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SILENT RETREAT

The Future of U.S. Nuclear Weapons

Dennis M. Gormley

The stage may be set for what could be a historic turning point in America's reliance on nuclear weapons to meet its fundamental national security interests. Proponents of a refurbished nuclear stockpile and infrastructure are convinced that nuclear weapons will remain central to U.S. security interests, yet they admit that there is no national consensus on the need for and role of nuclear weapons. Nuclear opponents are gravely concerned that to the extent nuclear refurbishment creates a global perception that nuclear weapons remain essential instruments, it will eviscerate nuclear nonproliferation measures precisely at a time when nuclear ambitions are growing. Moreover, opponents see deterrence through advanced conventional weapons as decisively more credible than any nuclear alternative. With hopes of elevating discourse to the national level, this article examines the key current arguments pro and con within the specialist community and forecasts changes in the U.S. nuclear arsenal over the next decade. It concludes with a brief prognosis on prospects for complete nuclear disarmament.

KEYWORDS: United States; Nuclear weapons; Reliable Replacement Warhead; Nonproliferation regime; National security

Never before has the U.S. nuclear weapons establishment been so unsettled about its very *raison d'être* and how it will manage in the future to remain substantially and meaningfully in business. In a startlingly frank assessment of U.S. nuclear capabilities conducted by the Pentagon's Defense Science Board (DSB) and released in December 2006, the DSB's pro-nuclear panel members concluded that there is no national consensus on the need for and role of nuclear weapons.¹ Pleading for decisive White House reaffirmation of the need for nuclear weapons, they depicted a flawed set of government defense organizations and senior national leadership unwilling to confront an "entrenched set of views held by an influential segment of the U.S. population" challenging plans to produce more usable nuclear weapons and outfit a new and expensive nuclear weapons establishment as inimical to nuclear nonproliferation efforts. Indeed, the capstone to these "entrenched" views came less than a month after the release of the DSB report, when George Shultz, William Perry, Henry Kissinger, and Sam Nunn coauthored an extraordinary commentary for the *Wall Street Journal*, calling on the United States to take the lead in immediately reducing its reliance on nuclear weapons while renewing efforts to work toward the goal of a nuclear-free world.² In light of past congressional opposition even to administration attempts to study—never mind produce—new nuclear weapon designs, and the results of the 2006 midterm elections that arguably make congressional opposition to costly new nuclear endeavors even more certain, the stage is set for what could be a historic turning

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point in America's traditional reliance on nuclear weapons to buttress its fundamental national security interests.

This article dissects and examines the key arguments on each side of the debates surrounding the future role of nuclear weapons in U.S. national security over the next decade. Before examining these debates in detail, it first explores the provenance and the key assumptions underlying each side's positions, particularly those that preceded the Bush administration's issuance of the 2001 Nuclear Posture Review (NPR). Next, in view of these debates and bearing in mind the difficulty of forecasting surprise shocks to the international system, the article briefly entertains the likelihood of quantitative and qualitative changes in the U.S. nuclear arsenal over the next decade. Finally, the article concludes by touching on those key factors shaping prospects for complete U.S. nuclear disarmament and discusses the feasibility of such an outcome.

What Is Past Is Prologue

The Bush administration's presentation of the 2001 NPR may not have represented the radical new departure from America's nuclear past that many commentators perceived, but it surely created enough controversy to nurture the now entrenched set of views that the 2006 DSB nuclear study finds so unsettling.³ To be sure, the authors of the NPR sought to reformulate a role for nuclear weapons that transcended the widely held notion, popular during the Cold War, that nuclear weapons were expected to deter strikes not only on the U.S. homeland, but upon allies in Europe and Asia, too. The logic of nuclear deterrence during the Cold War depended centrally on the capacity to deliver a devastating second-strike attack against nuclear-armed adversaries. But there have always existed determined strategists who were dissatisfied with that form of strategic stalemate, which became known as mutual assured destruction, or more pejoratively cast, MAD. These strategists questioned this circumscribed role for nuclear weapons and contemplated the integration of battlefield nuclear weapons and "limited nuclear options" into counterforce strategies.⁴ In short, nuclear utilization target selection—just as pejoratively, NUTS—argues that the design of nuclear weapon should derive from the need to perform a specific military mission (say, attacking deep underground targets with a minimum of collateral damage) with great effectiveness.⁵ The latter quality renders nuclear use credible in the mind of one's adversary, without which, so goes the NUTS argument, deterrence is unachievable. The reappearance of the NUTS argument in the 2001 NPR produced a predictable, but in many ways, much more persuasive riposte than even the NUTS theorists might have predicted.

The end of the Cold War found a growing community of nuclear abolitionists arguing that a rare opportunity was at hand in the long-standing quest to eliminate nuclear weapons globally.⁶ Even those less keen to see nuclear weapons disappear drew hope for their substantial reduction from the collapse of the Soviet Union and the dissolution of the Warsaw Pact. No less important was the performance of smart conventional weapons during the 1991 Gulf War, which sparked a reassessment of nuclear weapons policy within the defense community. The idea that these highly precise weapons might represent a far more credible and usable instrument of war fighting and

(hence) deterrence found currency among an increasing number of military officers. In a series of war games sponsored by RAND Corporation between 1991 and 1993, military participants generally found nuclear weapons extraneous because smart conventional ones were capable of destroying virtually every military target that was once the exclusive province of nuclear weapons.⁷ About the same time, three prominent “wise men” of the U.S. national security establishment—McGeorge Bundy, Adm. William J. Crowe, and Sidney Drell—wrote in *Foreign Affairs*: “There is no vital interest of the U.S., except deterrence of nuclear attack, that cannot be met by prudent conventional readiness.”⁸ No less significantly, on December 5, 1996, 61 retired senior military officers from 17 countries, including U.S. Army Generals Andrew Goodpaster, Bernard Rogers, and John Galvin, all former NATO commanders, and U.S. Air Force General Lee Butler, former commander of the U.S. Strategic Command (STRATCOM), signed a joint statement calling for the substantial reduction of nuclear weapons and their ultimate elimination. In a separate joint statement released by Generals Butler and Goodpaster, they reasoned that “conventional capabilities can provide a sufficient deterrent and defense against conventional forces and, in combination with defensive measures, against the threat of chemical or biological weapons.”⁹

But perhaps the most profound source of diminishing the continued salience of nuclear weapons came from a most unexpected source, Paul H. Nitze, one of the principal architects of U.S. containment and nuclear deterrence policy. Writing in the *Washington Post* in January 1994, Nitze argued that it was time for the United States to reexamine its long-standing reliance on nuclear deterrence. He reasoned that the threat of nuclear retaliation would be unlikely to deter aggression by regional powers. What’s more, U.S. decisionmakers would be unwilling to use nuclear weapons to punish aggression. Instead, Nitze recommended converting the principal U.S. strategic deterrent from nuclear weapons to smart conventional weapons. Nitze believed that a conventional strategic deterrent would provide the United States with a more credible and flexible instrument of warfare. Most pointedly, Nitze observed that “it may well be that conventional strategic weapons will one day perform their primary mission of deterrence immeasurably better than nuclear weapons if only because we can—and will—use them.”¹⁰

Nitze’s invitation to examine whether or not it was time to “junk” America’s dependence on nuclear weapons fell largely on deaf ears within the broader defense and arms control communities. Most likely, these two communities perceived that unprecedented U.S. military superiority in conventional capabilities already sufficed to greatly diminish the salience of nuclear weapons. But Nitze’s argument was predicated not so much on the undeniable reality of U.S. military advantage than on whether or not that advantage could be translated into a truly potent capability to deny potential adversaries their specific military goals, as opposed to merely threatening them with overwhelming conventional retaliation.

Diehard nuclear advocates were also fixated at the time, as they are today, on the spread of biological and chemical arms as well as nuclear weapons. For them, the issue became how best to deter these weapons from ever being used, and conventional options were considered unavailing. Instead, the answer centered about the credibility and utility of nuclear options. Britain’s Sir Michael Quinlan best depicted the concern when he

examined in 1997 whether or not the mere existence of a nuclear stockpile (“an inert pile of materiel”), no matter its quality or reliability, was sufficient to deter potential adversaries from using nuclear, biological, or chemical weapons.¹¹ Of course, the U.S. nuclear arsenal was then and is today far from being “inert.” But Quinlan’s question struck at the heart of the nuclear establishment’s enduring worry about sustaining the nuclear stockpile over the next 50 years, especially without the benefit of further nuclear testing. Such anguish led the Pentagon’s DSB to create a task force on nuclear deterrence, which, in a report issued in 1998, found that the credibility of nuclear deterrence threats was destined to suffer from general erosion of nuclear expertise within the Department of Energy’s weapons laboratories, the Department of Defense, and the military services.¹² Such erosion, they argued, stemmed not only from the absence of new weapon development and testing, but also from the virtual demise of serious long-range nuclear planning within military circles.

The 2001 Nuclear Posture Review

The 1998 DSB report essentially set the stage for the Bush administration’s pronounced reformulation of the continuing importance of nuclear weapons in the guise of the 2001 NPR. The waning credibility of nuclear threats played a feature role but in a radically new way. In effect, it married Paul Nitze’s notion of strategic conventional strike to a substantially reduced nuclear force and accompanying stockpile, active and passive defenses, and a revitalized defense infrastructure to create the “New Triad.”¹³ The 2001 NPR, which appeared in late December of that year, reflected President George W. Bush’s November 2001 decision to reduce “operationally deployed” U.S. nuclear warheads by two-thirds to a level of 1,700–2,200 by December 2012.¹⁴ This provided the chief architects of the NPR room to argue that the New Triad would at once reduce reliance on nuclear weapons while necessitating improvements to existing nuclear weapons to make them more responsive to emerging threats, as well as to a decidedly more uncertain strategic environment compared to the Cold War.

While the 1998 DSB report had foretold the 2001 NPR’s attention to improving existing nuclear weapons and perhaps even producing new ones, the NPR’s inception of the non-nuclear leg of the New Triad was prefigured in the report of the congressionally mandated National Defense Panel in 1997. As that panel argued, “Advancing military technologies that merge the capabilities of information systems with precision-guided weaponry and real-time targeting . . . may provide a supplement or alternative to the nuclear arsenals of the Cold War.”¹⁵ Indeed, nine months prior to the NPR’s release, a Washington think tank released a report that largely advanced the logic of the 1997 National Defense Panel into a “New Triad” of slightly different makeup than the NPR’s.¹⁶ Notably, the report, titled *The Transformation of Strategic-Strike Operations*, gave substantially more attention to the role of long-range precision strike and electronic-strike capabilities (so-called non-kinetic weapons) as a means of diminishing the role of strategic nuclear weapons than did the NPR. In the end, although the 2001 NPR dealt with both nuclear and non-nuclear capabilities and can rightfully take credit for

formalizing the New Triad, it telegraphed its authors' preferences by devoting the lion's share of its attention to nuclear capabilities.¹⁷

Most importantly, the 2001 NPR articulated a rationale for why existing nuclear weapons were incapable of dealing with emerging new threats. New capabilities were needed to defeat hardened underground sites housing a variety of military targets, including weapons of mass destruction (WMD), missile bases, and supporting leadership cadres; mobile and relocatable targets (meaning ballistic and cruise missile launchers armed with WMD warheads); and biological and chemical agents.¹⁸ Moreover, improved delivery accuracy and lower collateral damage were deemed necessary to enhance the credibility of nuclear threats. Existing nuclear weapons were believed insufficient to deal with these threats because they were generally not accurate enough and their nuclear yields were too large to make them a discrete and credible threat in the eyes of the targeted adversary. Thus, the United States risked being self-deterred.

The NPR's authors devoted most attention to earth-penetrating nuclear weapons. They proposed studying the feasibility of converting existing nuclear bombs into earth penetrators adequate to contain collateral damage while destroying the target. Such a study offered hope that a more usable nuclear device could then be developed, which would enhance the credibility of an otherwise diminishing U.S. nuclear stockpile. But both houses of the U.S. Congress were steadfast in their aversion to sponsoring or even studying new nuclear weapon programs at a time when America possessed overwhelming conventional dominance against any prospective major competitor. The Republican-controlled Congress deleted all funding for the nuclear earth penetrator and research into new types of nuclear weapons with reduced collateral damage in the fiscal 2005 and 2006 appropriation bills.¹⁹ In its 2007 budget request, the administration decided not to request any funding for the nuclear earth penetrator study and instead turned its attention to supporting the Reliable Replacement Warhead (RRW) program, which was approved by Congress in late 2004 and is designed "to improve the reliability, longevity, and certifiability of existing weapons and their constituents."²⁰ Skeptics fear that the RRW program will inevitably gravitate toward developing new nuclear weapons, although no military requirement currently exists for such a new weapon, and could reopen pressures for the resumption of nuclear testing.

Dissecting Current Nuclear Debates

There is no national debate on the need for particular types of nuclear weapons to achieve the kind of role foreseen by the authors of the 2001 NPR. Limited polling does suggest that the American public concurs with conservative nuclear proponents that the post-Cold War security environment in many respects presents more uncertainties and complexities than during the Cold War. In a March 2005 poll commissioned by the Associated Press, a majority of respondents believed that it is likely that terrorists or a state will employ nuclear weapons within a five-year period. Yet, the same poll reports that two-thirds of those polled said that no nation, including the United States, should possess nuclear weapons.²¹ Of course, a fundamental ambivalence underlies most American views on nuclear weapons. While most Americans would prefer a nuclear-free world, they realize

the challenge lies in getting to that point safely, and that in the meantime, some nuclear weapons are likely to remain important to America's national security interests.²² But regarding the question of what kind of nuclear deterrent to maintain, the 2006 DSB report is probably correct in stating, "there are sharp differences [publicly] on the role and complexion of how the U.S. nuclear deterrent should shape the security environment."²³ With Iraq consuming strategic preoccupation on both the official and the popular level, no robust public debates have occurred.

Were such a debate to take place, a useful starting point would be to entertain what the 2006 DSB report calls "an entrenched set of views held by an influential segment of the U.S. population that transforming the stockpile is the wrong way to shape the security environment and counter nuclear proliferation pressures." Nuclear proponents believe that these deeply held negative views about the role of nuclear weapons have dominated public discourse and prevented the needed nuclear consensus from developing. Were the alternative views of nuclear proponents only more widely known and appreciated, the proponents maintain that a consensus would form around the need "to transform the nuclear enterprise to one effective in meeting the security threats we face today."²⁴

On the Feasibility and Importance of Nuclear Disarmament

According to the 2006 DSB report's authors, entrenched view number one is that "lower numbers of U.S. nuclear weapons are preferable regardless of the starting point, with zero as the ultimate goal." They claim that proponents of this view see nuclear abolition as a desirable end in itself, while occasionally arguing that a nuclear-free world would be safer because of U.S. advantages in conventional weapons. Left out, of course, is the widespread impression that nuclear weapons represent America's greatest threat. Alternatively, nuclear proponents see the desirability of a nuclear-free world as irrelevant because the technology for building nuclear weapons cannot be "erased from history." They immediately jump from declaring the impossibility of verifying such a nuclear-free world to asserting that the belief system of nuclear opponents would leave the United States with a nuclear deterrent inadequate to deal with current and emerging WMD threats. Their view is predicated on articulating a clear nuclear objective: achieving a nuclear force that possesses credible and sustainable capabilities (reliable, safe, and secure). Further, "a fundamental requirement for credibility is the belief by the potential adversary that we would execute our deterrent threat." An oft-repeated mantra of nuclear proponents is that deterrence is based upon capability (or the weapon's specific capacity to defeat a particular target) and will (or the aforementioned belief by the adversary that a U.S. president would authorize use of the weapon). Without this combination, proponents argue, deterrence is virtually assured of failing.²⁵

The nuclear proponents' argument on the demerits of nuclear disarmament comes up short in several respects. Many supporters of substantially reducing our reliance on nuclear weapons, including Nitze and numerous American general officers, are hardly utopian. Rather than depending on nuclear weapons as credible war-fighting instruments to meet the needs of deterrence, they generally seek to reduce the U.S. nuclear stockpile to a number sufficient to meet the needs of a "last-resort" posture against nuclear threats.

Generals Butler and Goodpaster argued for a substantial reduction in nuclear arsenals and a lowering of their alert status as a first step, followed by efforts aimed at “exploring the feasibility of their ultimate complete elimination.”²⁶ In his 1994 article, Nitze argued that smart conventional weapons would suffice for deterrence. Although he was more inclined than most advocates of conventional sufficiency to worry about the details, Nitze contended that nuclear weapons were unlikely to deter regional aggressors and that presidents would be unwilling to use them even to punish aggression.²⁷ The latter point is amply supported in the now public views of key policymakers. Secretary of Defense Robert McNamara and Secretary of State Dean Rusk both came to view the use of nuclear weapons as mostly “unthinkable” on political and moral grounds as well as military ones.²⁸ After the 1991 Gulf War, Colin Powell dismissed the utility of nuclear use, while his commander-in-chief, President George H.W. Bush, acknowledged in his memoir that he had ruled out a nuclear response in the 1991 Gulf War.²⁹

Nuclear proponents also take an overly myopic view of the elements of effective deterrence. Even the Bush administration’s 2006 Quadrennial Defense Review (QDR) rhetorically concedes that deterrence needs to be “tailored” to the unique features of the particular target.³⁰ What little attention the 2006 QDR devotes to tailoring deterrence ends up as being little more than an accounting of the New Triad’s conventional and nuclear features. But as M. Elaine Bunn has argued, tailoring deterrence must stretch beyond the New Triad to address “the full range of military capabilities, presence, and cooperation, as well as diplomatic, informational, and economic instruments.”³¹ Although Bunn agrees that the success of deterrent measures hinges on the credibility and clarity of the messages conveyed by U.S. decisionmakers, she maintains that tailoring implies that such messages—and any accompanying threats—must derive from a meticulous understanding of the society and leadership we intend to shape.

Similarly, extending deterrence guarantees to allies and friends depends on how the ally or friend views the component features of America’s deterrence strategy. Given the size and diversity of the existing U.S. nuclear stockpile, allies have rarely if ever sought reassurance that America possessed more usable or specially tailored nuclear weapons to enhance extending deterrence to allies. As David Yost has argued, despite the fact that most of America’s NATO allies understood the logic behind the U.S. argument that more usable nuclear weapons enhanced deterrence, they repudiated “any doctrine conveying the impression that nuclear weapons could be more readily employed.”³² There is similarly no good evidence that Japanese decisionmakers are any less reassured about America’s capacity to extend its deterrence guarantees to that nation because the U.S. Congress has failed to approve funding for a new nuclear earth penetrator. Indeed, the U.S. presence in East Asia and the growing U.S. conventional defense cooperation with Japan contribute far more substantially to reassuring Japan about America’s security guarantee than any conceivable new family of more usable nuclear weapons.³³

On the Causes of Nuclear Proliferation

Entrenched view number two of the nuclear opponents, as seen by nuclear proponents, is the belief that U.S. nuclear weapon initiatives cause others to see great value in nuclear

weapons, thereby encouraging their proliferation.³⁴ The corollary, of course, is that if only the United States did more to reduce the salience of nuclear weapons, it would have a palpably positive effect on U.S. efforts to reduce nuclear proliferation.

It is hard to dispute the nuclear proponents' argument that states acquire nuclear weapons because they view them as central to their national interests, not because of any particular nuclear-related activity of the United States.³⁵ Indeed, U.S. nuclear capabilities probably play only a minor role in Tehran and Pyongyang's motivations to acquire nuclear weapons. It is more likely that U.S. advanced conventional capabilities, when combined with confrontational policies, intensify Iran and North Korea's nuclear ambitions. That said, U.S. notions of making new nuclear weapons more usable foster the unwanted impression that they are instrumental to securing U.S. interests. Bolstering the perceived utility of nuclear weapons as the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) has become enervated can only undercut nonproliferation diplomacy—most notably with respect to Iran and North Korea.

For example, the Pentagon has linked America's post-September 11, 2001 formulation of the doctrine of preemption with nuclear weapons, attempting (unsuccessfully thus far) to modify military doctrine for nuclear operations to accommodate requests for preemptive nuclear use. One clear consequence of this aggressive articulation of the preemption doctrine is a global scramble among militarily ambitious states to adopt their own preemption doctrines, with untold—but hardly positive—repercussions for regional stability.³⁶ Washington has already had to quietly express its worries to Taiwan's leadership about its military's pursuit of offensive missile options coupled to a doctrine of "preventive self-defense." The fear, no doubt, is that Taiwan's actions might provoke China, whose military already embraces a doctrine of "actively taking the initiative" to catch the enemy unprepared.³⁷ The upshot of this shortsighted behavior is to undercut U.S. moral authority, placing America at a decided disadvantage in leading the international community toward building coalitions capable of dissuading states from pursuing nuclear weapons status.

Nuclear proponents counter this line of reasoning by arguing that a more usable nuclear deterrent is a more effective means of dissuasion. They also contend that the credibility of U.S. nuclear capabilities together with a willingness to employ them has moved "a number of nations" to defer decisions to go nuclear.³⁸ At the same time, nuclear proponents believe that such capabilities and intentions, which lie at the heart of America's extended deterrence concept, have both reassured allies and thereby reduced their motivation to go nuclear or increase their existing arsenal. Evidence for these assertions of policy impact is slim, if not altogether absent. As previously noted, while America's allies understand the U.S. rationale behind notions of nuclear credibility and usability, they generally prefer not to see any overt manifestation of such policies emerge as a central feature of their relationship with America. Nor is there evidence that brandishing "credible" nuclear threats has convinced states otherwise inclined to go nuclear not to do so. Such an argument downplays the burdensome challenges surrounding a state's decision to go nuclear, including the huge commitment of resources, the extraordinary personnel requirements, and the determination required of leadership under adverse international pressure (including the imposition of severe economic

penalties). Thus, the nuclear proponents' case constitutes an overly simplistic explanation of how and why states proliferate.³⁹

On the Relative Value of Nonproliferation and Nuclear Deterrence

Apropos entrenched view number three, nuclear proponents perceive that nuclear opponents have convinced the public that nuclear deterrence is a lower priority goal than nonproliferation. Nuclear proponents claim that, together with the (mistaken) view that any new nuclear developments cause states to go nuclear, this idea has produced a compelling logic for dismissing arguments in support of new nuclear initiatives and the refurbishment of America's nuclear infrastructure. Nuclear opponents further conclude that "even if a nuclear initiative might contribute to deterrence, it should not go forward." In other words, given the threat of nuclear proliferation, nonproliferation should always trump any U.S. nuclear enhancements efforts. The nuclear proponents' counterargument is that as long as WMD threats exist, the U.S. government's first priority is to protect the American people from attack. Thus, nuclear deterrence should always have a correspondingly higher priority than nonproliferation. Nuclear proponents worry most about a resurgent Russia and a rising China, inferring from these uncertainties the need to maintain and enhance nuclear deterrence indefinitely.⁴⁰

A key ingredient of the debate is the relative capacity of advanced conventional weapons, compared with nuclear weapons, to deter, assure, dissuade, and defeat U.S. enemies. The central question is: given U.S. conventional dominance, which arguably will only grow over the foreseeable future, how salient should nuclear weapons remain to meet the challenges of U.S. deterrence strategy?

Nuclear proponents offer little of substance to counter the nuclear opponents' principal argument about conventional sufficiency. In brief, the argument runs that since at least 1991, U.S. security has depended almost exclusively on increasingly smart conventional weapons, the effectiveness of which is arguably equal to that of nuclear weapons for attacking the kinds of targets the nuclear proponents believe are essential to keep at risk for deterrence purposes. The authors of the 2006 DSB report assert that nuclear disarmament or the absence of new and more credible nuclear weapons—presumably a more robust nuclear earth-penetrator weapon—would leave the United States with "a nuclear deterrent that is inadequate to address the variety of weapons of mass destruction . . . threats confronting the United States and its allies."⁴¹ The implication is that without a corresponding biological or chemical retaliatory capability, U.S. planners would be ill-prepared to deal with these adversary threats, particularly were such weapons stored in hardened underground facilities. Upon examination, however, the preponderance of evidence supports the proposition that for even the most challenging military missions, smart conventional weapons perform as well as nuclear weapons, even newly designed ones.⁴²

The role for which nuclear weapons seem most indispensable is in attacking strategic underground targets, of which U.S. intelligence believes there are roughly 2,000 of interest to U.S. planners. Because of their burial depth, a good number of these facilities are beyond the reach of existing conventional earth-penetrator weapons.⁴³ Many are

susceptible to destruction by one or more nuclear earth penetrators, but not without unwanted consequences. Because more than half of these strategic underground targets are located near or in urban areas, a nuclear attack could produce significant civilian casualties (depending on yield, between thousands and more than a million, according to the U.S. National Academy of Sciences).⁴⁴ Even in more remote areas, casualties could range between a few hundred to hundreds of thousands, depending on yield and wind conditions. A new nuclear earth-penetrator weapon, which the Bush administration has favored studying and the NPR endorsed but Congress rejected, would effectively capture a few hundred of these strategic underground targets, but some uncertain number would presumably remain beyond reach, and such weapons would still produce unwanted collateral effects.⁴⁵ Adversaries are shrewd enough to know that once their strategic facilities are at risk, they need only relocate their prized assets deeper underground. This is precisely why the U.S. intelligence community has discovered more than 10,000 underground facilities (not all of which are of strategic value), demonstrating that U.S. adversaries have already attempted to adjust to the U.S. revolution in precision conventional targeting.⁴⁶

Eliminating biological agents stored underground presents extraordinarily difficult targeting challenges for either nuclear or conventional penetrators. Because the intense fireball created by either a nuclear or conventional weapon would, in theory, sterilize biological agents stored in a confined space, knowing precisely where that space is becomes essential. Sometimes U.S. intelligence satellites succeed in closely monitoring the construction of strategic underground structures, as they have at the Iranian facility at Natanz, where uranium enrichment is taking place. But such success may be the exception rather than the rule, as these facilities frequently are not detected until it is too late to disclose the precise location of the facility, the specific construction techniques, and materials employed.⁴⁷ In the end, the best strategy may lie in persistent harassment, consisting of precise and repeated attacks with smart conventional weapons against ground-level adits supporting underground facilities. In 2003, Adm. James O. Ellis Jr., then head of STRATCOM, agreed that precision conventional weapons could do just as good a job as any nuclear earth-penetrating weapons by sealing off underground facilities through multiple attacks.⁴⁸

Finding and attacking mobile targets—foremost ballistic or cruise missiles armed with nuclear, biological, or chemical warheads—is admittedly a daunting operational task. Witness the fact that during the first Gulf War in 1991, the only major failure during the war was the inability of coalition air forces to destroy a single Iraqi mobile missile launcher.⁴⁹ Cold War planners entertained the notion that the robust destructive effects of nuclear weapons could compensate for inaccuracies in searching for such difficult-to-locate targets. Today's aversion to collateral damage would suggest that were small-yield nuclear weapons considered for use against missile launchers, it might only occur were they operating in unpopulated desert areas. But even in that case, weather uncertainty could yield highly unwelcome casualties, rendered all the more unnecessary by the extraordinary progress the U.S. military has recently achieved in finding and attacking fleeting targets.

Whereas coalition air forces came up empty-handed in Iraq during the 1991 air campaign, they achieved devastating effects during the 2003 war against Iraq. In his book on the 2003 Iraq war and its aftermath, *Washington Post* reporter Tom Ricks tells the story of how, in the midst of a huge three-day sandstorm and rainstorm that stalled the U.S. military advance on Baghdad, the U.S. Air Force nonetheless managed to find, attack, and destroy an Iraqi missile launcher and its related support vehicles located off the road, hidden deeply under trees, at night, in one of Baghdad's northern suburbs. An Iraqi Republican Guard captain later reported that the missile troops were so demoralized by the attack's effectiveness that they fled the area without returning to their unit. Word spread that a spy must have reported on the unit's location because no satellite or aircraft could operate with such effectiveness, given the combination of their cover and the adverse weather.⁵⁰

Conceptual and organizational changes have as much to do with these improvements as with new search capacity, notably that realized by unmanned aerial vehicles (UAVs) for dedicated reconnaissance missions. Conceptually, the U.S. Air Force has only recently recognized that finding and attacking WMD-armed mobile missiles (and terrorists of strategic value) cannot succeed with a one-size-fits-all doctrine, and that doing so constitutes a critically important and distinctively different combat goal, meriting specialized conceptual treatment.⁵¹ This also means that the air force alone cannot succeed in this difficult task. But with special operations forces and perhaps other support on the ground, seamlessly integrated with attack forces in the air, shortening the attack cycle against fleeting targets is eminently possible. The average time required to execute a time-sensitive targeting strike has fallen from two hours in 2002 to 10 minutes in 2004.⁵² The air force goal is now to achieve what their former chief of staff, Gen. John Jumper, called "time of flight" time-sensitive targeting, or hitting the target in the amount of time it takes for delivering the weapon—meaning less than a minute for a manned or unmanned weapons platform loitering nearby. While Israel, in its recent war in Lebanon, struggled to find and attack Hezbollah's ubiquitous short-range Katyusha rockets, which can be emplaced by one man in a matter of moments, Israeli air and ground forces effectively flooded the skies with UAVs networked together to provide loitering aircraft with precise targeting coordinates of detected medium- and long-range Hezbollah rocket launchers. As a result, Israel managed to destroy between 80 and 90 percent of Hezbollah's longer-range launchers (around 125), all within a time frame of between 45 and 60 seconds between detection and attack.⁵³

Of course, counterforce operations against WMD-armed mobile missiles represent only one layer of an effective conventional denial strategy. Yet to the extent counterforce attacks succeed in reducing the in-flight threat, they improve the prospects that ballistic and cruise missile defenses, together with passive defenses (vaccines for biological attack, for example) can handle surviving missile threats. Of course, should a nation threaten to use nuclear weapons against the United States or its allies, it would face the prospect of a devastating, last-resort nuclear response, which even the Bush administration admits is more than adequate to deter even enigmatic countries like North Korea.⁵⁴ That said, missile defense effectiveness—particularly as prospective adversaries perceive it—is a key measure of a denial strategy's potency. There is little evidence that foreign audiences

share American missile defense critics' belief that current or future missile defense technologies will not perform as promised.⁵⁵

Shorter-range components of a multilayered global system, consisting of Standard SM-3 interceptors deployed on Aegis-class cruisers/destroyers and ground-based Patriot PAC-3 interceptors, have performed admirably both in recent tests and, in the case of Patriot, in combat.⁵⁶ The chief limitation in this category of defense lies in America's imperfect cruise missile defense posture, which is less a product of technological impediment than organizational discipline. Defending against low-flying cruise missiles depends critically on netting various service sensors together, but each service approaches the problem as if the other services didn't exist. The only solution may rest with removing control of financial resources from the individual services and placing cruise missile defense under the control of a coordinative Pentagon agency.⁵⁷

The only place nuclear weapons would figure into missile defenses would be to compensate for the problems mid-course interceptors face in discriminating between real and decoy targets. In 2002, then-Secretary of Defense Donald Rumsfeld encouraged the DSB to study using a small nuclear-tipped interceptor, which would both reduce hit-to-kill uncertainties and in theory destroy decoys as well. But nuclear indiscriminateness in space has its own drawbacks, specifically with regard to damaging unhardened commercial satellites.⁵⁸ Not surprisingly, the notion failed to achieve any political support, as Congress banned spending for the idea in the 2003 appropriations bill. Given the state of advances in U.S. conventional weapons technologies, the initial decision to abandon nuclear interception three decades ago was surely the right course of action, technically and politically. In view of not just America's overall conventional military dominance but also its robust existing capabilities in specific mission areas for nuclear weapons, deterrence through conventional weapons is decisively more credible than it is through any existing or prospective nuclear alternatives because U.S. adversaries know that the United States will use conventional weapons if compelled to do so.

On What Nuclear Weapons Should Deter

According to nuclear proponents, entrenched view number four is the proposition that nuclear weapons should only deter nuclear threats. Therefore, to the extent nuclear weapons have a role to play, it is a much narrower one than what the nuclear proponents argue for. It can safely be assumed that such a diminished nuclear salience would include reducing not only the numbers of nuclear weapons but also their role in every conceivable way except as weapons of last resort.

The alternative position of nuclear proponents is that while nuclear threats alone would justify new nuclear developments, the latter are particularly compelling in light of the biological and chemical threats the United States and its allies face. Nuclear proponents firmly believe that the United States should forgo its so-called negative security assurances, which were first introduced in 1978 when the United States pledged not to use nuclear weapons against non-nuclear weapon states that are signatories to the NPT. These pledges notwithstanding, administrations since then have employed ambiguity with respect to what kind of weapon might be employed were biological or

chemical weapons used against the United States.⁵⁹ Because nuclear proponents anticipate a significant growth of such WMD threats, they conclude that "it would be hubris in the extreme to base U.S. and allied security on the proposition that U.S. non-nuclear weapons are and will be adequate to deter all CBW threats."⁶⁰

Three important issues seem self-evident to those who disagree with the alternative propositions of nuclear advocates. The first has to do with conflating nuclear, biological, and chemical weapons into the common appellation "weapons of mass destruction," as if they were of equal consequence if employed, equally deserving of a nuclear riposte or the threat thereof. According to physicist Wolfgang Panofsky, the effects of chemical weapons are not too different from those produced by conventional weapons.⁶¹ Biological weapons potentially could produce mass effects, but the agents are notoriously difficult to disseminate effectively, and an array of protective measures can conceivably mitigate their effects. By comparison, the prompt and delayed effects of nuclear weapons are even worse than the general public might imagine, policymakers might care to understand, and even highly trained targeting specialists are willing to believe. Despite the uncontested authenticity of government-sponsored research establishing that damage from nuclear fires is two to five times that from nuclear blast effects, the government still only considers the latter.⁶² In short, the palpable differences in effects between nuclear and other so-called WMD require a more nuanced assessment of what nuclear weapons ought to deter.

The second and third reasons relate to the credibility of retaliatory or preemptive threats against chemical or biological weapon (CBW) challenges. Much is made of the messages conveyed to Saddam Hussein by U.S. officials prior to his invasion of Kuwait in 1990 that were he to authorize the use of CBW, nuclear weapons might be used in response. President George H.W. Bush even wrote a letter to Hussein stating, however ambiguously, that Iraq's CBW use would "demand the strongest possible response."⁶³ But the questionable credibility of brandishing nuclear threats became suspect when, as noted previously, President Bush later wrote in his presidential memoir that he had ruled out a nuclear response in the 1991 Gulf War. As for the mistaken hubris of those who believe that advanced conventional weapons are the preferred alternative to nuclear weapons in dealing with CBW threats, it should be instructive to recall that the list of conventional proponents includes, among many others, Nitze and three retired four-star generals who were commanders of NATO forces—none of whom can fairly be accused of excessive sanguineness about conventional deterrence.

On the Need for New Nuclear Initiatives

Nuclear proponents characterize the fifth and final entrenched view of nuclear opponents as their belief that any new nuclear development is unneeded and inconsistent with nonproliferation priorities. Although this comes close to approximating entrenched view number three, the nuclear proponents' objective here is to force a debate on the need for new nuclear weapons and their related infrastructure. Nuclear opponents are seen as believing that existing nuclear weapons are more than sufficient to meet the needs of last-resort retaliation, while nuclear proponents instead fix on the inadequacies of limited-lifetime weapons that no longer meet an already changed and ever-worsening security

environment. The most critical point of the nuclear proponents' argument is the urgent need to replace today's nuclear warheads with new ones; otherwise, the nuclear deterrent's credibility is increasingly at risk.⁶⁴

At the heart of this debate are two issues central to the nuclear proponents' belief system: that existing nuclear weapons are too inaccurate and their yields too high to constitute credible war-fighting instruments in support of U.S. deterrence requirements; and that new nuclear warheads will be needed to replace aging Cold War ones. Regarding the supposed ill-suitability of existing weapons, nuclear opponents counter that today's strategic nuclear delivery systems are accurate to within 100 meters of a target and are already undergoing further accuracy improvements.⁶⁵ Cruise missiles are even more accurate, and in the case of those earmarked for nuclear missions can always be made the equivalent of their advanced conventional brethren. Furthermore, nuclear yields of less than a kiloton are available in some bombs and cruise missiles.⁶⁶ Most importantly, advanced conventional weapons can perform just as well without incurring the moral and political consequences of breaking the long-standing taboo against nuclear use.

On the need to replace aging warheads, nuclear proponents have staked their future on the RRW program—not just as originally conceived by Congress in 2004 as a program to improve the reliability, longevity, and certifiability of existing nuclear weapons, but also as a wedge into the wholesale transformation of the existing nuclear stockpile and its supporting infrastructure. According to a Department of Energy (DOE) advisory panel, this would include new RRWs planned on five-year cycles.⁶⁷

Despite the fact that nuclear laboratory directors have annually certified the stockpile's safety and reliability since the creation of the Stockpile Stewardship Program in 1993, nuclear proponents remain dissatisfied with existing constraints on new design work that could cause a unique set of specialized skills and knowledge to atrophy.⁶⁸ This concern reinforces the views reflected in both the 2001 NPR and the 2006 DSB report regarding the need for new warheads and a refurbished nuclear infrastructure. The wedge that the RRW program represents derives from the nuclear establishment's liberal interpretation of what the RRW program permits. Where Stockpile Stewardship stressed achieving reliability and safety through minimal changes in components and no new designs of nuclear explosive packages, the RRW is seen as permitting complete upgrades of both components and nuclear packages. This interpretation is inconsistent with that of Representative David Hobson (Republican of Ohio) and Representative Pete Visclosky (Democrat of Indiana), successive chairmen of the House Appropriations Subcommittee on Energy and Water Development. Earlier this year, both threatened to eliminate funding for the RRW program because they were upset with the DOE's plans for refurbishing the weapons production complex.⁶⁹

The DOE's National Nuclear Security Administration (NNSA) has employed the RRW program as a driving rationale for its Complex 2030, a complete refurbishment and reconfiguration of the nation's nuclear infrastructure, costing some \$150 billion over 25 years, according to extremely preliminary DOE estimates. But the U.S. Government Accountability Office, citing DOE's history of "poor project management," has urged Congress to impose more discipline in these estimates as well as a more systematic consideration of alternative approaches to achieving a more responsive and efficient

nuclear infrastructure.⁷⁰ One alternative that DOE seems to have rejected is Hobson's urging that DOE consolidate nuclear facilities that are now spread across the country into one large facility, called the Consolidated Nuclear Production Complex (CNPC). Hobson and Visclosky's animus arose when they learned that DOE, without any serious analysis of Hobson's proposal, rejected the CNPC idea in favor of Complex 2030.

Controversy over the nuclear production complex is peaking just as the NNSA announced, on March 3, 2007, its selection of the first warhead under the RRW program from competing designs—a replacement for the W76 warhead deployed on Trident submarine-launched missiles. One team was headed by Los Alamos National Laboratory in New Mexico, the other by Livermore National Laboratory in California. Los Alamos's design reportedly was one based on several existing weapons, but the composite design had never undergone a test. Livermore's design depended entirely on a warhead that had been tested in the 1980s but was never deployed.⁷¹ In announcing the selection of the Livermore design, Thomas P. D'Agostino, NNSA's acting administrator, stated that the Livermore team demonstrated a "higher confidence" that the new warhead could achieve military certification without undergoing nuclear testing. D'Agostino also noted that Los Alamos would not be cut out entirely from RRW work, as certain "highly innovative" features of their proposed design would be developed "in parallel with the Livermore effort."⁷² Prospects for congressional support for the RRW program remain in doubt, however. Visclosky, whose House appropriations subcommittee controls the RRW's purse strings, immediately responded to the NNSA announcement by questioning the need for such a new warhead, while suggesting that until the administration presented a strategy "that defines the future mission, the emerging threats, and the specific U.S. nuclear stockpile necessary to achieve the strategic objectives," he would pursue slowing down or eliminating the RRW program.⁷³

Much of the logic behind those questioning the long-term reliability of the existing stockpile fell apart last November when a distinguished government panel of scientists, called Jason, concluded that the plutonium pits in many of the U.S. stockpile's nuclear warheads have an expected life of more than a century, instead of the previously assumed 45–60 years.⁷⁴ Not surprisingly, nuclear proponents have turned their attention instead to emphasizing the compelling need to replace warheads in order to make them virtually impregnable to terrorists. But given the perceived post-9/11 importance of protecting nuclear weapons, it is inconceivable that security around nuclear storage sites or weapons in transit would ever be reduced.

Prospects for Changes in the U.S. Nuclear Arsenal

It is axiomatic that forecasting is fraught with limitations, not least its dependence on the past as prologue to the future. Sadly, no one can predict when a profound discontinuity with the past will fundamentally alter our predictions. Such discontinuities could drive changes in the U.S. nuclear arsenal either quantitatively and qualitatively, up or down. Although it is important to carefully think through why nuclear weapons should become more important, the wildcards of choice these days seem either to be Russia's sliding back into militant autocracy or China's adopting a much more aggressive pursuit of its interests.

There is also the prospect that if Iran succeeds in joining North Korea as a nuclear weapon state, others in their regions (Japan, Turkey, Saudi Arabia, Egypt) will follow, with uncertain consequences for shaping future policy prescriptions.

Much more immediate change could occur as a consequence of the Democratic Party's winning the White House in 2008. As already noted, there is no national debate on the future of nuclear weapons. It remains largely a specialist pursuit, albeit a heated and enduring one. As evidenced by the DSB's recent report, nuclear proponents seem bent on making this a national issue—a wish no doubt shared by their opponents and recently reinforced by the Shultz, Perry, Kissinger, and Nunn call for just such a debate. Although the public is gravely concerned about terrorist access to WMD, most prominently nuclear or radiological weapons, U.S. Iraq policy is still likely to dominate the next presidential cycle.

We should not assume that likely occupants of senior posts shaping policy in a Democratic White House would seek radical changes from past nuclear policy prescriptions. For example, John Deutch, who served Presidents Jimmy Carter and Bill Clinton in key posts affecting nuclear policy, argued publicly in 2005 that while the United States should cut its planned 2012 nuclear arsenal roughly in half and stop embracing nuclear weapons as instruments for war fighting or deterring conventional war, it should not abandon "effective nuclear forces," including reserving the right to conduct infrequent "scientific confirmation tests" to assure stockpile reliability and safety. Deutch also finds the arguments supporting a nuclear "no-first-use" pledge and de-alerting nuclear forces unpersuasive. On complete nuclear disarmament, Deutch unabashedly observes: "they [nuclear weapons] cannot simply be eliminated, despite . . . the stated goals of the NPT."⁷⁵ Deutch's views should not necessarily be read as emblematic of what to expect should the Democrats take the White House, yet they suggest the broad diversity of views on nuclear issues that perhaps explains why there is no solid national consensus on the matter.

Nevertheless, the DSB's 2006 report reflects the fact that the balance has clearly shifted in the direction of nuclear opponents. They would prefer to see a Democratic-controlled Congress cancel the RRW program as well as force the DOE to consolidate the production complex along the lines suggested by Hobson. An alternative approach to assuring warhead reliability and safety would entail replacing aging components with identical or virtually identical replicas of the original, with modification to the warhead occurring only if an identical or near-identical component was no longer available. According to its advocates, this approach, called Stockpile Curatorship, would cost less than the current Stockpile Stewardship Program, avoid pressure for resumed testing, and reduce the likelihood of degradation in reliability that might arise through frequent modifications to well-tested warhead designs.⁷⁶

Were Congress not to cancel the RRW program, it could conceivably impose severe constraints on program reporting and oversight to avoid new design modifications from occurring in replacement warheads. Should this scenario prevail, the U.S. nuclear stockpile in a decade would qualitatively look like today's stockpile, with enough accuracy and yield variability to provide for a credible last-resort option.⁷⁷ Besides matters of cost, left hanging would be the consequences of U.S. production of new nuclear warheads (albeit

based on previously tested but unproduced designs) at a time when a nuclear proliferation tipping point may be at hand.

Quantitatively, a further reduction in U.S. nuclear warheads would be conceivable within the next decade. A reasonable expectation is for a 50 percent reduction below the target of the Strategic Offensive Reductions Treaty (the Moscow Treaty) of 1,700–2,200 operational warheads. Much would depend on jump-starting formal arms control, a notion not completely foreign even to the Bush administration. Senior U.S. and Russian officials met in Moscow in mid-June 2006 to discuss creating a new bilateral intergovernmental strategic security group, which would aim to discuss the full spectrum of nonproliferation issues.⁷⁸ A useful starting point for a new administration would be to study closely proposals offered by Alexei Arbatov and Vladimir Dvorkin, who, in their 2005 monograph *Revising Nuclear Deterrence*, propose a comprehensive set of practical proposals (including cuts in the strategic nuclear arsenals down to 1,000–1,200 warheads by 2017).⁷⁹ If formal negotiations were to recommence in 2009, the two sides could extend the provisions of the Strategic Arms Reduction Treaty I on nuclear weapons, rather than letting them expire in 2009, and then work toward cutting their respective arsenals in half.⁸⁰

The future shape of the U.S. nuclear posture will also depend critically on corresponding improvements in U.S. advanced conventional programs. Arguably, the performance of U.S. conventional capabilities could be made even more effective sooner, were the opportunity costs associated with the nuclear establishment's most ambitious future plans scuttled or greatly scaled back. Experts already foresee the distinct possibility that the RRW program will adversely affect conventional weapon funding.⁸¹ Conversely, cutting it back substantially could free up funds for important conventional programs.

The New Triad's notion of "prompt global strike" has suffered in media and expert circles, largely because of the 2001 NPR's call for integrating nuclear and conventional means as if they were equally usable weapons of war. But the truth is that future plans for prompt global strike for the most part involve conventional weapons. (For more on this, see Hans Kristensen's article, "U.S. Strategic War Planning after 9/11," in this issue.) This may explain the concept's surprising endorsement by Congress in late 2003, as well as the challenges ahead in producing viable strike options that truly merit the appellation "prompt."⁸² Most familiar are the near-term programs, including the navy's conversion of four Trident ballistic-missile submarines into conventional cruise missile and special operations vessels and the navy's controversial plans to outfit a small number of Trident D5 nuclear missiles on the remaining 14 submarines with conventional warheads. The latter program elicited a strong cautionary provision from both houses of Congress, requiring the administration to provide details on how to ensure that use of such a missile would not result in inadvertent or accidental retaliatory nuclear response before any funds are expended.⁸³ The air force has plans for a new long-range bomber by 2018, but here too, should nuclear weapons figure into this plane's future, they would constrain the plane's design parameters to a manned rather than unmanned system. Yet taking the pilot out of the loop could make the future bomber much more survivable and maneuverable.

Nuclear ambiguity could be removed entirely if various U.S. Air Force and Defense Advanced Research Projects Agency (DARPA) projects, drawn together under a program dubbed FALCON, for Force Application and Launch from CONUS (Continental United

States), were given the higher priority and the funding they deserve. The air force seems least enamored with efforts to develop small, expendable rocket boosters launching highly maneuverable and conventionally armed aerospace vehicles over intercontinental distances. The greatest hope hinges on the success of emerging hypersonic cruise vehicles, the first of which (the X-51, a Mach 5, 1,100 kilometer test vehicle) will undergo testing in 2008 and is being designed not just as a lab experiment but also as a deployable system.⁸⁴ Longer-term hypersonic concepts focus on reusable vehicles capable of carrying 5,500-kilogram payloads over 14,500 kilometers within two hours.⁸⁵ The clear virtue of hypersonic cruise missiles is not only that they share the ballistic missile's hypersonic speed and prompt strike capability, but also that they would do so without creating confusion over nuclear intentions.

The current legislative pause in moving ahead with funds to support arming some Trident missiles with conventional warheads offers an opportunity to explore what to do with both land- and sea-based nuclear delivery systems. The unparalleled survivability of the submarine force is ample reason to keep it as the primary nuclear component. Most, or all, of a 1,000-warhead force could be readily accommodated in the Trident fleet of boats. The best approach would be to avoid mixing conventional and nuclear ballistic missiles launched from submarines, and, to the extent they are needed before purely conventional strike systems (e.g., hypersonic cruise vehicles) are available, placing conventional warheads on land-based missiles located separately from extant land-based nuclear missile sites. In addition, the United States and Russia might agree to restart stalled efforts to build the Joint Data Exchange Center in Moscow, something originally agreed upon in principle in 1998 and more concretely in June 2000. Shared missile warning would help allay Moscow's concerns over the conventional arming of ballistic missiles.

Prospects for Nuclear Elimination

Despite the fact that a solid majority of the American public believes that no country, including the United States, should possess nuclear weapons, the chances for achieving a non-nuclear world remain chimerical. The bipartisan call for U.S. leadership by Shultz, Perry, Kissinger, and Nunn is at heart a plea for reaffirming the visionary principles of the NPT. Vision is essential, but the practical steps toward fulfilling the vision are daunting. In endorsing the group of four's "world free of nuclear weapons," former Soviet leader Mikhail Gorbachev wisely observes that "the goal of the elimination of nuclear weapons has been so much on the back burner that it will take a true political breakthrough and a major intellectual effort to achieve success in this endeavor."⁸⁶

There are both challenges and opportunities in the nuclear opponents' quest for a nuclear-free world. As noted previously, states like North Korea and Iran are motivated to acquire nuclear weapons primarily because of the overwhelming U.S. conventional superiority. Russia and China surely would find an international system dominated militarily by U.S. conventional superiority an unacceptable alternative to today's nuclear-enabled balance of military power. Furthermore, it is widely presumed that the nuclear genie is out of the bag and can never be put back. Scholars in the field of science and technology studies, however, argue that both explicit and tacit knowledge are essential

to nuclear weapons development.⁸⁷ Explicit knowledge consists of information or engineering formulations that can be recorded and passed easily from one facility to another. Tacit knowledge can't be written down; rather, it is acquired through an often lengthy process of apprenticeship. To that end it is a local phenomenon, the product of a unique social and intellectual environment composed of highly skilled senior and junior colleagues, who pass this specialized knowledge around from one individual to another. In that sense, tacit knowledge-based skills are not widely diffused, as explicit knowledge often is.⁸⁸ As Donald MacKenzie has illuminated, the history of the U.S. Manhattan Project shows that the explicit knowledge of physics, while surely necessary, was not sufficient to achieve the first bomb's success. The project's physicists had underestimated the importance of innumerable technological design tasks, which ended up accounting for an unexpectedly large staff of several thousand and required coordination and cumulative interpersonal familiarity.⁸⁹ If tacit knowledge skills are not passed on directly to the next generation of designers, Donald MacKenzie and Graham Spinardi argue, "in an important (though qualified) sense nuclear weapons will have been uninvented."⁹⁰

Should the United States ratify the Comprehensive Nuclear-Test-Ban Treaty within the next decade, which seems plausible, or even without such ratification, should the next administration choose not to conduct underground tests and abstain from any new design work that does not have a direct connection to a tested weapon, then an entirely different nuclear "elimination" might well occur. That small body of scientists and engineers who designed and tested the bulk of the current U.S. nuclear stockpile is already retired. As more time passes, the U.S. and other nations' arsenals may contain nuclear curios, still capable of working should they be needed (at least within the 100-year lifetime of their plutonium cores) and certainly capable of being reinvented, but otherwise fast becoming relics of a bygone era.⁹¹

This silent retreat in nuclear capacity underscores the magnitude of what could be a historic turning point in the traditional U.S. reliance on nuclear weapons. Surely the importance of decisions expected to be taken in the next decade merits the kind of intellectual effort today's visionaries are calling for, but which has thus far not occurred, most notably within Congress or as part of a larger national debate. Indeed, the specialist communities, nuclear proponents and opponents alike, have focused on the right questions: How critical a role should nuclear weapons play in U.S. security policy for the next several decades? Why can't the United States rely instead on advanced conventional weapons, which are arguably equal or better than nuclear weapons in attacking the most difficult targets, and provide a more robust form of deterrence simply because adversaries can count on U.S. use if needed? If the answers to these questions support the conclusion that nuclear weapons are indeed relics of a bygone era and no longer central to U.S. national security, can the United States afford to see international nuclear nonproliferation norms further enervated when virtually everyone agrees that nuclear proliferation is one of America's greatest dangers? Silence, in this life-or-death regard, cannot be seen as golden.

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NOTES

1. *Report of the Defense Science Board Task Force on Nuclear Capabilities, Report Summary*, hereafter 2006 DSB Report (Washington, DC: Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, December 2006), <www.fas.org/irp/agency/dod/dsb/nuclear.pdf>.
2. George P. Shultz, William J. Perry, Henry A. Kissinger, and Sam Nunn, "A World Free of Nuclear Weapons," *Wall Street Journal*, January 4, 2007, p. A15. The 2006 DSB Report's use of the word "entrenched" to describe the views of nuclear opponents unfairly suggests that they are inviolate. The mere fact that such views are spreading, not only among influential elite audiences but also within the public domain, suggests that perhaps the views of nuclear proponents are far less subject to systematic inquiry.
3. For a useful analysis of the Bush administration's attempts to revise nuclear strategy and elements of the nuclear stockpile, see David S. McDonough, *Nuclear Superiority: The "New Triad" and the Evolution of Nuclear Strategy*, Adelphi Paper 383 (New York: Routledge for the International Institute for Strategic Studies, 2006).
4. Interest in counterforce strategies naturally long preceded dependence on a mutual assured destruction strategy. The Eisenhower administration attempted unsuccessfully to reduce the stigma associated with nuclear use by placing heavy reliance on tactical nuclear weapons for battlefield use. Secretary of Defense Robert McNamara announced early in the new Kennedy administration (June 1962): "the principal military objectives, in the event of a nuclear war . . . should be the destruction of the enemy's military forces, not of his civilian population." As the Soviet Union acquired an assured second-strike capacity, mutual assured destruction eventually replaced a predominantly counterforce strategy. For the source of the McNamara citation and further elaboration of U.S. nuclear strategy, see McDonough, *Nuclear Superiority*, chapter 1.
5. See Spurgeon M. Keeny Jr. and Wolfgang K.H. Panofsky, "Nuclear Weapons in the 1980s: MAD vs. NUTS," *Foreign Affairs* 60 (Winter 1981/2), p. 289.
6. The abolitionists' argument is perhaps best established in the 1997 *Report of the Canberra Commission on the Elimination of Nuclear Weapons*, <www.dfat.gov.au/cc/cchome.html>.
7. Mark Dean Millot, "Facing the Emerging Reality of Regional Nuclear Adversaries," *Washington Quarterly* 17 (Summer 1994), pp. 50–51. This finding should come as no great surprise. Other than those officers who spent their careers in nuclear occupational specialties, the uniformed military largely viewed nuclear weapons as a custodial responsibility rather than as a useful instrument of warfare. As the 2006 DSB Report notes, "Even during the Cold War, nuclear weapons were something of a round peg in a square hole in DoD [Department of Defense]." See 2006 DSB Report, p. 29.
8. Cited in Jack Mendelsohn, "Deligitimizing Nuclear Weapons," *Issues in Science and Technology*, Spring 2006, <www.issues.org/22.3/mendelsohn.html>.
9. For both the "Joint Statement on Reduction of Nuclear Weapons Arsenals: Declining Utility, Continuing Risks," issued by Gen. Lee Butler and Gen. Andrew Goodpaster, and the full text of the 61 retired generals and admirals, <www.acronym.org.uk/dd/dd11/11nfwf.htm>.
10. Paul H. Nitze, "Is it Time to Junk Our Nukes?" *Washington Post*, January 16, 1994, p. C1.
11. Michael Quinlan, *Thinking About Nuclear Weapons* (London: RUSI Whitehall Paper Series, 1997), p. 15.
12. *Report of the Defense Science Board Task Force on Nuclear Deterrence* (Washington, DC: Office of the Under Secretary of Defense for Acquisition and Technology, October 1998). See also James J. Wirtz, "Do U.S. Nuclear Weapons Have a Future?" *Strategic Insights*, <www.ccc.nps.navy.mil/si/2006/Mar/wirtzMar06.pdf>.

13. The three legs of the old triad consisted of land-based, nuclear-armed ballistic missiles, submarine-launched ballistic missiles, and strategic aircraft.
14. A substantial number of non-deployed warheads would also be retained in strategic reserve. The Nuclear Posture Review's (NPR) official text remains classified, but most of it has been posted on the globalsecurity.org Web Site, <globalsecurity.org/wmd/library/policy/dod/npr.htm> (hereafter NPR Excerpts).
15. Cited in Andrew Krepinevich and Robert Martinage, *The Transformation of Strategic-Strike Operations* (Washington, DC: Center for Strategic and Budgetary Assessments, 2001), <www.csbaonline.org/>.
16. *Ibid.* The provenance of the New Triad and its relationship to the 1997 National Defense Panel surely relates to the fact that Andrew Krepinevich served as one of the panel's nine members as well as coauthor of *The Transformation of Strategic-Strike Operations*.
17. M. Elaine Bunn, a National Defense University senior research fellow, argues that the NPR was misnamed and should have been called the Strategic Posture Review because it addressed more than just nuclear capabilities. See M. Elaine Bunn, "Can Deterrence Be Tailored?" *Strategic Forum* 225 (Institute for National Strategic Studies, January 2007).
18. NPR Excerpts, p. 46.
19. "No Nuclear 'Bunker Buster' Money in FY 2006 DOE Funding Bill," <www.aip.org/fyi/2005/152.html>.
20. Congress provided \$9 million in fiscal 2005 and \$25 million in fiscal 2006. The administration requested \$27.7 million for fiscal 2007 and \$88.8 for the National Nuclear Security Administration and \$30 million for the navy in fiscal 2008. For details see Jonathan Medalia, *Nuclear Weapons: The Reliable Replacement Warhead Program*, RL32929 (Washington, DC: Congressional Research Service, February 8, 2007), <fas.org/sgp/crs/nuke/RL32929.pdf>.
21. Will Lester, "Most Americans Say No Nations Should Have Nuclear Weapons," *Associated Press*, March 31, 2005, <www.commondreams.org/headlines05/0331-05.htm>.
22. This is roughly the point made by senior military officers, who in December 1996 issued a call for the elimination of nuclear weapons. See "Joint Statement on Reduction of Nuclear Weapons Arsenals: Declining Utility, Continuing Risks." In a 1999 poll conducted by the University of New Mexico's Institute for Public Policy for Sandia National Laboratories, 69 percent of the respondents agreed that the world would be safer without nuclear weapons, but 84 percent admitted that such elimination couldn't be achieved because knowledge is too widespread. The full text of the survey is at <www.cmc.sandia.gov/survey.htm>.
23. 2006 DSB Report, p. 2.
24. *Ibid.*
25. *Ibid.*, p. 3.
26. Butler and Goodpaster, "Joint Statement on Reduction of Nuclear Weapons Arsenals."
27. Nitze, "Is It Time To Junk Our Nukes?"
28. Nina Tannenwald, "Stigmatizing the Bomb," *International Security* 29 (Spring 2005), p. 30.
29. Colin L. Powell with Joseph E. Perisco, *My American Journey: An Autobiography* (New York: Random House, 1995), pp. 323–324, 485–486, and 540–541. See also George Bush and Brent Scowcroft, *A World Transformed* (New York: Knopf, 1998), p. 463: "... No one advanced the notion of using nuclear weapons, and the President rejected it even in retaliation for chemical or biological attacks. We deliberately avoid spoken or unspoken threats to use them on the grounds that it is bad practice to threaten something you have no intention of carrying out. Publicly, we left the matter ambiguous. There was no point in undermining the deterrence it might be offering."
30. *Quadrennial Defense Review Report* (Washington, DC: Department of Defense, February 6, 2006), pp. 27, 41, and 49.
31. M. Elaine Bunn, "Can Deterrence Be Tailored?" p. 1.
32. David S. Yost, "The NATO Allies," in James J. Wirtz and Jeffrey A. Larsen, eds., *Nuclear Transformation: The New U.S. Nuclear Doctrine* (New York: Palgrave Macmillan, 2005), p. 187.
33. Government think tank analysts, interviews in Toyko, March 2005.
34. 2006 DSB Report, p. 3.
35. See Kurt M. Campbell, Robert J. Einhorn, and Mitchell B. Reiss, eds., *The Nuclear Tipping Point: Why States Reconsider Their Nuclear Choices* (Washington, DC: Brookings Institution Press, 2004), especially pp. 344–345. Campbell and Einhorn conclude: "There is no indication that controversial policies of the

- Bush administration regarding nuclear weapons... have had a direct impact on deliberations regarding the acquisition of an independent nuclear capability in any of the countries studied."
36. Steven Andreasen and Dennis Gormley, "Edging Ever Closer to a Nuclear Death Row," *Minneapolis Star-Tribune*, March 29, 2006, p. A13.
 37. On Taiwan and China's interacting offensive doctrines, see Dennis M. Gormley, "Cruise Control," *Bulletin of the Atomic Scientists* 62 (March/April 2006), pp. 26–33; on Washington's concern, see Wendell Minnick, "Taiwan's Missile Program Draws Concern," *Defense News*, June 19, 2006, p. 1.
 38. 2006 DSB Report, p. 3.
 39. For a recent and useful treatment of the subject, see Campbell, Einhorn, and Reiss, eds., *The Nuclear Tipping Point*.
 40. 2006 DSB Report, pp. 3–4.
 41. 2006 DSB Report, p. 3.
 42. For the arguments of conventional proponents, see Dennis M. Gormley, "Securing Nuclear Obsolescence," *Survival* 48 (Autumn 2006), pp. 127–148, <cns.miis.edu/pubs/other/Securing_Nuclear_Obsolescence.pdf>; Ivan Oelrich, *Missions for Nuclear Weapons after the Cold War*, Occasional Paper No. 3 (Washington, DC: Federation of American Scientists, 2005); and Michael A. Levi, *Fire in the Hole: Nuclear and Non-Nuclear Options for Counterproliferation*, Working Papers No. 31 (Washington, DC: Carnegie Endowment for International Peace, 2002). For an analysis by nuclear proponents, see Bryan L. Fearey, Paul White, John St. Ledger, and John Immele, "An Analysis of Reduced Collateral Damage Nuclear Weapons," *Comparative Strategy* 22 (October/November 2003), pp. 305–324.
 43. One conventional concept under current consideration takes advantage of precision location accuracy by attacking a single entry point repeatedly, thus drilling down the same entry hole until the weapon achieves the required depth. The weapon's effectiveness would most critically depend on perhaps an order of magnitude improvement in accuracy over today's weapons, which are quite conceivable as improvements take place in the Global Positioning System. Interview with industry official, April 2006.
 44. All information on casualties is taken from *Effects of Nuclear Earth-Penetrator and Other Weapons* (Washington, DC: National Academy of Sciences, 2005), at <www.nap.edu/cata log/11282.html>.
 45. Instead of employing a surface burst, new weapons with perhaps 5–10 kiloton yields would penetrate the earth's surface to a depth of a few meters in granite and perhaps 30 meter in soil in order to destroy facilities buried up to 100 meters under ground. But even here collateral damage could be significant. See Roger Speed and Michael May, "Dangerous Doctrine," *Bulletin of the Atomic Scientists* 61 (March/April 2005), pp. 38–49, <thebulletin.metapress.com/content/9pmq53321645902/fulltext.pdf>.
 46. Commercially available boring equipment can now dig a tunnel 18 meters in diameter at a rate of 70 meters each day. See Gormley, "Securing Nuclear Obsolescence," pp. 133–134 for more on adversary targeting such facilities.
 47. "US Military Options Against Emerging Nuclear Threats," *IJSS Strategic Comments* 12 (April 2006).
 48. Walter Pincus, "Rumsfeld Seeks to Revive Burrowing Nuclear Bomb," *Washington Post*, February 1, 2005, p. A2.
 49. It was special operations forces operating on the ground that achieved the only success by finding and destroying one Iraqi missile launcher. For more on this mission, see Gormley, "Securing Nuclear Obsolescence," pp. 134–137.
 50. Thomas E. Ricks, *Fiasco: The American Military Adventure in Iraq* (New York: Penguin Press, 2006), pp. 124–125. To be sure, the Iraqis managed to continue firing both ballistic and cruise missiles throughout the brief campaign, but not nearly at the same rate per day as during the first Gulf War in 1991.
 51. In military parlance, this means developing special tactics, techniques, training, and procedures to find and attack such targets. See Robert P. Hoffa Jr. and Jasper Welch, "Command and Control Arrangements for the Attack of Time-Sensitive Targets," Northrop-Grumman Analysis Center, November 2005, p. 34.
 52. Gen. Hal M. Hornburg, air combat commander, quoted in *Air Force*, November 2004, p. 72, as cited in *ibid.*, p. 39.
 53. See Barbara Opall-Rome, "Sensor to Shooter in 1 Minute," *Defense News*, October 2, 2006, p. 1. Opall-Rome reports "over 100" Hezbollah rocket launchers were destroyed. The figure, 125, is reported in No'am Ofir, "Look Not to the Skies: The IAF vs. Surface-to-Surface Rocket Launchers," *Strategic*

Assessment, November 1–30, 2006, e-mail text published by the Jaffee Center for Strategic Studies, Tel Aviv, Israel, <www.tau.ac.il/jcss>.

54. David Sanger, "Don't Shoot. We're Not Ready," *New York Times*, June 25, 2006, Section 4, p. 1.
55. Russia remains concerned about America's capacity to employ powerful ground- and space-based radars and infrared sensors to greatly improve prospects for thick defenses. China is most animated about U.S. expansion of missile defense into space. See Tom Sauer, "Limiting National Missile Defence," *Bulletin 22—Nuclear Policy, Terrorism and Missile Defence, International Network of Engineers and Scientists Against Proliferation*, <www.inesap.org/bulletin22/bul22art31.htm>.
56. Although Patriot units performed admirably during the 2003 war in Iraq against ballistic missiles (scoring 100 percent effectiveness), they failed altogether against Iraq's surprise use of five cruise missiles. This had little to do with Patriot itself, but instead with the failure to link airborne sensors to Patriot's ground-based radar. See Dennis M. Gormley, "Missile Defence Myopia: Lessons from the Iraq War," *Survival* 45 (Winter 2003-04), pp. 61–86.
57. Rumors persist that such a move may well occur. For more on the mission, see Gormley, "Securing Nuclear Obsolescence," pp. 139–140.
58. For an unfavorable technical evaluation of the concept, see Peter D. Zimmerman and Charles D. Ferguson, "Sweeping the Skies," *Bulletin of the Atomic Scientists* 59 (November/December 2003), pp. 57–61.
59. For a useful fact sheet on the subject, see the Arms Control Association Web Site, <www.armscontrol.org/factsheets/negsec.asp>. Note that such assurances do not pertain to an attacking state that is allied with a nuclear weapon state.
60. 2006 DSB Report, p. 4.
61. Wolfgang K.H. Panofsky, "A Damaging Designation," *Bulletin of the Atomic Scientists* 63 (January/February 2007), pp. 37–39, <thebulletin.metapress.com/content/n13mw46309hk7563/fulltext.pdf>.
62. See Lynn Eden, *Whole World on Fire: Organizations, Knowledge, & Nuclear Weapons Devastation* (Ithaca: Cornell University Press, 2004). As Eden demonstrates, no sinister plot lay behind why this failure occurred (e.g., reluctance to reduce the nuclear arsenal). Rather, the reasons relate more to constraints in the way knowledge organizations incorporate new routines.
63. Cited in McDonough, *Nuclear Superiority*, p. 39.
64. 2006 DSB Report, p. 5.
65. The air force has a \$6 billion–\$7 billion modernization program under way to provide the more sophisticated N-50 guidance system, while the navy also plans to upgrade the Mk-6 guidance system for its Trident missile fleet. McDonough, *Nuclear Superiority*, p. 46.
66. Speed and May, "Dangerous Doctrine."
67. See Jonathan Medalia, *Nuclear Weapons: The Reliable Replacement Warhead Program*. For a critical appraisal, see Stephen I. Schwartz, "Warheads Aren't Forever," *Bulletin of the Atomic Scientists* 61 (September/October 2005), pp. 58–64, <thebulletin.metapress.com/content/y604v12027758177/fulltext.pdf>.
68. See Donald MacKenzie and Graham Spinardi, "Tacit Knowledge, Weapons Design, and the Uninvention of Nuclear Weapons," *American Journal of Sociology* 101 (July 1995), pp. 44–99.
69. James Sterngold, "Key Legislators Threaten Funds for Nuclear Weapons Overhaul," *San Francisco Chronicle*, January 14, 2007, p. A4.
70. Jon Fox, "U.S. Reaffirms Need for Modernizing Nuclear Complex," *Global Security Newswire*, December 15, 2006, <www.nti.org/d_newswire/issues/2006/12/15/774DFOAF-09BE-4E4E-BB2D-19AC324853F1.html>.
71. William J. Broad, David E. Sanger, and Thom Shanker, "U.S. Selecting Hybrid Design for Warheads," *New York Times*, January 7, 2007, p. 1.
72. Walter Pincus, "U.S. Selects Design for New Nuclear Warhead," *Washington Post*, March 3, 2007, p. A8.
73. Walter Pincus, "Nuclear Warhead Plan Draws Opposition," *Washington Post*, March 4, 2007, p. A5.
74. *Ibid.* See also, R.J. Hemley and D. Meiron, et al., "Pit Lifetime," JSR-06-335, November 20, 2006, <www.nukewatch.org/facts/nwd/JASON_ReportPuAging.pdf>.
75. John Deutch, "A Nuclear Posture for Today," *Foreign Affairs* 84 (January/February 2005).
76. Robert Civiak, *The Reliable Replacement Warhead Program: A Slippery Slope to New Nuclear Weapons* (Livermore, CA: Tri-Valley CAREs, January 2005). Nuclear lab interest in the Reliable Replacement

Warhead does not mean that they oppose the current warhead life extension program. See Medalia, *Nuclear Weapons*, p. 5.

77. As Stephen Schwartz has noted, to the military an unreliable weapon isn't one that will not explode, but one that achieves less than its expected nuclear yield. Such weapons would certainly leave something to chance in the minds of adversaries. See Schwartz, "Warheads Aren't Forever."
78. "US, Russia to Set Up Bilateral Security Group," Moscow ITAR-TASS in English, June 13, 2006.
79. Alexei Arbatov and Vladimir Dvorkin, *Revising Nuclear Deterrence* (College Park, MD: Center for International Security Studies, October 2005).
80. Cuts in respective U.S. and Russian arsenals should extend beyond so-called deployable warheads to include reserve and even dismantled ones. See Deutch, "A Nuclear Posture for Today," p. 54.
81. Seth Owen, "New Warhead Could Siphon Funds From Sub Builders: Two Labs Compete to Design New Tips for Trident Missile," *The Day* (Groton, CT), January 13, 2007, <www.theday.com/store/itm.aspx?re=d4dfcb56-86f8-4cdc-9faf-01aca0bf7522&itm=art>.
82. On congressional support, see William Matthews, "U.S. Lawmakers Push 'Prompt Global Strike,'" *Defense News*, November 24, 2003, p. 4.
83. On congressional reaction, see Chris Johnson, "Senate Panel Kills Trident Missile Plan," *InsideDefense.com NewsStand*, August 1, 2006, <www.military.com/features/0,15240,107820,00.html>. For a critical evaluation of the concept, see Steve Andreasen, "Off Target? The Bush Administration's Plan to Arm Long-Range Ballistic Missile with Conventional Warheads," *Arms Control Today*, July/August 2006, <www.armscontrol.org/act/2006_07-08/CoverStory.asp>.
84. Noah Shachtman, "Hypersonic Cruise Missile: America's New Global Strike Weapon," *Popular Mechanics*, January 2007, <www.popularmechanics.com/technology/military_law/4203874.html>.
85. For more on global strike plans, see Dennis M. Gormley, "Conventional Force Integration in Global Strike," Wirtz and Larsen, *Nuclear Transformation*, pp. 53–68.
86. Mikhail Gorbachev, "The Nuclear Threat," *Wall Street Journal*, January 31, 2007, p. A13.
87. For a general treatment of types of scientific knowledge, see H.M. Collins, "Tacit Knowledge, Trust, and the Q Sapphire," *Social Studies of Science* 31 (2001), pp. 71–85. For its relevance to nuclear weapons, see MacKenzie and Spinardi, "Tacit Knowledge, Weapons Design, and the Uninvention of Nuclear Weapons."
88. Donald MacKenzie, "Theories of Technology and the Abolition of Nuclear Weapons," in Donald MacKenzie and Judy Wajcman, eds., *The Social Shaping of Technology* (Philadelphia: Open University Press, 1999), pp. 425–429.
89. *Ibid.*, p. 427.
90. MacKenzie and Spinardi, "Tacit Knowledge, Weapons Design, and the Uninvention of Nuclear Weapons," p. 44.
91. And in that event, the United States would more than likely have a decided advantage over other states, not least because of its extensive advantages in conventional weapons development and the advanced state it had reached in its nuclear weapons program.