Lecture 2: Nuclear Deterrence

QUESTIONS TO BE ADDRESSED:

I. **Why examining nuclear deterrence is necessary**

II. **What can be learned from the military efforts at deterrence during WWII?**

III. **What were the first thoughts on nuclear deterrence?**

IV. **What does creating and maintaining a robust nuclear deterrent force require?**

V. **How sound are the most popular current views on deterrence and the first use of nuclear arms?**

I. Why examining nuclear deterrence is necessary

A popular argument academics and policy makers make to justify acquiring or enhancing nuclear weapons is that the deterrence they engender keeps the peace. Now, if they do, it would seem foolish to worry about their further spread, development, or use. Instead, having more nuclear weapons in more hands would deter better and better nuclear weapons would deter even more. On the other hand, if they might increase the prospects for massive destruction war, their proliferation would be a worry and determining how many we and other nuclear-weapon states should have and of what type would be major issues.[1]

What is meant by "deterrence"?

Deterrence is a noun. Yet, two hundred years ago, only the verbal form was used—to deter. Criminal lawyers in the 16th-century converted the verb, "to deter," into a noun, "deterrent," and applied it to their use of punishments to create "deterrent" examples. Shortly thereafter, they coined the word "deterrence" to refer to the ability to prevent with appropriate threats of

1. For a full debate on the merits and risks of allowing nuclear proliferation, see Henry D. Sokolski, ed., *Should We Let the Bomb Spread?*, Carlisle, PA: Strategic Studies Institute, 2016, available from http://npolicy.org/books/Should_We_Let_the_Bomb_Spread/Full_Book.pdf; Scott Sagan and Kenneth Waltz, *The Spread of Nuclear Weapons: A Debate*, New York: W.V. Norton, 1995; Matthew Kroenig, "The History of Proliferation Optimism: Does It Have a Future?" in Henry D. Sokolski, ed., *Moving Beyond Pretense: Nuclear Power and Nonproliferation*, Carlisle, PA: Strategic Studies Institute, 2014, pp. 45-89, available from http://www.npolicy.org/books/Moving_Beyond_Pretense/Ch3_Kroenig.pdf; Bruce Mueno de Mesquita and William Riker, "An Assessment of the Merits of Selective Nuclear Proliferation," *Journal of Conflict Resolution* 26, no. 2, 1982, pp. 283-306; Steven Kidd, "Nuclear proliferation risk – is it vastly overrated?" Nuclear Engineering International, July 23, 2010, available from http://www.neimagazine.com/opinion/opinionnuclear-proliferation-risk-is-it-vastly-overrated/; and Matthew Fuhrmann, "Preventive War and the Spread of Nuclear Programs," in *Moving Beyond Pretense*, pp. 91-115, available from http://www.npolicy.org/books/Moving_Beyond_Pretense/Ch4_Fuhrmann.pdf.

punishment. Economists subsequently referred to efforts to tax certain behaviors to "deter" or make them less prevalent. Finally military strategists used it just before the First World War when to describe how the British, French, and Russians hoped their complex system of alliances might "deter" German aggression.

Turning a verb into a noun necessarily entails abstraction.[2] As a result, the deterrence literature is a rich and controversial one. Its application to military matters has produced an extremely complex lexicon replete with nuanced distinctions.[3] Proving that deterrence has worked in any specific case also requires proving a counterfactual, i.e., why something did not happen. As a result, it is a bit like trying to divide an integer by zero: You can get nearly any answer you want. This helps explain why the academic literature on deterrence is so extensive.

The topic of deterrence, however, is not simply an academic exercise. If the public or leadership of a country believes a certain military deterrent force will (or will not) work, that belief itself becomes a military factor that shapes military operations. Successful deterrence may be difficult to prove or disprove, but perceptions of how well a deterrent force will or will not work matter. As a consequence, we at least have historical evidence of when attempts to deter have failed, which helps us appreciate what military deterrence operationally requires.

Here, a good place to start is the lead-up to WWII and how the United States hoped its military deployments might deter Axis aggression. As we will see, the lessons from this history shaped security experts' thinking about how nuclear deterrence might work.

II. **What can we learn from the military efforts at deterring during WWII?**

Aerial Deterrence: B-17s in the Philippines

In 1940-41, American officials feared Japan would invade South East Asia and America's Pacific territories—Hawaii, Alaska, Guam, and the Philippines. To deter the Japanese, the U.S. Army

2. This also suggests "proliferation" and "nonproliferation" are suspect. Here you're taking a verb, turning it into a noun, and, in the case of "nonproliferation," putting the word "non" in front of it.

3. The academic literature makes a number of distinctions between different kinds of nuclear deterrence. Perhaps the most significant is deterring military aggression by threatening unacceptable punishment after the fact, versus deterring military aggression by convincing an adversary that the attack will not succeed at anything approaching an acceptable cost. The former is called deterrence by punishment while the latter is called deterrence by denial. See, Glenn Snyder, *Deterrence and Defense: Toward a Theory of National Security* Princeton, NJ: Princeton University Press, 1961. There is also a distinction between convincing an adversary not to take an action (deterrence) and convincing him to take an action he otherwise would not (compellence/coercion). The latter is recognized to be substantially more difficult. See, Thomas C. Schelling, *Arms and Influence*, New Haven, Yale University Press, 2008, pp 69-78. For a recent treatment of nuclear coercion see, e.g., Matthew Furhman and Todd S. Sechser, *Nuclear Weapons and Coercive Diplomacy*, Cambridge: Cambridge University Press, 2017.

sent its best bombers—a fleet of B-17s—as far forward as possible at Clark Air Base in the Philippines.

FIGURE 1:U.S. bombers lined up wing tip to wing tip at Clark Field

The US military lined its bombers up wing tip to wing tip, which made it easier to keep the taxiways clear for departure. The thought here was that these bombers would give Japan pause and, if the Japanese "did anything," the bombers would be on the ready for quick take off. The unspoken hope was that the planes would deliver some sort of "counterpunch" against Japan. It is unclear what this counterpunch would consist of. What became all too apparent, however, is this plan didn't work. Lined up, as they were for takeoff, the bomber force was quite vulnerable to attack and made quite an attractive target. This enticed the Japanese to strike first, knocking out the entire fleet of American B-17 bombers.

This suggests that threatening to retaliate isn't terribly credible if your adversary decides to attack your retaliatory forces and you can't survive ***their*** first strike against them. This lesson was learned, not only with the destruction of the B-17s in the Philippines, but also with U.S. forces forward deployed at Pearl Harbor.

Naval Deterrence: Pearl Harbor

FIGURE 2: Attack on Pearl Harbor

President Franklin Delano Roosevelt (FDR) tried to exercise more than aerial deterrence against the Japanese. He also moved most of the U.S. naval battle fleet, based on the West Coast, forward to Honolulu in 1940. The idea here, again, was that if the United States had a portion of its capital fleet deployed closer to Japan, this would chasten Tokyo against invading U.S. and allied colonies (including the East Dutch Indies for its oil resources). Once situated at Pearl Harbor, America's fleet would be ready to respond quickly to disrupt any major Japanese naval operations. Unfortunately, this forward deployment only made it more attractive and feasible for Japan to cripple the U.S. fleet in a first strike, which, in turn, allowed Japan to assault the rest of the western Pacific.

The Japanese were innovative in their strike against Pearl Harbor. In 1940, the British determined that making aerial torpedoes with wire leads could make their landing relatively flat when they hit the water. This, in turn, could keep them from diving at steep angles that otherwise would get them stuck on the harbor's muddy bottom. The harbor at Taranto, Italy was quite shallow. Yet, armed with their innovative torpedoes, the British succeeded In sinking half of the Italian fleet anchored at Taranto. Great Britian's success prompted the Japanese, who visited Taranto to learn more, to copy the British example. The Japanese had been working on shallow-water aerial torpedoes of their own that used breakaway wooden fins and a breakaway softwood nose cones to keep them from diving too deep. The result of their attention to these details was near total destruction of an all-too vulnerable U.S. fleet at Pearl Harbor that U.S. officials mistakenly assumed would be immune to torpedo attacks given how shallow Pearl Harbor war. The United States also failed to deploy enough passive and active air defenses at the base to protect the fleet once it was attacked.

Another takeaway from the Japanese raids on Pearl Harbor and the Philippines concerns intelligence and uncertainty. After the attacks, many argued that Roosevelt should have known that the Japanese were going to strike. Washington had access to the encryption codes used by the Japanese government and military. This allowed U.S. officials to read some of the most private messages the Japanese were sending to their diplomats and military commanders. Roosevelt, his critics argued, should have known what was going to happen. A few even argued that Roosevelt cynically let the Japanese attack so that he could have an easier time convincing the U.S. public to fight Japan's stronger European allies, the Nazis.

Roberta Wohlstetter, author of *Pearl Harbor: Warning and Decision*, carefully examined this contention. She came to quite a different conclusion. Yes, Washington received intelligence that suggested an attack might take place, but these signals were largely drowned out by other less telling information or "noise." This noise made it difficult to know precisely what the Japanese were up to. What you want, she argued, are clear signals and not so much noise.[4]

This suggests a critical requirement for deterrence: You either have to know precisely what's coming and when, *or* you have to have defenses that can deal with a fairly wide range of uncertainty about what your opponent might do. If you don't have either, your deterrent forces could get caught off guard. With Pearl Harbor and the Philippines, the United States lacked sufficient intelligence, had its forces forward deployed in a manner that increased their vulnerability, and lacked defenses that could cope with a variety of different possible kinds of attacks.

Chemical and Biological Weapons Deterrence

4. See Roberta Wohlstetter, *Pearl Harbor: Warning and Decision*, Stanford, CA: Stanford University Press, 1962.

FIGURE 3: Japanese soldiers wearing gas

With chemical and biological weapons, deterrence worked differently. The Nazis, Japanese, British, Americans, and Soviets all had chemical and biological weapons stockpiles. Hitler experienced the horrors of trench and chemical warfare first-hand during WWI. Perhaps because of this, he never used chemical weapons against combatants. The Allies did not either, in part, because of their own WWI experience, but also because Interwar aerial warfare indicated that the use of high-explosives was more predictable. Only the Japanese used chemical and biological weapons against the Chinese who lacked either. This suggests that lacking any ability to strike back in kind may leave one open to being attacked. It also suggests that having weapons that can inflict massive destruction may not immediately lead to their actual use if other weapons can accomplish preferred military missions with more contained consequences.

III. First thoughts on nuclear deterrence

As we've seen, even before the advent of nuclear weapons, military planners thought about strategic deterrence. However, their thinking hardly reflected much in-depth analysis. Consider what security experts made of America's nuclear bombing of Hiroshima and Nagasaki.

For most Americans in 1945, these nuclear raids ended the war. When Japan surrendered, the Japanese Emperor referred to the bombings. Allied officials concluded that using nuclear weapons was not just instrumental, but decisive to ending the war. They also concluded that the first use of nuclear weapons would ensure a quick victory against any future adversary.

Popular revisionist academics, as well as the official American history of the air war, *The U.S. Strategic Bombing Survey*, offered alternative views.[5] The revisionists insist Japanese Emperor Hirohito ended the war because he knew Russia would soon enter the war against Japan and force Japan's defeat. Japan's Emperor cited the bombings of Hiroshima and Nagasaki, they argue, not because these raids themselves forced him to surrender, but to save face, i.e., to help excuse his decision to surrender. Meanwhile, *The U.S. Strategic Bombing Survey* speculated that Japan might have surrendered if U.S. Navy's blockade of Japan continued. Although both of these views are plausible, neither was shared by most U.S. and allied officials in 1945.[6]

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5. See, e.g., Wilson, Ward, "The Bomb Didn't Beat Japan…Stalin Did." *Foreign Policy*, May 29, 2013, available from https://foreignpolicy.com/2013/05/30/the-bomb-didnt-beat-japan-stalin-did/ and U.S. Department of War, *U.S. Strategic Bombing Survey: Pacific War*, Washington, DC: United States Government Printing Office, July 1, 1946. A summary is available from http://www.anesi.com/ussbs01.htm.

6. For a set of worthy counterarguments to these revisionist views, including that the anticipated costs of invading Japan seemed prohibitive and that many officials hoped that the firebombing and nuclear bombing of Japan's cities might eliminate the need for the U.S. to invade Japan, see Alexander B. Downes, "Strategic Bombing in World War II: The Firebombing of Japan and the Blitz," *In Targeting Civilians in War*, Cornell Studies in Security Affairs, pp. 115-155, Ithaca, NY: Cornell University Press, 2008, available from http://nuclearpolicy101.org/wp-content/uploads/Restricted/Downes_Targeting-Civilians-in-War_Ch-4.pdf Password protected PDF. Protected PDF;

The Scientists' Movement

Instead, after the war, U.S. security experts used Hiroshima and Nagasaki to support an expansive view of nuclear deterrence. This view was popularized by the Scientists' Movement—a group of Manhattan Project scientists who objected to the bomb's use against Japan.[7] Their views on nuclear deterrence served as the key premises of the Acheson-Lilienthal Report and the first U.S. initiatives to control nuclear energy internationally.[8]

The Manhattan Project's original goal was to assure the United States got the bomb before Hitler. When it became clear that U.S. nuclear weapons weren't going to be used against Germany, but might be against Japan (a country that many thought already was on its knees), America's nuclear scientists appealed to their superiors not to use the bomb. These appeals were essentially ignored.

After war, though, the American Scientists' Movement's views became quite popular. The movement assumed that whatever state attacked first with nuclear weapons would win any war, that the prime target would be cities (which would be easy to knock out quickly), and that it would be almost impossible to defend against such attacks.[9]

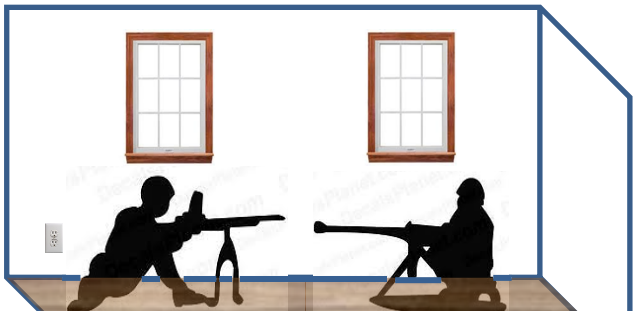

FIGURE 4: Two machine gunners in a small room

This line of thinking led many experts in and outside of the Scientists' Movement to believe that any two nuclear foes were like "two machine gunners in a small room": Whoever pulled the nuclear trigger first would win.[10] Allied to this view was the notion that, to avoid global destruction, states had to surrender much of their sovereignty to create a new, international nuclear authority. These views were reflected in U.S. and allied joint

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7. See, e.g., *Alice Kimball Smith, A Peril and a Hope: The Scientists' Movement in America, 1945-47*, Chicago, IL: University of Chicago Press, 1965, Part 1 available from http://nuclearpolicy101.org/wp-content/uploads/Restricted/Smith_Peril-and-a-Hope_Part-1.pdf Password Protected PDF; Part 2 available from http://nuclearpolicy101.org/wp-content/uploads/Restricted/Smith_Peril-and-a-Hope_Part-2.pdf Password Protected PDF.

8. See, *The Acheson-Lilienthal Report: Report on the International Control of Atomic Energy*, Washington, DC: U.S. Government Printing Office, 1946, available from http://www.learnworld.com/ZNW/LWText.Acheson-Lilienthal.html and U.S. Department of State. Press Release No. 235, April 9, 1946, available from http://www.learnworld.com/ZNW/LWText.Acheson-Lilienthal.html.

9. See, e.g., Louis N. Ridenour, "There is No Defense," In Dexter Masters and Katherine Way, eds. *One World or None*. New York: McGraw-Hill Book Co., Inc., 1946, available from http://nuclearpolicy101.org/wp-content/uploads/Restricted/Masters-and-Way_One-World-or-None.pdf Password Protected PDF.

10. See, e.g., "Prospectus on Nucleonics (The Jeffries Report)." Reprinted in Alice Kimball Smith, *A Peril and a Hope*, pp. 539-559, Chicago, IL: The University of Chicago Press, 1965, available from

statements about how best to control nuclear energy and in the U.S. proposal made before the United Nations (UN) in 1946 known as the Baruch Plan.[11]

Early, Contrarian Views

There were other ideas, however. Early in 1940, two scientific advisors to the British nuclear effort, Otto Frisch and Rudolph Peierls, wrote to Churchill about the military implications of nuclear energy. In that note, they argued that deterring enemy nuclear use was the key reason for acquiring nuclear weapons:

> If one works on the assumption that Germany is, or will be, in the possession of this weapon, it must be realized that no shelters are available that would be effective and that could be used on a large scale. The most effective reply would be a counter-threat with a similar bomb. Therefore, it seems to us important to start production as soon as and as rapidly as possible, even if it is not intended to use the bomb as a means of attack.[12]

After Hiroshima and Nagasaki, Bernard Brodie, then an analyst at Yale's Institute of International Studies, was quick to pick up on this line of thinking. Although Brodie agreed with the Scientists' Movement that cities would be primary targets and that there were no effective defenses against nuclear attack, he flatly rejected the movement's conclusion that the aggressor would always win. As he noted in *The Absolute Weapon:*

> If the aggressor state must fear retaliation, it will know that even if it is the victor, it will suffer a degree of physical destruction incomparably greater than that suffered by any defeated nation in history, incomparably greater, that is, than that suffered by Germany in the recent war. Under those circumstances no victory, even if guaranteed in advance – which it never is – would be worth the price…Thus, the first and most vital step in any American security program for the age of atomic bombs is to take measures to guarantee to ourselves in case of attack the possibility of retaliation in kind…Thus far

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http://nuclearpolicy101.org/wp-content/uploads/Restricted/Prospectus-on-Nucleonics_The-Jeffries-Report.pdf Password Protected PDF.

11. See. "Declaration on the Atomic Bomb by President Truman and Prime Minister Attlee and King," November 15, 1945, available at http://www.nuclearfiles.org/menu/key-issues/nuclear-energy/history/dec-truma-atlee-king_1945-11-15.htm ; Dexter Masters and Katherine Way.; "One World or None," Film by National Committee on Atomic Information with technical assistance by the Federation of American Scientists, 1946, available at http://www.youtube.com/watch?list=UUCxcHC3xqiPNXAPYNIUTyOg&v=eM7-4Ikyw08&feature=player_detailpage; and "The Franck Report." Reprinted in Alice Kimball Smith, *A Peril and a Hope,* pp. 560-565, available at http://nuclearpolicy101.org/wp-content/uploads/Restricted/Franck-Report.pdf Password Protected PDF.

12. See The Frisch/Peierls Memoranda of March 1940, available from https://web.stanford.edu/class/history5n/FPmemo.pdf.

> the chief purpose of our military establishment has been to win wars. From now on its chief purpose must be to avert them.[13]

Other lesser known analysts at the time, though, doubted nuclear deterrence would be so automatic. They rejected the assumption that cities were the prime targets and that defenses were pointless. A law student and former WWII bombardier, William L. Borden, who later became staff director of the U.S. Joint Atomic Energy Committee, argued in his 1946 book, *There Will Be No Time,* that future wars would be fought "between the bases," not by "pulverizing cities and industry, but by destroying the enemy's military power of retaliation." Cities would not be the prime target of any first strike. "Why squander the precious assets of surprise and the initiative by attacking cities, a mission which can so easily be carried out later when the main obstacle to a lightning victory is air forces-in-being?"[14]

A fulsome discussion of these points also was offered by Jacob Viner, a respected economist. He too denied that cities were the prime target and that deterrence was impossible. He also attacked the Scientists Movement's contention that nuclear weapons made international government imperative.[15]

Why, Viner argued, would any state target an opponent's cities in a first strike? They are big, undefended, and immobile, but for those very same reasons, they seemed an odd place for states to base their critical nuclear strategic assets. What if states went out of their way to base their nuclear retaliatory forces outside of cities? What if they hid them? What if they had so many it was difficult to knock them all out? What if they were mobile and hard to locate? What if a state couldn't be confident in knocking out his opponent's nuclear retaliatory forces, wouldn't this deter it from attacking in the first place?

All of these rejoinders undermined the notion that nuclear weapons had created an entirely new, dire world disorder that only some new form of world government could resolve. While Viner admitted that the spread of nuclear weapons would make small nations more important, it did not make all nations equally vulnerable to nuclear attack, and it certainly did not eliminate the advantages large nations would have over small ones if the large states had more of these weapons properly deployed.

To accuse people of putting their heads in the sand if they didn't adopt some form of world government over nuclear energy, as those in the Scientists' Movement were doing, Viner argued, seemed hysterical. Those who propounded such world governance presuming that nuclear energy had radically changed the relations between nations, were putting their heads

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13. See Bernard Brodie, editor, *The Absolute Weapon: Atomic Power and the World Order*, New Haven Connecticut: Yale Institute of International Studies, February 15, 1946, pp. 60-62, available from https://www.osti.gov/opennet/servlets/purl/16380564-wvLB09/16380564.pdf.

14. William L. Borden, *There Will Be No Time*: *The Revolution in Strategy*, New York: The Macmillan Company, 1946.

15. See Jacob Viner, "The Implications of the Atomic Bomb for International Relations," in Symposium on Atomic Energy and its Implications: Papers read at the joint meeting of the American Philosophical Society and the National Academy of Sciences, November 16 and 17, 1945, Philadelphia: American Philosophical Society, 1946, available from http://nuclearpolicy101.org/wp-content/uploads/Restricted/Viner-The-Implications-of-the-Atomic-Bomb.pdf.

in the clouds. Viner ultimately took a more moderate position: While nuclear weapons will make smaller nations more important and war more costly, they hardly change the system of international relations as radically as the Scientists' Movement claimed.[16]

"Balance of Terror" Thinking and the Presumed Automaticity of Nuclear Deterrence

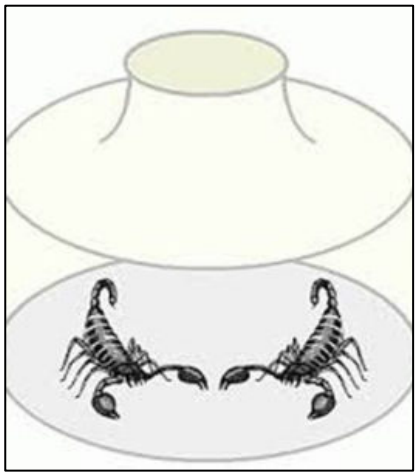

FIGURE 5: Two scorpions in a bottle

Another notion that became popular after the Soviet Union and the British acquired nuclear weapons in 1949 and 1952 was that threatening to use a few nuclear weapons against an opponent's cities would deter war. British Prime Minister Winston Churchill captured this idea best when he noted, "safety will be the sturdy child of terror, and survival the twin brother of annihilation." Former Canadian Prime Minister Lester Pearson put it more plainly: "the balance of terror has replaced the balance of power."

J. Robert Oppenheimer, cribbing from Bernard Brodie, coined a much darker analogy to describe this condition: The U.S. and Russia, he argued, were now like "two scorpions in a bottle" — whoever struck first would effectively kill the other nation but would suffer devastating destruction from the assured nuclear retaliation the few surviving nuclear systems were sure to deliver.[17]

These views, however, were overstated. As Viner and Borden argued, nations with nuclear weapons would balance their power against other nuclear states by decentralizing, protecting, and multiplying certain key military and major industrial assets. States would likely still fight wars, but only use nuclear weapons if they were pressed by extreme circumstances. Early first use was not a given (or even likely), but securing effective nuclear deterrence would not be cheap or easy.[18]

IV. The requirements for creating and maintaining a robust nuclear deterrent force

16. Viner's insights inspired some of the most important work on the character and requirements of nuclear deterrence at the RAND Corporation—a post-World War II Air Force think tank, which conducted nuclear strategic analysis in the 1950s and 1960s under the leadership of Albert Wohlstetter, Andrew Marshall, Henry Rowen, Herman Kahn, Bernard Brodie, and Fred Hoffman.

17. See J. Robert Oppenheimer, "Atomic Weapons and American Policy," *Foreign Affairs*, July 1953, available from https://www.foreignaffairs.com/articles/united-states/1953-07-01/atomic-weapons-and-american-policy.

18. See notes 14 and 15.

Certainly, Viner, and after him, Albert Wohlstetter, and most of his associates at RAND emphasized that this balance was "delicate." The benefits of nuclear deterrence (much less deterring nonnuclear forms of aggression), in fact, were difficult to attain and maintain without first assuring your nuclear force had achieved certain prerequisites. Failure to meet these requirements could actually invite attacks like those the United States suffered at Clark Field and Pearl Harbor and could encourage unintended or accidental use.

Wohlstetter expanded on these insights in "The Delicate Balance of Terror," which appeared in *Foreign Affairs* in 1959. The article was based on a series of detailed, classified RAND studies, which clarified what these hurdles were.[19]

The **FIRST HURDLE** was that one's nuclear forces had to afford "stable peacetime operation." Constantly spending ever larger dollar amounts in peacetime in order to maintain one's strategic forces or deploying them in a manner that might provoke an attack or make them prone to accidental of authorized use is self-defeating.

FIGURE 6:(from left to right) Solid Fueled, Silo-based Missile in the 1970s vs. Vulnerable, Liquid Fueled Jupiter In the Early 1960s

In the very early 1950s, RAND was concerned that the U.S. Strategic Air Command's (SAC's) enthusiasm for placing America's bomber force on nearly constant armed air alert might lead to accidents, including possible unauthorized or accidental nuclear wars. Proliferating them on mobile truck launchers could risk a loss of positive control. Finally, RAND analysts were concerned that some efforts to proliferate and distribute nuclear weapons systems to make them more survivable might drive their costs beyond sustainable levels during peacetime. Fortunately, extensive RAND research demonstrated that long-range bombers and ballistic missiles in hardened silos could be far more cost effective and far less prone to accidental or unauthorized use than keeping SAC bombers on constant armed alert.

19. See Albert Wohlstetter, *The Delicate Balance of Terror*, Santa Monica, Calif.: RAND Corporation, P-1472, November 6, 1958, available from http://www.rand.org/about/history/wohlstetter/P1472/P1472.html.

Wohlstetter's RAND analysis, in particular, proved prescient. In the 1960s, SAC heeded his team's advice and based U.S. nuclear missiles in hardened concrete silos.[20] These U.S. intercontinental ballistic missiles (ICBMs), known as Minutemen, were invulnerable to Soviet attacks in the 1960s and 1970s because Russia's missiles initially lacked the accuracy to knock them out.

Not only were American siloed missiles relatively invulnerable, but because were solid-fueled, they also were relatively easy to maintain and did not need to be on as much of a hair-trigger than the missiles they replaced. These predecessors were fueled with non-storable liquids (the Jupiter, Atlas, and Thor systems) and had to be erected in advance; they couldn't be easily moved. They also needed to be near factories that made liquid oxygen and other rocket fuels. Once fueled, these liquid rockets' performance deteriorated quickly. This created pressures to fire them. As a result, until stable, storable liquid and solid rocket fuels were developed in the 1960s, states didn't fuel their strategic rockets lightly. They were based above ground. So fueling them would send a very loud signal: "I'm getting ready to attack you."

On the other hand, if your missiles were based in underground, hardened silos and were solid-fueled or fueled with stable, storable liquid fuels, your intent to attack would be far more difficult to detect, and the pressures to "use or lose them" would be far less. In addition, because many of the first U.S. rockets, like the Jupiter, were medium, not intercontinental ranged systems, the United States had to base them close to Russia where they were difficult to defend against surprise attack. All of these shortcomings encouraged officials to think that they needed to field a massive numbers of missiles to ensure they could achieve their mission.

In contrast, after building hardened silos and buying the solid-fueled rockets, the cost of maintaining Minuteman systems was relatively low and stable compared to fielding a larger number of liquid-fueled and shorter ranged systems, let alone maintaining large numbers of SAC bombers on constant alert. In fact, in the early 1960s, some experts suggested buying as many as 10,000 Minutemen and basing them above ground, much like the Atlas and Thors were based. That would have cost a considerable amount and the force would have been quite vulnerable to being knocked out in a first strike.

Because of the RAND analysis, though, the Defense Department decided instead to buy 1,000 missiles and to base them in hardened silos.[21] This saved money, increased the survivability of the force, and reduced Soviet temptations to strike first. The Kennedy Administration also decided to close America's forward nuclear bases, including in Turkey. This step was taken as part of a secret deal between Kennedy and Khrushchev to help end the Cuban Missile Crisis.

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20. See, Albert Wohlstetter, Fred S. Hoffman, Robert J. Lutz and Henry S. Rowen, *Selection of Strategic Air Bases*, special staff report, R-244-S, Santa Monica, CA: RAND Corporation, March 1, 1953 and R-266, Santa Monica, CA: RAND Corporation, April 1954, available from http://www.albertwohlstetter.com/writings/19530301-AW-EtAl-R244S.pdf and http://www.rand.org/content/dam/rand/pubs/reports/2006/R266.pdf and Albert Wohlstetter, Fred S. Hoffman and Henry S. Rowen, *Protecting U.S. Power to Strike Back in the 1950's and 1960's*, staff report, R-290, Santa Monica, CA: RAND Corporation, September 1, 1956, top secret, declassified circa mid-1960s, available from http://www.albertwohlstetter.com/writings/19560901-AW-EtAl-R290.pdf.

21. At one point, the Kennedy Administration even considered deploying as few as 600 siloed Minuteman missiles. See Fred Kaplan, *The Bomb: Presidents, Generals and the Secret History of Nuclear War* (New York, NY: Simon and Schuster, 2020) p. 43.

Unrelated to this crisis, the United States also closed most of its forward SAC bases in Europe, built much longer range bombers, and based them in the continental United States.

This ties into the **SECOND HURDLE** Wohlstetter spotlighted, which was that a strategic nuclear force has to survive an enemy's attempts to destroy it in a first strike. *A*fter the disastrous forward basing of America's potent B-17 bombers at Clark Airfield in 1941, you would think U.S. officials would do all they could to ever basing U.S. strategic forces in such a vulnerable fashion again. Instead, for much of the 1950s, the U.S. Air Force was so confident in its first-strike nuclear capabilities against Russia, it hardly attended to their vulnerability.

FIGURE 7: Japan attack vulnerable airpower deployments at Clark Airfield, 1941

In fact, the bomber basing studies the Air Force asked RAND to conduct in the early 1950s initially were not focused on base vulnerability at all. Instead, the Air Force asked RAND to determine what the optimal location might be for Strategic Air Command (SAC) bases from a merely logistical stand point. The idea here was to compare the costs of getting local food, fuel, services, and anything else a base might need to operate at different locations. The Air Force, then, wanted RAND to balance these costs with the benefits the Air Force assumed would come from locating the bases close to the enemy, which included having to spend less money on fuel to strike the enemy and being able to strike quickly with an element of surprise. The more Wohlstetter looked at these Air Force taskings, though, the more he wanted to redefine what he was being asked to assess. What interested him was not how to reduce the logistical costs of operating SAC bases or maximizing their ability to strike the Soviets first, but rather how best to reduce their vulnerability to a Soviet first-strike.

About the same time Wohlstetter raised these questions, a tornado ripped through America's largest SAC base at Carswell, Texas in September of 1952. The planes were parked so the bombers could strike the Soviet Union at the drop of a hat—to lift off with their bombs, fuel, and crews with 30 minutes or less of an alert. The base had two full hours warning of the

coming tornadoes. Yet, none of the planes took off before the storm hit. As a result, all of the SAC bombers were destroyed or damaged on the ground, putting over two-thirds of America's strategic bomber force out of action.

This disaster heightened concerns that SAC hadn't developed a survivable basing mode for its bombers. It also suggested that SAC commander Curtis Lemay's preoccupation with knocking out the Soviets at the earliest warning of a possible attack was overly optimistic. All of this made it easier for RAND to convince the Air Force to change its guidance for the RAND basing study.

FIGURE 8: Damaged planes at Carswell

Later, in the 1960s, the United States made its nuclear forces much more survivable and gains a possible soviet first strike by silo-basing U.S. ICBMs and putting America's long-range ballistic missiles on nuclear submarines. The United States also dispersed most of its bombers within the continental United States to a larger number of bases. The Air Force didn't go with RAND's suggestions of mobile ground-basing of its ICBMs, but made sure it had to option to do so later (making the Minuteman light enough to be transported by truck).

After the Soviets acquired enough accurate ICBMs in the 1970s to knock out America's silo-based Minutemen and Titan missiles, SAC proposed to launch U.S. missiles at the first warning of a Soviet attack (launch on warning or LOW) or a nuclear detonation on U.S. soil (launch under attack or LUA). The hope was that threatening to launch U.S. ICBMs automatically would deter a Soviet first strike even if our retaliatory ICBM force was itself vulnerable. However, the problem with LOW and LUA was that the United States would have to launch its ICBMs without necessarily knowing if the Soviet attack was real or intended. This could result in engaging in an all-out nuclear war on false or incomplete information. [22]

By the 1980s, with missile silos still vulnerable to Soviet ICBMs, the United States considered a number of mobile-basing options for the MX, or Peacekeeper missiles and the Midgetman, the Minuteman's intended successors. In an arguably provocative move, the Reagan administration ultimately dealt with the increasing vulnerability of U.S. missile silos by proposing to deploy MX missiles in a closely based, fixed silo system called Dense Pack. The idea here was to take advantage of the debris that attacking Soviet missiles would throw up as soon as they hit a U.S. silos. Once the debris was thrown up, Dense Pack proponents said that it would prevent incoming Soviet missiles from being able to destroy the remaining nearby Dense Pack silos

22. More recently, the question has arisen whether if, with hypersonic missiles with flight times as short as six minutes or less, the United States needs to rely on artificial intelligence systems to assess incoming threats and decide if and how to counterattack. See Edward Geist and Andrew J. Lohn, *How Might Artificial Intelligence Affect the Risk of Nuclear War?* (Santa Monica, CA: RAND Corporation, 2018), available at https://www.rand.org/pubs/perspectives/PE296.html.

before those missiles might be fired against Russia in retaliation. Some doubted that Dense Pack could survive a Soviet attack and argued it was part of an effort to scare the Soviets into thinking the United States might strike first. In any case, shortly after deploying the MX missiles, the Cold War ended, Washington and Moscow dramatically reduced their deployed nuclear weapons forces, and the United States eliminated the MX/Peacekeeper, Dense Pack, and Midgetman missile programs.

Today, the Russians, the Chinese, the North Koreans, the Indians, and the Pakistanis all use road-mobile, long-range ballistic missile systems, which are very difficult to target. Some experts argue that the United States should go to some form of mobile ICBM basing (building more silos and moving the missiles in and out of empty holes as a shell game, putting the missiles on rail or trucks, or basing them on coastal diesel submarines, commercial airplanes or container ships) to cope with increased threats from China and Russia. Others argue that maintaining a policy of launch on warning and launch under attack eliminates the need to make American ICBMs less vulnerable. So, the issue of vulnerability to first strikes is still a concern.[23]

FIGURE 9: Air-based C^3I

This brings us to the **THIRD HURDLE** RAND's basing studies identified—making sure one can maintain command, control, and communication with one's strategic forces, as well as maintain the ability to update one's intelligence in the middle of a major nuclear exchange. Wohlstetter worried that making our nuclear forces more mobile would also make them more difficult to command, control, and communicate with. Another worry was that Russia might knock out U.S. command centers and decapitate U.S. strategic forces.

To address this concern, the United States located most of its command and control systems deep within Cheyenne Mountain in Wyoming. However, that command system was downgraded in the 1980s because it became vulnerable to increasingly accurate Soviet missiles. Currently, the United States has airborne command systems that are more difficult to locate, sabotage, or knockout. Even now, however, it is unclear how well the president and his chain of command can send orders from the White House or an aerial command system to the various strategic command posts during war, particularly after a nuclear exchange.

23. For example, current debates on the necessity of maintaining the nuclear triad still focus on the survivability of the U.S. nuclear force. See, e.g., Peter Huessy, "In Defense of the Nuclear Triad," *Defense One*, October 18, 2013, available at http://www.defenseone.com/ideas/2013/10/defense-nuclear-triad/72242/ and U.S. Strategic Command, "2022 Space and Missile Defense Symposium: available at https://www.stratcom.mil/Media/Speeches/Article/3126694/2022-space-and-missile-defense-symposium/ ,

Under any command and control system, you want your nuclear forces to work when you want them to and not to when you don't. These two demands, unfortunately, can be in operational tension with one another. To prevent unauthorized and accidental use, you need to make it more difficult for these weapons to be accessed, armed, and delivered. To do this, you might put various locks and codes on the weapons to prevent easy access to them (these are called permissive action links or PALs). You would also want to centralize the command and control of the weapons to prevent unauthorized firings.

These measures, though, can risk making the weapons more difficult to arm and use quickly when you might want to use them most—when you are under attack. To make sure they cannot be knocked out in an adversary's first strike, there is a strong temptation to pre-delegate launch authority, to decentralize their deployment, and to otherwise keep your nuclear weapon systems on hair-trigger alert.[24] This, however, increases the risk of unauthorized use.

These sets of command and control worries are enduring for any nuclear-armed state. Could the Russians or Chinese electronically or kinetically knock out or disable enough ground and space-based U.S. and allied military satellite, computer, communication, control, and intelligence systems to lobotomize U.S. strategic forces? Could they blind or damage U.S. and allied satellites with lasers or electronic jammers? The United States has direct ascent anti-satellite missiles, maneuvering satellites, jamming systems, and Special Forces to neutralize Russian and Chinese ground and space based command, control, and intelligence systems. The hope is this will be enough to deter similar attacks against U.S. command, control, and nuclear systems by the Chinese and Russians.

The Chinese and Russians are also developing and deploying satellites that can shadow U.S. and allied satellites and possibly knockout a large portion of our critical space-based military satellite warning, surveillance, imaging, navigation, and communications systems with little or no warning. This has prompted calls for prohibiting states from having more than a handful of its satellites near anyone else's at any one time. A violation of this rule might allow states to take defensive action to either to push trespassing satellites out of one's zone or, if necessary, to disable the shadowing satellite.[25]

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24. For more on this, see, Scott Sagan, "Perils of Proliferation: Organization Theory, Deterrence Theory, and the Spread of Nuclear Weapons," *International Security*, Spring 1994, pp. 66-107, available from https://lagunita.stanford.edu/asset-v1:MSandE+NuclearBrink+SelfPaced+type@asset+block/Sagan_-_The_Perils_of_Proliferation.pdf Eric Schlosser, *Command and Control: Nuclear Weapons, the Damascus Accident, and the Illusion of Safety*, New York: Penguin Press, 2013; and Eric Schlosser, "World War III by Mistake," *The New Yorker*, December 23, 206, available from http://www.newyorker.com/news/news-desk/world-war-three-by-mistake. Also, for a history of the accident record of the U.K. nuclear weapon's program over its 65-year history, see Peter Burt, *Playing With Fire: Nuclear Weapons Incidents and Accidents in the United Kingdom*, Reading, UK, Nuclear Information Service, February 2017, available from https://www.nuclearinfo.org/article/nis-reports/playing-fire-nuclear-weapons-incidents-and-accidents-united-kingdom.

25. See, Sara Scoles, "New Space Robots Will Fix Satellites, Or Maybe Destroy Them," *WIRED*, September 10, 2018, available from https://www.wired.com/story/new-space-robots-will-fix-satellites-or-maybe-destroy-them/ and Brian Chow, "Stalkers in Space: Defeating the Threat," *Strategic Studies Quarterly,* May 30, 2017, available from http://www.airuniversity.af.mil/Portals/10/SSQ/documents/Volume-11_Issue-2/Chow.pdf.

A number of defense experts also worry that cyber attacks and electromagnetic pulse (EMP) tailored nuclear weapons might predetermine the outcome of any strategic exchange by blocking our ability to communicate with our forces in times of war or to terminate conflict if nuclear weapons are used. If you set off a nuclear weapon at high altitude over a city or a country and you design it just so, you can produce emissions that could overwhelm electric circuits, including the electrical grid and even ignition systems in cars. A low-earth orbit nuclear detonation also could disable satellites operating there. Perfecting these weapons and knowing precisely what their effects are, however, is challenging, and would probably require nuclear testing. The character of this threat is hotly debated.[26] On the other hand,

ks can threaten communication

if a country used an EMP weapon, it's not clear what the response might be, particularly if it used them over their own territory to degrade invading expeditionary forces. In such a case, would the United States react by using a nuclear weapon or leave the area? Similar operational concerns would arise if U.S. strategic systems were disabled by a cyber-attack. Hypersonic missiles have raised the specter of extremely short flight times, which would compress the President's decision time-line to counterattack down to a handful of minutes. Some have suggested that the application of artificial intelligence may be the fix. However, these systems could be subject to hacking by adversaries and could introduce errors.[27]

A more recent concern is the possibility that Russian and Chinese ground-based lasers could use adaptive optics to dazzle, blind, or permanently damage U.S. and allied military satellites.

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26. For example, see, e.g., "Electromagnetic pulse," *Wikipedia*, available from https://en.wikipedia.org/wiki/Electromagnetic_pulse; "Electromagnetic Pulses (EMPs): Myths vs. Facts," *Edison Electric Institute*, February 2015, available from https://fdocuments.net/document/electromagnetic-pulses-emps-myths-vs-facts-eeiwwweeiorgissuesandpolicycybersecuritydocumentselectromagnetpdf.html ; Jerry Emanuelson, "EMP Myths," *Future Science, LLC*, available from http://www.futurescience.com/emp/EMP-myths.html, Patrick Disney, "The Campaign to Terrify You About EMP," *The Atlantic*, July 15, 2011, available from https://www.theatlantic.com/international/archive/2011/07/the-campaign-to-terrify-you-about-emp/241971/; and Jack Spencer, "The Electromagnetic Pulse Commission Warns of an Old Threat with a New Face," *The Heritage Foundation*, August 3, 2004, available from http://www.heritage.org/defense/report/the-electromagnetic-pulse-commission-warns-old-threat-new-face.

27. See Note 21

Hardening one's satellites to deal with these threats as well as developing active defense and devising rules and declaratory policies may be needed to cope with these dangers.[28]

Clearly, ensuring the invulnerability and functionality of one's nuclear weapon-related systems is a continuous effort. If you fail to keep up with emerging threats, you risk being knocked out. As difficult as it is for large, wealthy nations to "keep up," it is even more difficult for small, poorer states to do so.

The **FOURTH HURDLE** Wohlstetter identified is the need to have enough fuel and range to get to the intended target. Ideally, if you have a manned bomber, you would want to hit the target and have enough fuel to return home safely.

With the 1942 Doolittle Raid against Tokyo, which President Roosevelt ordered to avenge the Pearl Harbor attack, the mission of hitting Tokyo was accomplished, but at a cost. The Doolittle raiders had enough fuel to strike Tokyo but not enough to return home. The bombers had to crash land in China.

We now have aerial refueling planes for our strategic bombers. These refueling planes, however, often need forward bases, which can make them vulnerable. Also, some new nuclear states, such as North Korea, India, and Pakistan are still working to extend the range of their missile delivery systems.

FIGURE 11: Long-range aerial refueling

The **FIFTH HURDLE** the RAND basing studies focused on is the need to overcome enemy air defenses.

FIGURE 12: Plane from a WWII raid on ball bearing plant

In the 1940s, our Army Air Corp had the bitter experience of trying to conduct precise air raids to knock out ball bearing plants in Germany. The United States sent 376 B-17s in one raid—60 of them were shot down and 95 were heavily damaged by German air defenses. As a result, our air forces could not follow up the mission in a timely fashion and it was unclear how much of the mission was even accomplished.

Wohlstetter reflected on this and concluded that there would always be a tension between having enough bombers and missiles to overcome the enemy's air and missile defenses and making sure that they all were based in a suitably survivable mode to cope with first strikes. He also raised the concern that making our missile systems light enough to be mobile and more difficult to hit might come at the cost of

28. See Brian Chow and Henry Sokolski, U.S. Satellites Increasingly Vulnerble to China's Ground-based Lasers, *Space News*, July 10, 2020, available at http://npolicy.org/article.php?aid=1484&rtid=5 ,

them having large enough payloads to carry the penetration aids they might need to get through Soviet missile defenses.

During the Cold War, the United States dealt with these concerns by constantly developing new offensive delivery systems that could evade Soviet active defenses. First, in the 1960s, the United States developed bombers that flew higher than Russia's air defense interceptors could reach. Although the United States never actually deployed the B-70 (only two were ever built), its development forced the Soviets to respond with the development and deployment of high-altitude interceptors. Then, the United States developed low-altitude, radar-evading flying tactics for its large B-52 bombers. When the Soviets figured out how to intercept these B-52s, the United States developed stand-off missiles that its bombers could launch. These missiles were much smaller than the bombers, were more difficult to detect, and allowed U.S. to safely deliver munitions against numerous surface-to-air missile and radar sites. In the 1980s, the United States developed stealth technology which allowed its bombers to evade traditional tracking technologies, such as radar.

Throughout this multi-decade competition, it cost the U.S. Air Force far less to develop air offensive systems that could penetrate Soviet air defenses than it cost the Soviets to defend against them. The end result was that Russia diverted vast sums away from offensive systems that could harm the United States to build defensive systems that couldn't. In this, Washington forced the Soviets to react to what defense experts now describe as a competitive strategy.

The Soviet communists knew their rule was far from popular; they feared political decapitation. As a result, they spent heavily on defensive systems to protect against the latest U.S. offensive air system that might threaten their command centers and decapitate them militarily. Ultimately, defending against this threat helped bankrupt the Soviets. The United States encouraged Moscow to worry about being attacked, got it to spend money on systems that couldn't strike the United States, and kept the competition going at a relatively lower cost to Washington until the Soviets literally went out of business.

The United States also deployed ballistic missiles to penetrate Soviet missile defenses. When the Russians developed crude nuclear anti-ballistic missile defenses, the United States developed multiple independently targetable reentry vehicle systems (MIRVs – missile payloads consisting of several warheads that can be aimed against different targets) to penetrate Moscow's system. The United States also developed maneuvering reentry vehicles (MaRVs), a missile warheads that can maneuver in the atmosphere on unpredictable trajectories and yet hit their intended targets with terminal guidance precision. In the 1980s, United States deployed MaRVs on its intermediate-range Pershing II missiles to punch through Warsaw Pact defenses and threaten Soviet command bunkers.

Today, to deal with more advanced air and missile defenses, Russia, China, Iran, India, South Korea, and North Korea, all have maneuvering reentry vehicles. In addition, China, Russia, the United States, and India are working on hypersonic boost glide and powered hypersonic systems that can fly 5 to 25 times the speed of sound to punch through air and missile defenses. The United States, China and others are also currently developing "swarms" of cheap unmanned systems to overwhelm air defenses.

This brings us to the **SIXTH HURDLE** Wohlstetter identified—that an effective strategic force must be able to destroy its targets (and be able to know it has), even if these targets are passively defended.

Wohlstetter worried that mobile, survivable ICBMs and SLBMs might not be numerous enough nor have sufficient nuclear payloads to destroy defended, mobile, or hardened targets. Today, the United States can hit and destroy many of Russia's military silos as can the Russians against the United States. That's one reason France eliminated their silo-based missiles and why North Korea, Russia and China developed mobile missile systems.

FIGURE 13: China's Underground Great Wall

In addition, the United States now has the challenge of targeting deeply buried, hardened targets. An important deep, underground command and nuclear basing system is China's Underground Great Wall. This system consists of 3,000 miles of deep underground tunnels that Chinese nuclear-capable missiles can be launched from.[29] Russia also has a deep underground command system. It was actually upgraded and improved after the Cold War, which suggests the Russians still think a nuclear war is possible.[30] This Russian command center is very large and very difficult to knock out.

There also are deep targets in Iran. Austrian drilling equipment enabled the Iranians to burrow their nuclear enrichment plants and nuclear-capable rockets into mountains. Iran also has used ultra-high performance concrete to protect some of its underground nuclear enrichment plants. North Korea, meanwhile, has over 10,000 deeply buried military tunnels.

How one puts these underground targets at risk without using nuclear weapons is not entirely clear. Some experts argue that we need to develop better "earth penetrating" nuclear warheads. Others argue that we must locate all of the entrances to underground facilities and keep bombing them so that nothing can get out. This would be a stressful intelligence and military task. The challenge of destroying key targets remains.

Persistence: The Final Hurdle

Clearing all six of these hurdles is challenging. Initially, new nuclear states downplay the difficulty of doing so, but, over time, they almost always discover how hard surmounting these hurdles is. Once they do surmount them, though, they must keep at it. Albert Wohlstetter once recounted how, in the mid-1950s, he briefed a group of portly middle-aged generals and corporate figures on RAND's bomber base vulnerability study. They asked him at what point the

29. See, William Wan, "Georgetown Students Shed Light on China's Tunnel System for Nuclear Weapons," *The Washington Post*, November 29, 2011, available from http://www.washingtonpost.com/world/national-security/georgetown-students-shed-light-on-chinas-tunnel-system-for-nuclear-weapons/2011/11/16/gIQA6AmKAO_story.html.

30. Bill Gertz, "Russia Building New Underground Nuclear Command Posts," *The Washington Free Beacon*, August 15, 2016, available from http://freebeacon.com/national-security/russia-building-new-underground-nuclear-command-posts/.

United States might clear these hurdles so it could stop spending to upgrade its nuclear strategic forces. He replied, "well gentlemen, it's a bit like trying to keep your weight down after age 30; it's a constant effort." At that point, Wohlstetter recalled, "you could hear everyone around the table sucking their guts in to minimize their midriffs."

Of course, surmounting Wohlstetter's six barriers does not guarantee your nuclear forces will succeed in deterring all forms of aggression. Instead, they are necessary to ensure that your forces won't encourage your adversaries to attack them, that they won't be prone to accidents or unauthorized use, and, if used, they will not be militarily useless or worse.

V. How sound are the most popular views on nuclear deterrence and the first use of nuclear arms?

Reviewing the requirements to stand up a credible deterrent force is helpful, but it does not tell us how nuclear deterrence might work after one has met the requirements. Is it sufficient merely to target your opponent's cities? Is it credible or desirable to foreswear using your nuclear weapons first against an opponent? Is it wasteful to get more weapons than might be needed to wipe out your opponent's population centers? To get the answers to these questions, it is useful to understand and analyze the doctrines of finite deterrence and no first use — two popular ideas that enjoy considerable support.

In the late 1950s, the arms control community worried that U.S., Russian, and NATO acquisition of ever larger yield nuclear weapons in ever larger numbers was increasing the odds of accidental or unauthorized nuclear use. This prompted security experts to ask how many nuclear weapons a country might need to deter attacks against itself. The quick answer was a "finite" number. What did such a nuclear arsenal consist of? Enough weapons to destroy most of an adversary's large population centers. Why just these targets? The answer had to do with the inaccuracy of the nuclear delivery systems then available.

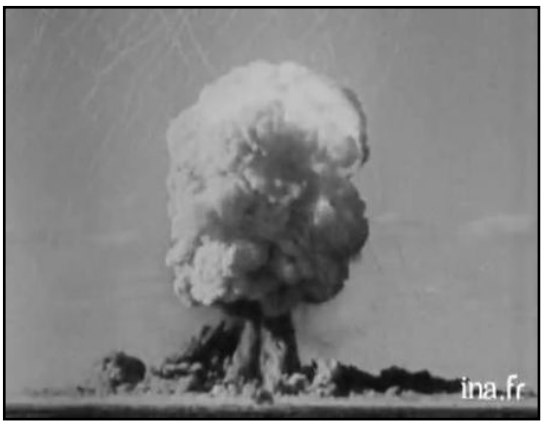
In the 1950s and early 1960s, aerial bombing aiming accuracies were still so poor that multi-megaton nuclear weapons were needed to ensure the destruction of point targets. The end result was that, even if the United States only wanted to destroy Russian nuclear forces and its military infrastructure (these were referred to as "Bravo" targets), it would invariably end up killing many millions of Russian civilians. For these reasons, large industrial centers or cities (known as "Delta" targets) were explicitly targeted during much of the Cold War.[31]

31. For a brief history of U.S. thinking on deterrence, see Michael S. Gerson, "The Origins of Strategic Stability: The United States and the Threat of Surprise Attack," in Elbridge A. Colby and Michael S. Gerson, eds., *Strategic Stability: Contending Interpretations*, Carlisle, PA: Strategic Studies Institute, 2013, available from https://www.globalsecurity.org/military/library/report/2013/ssi_colby-gerson.htmand David Alan Rosenberg, "The Origins of Overkill: Nuclear Weapons and American Strategy, 1945-1960," in Steve Miller, ed., *Strategy and Nuclear Deterrence: An International Security Reader*, Princeton, NJ: Princeton University Press, 1984, pp. 113-181, available from http://nuclearpolicy101.org/wp-content/uploads/Restricted/Rosenberg_The-Origins-of-Overkill.pdf.

Similarly, in the late 50s and early 60s, the aiming accuracies of US submarine-based delivery systems (mostly crude cruise missiles) were poor. Officials assumed that the submarine-launched ballistic missiles then under development would be inaccurate as well. The difficulty of determining where the submarine itself was compounded by inaccuracies generated during the missile's flight. Submarine-based cruise missiles at the time, such as the Matador and Regulus, had gyroscopes guiding them with inherent drifting errors that over hours of flight took these missiles miles off course. This led many experts to believe that submarine-launched missiles would be lucky if they hit within several miles of the intended target. These factors, again, encouraged the use of larger and larger yield nuclear weapons against the largest, softest targets—cities.

It was during this period, that two major military proponents made the case for "finite" deterrence. The first was the French military, which in the late 1950s wanted nuclear weapons.[32] The French reasoned that even though France was a member of NATO, which was protected by American and British troops and nuclear weapons, France couldn't count on the United States or the UK to risk American or British lives to save French ones. If Washington or London ever used nuclear weapons in defense of France, the French reasoned, it would only invite Russian retaliation against American and British cities.

French officials concluded that France had to rely on itself. Although France could not destroy Russia, it could use a few nuclear weapons to "tear off a [Soviet] arm" by targeting several major Russian cities. This, they insisted, would be enough to ensure Russia never attacked France. In an effort to be evenhanded, the French made a point of threatening nuclear attacks not just against the Soviets, but everyone (*tous azimuts*), including friends, such as the United States.



32. See, Bruno Tertrais, "'Destruction Assurée': The Origins and Development of French Nuclear Strategy," in *Getting MAD: Nuclear Mutual Assured Destruction, Its Origins and Practice* , pp. 51-122, available fromhttp://www.npolicy.org/books/Getting_MAD/Full_Book.pdf ; and David S. Yost, "France's Nuclear Deterrence Strategy: Concepts and Operations Implementation," in Getting MAD: Nuclear Mutual Assured Destruction, Its Origins and Practice, pp. 197- 237, available from http://www.npolicy.org/userfilesfile/Getting%20Mad-Frances%20Nuclear%20Deterrence%20Strategy.pdf. Also see, Pierre Marie Gallois, Strategie de l'age nucleair, Paris: Francois-Xavier de Guibert, 1960.

Much of this was rebuttable. RAND analyses in the 1970s determined that the first generation French force was so vulnerable to a Soviet first strike that it would take only a small fraction of the Soviet's theater nuclear force to knock it out.[33] The French were aware of this. They decided to develop not just air-delivery, but also medium and intercontinental ballistic missiles based in silos. After these silo-based missiles became vulnerable to accurate Russian missiles and bombers, the French spent additional billions of dollars to develop and deploy less vulnerable nuclear ballistic missile submarines. As a result, France's "finite deterrence" force today is relatively small but quite expensive.

The other early proponents of finite deterrence were supporters of the U.S. Polaris ballistic missile submarine program. In the 1950s, the U.S. Navy hit on the idea of putting ballistic missiles on nuclear submarines, arguing they would be much less vulnerable to attack than bomber bases. At the time, the Strategic Air Command (SAC) controlled all of America's strategic nuclear arsenal. The Navy wanted in on this strategic mission, but SAC argued that it already had everything covered.

FIGURE 15: Polaris submarine launched ballistic missile

The submarine proponents countered that with a much less vulnerable submarine-based force, the United States wouldn't need so many nuclear weapons or delivery systems. Instead, it would only need a few warheads on a few submarines. Given the Navy thought it couldn't hit anything accurately, it initially assumed it could only target cities. This, the Navy argued, was a plus since the target set didn't require many warheads to destroy.[34] As the Polaris missile technology was deployed, though, the missiles turned out to be much more accurate than the Navy originally projected, and this accuracy only improved over time. Now, our Trident submarine missiles are just as accurate as our silo-based ICBMs.

Finite deterrence, then, was based on French and U.S. Navy assumptions that turned out to be wrong. The French nuclear force during the Cold War may have only made Russia *more* likely to aim its nuclear weapons at France, not less, and the U.S. Navy's assumption that it should aim at a few cities, since its missiles would not be able to hit anything else, was mistaken. Neither of these facts, however, killed the idea of finite deterrence.

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33. See Albert Wohlstetter, "Nuclear Sharing: NATO and the N+1 Country," *Foreign Affairs* 39, no. 3, April 1961, pp. 355-387, available from http://npolicy.org/userfiles/file/Nuclear%20Heuristics-Nuclear%20Sharing.pdf.

34. See, Commander P.H. Backus, "Finite Deterrence, Controlled Retaliation," *U.S. Naval Institute Proceedings*, March 1959, pp. 23-29; Harvey Sapolsky, "The U.S. Navy's Fleet Ballistic Missile Program and Finite Deterrence," in Henry Sokolski, ed. *Getting MAD: Nuclear Mutual Assured Destruction, Its Origins and Practices*, pp. 123-135, available from http://www.npolicy.org/userfiles/file/Getting%20Mad-The%20US%20Navys%20Fleet%20Ballistic%20Missile%20Program%20and%20Finite%20Deterrence.pdf; William Burr, "'How Much is Enough?': The U.S. Navy and 'Finite Deterrence,'" *National Security Archive*, Electronic Briefing Book No. 275, May 1, 2009, available from http://www.gwu.edu/~nsarchiv/nukevault/ebb275/index.htm; and David Alan Rosenberg, "The Origins of Overkill: Nuclear Weapons and American Strategy, 1945-1960," in Steven E. Miller, Ed., *Strategy and Nuclear Deterrence: An International Security Reader* (Princeton, NJ: Princeton University Press, 1984), 113-181.

Today, one can find arguments that to reduce our nuclear weapon arsenals further we need to limit our targeting to only a few "high value" targets—cities. If we did this, it's argued, we wouldn't need so many nuclear weapons. This line of reasoning is a favorite of the arms control community.[35] The problem with this thinking, though, is if you had a choice, would you ever *want* to kill innocents? If not, does it make sense to design a force and policies to do so?

The No First Use Debate

In a not so conscious effort to skirt this set of questions, many experts have suggested that nuclear-armed states should pledge never to be first to use nuclear weapons. If everyone promised to do this, they insist, we would not have to worry about anyone ever using nuclear weapons.

FIGURE 16: Sir Michael Quinlan

Sir Michael Quinlan, who was responsible for British nuclear weapons targeting policy during much of the Cold War, is worth reading on this matter.[36] Later in his life, he was keen on promoting arms control and was by no means a dyed-in-the-wool enthusiast for nuclear weapons. Yet, he had a very austere argument on why pushing a no first use policy was unsound.

Any country with the capability to threaten to use nuclear weapons could still announce, as the United States has, that it had a preference not to use nuclear weapons against anyone. Yet, it may also have scenarios in mind where its interests would be so threatened it would want to make it clear to the other side that if "you cross these lines we will use them." In this case, the last thing you would want, Quinlan argued, would be to encourage the other side to misread or take advantage of your preference to not use nuclear weapons.

Certainly, the idea that a preference not to use nuclear weapons first should be turned into an absolute policy struck Quinlan as a very bad idea. Quinlan thought no country that acquired nuclear weapons could refuse to threaten to use them first without essentially forfeiting the deterrence value they might have. If one belives that nuclear weapons are *only* good for deterring nuclear wars is opposed to nuclear weapons, pushing a no first-use policy may be problematic.[37]

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35. See, e.g., Benjamin Friedman, Christopher Preble, and Matt Fay, "The End of Overkill: Reassessing U.S. Nuclear Weapons Policy," *CATO Institute*, 2013, available from http://nuclearpolicy101.org/nuclear-deterrence-readings/ and Harold Smith and Raymond Jeanloz, "Britain Leads the Way to Global Zero," *Arms Control Today* 40, no. 10, December 2010, available from http://nuclearpolicy101.org/nuclear-deterrence-readings/. For a counterargument, see Keith B. Payne, "Why Do US Nuclear Force Numbers Matter for Deterrence?" *National Institute for Public Policy, Information Series* no. 404, March 9, 2016, available from http://www.nipp.org/wp-content/uploads/2016/03/IS-404.pdf.

36. See, Michael Quinlan, "Easements and Escape Routes." In *Thinking About Nuclear Weapons*, Oxford: Oxford University Press, 2009. pp. 99-111, available from http://nuclearpolicy101.org/wp-content/uploads/Restricted/Quinlan_Easements-and-Escape-Routes.pdf.

37. For a counterargument that makes the case for a no first use policy, see Scott Sagan, "The Case for No First Use," *Survival* 51, no. 3, June-July 2009, pp. 163-182, available from https://www.files.ethz.ch/isn/123390/2009_10_NFU_Forum_Proof.pdf. Michael Krepon also makes a case for No

What Do Nuclear Weapons Deter?

There are more than a few cases where the threat of nuclear use is claimed to have prevented wars or to de-escalate them. During the Korean War, the United States hinted it might use nuclear weapons. Some claim that this helped bring the Chinese and the North Koreans to the negotiating table and to agree to a truce.[38]

In the Suez Crisis of 1956, the threat of using nuclear weapons by the Russians was met by a counter-threat from the United States, which many historians believe helped bring that war to a halt. Similarly, most experts believe that fear of nuclear weapons use convinced both sides of the Cuban Missile Crisis to reach an agreement.[39]

Then, there is the 1973 Israeli War. Early in the fighting, it appeared Israel might lose. The Israelis put their nuclear capable missiles on alert (a step the United States, which was shipping Israel arms, noticed and worried it might presage nuclear use). When the war quickly turned to Israel's favor, though, the Russians threatened to insert their own troops to protect Egypt and Syria. In response, President Nixon put U.S. strategic forces on high alert (DEFCON 3; there's only two more nuclear alert levels — DEFCON 1 and 2). The Russians stood down, and the Israelis took guidance from Washington to end their offensive.[40]

All of these cases suggest nuclear weapons, and their threatened use, deterred the worst. Yet, many cases, there are critiques that suggest nuclear persuasion was hardly in play, or that plans to rely on nuclear threats would have been a mistake.[41]

First Use, but argues that the posture should change gradually and should not occur while Donald Trump is in office. See Michael Krepon, "Not Just Yet for No First Use," *Arms Control Wonk*, July 31, 2016, available from http://www.armscontrolwonk.com/archive/1201722/not-just-yet-for-no-first-use/. During the Obama presidency, U.S. allies like Japan, South Korea, France, and Britain expressed concern about the possibility of the U.S. establishing a no first use policy and the impact it would have on the credibility of the U.S. nuclear security umbrella. See Josh Rogin, "U.S. allies unite to block Obama's nuclear 'legacy'" *The Washington Post*, August 14, 2016, available from https://www.washingtonpost.com/opinions/global-opinions/allies-unite-to-block-an-obama-legacy/2016/08/14/cdb8d8e4-60b9-11e6-8e45-477372e89d78_story.html?utm_term=.902cee0531f6.

38. See, however, William I. Hitchcock, "Washington Post: Trump Threatened to Nuke North Korea, but Did Ike Do the Same," *Concord Monitor*, August 13, 2017, available from http://www.concordmonitor.com/Did-Ike-threaten-to-nuke-North-Korea-11810248.

39. See, however, Matt Fuhrmann and Sescher.

40. For more on cases where nuclear weapons use was considered, see William C. Yengst, et al., "Nuclear Weapons that Went to War," draft final report DNA-TR-96, Alexandria, VA: Defense Special Weapons Agency, October 1996, available from http://www.npolicy.org/article.php?aid=80&rt=&key=nwtwtw&sec=article&author= and Fredrik Logevall, ""We Might Give Them a Few." Did the U.S. Offer to Drop Atom Bombs at Dien Bien Phu?" *Bulletin of the Atomic Scientists*, February 21, 2016, available from http://thebulletin.org/we-might-give-them-few-did-us-offer-drop-atom-bombs-dien-bien-phu9175..

41. See. e.g., Ward Wilson, "The Myth of Nuclear Deterrence," *Nonproliferation Review* 15, no. 3, November 2008, pp. 421-439, available from http://www.nonproliferation.org/wp-content/uploads/npr/153_wilson.pdf and a critique of nuclear bluffing and the so-called "Madmen" theory of nuclear deterrence, see Sebastien Roblin,

In the 1980s, South Africa argued that their nuclear weapons were designed to deter Communist aggression in Angola.[42] Others argue that the fate of Muammar Gaddafi and Saddam Hussein would have been different if either of them had actually acquired nuclear weapons. Proof of these points, however, is necessarily allusive.

That said, most nuclear-armed states don't need proof. The Pakistanis, looking at the Cold War in Europe, believe they can use their nuclear weapons to deter and a neutralize any Indian conventional or nuclear attack, as the United States claimed it could with the Soviets.[43] The Russians, meanwhile, believe that they can counter NATO conventional forces with Russian nuclear systems and can intimidate those opposing their wishes in the "Near Abroad." They even argue that early use of their nuclear weapons might quickly end conventional military crises.[44] Finally, Chinese military writing suggests that the threat of nuclear use might help China impose its will in the Western Pacific and the North Koreans subscribe to similar thinking regarding their nuclear arsenal's powers over South Korea, Japan, and the United States.

Given these countries' views, some analysts are now wary of overselling the strategic "stability" nuclear forces might instill.[45] It is one thing, they argue, to make American and Russian forces less vulnerable to first strikes. It is another to presume that these forces are perfectly invulnerable or that they would never be used first by anyone. Alternatively, if Moscow or other

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"Madmen With Nuclear Codes — An History of Unpredictable Foreign Policy," *War is Boring*, November 22, 2016, available from https://warisboring.com/madmen-with-nuclear-codes-an-history-of-unpredictable-foreign-policy/.

42. See John Mueller, "Deterring World War III: Essential Irrelevance." In *Atomic Obsession: Nuclear Alarmism from Hiroshima to Al Qaeda*, pp. 29-42, New York: Oxford, 2010, available from http://nuclearpolicy101.org/wp-content/uploads/Restricted/Mueller_Atomic-Obsession_full-book.pdf. Password Protected PDF.

43. For more on Pakistan's reliance on nuclear weapons, especially tactical ones, to offset India's conventional superiority and the problems this posture might pose, see Jeffrey D. McCausland, "Pakistan's Nuclear Weapons: Operational Myths and Realities," *Stimson Center Analysis*, March 10, 2015, available from https://www.stimson.org/sites/default/files/file-attachments/McCausland.pdf.

44. For more on Russia's escalate to deescalate strategy and nuclear posture, see Elbridge Colby, "Russia's Evolving Nuclear Doctrine and its Implications," *Foundation pour la Recherche Stratégique* no. 1, January 2016, available from https://www.frstrategie.org/en/publications/notes/russias-evolving-nuclear-doctrine-implications-2016 and Mark Schneider, *The Nuclear Forces and Doctrine of the Russian Federation*, Fairfax, VA: National Institute Press, 2006, available from http://www.nipp.org/wp-content/uploads/2014/12/Russian-nuclear-doctrine-NSF-for-print.pdf.

45. For example, a competitive strategies analysis done by CSIS argues that due to U.S. conventional superiority adversaries could develop nuclear use strategies with low yield weapons to get the U.S. to "back off" early in a conflict. See Clark Murdock, et al., *Project Atom: A Competitive Strategies Approach to Defining U.S. Nuclear Strategy and Posture for 2025-2050*, CSIS Reports, Center for Strategic & International Studies, May 2015, available from https://csis-prod.s3.amazonaws.com/s3fs-public/legacy_files/files/publication/150601_Murdock_ProjectAtom_Web.pdf. For an analysis of whether the United States would or should respond to a nuclear or other WMD attack in kind, see Tod Lindberg, "Nuclear and Other Retaliation After Deterrence Fails," in Henry D. Sokolski, ed., G*etting MAD: Nuclear Mutual Assured Destruction, Its Origins and Practice*, pp. 317-339, available from http://nuclearpolicy101.org/nuclear-deterrence-readings/.

nuclear-armed adversaries presumed the United States would never want to strike first, the deterrence value of U.S. forces against hostile nuclear strikes would vanish.[46]

These considerations alone would suggest that nuclear deterrence is less than perfect or assured.[47] As such, optimism that they can be counted upon to keep the peace, will always deter aggression, and that their further spread or possible use are of little moment, is likely just that — optimism.[48]

46. For more on this point, see, e.g., Elbridge A. Colby, "Defining Strategic Stability: Reconciling Stability and Deterrence," in Elbridge A. Colby and Michael S. Gerson, eds., *Strategic Stability: Contending Interpretations*, Carlisle, PA: Strategic Studies Institute, 2013, available fromhttps://www.globalsecurity.org/military/library/report/2013/ssi_colby-gerson.htm .

47. For a brief analysis of additional emerging considerations that suggest that the future of nuclear deterrence is uncertain, see Andrew Krepinevich, "The Eroding Balance of Terror," *Foreign Affairs*, January/February 201 available at http://nuclearpolicy101.org/wp-content/uploads/2018/12/Krepinevich_Eroding_Balance_of_Terror.pdf

48. See, e.g., Keith Payne, "Minimum Deterrence: Examining the Evidence," Fairfax, VA: National Institute Press, 2013, available fromhttps://basicint.org/blogs/2013/09/minimum-deterrence-examining-examination; Chris Ford, "The Future of Nuclear Deterrence," *Hudson Institute*, March 17, 2011, available from http://nuclearpolicy101.org/nuclear-deterrence-readings/; Victor Gilinsky, "How Will the Nuclear Weapons Story End?" remarks prepared for the 10th PIIC Beijing Seminar on International Security, Xiamen, China, September 24-29, 2006, available from http://www.npolicy.org/article.php?aid=129&rt=&key=gilinsky%20how%20will%20the%20nuclear&sec=article&author=; and Victor Gilinsky, "What if the taboo on nuclear weapon use is broken," Paper prepared for 15th PIIC Beijing Seminar, October 16, 2016, available from http://nuclearpolicy101.org/wp-content/uploads/2017/08/What-if-the-taboo-on-nuclear-use-is-broken-1.pdf. On the human factors that could lead to nuclear weapons use, see Victor Gilinsky, "On Tickling the Dragon's Tail," *Bulletin of the Atomic Scientists*, February 26, 2016, available from http://thebulletin.org/tickling-dragon%E2%80%99s-tail9192.