normal part of all tactical operations, and thorough training of soldiers of all ranks in nuclear weapons effects and employment doctrine and in survival in a nuclear environment.]

1979b "Nuclear Weapons: Image versus Reality"
Field Artillery Journal 47:46-50

[Rose presents a good summary of characteristics of various new-generation tactical nuclear weapons. He argues strongly for their integration into tactical doctrine as effective weapons whose effects can be

controlled, in some cases, better than those of conventional weapons. He suggests that the escalation danger is perhaps less great than with conventional weapons, and that "such weapons [new tactical nuclear weapons] represent a firebreak to a strategic exchange" (50), but does not define firebreak or specifically discuss the boundary and threshold concepts.]

1979c "Tactical Nuclear Weapons Are Just One More Form Of Combat Power On The Battlefield"
Marine Corps Gazette, April 1979, pp. 47-50

[States the case for the thesis expressed in the article's title. Does not deal explicitly with the nuclear threshold concept, but refers to the "notion of avoiding nuclear war on any level." The discussion of the varied characteristics of tactical nuclear weapons and the stressed affirmation that battlefield nuclear war is not different in kind from any other war illustrate some of the forces now tending to blur the nuclear boundary.]

SCHELLING, Thomas C.

1966 Arms and Influence
Yale University Press: New Haven, Conn.

[Includes an extremely useful discussion of "thresholds" in military operations, pp. 131-34, 157, 165. Schelling's thresholds are stopping places, dividing lines, which can be used as tools for limiting conflict. He discusses the following in this role: rivers, parallels of latitude, coastlines, and the lines between air support commitment and commitment of ground forces, between not attacking cities and attacking cities, between nonuse of gas and use of gas, between nonuse of nuclear weapons and use of nuclear weapons.]

SCOTT, John F.

1974 "What We Know, and What We Don't Know, about Tactical Nuclear War"
Air University Review 25 (No. 5): 52-54

[Does not mention nuclear threshold concept, but deals with closely related subjects. Scott opposes any "very early" resort to tactical nuclear weapons against conventional attacks and opposes using nuclear weapons for demonstration purposes in a conflict with a nonnuclear opponent.]

SIGAL, Leon V.

1979 "Rethinking the Unthinkable"
Foreign Policy, No. 34 (spring 1979), pp. 35-51

[Sigal outlines what he describes as a current debate between "stable balancers" and "war fighters." A clue to his point of view comes in the first paragraph, when he states that the debate has been stimulated by recent innovations in weapons systems, without mentioning reasons that appear at least as important: the great recent Soviet buildup in both nuclear and conventional weapons, and other evidence that the Soviet Union is planning and preparing a nuclear war-waging capability. His flat statement, "These traditionalists find nuclear war fighting attractive," is certainly not true of most of the military people and defense analysts of whom he is speaking.
Sigal says that "stable balancers," with whom he seems to identify himself, believe that "The certainty that any use of nuclear weapons could result in unprecedented devastation makes the firebreak between conventional and nuclear weapons more salient than any other distinction, geographical or functional." (39-40) He quotes Paul Warnke against making small nuclear weapons on the grounds that this would lower the nuclear threshold.]

SNYDER, Jack L.

1977 The Soviet Strategic Culture: Implications for Limited Nuclear Operations.
Project AIR FORCE Report (RAND)
RAND Corporation: Santa Monica, Calif.

[Includes a good section on thresholds (boundaries), including US and Soviet attitudes toward them, pp. 18-19.]

US JOINT CHIEFS OF STAFF

1974 Department of Defense Dictionary of Military and Associated Terms
JCS Pub. 1, September 3, 1974
Joint Chiefs of Staff: Washington, D.C.

[Useful for its official definitions of terms related to nuclear weapons and operations. Does not include definition for nuclear threshold.]

VERNON, Graham D.

1979 Soviet Options for War in Europe: Nuclear or Conventional
National Security Affairs Monograph Series 79-1
National Defense University: Washington, D.C.

[Convincingly presents the thesis that if the Soviet Union should initiate war against NATO, it would probably be nuclear war from the beginning. Includes brief discussion, pp. 5-6, of concept of "NATO's nuclear threshold," defined as "the point at which NATO must resort to nuclear weapons rather than accept defeat by Pact conventional forces." Suggests that one must consider the logical possibility that if stronger NATO conventional forces raise the nuclear threshold for NATO they correspondingly lower it for Warsaw Pact forces, but concludes stronger NATO conventional forces would be more likely to deter any Warsaw Pact attack.]