Chapter 8

The Proliferation of Weapons of Mass Destruction

Problems of WMD Proliferation

Our worst fears regarding the proliferation and use of weapons of mass destruction (WMD) have not been realized to date, but important trends bearing on nuclear, biological, and chemical weapons have made it increasingly possible that they will be.

WMD Use

The absence of catastrophic WMD use is the most positive WMD trend of the last decade. No nuclear weapons were detonated except for test purposes. As disruptive and costly as the 2001 anthrax letters incident proved, only 5 people are known to have died and 22 to have sustained injury as a result of those letters. Terrorist use of chlorine gas in conjunction with high explosive attacks in Iraq in 2006 had little impact. A radioactive isotope, polonium, was used to assassinate Alexander Litvinenko in 2007.

Why there has not been catastrophic (or much of any) WMD use is unclear, particularly given how easy it would be for terrorist entities that have expressed interest in acquiring and utilizing such weapons to obtain some forms of WMD. The reasons probably reflect some combination of deterrence, offense, defense and interdiction, and technical obstacles. Sources of deterrence include the threat of retaliation, particularly against states, given the explicit U.S. threat of an "overwhelming response" to WMD use against it and its allies; fear of failure, given strengthened homeland security and force

AP Images (Hasan Sarbakhshian)

Iranian Shahab-3 missile, allegedly capable of carrying a nuclear warhead and reaching Europe, Israel, and U.S. forces in the Middle East, displayed in Tehran

protection measures; and fear of alienating core constituencies, given the criticism increasingly directed against al Qaeda within the Islamic world for its violence against Muslims. The U.S.-led war on terror likely has denied al Qaeda and its co-travelers the time and space they need to develop WMD. And while some forms of WMD currently are accessible to terrorists, they may consider more familiar and more easily acquired high explosives sufficient or preferable for their purposes.

Nuclear Proliferation

WMD proliferation developments over the last decade have been mixed. There is little information available about actual terrorist development or acquisition of WMD. On the state side, Iraq and Libya shed their WMD programs or legacies as well as their rogue state status. India and Pakistan emerged from U.S. sanctions imposed after their 1998 nuclear tests. This reflected in part those states' geopolitical importance in the post-9/11 international security environment, and in part efforts or assurances they made to contain their nuclear rivalry with one another and secure their nuclear capabilities. The recent U.S.-India agreement on civil nuclear cooperation[1] was approved by the U.S. Senate in October 2008 and signed into law by President George W. Bush. The agreement, signed by Indian External Affairs Minister Pranab Mukherjee and his counterpart Secretary of State Condoleezza Rice, represents an important effort to bring into the broader nuclear nonproliferation regime a nuclear weapons state not recognized as such under the Nuclear Nonproliferation Treaty (NPT).

In April 2003, North Korea became the first state ever to withdraw from the NPT (joining at least India and Pakistan as nonmembers), asserted its possession of nuclear weapons in early 2005, and tested a nuclear device in October 2006. More recently, North Korea took significant initial steps toward implementing an agreement under the auspices of the Six Party Talks to abandon its nuclear weapons program in return for specified economic and political concessions. In September 2008, however, North Korea moved to restart its Yongbyon nuclear facilities in protest over the Bush administration's failure to remove North Korea from its terrorism blacklist, as was promised in the earlier agreement. While the Bush administration subsequently fulfilled that promise in October 2008, Pyongyang moved ahead with a test launch of a ballistic missile on April 5, 2009, subsequently declared that it had restarted its nuclear weapons development program, asked International Atomic Energy Agency inspectors to leave the country in mid-April, and exploded another nuclear device in May. Thus, the path ahead for North Korea's denuclearization remains long and the outcome more uncertain than ever.

Iran's covert development of uranium enrichment and other nuclear weapons–relevant capabilities was exposed, at least to the general public, in 2003. Iran has defied international efforts, including sanctions imposed through United Nations Security Council resolutions, to halt its uranium enrichment activities and demonstrated the peaceful nature of its nuclear program. Although a November 2007 U.S. National Intelligence Estimate assessed that Iran had, in 2003, suspended those aspects of its nuclear program directly related to weaponization,[2] the United States and its major European allies, among others, remain concerned that the continuing expansion of Iran's uranium enrichment capability is removing the greatest obstacle to its ability to develop nuclear weapons.

Syria more recently appeared on the nuclear stage. In September 2007, Israel bombed a site in Syria that U.S. Government officials and outside analysts contend was a nuclear reactor nearing completion, built covertly and with North Korean assistance. Syria denies the nuclear nature of the site, but it moved quickly after the Israeli bombing to eliminate traces of the bombed structure.[3]

North Korea's and Iran's demonstrated or suspected pursuit of nuclear weapons, and perhaps also Syria's, could set the stage for another round of nuclear proliferation. Following North Korea's 2006 nuclear test, prominent individuals in Japan and South Korea called for their nations to reconsider their non-nuclear weapon status,[4] although both nations' governments reaffirmed their longstanding policy of not pursuing such weapons, and the United States reiterated its extended nuclear deterrence commitments to these allies.[5] While any additional defections from the nuclear nonproliferation regime could cause more states to reconsider their nuclear status, Japan's defection would be disproportionately significant as it is one of the most prominent proponents of that regime and claims exceptional moral authority as the only country to have suffered nuclear attack.

Iran's apparent pursuit of a nuclear weapons capability likely is a significant factor in the recent dramatic expansion in the number of nations in its region expressing interest in establishing civilian nuclear programs. Of the nearly 30 nations currently interested in joining the more than 30 that already

operate nuclear reactors, 13 are Arab or border Iran.[6] Some of these 14 nations perceive Iran as a security threat that is exacerbated by its nuclear program. Others may feel less directly threatened by Iran, but could feel their security threatened or their regional leadership positions challenged if other regional states acquired nuclear weapons in response to Iran's nuclear program.

By expressing interest in establishing civilian nuclear programs, at least some of these states are signaling to Iran, their neighbors, and the United States that they are not prepared to cede the nuclear option to Iran or others in their region. They thereby may hope to dissuade Iran or other regional states from pursuing nuclear weapons programs and/or to motivate the United States and other international actors to do more to stop Iran's program or otherwise address their security concerns. To the extent that they act on their interest in civilian nuclear energy, they can acquire expertise and infrastructure useful to a potential nuclear weapons development effort. While technologies exist that would allow these countries access to nuclear power without leading to a weapons capability, if any of these countries decide to develop their own capacity to enrich uranium and/or reprocess spent reactor fuel, they could pose a serious proliferation risk.[7]

The prospects for a new round of nuclear weapons proliferation will be significantly influenced by the extent to which the United States and the larger international community can contain the regional proliferation impulses fueled by North Korea's, Iran's, and Syria's demonstrated or suspected nuclear weapons programs.

Chemical and Biological Proliferation

In contrast to the nuclear efforts of North Korea, Iran, and Syria, no states are newly pursuing, or suspected of pursuing, in an overt or exposed manner, chemical or biological weapons. This probably reflects in part the fact that chemical and biological weapons programs are comprehensively prohibited by international conventions, to which almost all nations are signatories.[8] Membership, of course, does not necessarily constitute compliance. The United States has expressed concerns about a number of parties' compliance with these conventions, among them Russia and China.[9] Noncompliance is hard to detect and harder to prove, however, because chemical and biological weapons programs can be concealed within dual-use facilities and activities. Moreover, the Biological and Toxin Weapons Convention has no enforcement mechanism, and no challenge inspections have been conducted

DOD (D. Myles Cullen)

Army Chief of Staff General George W. Casey, Jr., speaks during CBRNE incidents consequence management response force exercise

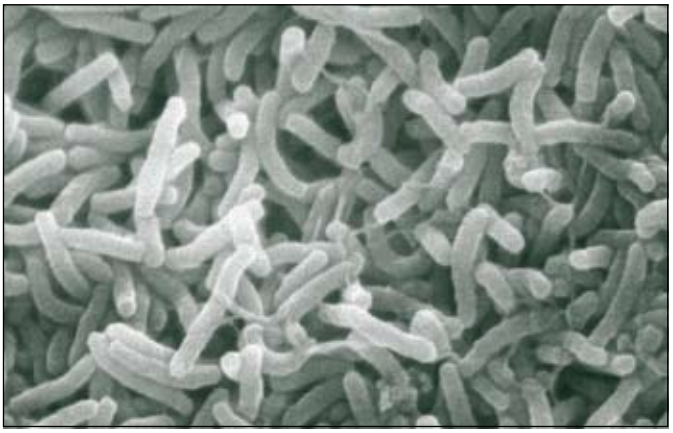
under the Chemical Weapons Convention's enforcement mechanism.

Most concerns about chemical and biological weapons proliferation center on the spread of scientific/technological and industrial capacity. Chemical manufacturing has globalized. Production no longer is dominated by a few, mainly Western, multinational companies, but now occurs in many more facilities spread over many more countries. This means that more people will be involved in chemical technology and manufacture. Growth has been particularly pronounced in Asia. Production facilities also are getting smaller and utilizing new technology: individual plants used to focus on the bulk production of just a few chemicals, while modern plants can economically produce a wide range. Furthermore, it may be harder to detect illicit activity in smaller plants that are utilizing new technology.[10] Such developments could facilitate chemical weapons proliferation.

New tools, including robotics, micro reactors, and ever more powerful computing capabilities, have dramatically increased the number of new compounds that can be synthesized, and the rate at which they can be synthesized and screened. Commercial entities are creating large libraries of new chemical compounds, some of which may be highly toxic and useful for weapons.[11] Nanotechnology is another rapidly developing area that could have important implications for chemical warfare, particularly for the identification and development of new or improved dissemination techniques. Ongoing work to use nanotechnology to improve the delivery of drugs for therapeutic purposes is one possible pathway.[12] There is an increasing convergence of chemistry and biology as biological and other scientific disciplines are increasingly being applied to the search for new chemical compounds with particular effects on biological systems.[13]

The rapid pace of development in the biological sciences and biotechnology is making the expertise and technology to produce biological weapons more accessible, and also may be enabling new types of such weapons. Organisms are available throughout the world. Most of the requisite expertise and equipment for biological weapons is dual-use, and much dual-use equipment is available for the production, processing, and dissemination of biological agents. The commercialization of bioreactors has made it easier to produce agents. Commercial technologies like agricultural sprayers, dry agent production techniques, and, more recently, microencapsulation, could facilitate agent dissemination, which had always been one of the chief obstacles in weaponization.

Revolutionary insights in biology are lowering the educational threshold needed to produce a pathogen. The diffusion of advanced techniques in the biological sciences has made routine what was once advanced science, just as the commercialization of advanced biotechnology has made common what was once a sophisticated capability. The number of recorded genetic sequences has increased dramatically. New classes of infectious agents have emerged, including prions, viroids, and satellite viruses/nucleic acids. The relatively new fields of synthetic biology and bioengineering already have enabled scientists to create the polio virus from scratch, and perhaps, in the not-so-distant future, will enable the "from-scratch" creation of more pathogenic viruses, like smallpox (which no longer exists in nature), as well as the engineering of new organisms, some of which may prove conducive to weaponization.



Molecular Biology

Electron microscope image of *Vibrio cholerae* bacteria, which infect the digestive system

Conclusions Regarding Proliferation

We still do not fully understand how the rapid advances in biological and chemical science and technology will change the landscape for biological and chemical weapons. These emerging developments are commercially driven and promise to yield many beneficial products for mankind. Yet like almost all scientific and technological progress, the potential to do good carries with it the potential to do harm, and where such potential exists, bad actors will endeavor to exploit it. The bad actors able to exploit the most technologically sophisticated developments first most likely will be states with offensive biological and/or chemical weapons programs, but commercialization and globalization already have made the catastrophic use of biological and chemical weapons

potentially accessible to terrorists. Rapid advances in science and technology likely will accord a continuing advantage to offense over defense, as defensive responses lag behind the development of new forms of attack. As technical barriers decline, adversary intent will become an ever more important part of the biological and chemical threat equation.

These trends toward a more WMD-capable world represent a serious threat to the United States and the international community because they give a much broader range of actors, state and nonstate, a capacity to inflict destruction and disruption that historically was available only to a few large and powerful states. As dangerous as powerful states have proven over the ages, they at least constituted a narrower focus for intelligence, diplomacy, and defense. Even the effectiveness of a Cold War–type nuclear deterrence becomes less certain as the number and nature of WMD-capable adversaries and rivals multiply, and particularly as terrorists acquire such catastrophic weapons.

International Net Assessment for the Second Nuclear Age

Strategic nuclear deterrence is becoming far more complex than in the "first" age. During the Cold War, the United States and its allies developed elaborate nuclear deterrence doctrines against a Soviet regime that turned out to be essentially conservative, stable, and unlikely to disrupt the status quo. After a short interlude in the 1990s, however, the world entered what Colin Gray has called "the second nuclear age," characterized by the original nuclear powers plus emerging states that either now have, or likely soon will have, nuclear weapons. Not all of them are stable, which poses serious questions for allied policymakers regarding how they will respond to proliferated nuclear threats, particularly with regard to deterrence strategies.

In addition to the increasing number of nuclear powers, technological developments have added unprecedented wrinkles to deterrence strategies. Offensive systems are more accurate, harder to find, and more mobile; some, including missiles that can reach from Esfahan to Berlin, are also more available on the global weapons market. Longer range missiles are able to span half the globe or more. Antimissile defenses at the mid- and long-range level did not exist in the past, and now add complexity to deterrence calculations on both sides of the Atlantic and the Pacific. Japan, for instance, is adding modern-

AP Images (Joerg Sarbach)

Federal Agency for Radiation Protection investigator removes computer disk from home in Haselau, Germany, where traces of radiation were found linked to poisoning of former Russian spy Alexander Litvinenko

ized antimissile-capable Aegis systems to its fleet. Additionally, the prospect that nonstate entities like terrorist groups could obtain nuclear weaponry casts doubt on the future reliability of deterrence strategies as they are presently understood.

The U.S. Department of Defense (DOD) defines deterrence as "the prevention from action by fear of the consequences. Deterrence is a state of mind brought about by a credible threat of unacceptable counteraction."[14] Fundamentally, though, "deterrence" is a difficult concept to prove, based as it is on causing something not to happen. Used against a more traditional nation-state with all the equities and responsibilities of statehood, strategies of dissuasion and deterrence are interwoven with traditional mechanisms used to maintain international stability, such as negotiations, treaties, arms control agreements, and other diplomatic tools. The same is not necessarily the case, though, when opaque outlier states like North Korea gain nuclear weapons. States with authoritarian governments and tendencies toward bellicose behavior may be less likely to enter into stable relationships than states with a history of more responsible behavior. Along with arms control agreements, international inspection regimes, and other diplomatic and military strategies designed to maintain a stable international system, deterrence may have little appeal to the leaders of North Korea, Iran, or a state-sponsored terrorist group with access to nuclear weapons. The nuclear world has changed to such an extent that creating credible "second age" nuclear strategies of deterrence and use is not simply the extension of previous experiences in statecraft, but a new challenge entirely.

Net Assessment

If nations are to work together to maintain stable nuclear weapons strategies in a proliferating world, they must establish some mechanism to understand and react appropriately to potentially hostile nuclear powers whose cultural and operational frames of reference for nuclear weapons may be far different from those in the West.[15] The predominant view that nuclear weapons are not "just a bigger bullet" is based on decades of increasingly sophisticated theorizing on the effects of nuclear persuasion, coercion, or deterrence. As a consequence, policy planners have long believed that nuclear forces serve primarily political functions. The United States and allies like the North Atlantic Treaty Organization (NATO), Japan, South Korea, and perhaps Israel are mostly concerned with the prevention of nuclear use, or wielding successfully the influence of the nuclear threat, rather than actual employment.

From that point of view, transparency concerning nuclear arsenals, aims, and capabilities is a major step toward deterring nuclear use by unstable regimes, just as clarity regarding capabilities and intentions is fundamental to the two-way dialogue necessary for deterrence policies. At present, though, the United States and its allies have no mechanism to measure accurately the nuclear balance between their own capabilities and those of potential opponents, a fundamental requirement for clarity on both sides of a deterrence dialogue. Given the growing complexity of the strategic environment, the need for a process that pulls together allies in this most complicated arena, and the vital necessity for universal transparency regarding nuclear deterrent policies, the United States should propose and lead the development of a common method to assess the net strengths of allies against potential threats as they relate to nuclear deterrent policies.

Of course this would not be the first time the United States has led in the formulation of nuclear deterrent policies. During the Cold War, U.S.-led nuclear policy development was the centerpiece of NATO defense planning. To develop valid deterrence strategies, in the early 1970s, DOD established the Office of Net Assessment, whose purpose was to make an accurate assessment of the capabilities and intentions of the Soviet threat as it measured up against NATO. Since net assessment is fundamentally the business of power balances, the term came to mean a process by which "Blue" (U.S. and NATO) and "Red" (Soviet and Warsaw Pact) forces could be weighed, wargamed, and studied, so policymakers could come to appropriate conclusions about their relative strengths. In the words of Paul Bracken, "Net assessment emphasizes that strategic interactions are shaped by the complex sprawling organizations that break complex problems into smaller ones. . . . Net assessment, thus, had its origins in the need to integrate Blue and Red strategy in a single place. This is where the term 'net' came from.[16]

So long as net assessment dealt with the roughly symmetrical balance between two peer adversaries, it could at least rely on roughly understood boundaries and the experience that came from decades of focusing on a single threat. Using this tool, over time the United States and its allies built a highly proficient nuclear deterrent subculture within the military and certain civilian agencies that culminated in the Single Integrated Operations Plan (SIOP), a combined

nuclear war plan that took priority over all other allied military operational planning; when SIOP was invoked, the bottom line was nuclear war and the survival of the West. Of course, everything else took a back seat.

With the collapse of the Soviet Union in 1991, the United States and its allies no longer focused on nuclear strategies with the same determination that had produced NATO nuclear strategy and the SIOP during the Cold War.[17] U.S. "strategic" intelligence was reoriented from nuclear threats to the support of operational forces, particularly during Operation *Desert Storm* in 1991 and, after 9/11, in Afghanistan and Iraq. Strategic intelligence staffs overall were cut; many of the intelligence analysts who spent their careers focused on Soviet nuclear missile sites were reassigned to other missions or retired. But with the emergence of potentially hostile nuclear capable states that are secretive by nature and often antagonistic to the West, there is a renewed need for expert strategic analysis and a realistic understanding of nuclear power balances. (Whether resources have followed the need remains an open question.) Shifts in allied policies and intra-alliance balances since the 1990s indicate a need to refocus and reenergize allied nuclear policy development; in particular, this means agreeing on common net assessments of potentially hostile nuclear powers. Common net assessments are essential for a unified approach to deterring nuclear capable rogue states.

Since "deterrence" works best when accurately focused on the motives and objectives of potential foes, the re-invention and internationalization of net assessment requires the development of new methods of analysis to take into account the more varied cultural and political motives of newly nuclear states. All states, not only our friends but also potentially hostile closed states like North Korea or Iran, have unique decisionmaking traditions and processes. Discerning the motives and common ground among friends is tough enough; understanding the hidden political and military milieu of potential adversaries is far harder. Future nuclear deterrent strategies must be developed in a cooperative, transparent, and joint environment, with broad political and military engagement among allies and partners. By the same token, each potential nuclear opponent will likewise require nuanced, tailored strategies appropriate to the specific circumstances. This is a call for highly detailed and accurate intelligence and analysis. As nuclear threats proliferate, allied intelligence agencies must return to Cold War levels of intensity to find out what makes certain ruling cliques or cadres tick, because what dissuades or deters one may be a spur to action for another.

Not all actors in international politics calculate utility in making decisions in the same way. Differences in values, culture, attitudes toward risk-taking, and so on vary greatly. There is no substitute for knowledge of the adversary's mindset and behavioral style, and this is often difficult to obtain or apply correctly in assessing intentions or predicting responses.[18]

Developing the ability to lead international second-age net assessments of emerging and existing nuclear threats should be a top priority for the United States, as a method to underpin successful future strategies of deterrence, as a way to reconcentrate U.S. intelligence and operational expertise on serious threats, and as a process to foster cooperative and sustainable international responses to nuclear proliferation.

Building the Structure

Any net assessment process requires focus and boundaries to keep it manageable. Commonly, these boundaries are set by mutually agreed conflict scenarios that include both military and political analyses. During the Cold War, the well-understood nuclear arsenals of the West on one hand and the Soviet Union on the other set the boundaries of Cold War nuclear net assessment. There were only two viable scenarios: one in which war began by miscalculation, and one in which the Soviet Union attacked Western Europe and the United States. Though our knowledge of Soviet motives and intentions was never as good as we wished, certain assumptions and conclusions could be drawn by U.S. and allied policymakers.[19] In either case, the overarching scenario became all-out nuclear exchange, in which first- and second-strike capabilities could be analyzed and described to senior policymakers.

Second-age nuclear net assessment, though, must deal with more complex possibilities. A three-tiered system can be developed to group systematically the weapons, command and control, and policymaking structures of potential adversaries. The first, of course, comprises the "traditional" nuclear powers of Russia and China, the former of which maintains a substantial nuclear arsenal. Both potential adversaries are signatories to the Nuclear Nonproliferation Treaty, and both are veterans of the decades-long series of negotiations and agreements to limit the spread of nuclear weapons and discourage their use.

Although neither state can be taken for granted, tensions between the two and the United States do not now rise to the level of concern about potential nuclear war.

The second tier may be more worrisome. India tested in 1974, but Pakistan and North Korea are more recently declared nuclear states, and Iran may well become a nuclear power within a decade. While Israel, India, and Pakistan are aligned with the United States, North Korea is a decidedly less friendly state with an opaque if uncertain leadership that periodically threatens Japan and South Korea. Additionally, North Korea is suspected of exporting nuclear weapons technology, most recently to Syria.[20] Iran could become a nuclear power within the decade.[21] Its leadership varies from the pragmatic to the zealous, though over decades it has been hostile to the West in general and the United States in particular.

Since the industrial capacity required to produce nuclear weapons can be built only by nation-states, access by nonstate groups to nuclear weapons can come either through sponsorship by a nuclear state or by the theft of sufficient fissile materiel to build a crude weapon. Tier three is therefore occupied by nonstate terror groups that either have potential nuclear state sponsors, and thus would be susceptible to pressure or control from their sponsor, or can manage on their own to obtain sufficient nuclear materials to produce their own weapon. Hizballah is potentially an example of the former, because it receives support from Iran. Al Qaeda is the unassociated terror group that is most likely to be seeking stolen nuclear materials.

Net assessment of these third-tier threats differs from those of state actors because the weapons balance between the United States and the threat—the net in net assessment—is stated in different terms, and nuclear net assessment of nonstate entities relies more on highly discriminating intelligence regarding specific groups than generalized assumptions about terrorists. Each terrorist group and splinter group has distinguishing characteristics that might provide some leverage for dissuasion or deterrence. In his book, *On Nuclear Terrorism*, Michael Levi says:

Nuclear experts often hold intuitive assumptions about terrorism that are not borne out in the study of actual terrorist groups. At the same time, it is impossible to adopt traditional counterterrorism strategies to the nuclear program without accounting for the special properties of nuclear weapons. Thus, any assessment should interweave expertise on nuclear weapons with expertise on terrorism, something that has not always occurred in past analysis.[22]

Scenarios play a vital role in "bounding" a nuclear net assessment, which is not simply a catalog of the other side's nuclear arsenals and governing systems, but a comparative analysis of the two sides' total capabilities with regard to potential nuclear conflict. An initial key consideration is what scenario the assessment should use, since scenarios provide the essential context for any analysis. Just as the East-West standoff was couched in terms of aggression by the Soviet Union against NATO, assessment of other potential nuclear threats must be undertaken within a scenario of the most likely nuclear conflict—for example, a North Korean attack on the South. Military experts then must spin away portions of the conflict that do not affect nuclear outcomes.[23] Assumptions on Red nuclear doctrine and a thorough knowledge of Red's arsenals and the backgrounds and predilections of Red's leadership are prerequisites, since some battlefield reverses might trigger Red nuclear responses.

Wargame results of nuclear effects—missile attacks and defenses, weapons effects, and the like—provide "hard" data based on both sides' weapons characteristics, missile flight data and dispositions, and so on. "Soft" data on policy, leadership, and intentions, derived from intelligence sources, is also critical—and in some ways more critical than the outcomes of weapons use. The data are arrayed in a four-way analysis that examines the scenario from four perspectives:

Blue against Red and Red against Blue can be standard gaming that pits the opposing sides against one another in the chosen scenario. For realism, all participants in a Blue-Red conflict must participate at some level; for example, in a North Korean scenario, major Blue players would be the United States, Japan, and South Korea, but a host of other Blue actors would have equities in the conflict and should be represented; other Asian states, U.S. allies, and the United Nations come to mind. Within the U.S. Blue team will be players representing the appropriate U.S. combatant and allied commands. Red would be a tougher challenge, because although North Korea has no formal allies, other states might be presumed to be friendly and provide intelligence or other aid. Games are conducted in order to determine likely outcomes should deterrence fail, and are assessed from both the Blue and the Red perspective. Both

"hard" and "soft" assessments are made during the game, and planners may find it necessary to execute more than one game.[24]

Blue against Blue and Red against Red are seminar and conference-style debates conducted after the wargames, and are designed to examine fundamental assumptions or reservations that Blue or Red hold about themselves but that may not be true. For example, how strongly does the North Korean government control its army? Would it actually devolve to ground commanders the authority needed to fight a modern war? What likely fissures would the threat of nuclear war open within the North Korean leadership? Are Blue missile defenses, based both in the immediate theater and around the world, really able to defeat certain modern missiles? Are allies sufficiently confident in joint defensive systems that they would risk the security of their countries?

Following conclusions taken from the Blue and Red analyses, an inclusive assessment should be possible to address the balance of nuclear forces between Blue and Red in a specific theater—in this case, Northeast Asia—and those consequential variables that might tip a balance decisively one way or another. The nuclear net assessment does not set policy, but rather offers up a picture of the balance of forces and possible outcomes, and most important, an understanding of Red's leadership, its motives and perspectives on nuclear use, and how it potentially would react in the most likely conflict scenario. An internationally derived nuclear net assessment would also encourage dialogue and intelligence-sharing among allies, and substantially support the development of common views on specific nuclear states and issues.

This process applies as well to a net assessment of nuclear terrorism, though some distinctions must be made between third-tier terrorists. Nuclear forensics, a process that makes possible the identification of the origins of nuclear material, could play a powerful role in detecting and thus deterring those states willing to turn over nuclear materials to nonstate groups. In any case, all terrorist organizations have motives, hierarchies, cultures, and internal fissures that can be discerned in a "Red against Red" analysis, and thus can be balanced against Blue capabilities and doctrines. The purpose of nuclear net assessment is to find power balances; therefore, any splits and contradictions in terrorist leadership or organizational failures that are highlighted—all logical outcomes of the assessment process—and a raised consensus among members of the Blue team would be advantageous to the development of common goals for countering nuclear terrorism. Michael Levi points out that states can play a role in discouraging nuclear terrorism:

U.S. Coast Guard (Cory J. Mendenhall)

Border Enforcement Security Task Force boarding team conducts security boarding on tanker off Long Beach, California, to enforce maritime laws and combat smuggling in ports

If states can play an important role in facilitating nuclear terrorism beyond directly transferring nuclear materials to terrorists, targeting such relationships could undermine nuclear terrorism in a variety of ways. In the face of potential cooperation between states and terrorists, diplomacy might be used to break state-terrorist relationships, or at least to convince states that supporting nuclear plots might be unwise.[25]

An allied program to develop shared nuclear net assessments would be most likely to succeed initially if it were begun within a standing treaty organization like NATO, where defense staffs and officials have over time forged the intelligence-sharing and bureaucratic ties necessary for a robust assessment process. The United States should lead, principally because it commands many of the new technologies, such as missile defenses. This project would require the development of consensus positions on intelligence, likely Red motives and alliance responses, as well as a vetting process at lower levels to ensure that military scenario development—the excruciatingly detailed description of missile sites, intelligence systems, and command and control systems—precedes and supports the more difficult identification and recruitment of experts in the softer fields of policy and political intelligence, both for Blue and Red. Older hands in the policy and weapons business will find considerable similarity between the present reorientation and deliberation on nuclear threats and SIOP planning decades ago. The primary difference is that the SIOP signified the failure of deterrence, the execution of the unthinkable, while nuclear net assessment will be a building block for a more nuanced nuclear deterrent policy.

An international net assessment program would focus policymakers, intelligence specialists, and military planners on allied nuclear objectives at a time when nuclear weapons appear likely to spread to irresponsible and potentially hostile states. Even if the United States, with its greater resources, agrees to lead an international net assessment program, getting consensus, assembling the right people, and doing the analysis is years away; begun soon, the first net assessment would probably be available about the time Iran fields its first nuclear weapon. But the alternative is worse: deterrent policies developed independently by leading states; little or no inclusive dialogue to develop agreement among allies; and the proliferation of nuclear weapons with no commonly held strategies, or even agreements on what the strategy should be. It is time to begin building the first international nuclear net assessment.

Homeland Security and Defense

The capacity to launch attacks with catastrophic effects, particularly those involving WMD, are no longer marshaled only by states or state-sponsored groups, but also by small, organized terror cells or even lone individuals (such as the 1995 Oklahoma City bombing). From advances in biotechnology and pharmaceuticals to the prevalence of chemical manufacturing and the widespread availability of radiological materials such as Cesium, the threat is increasingly global and dynamic and blurs criminal intent with national security consequences. This makes fashioning an effective response to protect the homeland highly complex.

While new actors and capabilities emerge to pose a different kind of challenge to the homeland, they augment rather than replace more traditional dangers, which did not disappear when new challenges appeared. State-based missile or nuclear weapons development and proliferation continue to menace U.S. and international security. Today's threat continuum ranges from homegrown extremists to global opportunists to criminal networks to pariah states.

This dynamic security environment requires an equally dynamic and vigorous response. Much conceptual confusion, however, continues to plague efforts to effectively combat the danger of catastrophic terrorism. Greater attention must be paid to the development of appropriate responses to a different type of enemy—one that blurs the distinction between crime and terror, and one that can easily exploit traditional divisions between Federal, state, and local governments.

Al Qaeda is one such adversary: its attacks come with little or no warning, entail potentially catastrophic consequences, and have the potential to overwhelm the capabilities of first responders. The 2007 National Intelligence Estimate makes this clear:

We judge the U.S. homeland will face a persistent and evolving terrorist threat over the next three years. . . . Al-Qa'ida is and will remain the most serious terrorist threat to the homeland. . . . . Al-Qa'ida's homeland plotting is likely to continue to focus on prominent political, economic and infrastructure targets, with the goal of producing mass casualties. We assess that Al Qa'ida will continue to try to acquire and employ chemical, biological, radiological or nuclear material in attacks and would not hesitate to use them if it develops what it deems is sufficient capability. The ability to detect broader and more diverse terrorist plotting in this environment will challenge current US

defensive efforts and the tools we use to detect and disrupt plots.[26]

Combating this threat requires coordinated procedures and synchronized efforts across the state, local, and Federal levels of U.S. Government. And at each level, particularly the Federal level, departments and agencies charged with law enforcement and national defense must be organized and equipped to act in an integrated and mutually reinforcing manner. Homeland security, conceptually and organizationally, brings together responsibilities and organizations that are spread out across the Federal Government. It attempts, through plans and strategies such as the National Response Framework, to link protection, detection, and response across the state, local, and Federal divide. The objective is to harmonize policies, develop effective capabilities, and deter adversaries. Four homeland security goals identified in the 2007 National Strategy for Homeland Security are to prevent and disrupt terrorist attacks; protect the American people, critical infrastructure, and key resources; respond to and recover from incidents that do occur; and, continue to strengthen the foundation of security to ensure our long-term success.

Who Does What?

In the United States, homeland security is a concerted national effort to prevent terrorist attacks, reduce the vulnerability to terrorism, and minimize the damage of and assist in the recovery from terrorist attacks.[27] The Department of Homeland Security (DHS) has the primary responsibility. Beyond the prevention of terrorism, DHS also has the responsibility to prepare for, respond to, and aid in the recovery from natural and manmade disasters, attacks that involve weapons of mass destruction, and other emergencies.

The Department of Justice enforces the law and defends the interests of the United States according to the law. The Attorney General, as chief law enforcement officer, leads the Nation's law enforcement efforts to detect, prevent, and investigate terrorist activity within the United States.

The Federal Bureau of Investigation (FBI) is the investigative arm of the Justice Department. The FBI protects and defends the United States against terrorist and foreign intelligence threats, upholds and enforces the criminal laws of the country, and provides leadership and criminal justice services to Federal, state, municipal, and international agencies and partners. The FBI is also responsible for crisis management of a terrorist event if it occurs in the homeland.

While homeland security is a national effort that involves various interagency actors such as Homeland Security, Justice, and the FBI, homeland defense is a critical subset of homeland security. Homeland defense is the protection of U.S. sovereignty, territory, the populace, and critical defense infrastructure from external threats and aggression or other threats as directed by the President. DOD serves as the Federal agency with lead responsibility for homeland defense; DOD may execute homeland defense missions alone or with support from other agencies such as DHS.[28]

DOD also supports homeland security by assisting U.S. civil authorities. Homeland defense and civil support operations may occur in parallel and require extensive integration and synchronization. Civil support operations may also shift between missions—for instance, from homeland defense to civil support to homeland security, with the lead depending on the particular circumstances of the situation and desired outcome or mission objectives. In areas of overlapping responsibility, the designation of a Federal agency with lead responsibility may not be predetermined. In time-critical situations, on-scene leaders are empowered to conduct appropriate operations in response to a particular threat.[29] As a result, the role of DOD may not be a fixed one during any particular crisis. Whether leading homeland defense operations against external threats, or supporting homeland security missions and tasks led by the Department of Homeland Security or other designated Federal lead agency, DOD's uniquely trained force and capabilities (including WMD detection, protection, and decontamination assets), coupled with command and control capacity from the tactical to the strategic level, make it an important component in homeland security.

DOD Homeland Defense

Defense of the homeland is DOD's highest priority, with the goal to defeat threats at a safe distance from American soil.[30] Therefore, while the U.S. military's primary focus is on overseas combat operations in furtherance of national defense, DOD does have a role, albeit a primarily supporting one, in domestic homeland security. The traditional limits on DOD's domestic role arise from deep skepticism after the Civil War over military forces acting in a domestic law enforcement capacity, embodied in the Posse Comitatus Act of 1878. In today's threat environment, where surprise is likely and the effects potentially catastrophic, the tradeoff against this

prohibition is based on the premise that DOD may have the most ready and effective capabilities, personnel, and command and control for the homeland security mission. These capabilities, some argue, can save time during a response, and saving time may save lives. For example, DOD has a range of unique resources, from chemical, biological, radiological, and nuclear (CBRN) expertise to large-scale logistics execution and management capabilities. The question then becomes how to effectively integrate those unique DOD capabilities with the civilian homeland security response, while respecting the principle of posse comitatus, which says that defense personnel should engage in law enforcement activities only as a last resort.

The Defense Department's concept or philosophy for civil support in any particular case is based on the understanding that civil resources and capabilities will be exhausted before DOD plays a major role in a response. For example, the response to Hurricane Katrina brought into question fundamental assumptions of the role of the Federal Government and the specific role of DOD in supporting civil authorities as they respond to a catastrophic natural disaster. With the Federal response predicated on augmenting state and local civil authorities, it is justifiable to question whether this framework is reasonable and even workable where local and state capacity to respond to an event no longer exists and the social fabric of a large urban area is no longer functioning. Large natural disasters such as hurricanes, pandemics such as an avian influenza outbreak, and CBRN attacks on, say, a state capital, certainly present the prospect of a situation where there was little, if any, remaining civil authority for a Federal response effort to augment. DOD plans call for civil support missions to be limited in duration and scope, and terminate as the crisis abates and civil authority is able to manage the situation effectively. While defense support to civil authorities will be a Total Force effort that utilizes both Active and Reserve elements as needed, the primary reliance for civil support will fall on the Reserve Component. Over time, "the goal is that the capacity of other agencies and state and local governments to respond to domestic incidents will be sufficient to perform their assigned responsibilities with minimal reliance on U.S. military support."[31]

To satisfy the broader homeland defense requirement, DOD established joint doctrine to provide guidance on this role. This doctrine calls for securing the United States from attack through layered "defense-in-depth" that integrates capabilities in the forward regions, the geographic approaches to U.S. territory, and within national borders. For the forward regions, or those areas far outside U.S. territory, the objective is to detect, deter, prevent, and defeat threats to the United States before they can mature to pose a threat to the homeland. For the approaches, the areas reaching from U.S. borders to the forward regions, the objective is to identify, characterize, and defeat threats as far away as possible. And for threats on U.S. soil, DOD must be able to take immediate, decisive action to defend against and defeat threats as they arise.

U.S. Northern Command (USNORTHCOM) has the operational responsibility for the conduct of military operations within the United States, utilizing forces to deter, detect, or defeat an incursion into sovereign territory. The command also maintains the responsibility for civil support activities for most of the United States.[32] USNORTHCOM carries out civil support missions with forces assigned as required from all the armed Services, typically through the creation of a joint task force.

Conclusion Regarding Homeland Security and Defense

Threats to the United States are not static, and responding to them requires flexibility. As traditional threats evolve and new ones emerge, DOD's homeland defense requirements will change and may require new approaches and tools, such as developing a joint command and control element for homeland defense and civil support missions, or a similar capability to manage the consequences of major catastrophic events, be they manmade or natural. Recognizing DOD's unique role in protecting the United States and capitalizing on its unique capabilities will assure U.S. security as the Nation adapts and responds to the emerging threat environment.

Proliferation and the Militarization of Space

Many concerns about WMD proliferation intersect issues related to the increasingly contested domain of space. Security through space and security in space are increasingly important issues. The proliferation of technology to disrupt or destroy satellites and other space assets is proceeding, even as reliance on these systems is growing. Not only are nuclear weapons and deterrent strategies interwoven with space systems, but also asymmetric attacks in space could pose potentially devastating security consequences and create major social and economic disruption.

Background

Since the launch of Sputnik by the Soviet Union in 1957, the uses of space—for economic, military, scientific, mass media, and other socio-cultural purposes—have grown dramatically, as has the number of actors involved with space. Globalization, arguably the defining dynamic of the 21st century, is dependent on the space-enabled information networks that have transformed the nature of human and technological interaction. Use of space is no longer just for superpowers. If one includes all parties that use at least some product or service created by activities conducted in space, then space activities directly benefit most people in the developed world and many in the developing world. From mobile telephones, Internet communications, and television to money transfers and automatic teller withdrawals, space-based technologies and services permit people to communicate, companies to do business, civic groups to serve the public, and scientists to conduct research. Much like highways and airways, water lines and electric grids, global utilities such as precision navigation and timing data (provided via satellite free of charge) form an increasingly important part of the global information infrastructures. A truly international space industry has developed and has witnessed the emergence of several international consortia with no readily ascertainable national identity. Revenues for the commercial space sector now exceed $100 billion per year. Today, commercial and even individual customers worldwide can purchase launch services or global imagery and other remote sensing data that were once available only to governments.

AP Images (Missile Defense Agency)

Rocket simulating speed and trajectory of North Korean rocket launched from Alaska as target for ground-based interceptor from Vandenberg Air Force Base, California

As critical as the space-enabled information infrastructure is to continued global economic growth and vitality, the full extent of this dependency on space is not widely understood. And with this dependency comes vulnerability, even if that vulnerability is often shared. Conflict involving threats to space-related assets would have serious effects on information flows vital to the global economy.

The military and national security uses of space have also grown. Intelligence information collected from space platforms has been an essential part of maintaining transparency in the international system, dating back to the "open skies" policy created by the space systems of the United States and the Soviet Union during the Cold War, to verify treaties through "national technical means" and be warned of missile attacks. Today, states use satellites for national security purposes to provide global communications capabilities; conduct photoreconnaissance; collect mapping, charting, geodetic, scientific, and environmental data; and gather information on natural or manmade disasters. This intelligence is essential to all aspects of national defense, from the formulation of policy to the management of crises and conflicts, the conduct of military operations, and the development of needed

capabilities. Space-based capabilities allow military forces to communicate instantaneously, obtain near-real-time information that can be transmitted rapidly from satellite to attack platform, navigate to a conflict area while avoiding hostile defenses along the way, and identify and strike targets from air, land, or sea with precise and devastating effect.

At the beginning of the space age, many space systems and capabilities were specialized to perform one specific function for a single user. Today, many space systems have become dual-use in that they simultaneously support both military and civilian applications. For example, commercial imagery companies now provide a major portion of space imagery used by the U.S. Government, and commercial systems carried over 80 percent of satellite communications traffic during the combat phase of Operation *Iraqi Freedom*.

Moreover, while space may have been perceived as a strategic sanctuary in the past, today it is becoming an increasingly contested military domain like land, sea, or air, where satellites face a variety of threats such as space debris, crowding, jamming, and the diffusion of countersatellite technology to a larger number of actors via dual-use capabilities and dedicated development.

Such capabilities are not just theoretical. China launched a direct-ascent antisatellite (ASAT) weapon on January 11, 2007, which struck a Chinese weather satellite in low Earth orbit. The successful test demonstrates China's ability to threaten a number of satellites in low orbit, which may include those used for reconnaissance, remote sensing, surveillance, electronic surveillance, and meteorology, as well as some civilian satellites with military applications. These satellites and the International Space Station are also at increased, although not significant, risk from the debris cloud created by the Chinese ASAT test. The direct-ascent ASAT appears to be part of a larger Chinese ASAT program that includes ground-based lasers and jamming of satellite signals.[33]

The United States has also demonstrated the ability to destroy satellites. On September 13, 1985, an F–15 fighter aircraft launched a miniature vehicle to destroy a defunct U.S. satellite. On February 21, 2008, the United States used a modified Navy missile (the Standard Missile 3) to shoot down a crippled reconnaissance satellite that was falling out of orbit and threatening to spill its toxic rocket fuel upon reentry.

The "Militarization" of Space

The "militarization" of space is an imprecise phrase. Some would note that space has been militarized for decades, with satellites used for intelligence and ballistic missiles that fly through space. Others think of militarization of space as involving kinetic weapons in space that could destroy either satellites or targets on Earth. Neither is a very enlightening or satisfactory way of looking at the issue.

There are two important military and security aspects for spacefaring nations or other actors to consider: security through space, and security in space.

Security through space implies the use of space assets to enhance the security posture of an actor or set of actors on Earth. Space capabilities may be used by an actor to prevent conflict and ensure stability through either transparency or deterrence. Transparency refers to the ability to "see" capabilities as they develop and events as they unfold. Deterrence could be holstered because space-based reconnaissance provides warning as well as command and control for nuclear forces. Conversely, a nation may use its space assets to enhance its terrestrial combat capability through either force enhancement or force application. Forces could be enhanced by the precision and capability of air, land, and sea forces through positioning, navigation, and timing; command and control; and intelligence, surveillance, and reconnaissance. Force application would result from actors developing ways to apply force directly from space to generate combat effects on the terrestrial battlefield, and from defenses that might be deployed in space to deter and protect against ballistic missile attacks.

Security in space concerns the protection of space assets themselves, whether used for military or civilian purposes. Nations, particularly those that already possess a strategic advantage, will seek to maximize their freedom of action in space. To do so, an actor may seek capabilities in four areas. The first area concerns transparency. Situational awareness is essential to identify potential threats in space. Equally important is the ability to track potential adversaries' ground-based activities as they relate to space. Second, security in space also involves protection. The fragile and vulnerable nature of space assets, particularly commercial and civil devices, suggests that protection measures be considered early in the design cycle of space systems. Military forces may be called upon to protect critical civilian assets. Denial is a third issue, because of the ability to negate an adversary's space capabilities, through such means as

▼ *Continued on p. 179*

Preventing Nuclear Proliferation: An Overview

There is a deep and longstanding worldwide recognition that the proliferation of nuclear weapons is dangerous and must be prevented. The ideal path to nonproliferation is to eliminate the reasons why countries may feel that they need nuclear weapons. Since, amid the world's political complexities, that cannot always be swiftly or dependably achieved, the countries of the world have assembled a substantial structure of more specific instruments. The record of achievement by this structure since the 1968 conclusion of the Nuclear Nonproliferation Treaty (NPT) is, in the round, not discouraging, and claims that the prevention regime now stands on the edge of an abyss are neither well founded nor helpful. There are, however, risks and dangers to be addressed in at least four areas:

- the problems of particular countries
- general weaknesses in the nonproliferation regime itself
- the danger of material diversion and terrorism
- the call for further disarmament by the nuclear-armed states.

Country Problems

The nonproliferation regime faces one definite new breakout (by North Korea) and one potential breakout (by Iran). The United States and others with a stake in the outcome must maintain pressure on North Korea to live up to its agreements and also must keep a close watch on Pyongyang's propensity for pernicious export activity. As long as Japan, in particular, sustains its mature refusal to let this beleaguered minor state provoke it into reversing its nonnuclear policy, a move that would be gravely unsettling region-wide, the North Korea problem is less troubling than that of Iran.

The size, resources, and location of Iran make it a much more important state. There may be no clear agreement among its leadership about ultimate goals, but present actions seem plainly to head toward creating at least a "threshold" capability, from which breakout to a deliverable nuclear weapon (with delivery vehicles already available) could be relatively swift. Even if progress went no further, that would be deeply damaging to the global regime and disruptive to Iran's region. Efforts to avert this outcome, through a combination of incentives and penalties, must continue to command a high priority in the international community. Policy—and public utterances about it—must, however, recognize an awkward tension. The hard truth is that if Iran is determined to continue down its current path, whatever the cost, it cannot permanently and dependably be prevented, whether by military intervention (which would, at best, carry massive costs for the interveners and their allies) or otherwise. Efforts at prevention must resolutely continue, with no hints of ultimate willingness to acquiesce. But prudent planning should also consider what could be done, if prevention does eventually fail, to ensure both that Iran suffers a lasting penalty and that regional neighbors do not feel compelled to traverse the same road.

A third country-specific issue, albeit one of a very different character, concerns India, a massive democratic state of increasingly positive global weight. Other states must balance their desire to assist in its nuclear energy program to ensure the program's safety and security with the maintenance of an objectively even-handed approach to the operation of the nonproliferation system. This issue interacts with more general questions about the future working of the regime.

General Weaknesses in the Nonproliferation Regime

An array of instruments and institutions that amount to a strong structure of constraint on proliferation has grown up around the cornerstone of the NPT itself—including, for example, the International Atomic Energy Agency (IAEA), the Nuclear Suppliers Group, and the U.S.-led Proliferation Security Initiative. But participation in some of them remains less widespread or energetic than it should be, and at least three specific weaknesses need to be tackled if the regime is going to be more effective.

The first concerns verification of the NPT's constraints. After the 1990–1991 Gulf War unmasked sweeping concealment and evasions by Iraq, a valuable Additional Protocol was given to the IAEA to apply; it would extend safeguards to help detect undeclared nuclear activity. But not enough states parties to the treaty have been willing to accept and implement the protocol, or to allocate adequate resources to the IAEA for its enforcement.

The second weakness is that Article X of the NPT allows states parties to withdraw from it—as North Korea has intermittently done—simply by giving 3 months' notice and some account (not subject to any evaluation) of its reasons for doing so. An entitlement of this

AP Images

Delegates attend Six-Party Talks in Beijing on denuclearizing North Korea

kind is, of course, fairly normal practice in treaties, as the U.S. withdrawal from the 1972 Anti-Ballistic Missile Treaty illustrated. But it is questionable whether such an easy escape clause is tolerable in a commitment that has become virtually a global norm, and where withdrawal by one party stands to undermine the treaty's benefits and credibility for numerous other parties. It is unlikely that formal amendment of the treaty to remove the right entirely would be politically feasible. There would, however, be an advantage—not least for deterrence—in developing and agreeing to a clearly understood package of disadvantages that any state withdrawing from the treaty without manifestly compelling reasons must expect to endure.

The third weakness relates to the "threshold" problem, vividly exemplified by Iran's behavior. Nothing in the NPT prevents states parties from developing their capability in the field of civil nuclear energy, in ways that would have the effect (intentional or not) of making the step to producing nuclear weapons (using highly enriched uranium or plutonium from the reprocessing of spent fuel) just a matter of months, or at most a few years. In fact, Article IV specifically grants nonnuclear weapons states the right to "equipment, materials and scientific and technological information for the peaceful uses of nuclear energy," as long as they meet the safeguards requirements laid out in earlier articles. This provision has already proved harmful to long-term confidence in the regime, and its significance will be heightened by the likelihood that over the next few decades, for a combination of reasons, nuclear power will play an increasingly important role in the energy mix for many countries.

This third weakness may well be, in the long run, the most important of the three. To rectify it, leading technologically capable countries will need to devise—preferably on the most cooperative basis that can be constructed—arrangements for the dissemination of nuclear energy technology that close off the threshold problem, yet are accessible, generous, politically nondiscriminatory, and dependable over the long term. Such carefully devised arrangements could convince recipient countries both that a fair and secure alternative path was available to meet their legitimate requirements, and that they should fully support action against any intransigent holdouts such as Iran. Article IV of the NPT has always recognized the value of nuclear energy, but it has not been taken up with much vigor by the nuclear weapons states or, to be fair, by the nonnuclear weapons states themselves.

All these weaknesses will need to be acknowledged and dealt with at the next review conference of NPT parties in 2010. The last conference, in 2005, was a fiasco, largely for political reasons that need not be recapitulated here. Another fiasco could imperil confidence in the entire regime. It would be an opportunity missed, moreover, for though the conferences are not the venue for detailed executive decisions, they can serve as both a setting for developing ideas and consensus about how to strengthen nonproliferation, and a political stimulus to concrete action by states or other collective bodies.

Nuclear Terrorism

Opinions differ widely on how real or likely the risk is that terrorists might obtain a nuclear bomb and use

it to inflict vast damage. Even those who regard the probability as slight, however, would agree that all reasonable efforts should be made to keep the risk as low as possible. Action to that end may need to take many forms, but two particular international prospects seem worth pursuing.

One instrument was provided in 2004 by United Nations (UN) Security Council Resolution 1540. This resolution, framed in the wake of revelations about Pakistani physicist A.Q. Khan's "nuclear black market," was passed under Chapter VII of the UN Charter and is therefore mandatory for all member states. It requires each one to put in place, operate effectively, and report on legal and administrative measures to prevent nonstate actors from acquiring materials for weapons of mass destruction. Action to fulfill this obligation is by no means globally complete, and some less well resourced countries are reported to be finding it difficult to implement the resolution fully. Where that is so, it is in the interest of leading states to be ready to help, as well as pressing for full compliance by all.

A second measure that could help to reduce dangers is the compilation of a thorough international data bank making it possible to swiftly trace the source of any fissile material used in a nuclear detonation. Such a bank would heighten the likelihood that any state that had been careless, or worse, in its stewardship of weapons-usable material would be exposed. This would have the corollary benefit of stimulating robust security and strengthening deterrence.

Reducing the Size and Salience of Nuclear Armories

It is politically (and many would say legally) impossible to decouple the prevention of proliferation from what the nuclear-armed countries do to reduce the scale of their own arsenals, mitigate their dangers, and deemphasize them within the total security toolbox. The nonproliferation regime imposes constraints and burdens upon the nonnuclear weapons states, and their willingness to continue accepting these wholeheartedly cannot be divorced from what most of them perceive about the fulfillment of the disarmament bargain indicated in NPT Article VI. The reassertion of that bargain was crucial to the indefinite extension of the treaty, agreed by consensus at the 1995 review conference, and it was reemphasized in 2000.

Until the end of the Cold War, the five official nuclear weapons states honored this clause of the treaty in the breach. Since then, all but China (which still has by far the smallest arsenal)—and especially the United States and Russia—have made a certain amount of progress in reducing both the numbers and kinds of weapons and delivery systems they possess. It might well be helpful if the facts of these reductions were more widely and vigorously publicized, and also if the possessors were more transparent about what they still hold. There remains valuable scope to do more, especially for the two weapons states with the largest stockpiles.

The 2002 Moscow Treaty limits U.S. and Russian strategic forces only at a single point in time, in 2012, and it has no verification provisions. It is important that a more robust and durable successor agreement be put in place. It would, moreover, be highly desirable, for several reasons, to reach an agreement to constrain and verify Russia's nonstrategic armory, which is far larger than that of the United States. If such an agreement required inducements from the U.S. side—for example, about the residual presence of U.S. nuclear arms in Europe, or the plans for a missile defense system in Central Europe—they should not be dismissed out of hand.

Beyond limitation on the size of weapons stockpiles, there is a strong case for movement on at least three further issues:

- reconsidering whether any nuclear systems still need to be kept on short-notice alert
- taking the Comprehensive Test Ban Treaty forward to full ratification and implementation
- moving forward on a fissile material cutoff treaty.

In cold strategic logic, the latter two projects may be less important than advocates claim, but they have acquired a political weight that by now has force in its own right.

There remains the idea of eventually abolishing all nuclear armories. That goal was agreed at the 2000 NPT review conference, and though at the 2005 conference the United States and France declined to reaffirm it, the aspiration has attracted growing attention in the past few years. However skeptical the nuclear weapons states' governments may be, there is a good case that they should be prepared to engage—as the United Kingdom has already proposed—in serious exploration of the concept, if only to ensure that its formidable difficulties and potential drawbacks, both political and technical, are adequately understood and exposed.

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antisatellite programs, may permanently or temporarily shift the relative advantage in space. Finally, space control—a combination of protection and denial strategies—is also significant. An actor desiring freedom of action in space may also wish to limit its adversary's freedom of action, to remove a perceived threat. This requires maximizing both protection and negation capabilities.

Prospects for International Space Security

The prospects for international space security are uncertain not least because the international regime regulating the use of space is embryonic. The Outer Space Treaty, which was ratified unanimously by the U.S. Senate and entered into force in 1967, defined the initial principles for space activity and described the dominant paradigm of the international community regarding space:[34]

- Space is the province of all mankind—a "global commons."
- Space is to be used only for peaceful purposes. No weapons of mass destruction will be placed in orbit, or installed on a celestial body such as the moon.
- All states have an equal right to explore and use space.
- International cooperation and consultation are essential.
- Signatories retain ownership of their space objects and bear responsibility for their space activities, including any damage inflicted on another state's space objects.

Although most, if not all, spacefaring actors ascribe to the principles of the Outer Space Treaty, a number of issues have arisen to challenge the dominant paradigm. The first problem concerns definitions. The terms peaceful uses and common heritage of man have widely varying interpretations among space actors. Moreover, there is no agreed definition of what constitutes a space weapon (see sidebar). Sovereignty and property rights pose a second challenge. Economic development in space under the current paradigm is stunted by lack of legal definition concerning these issues. Finally, self-interest may prevail over a weak international regime. As more actors enter into the space domain, there may be a growing tendency to pursue unilateral interests rather than adhere to established norms. The Outer Space Treaty has no enforcement mechanism, if anyone should choose to take that step.

A reframing of the current paradigm may be required to accommodate the changing nature of space activity. Nations will likely seek alternative arrangements in space if they perceive their security to be at greater risk. There are myriad ways in which the future framework might evolve. Some alternative ways that nations may choose to enhance security, either individually or collectively, include unilateral strategies; a balance of power approach; alliance-based arrangements; "rules of the road" through informal talks and agreements; frameworks for cooperation and interdependence in space, through existing alliances and institutions, or a new multilateral process; and negotiated arms control or other legal restraints, bilaterally or through a multilateral treaty process.

From the standpoint of international security, one can identify an optimal condition of enduring stability in the space domain. Its main attributes would include:

- a norm of unfettered access to space as a feature of amicable interstate relations
- a solid measure of protection, through individual or collective measures, against the aggressive or capricious acts of spoilers
- a situation in which the real or perceived vulnerabilities among space actors are minimized.

Ultimately, creating a condition of enduring stability in space will hinge on how tensions between national interests are addressed and whether there emerges over time a common perception of what actions tend, on balance, to strengthen or undermine stability. The simple truth is, if enduring stability is not the primary goal of major space powers, the prospects for military competition and conflict will increase. In a stable environment, space can enhance and strengthen the international system. Spacefaring actors may be driven by realistic self-interest to consider adopting cooperative approaches in space to address issues of global concern, such as energy scarcity, climate change, material resource scarcity, space situational awareness, space debris, and defense against Earth-colliding objects such as asteroids.

What Is a Space Weapon?

As with much else about space, there is considerable debate and uncertainty over what constitutes a space weapon, how such weapons might be defined, and how important it is to attempt to define and control such weapons. A 1991 study sponsored by the

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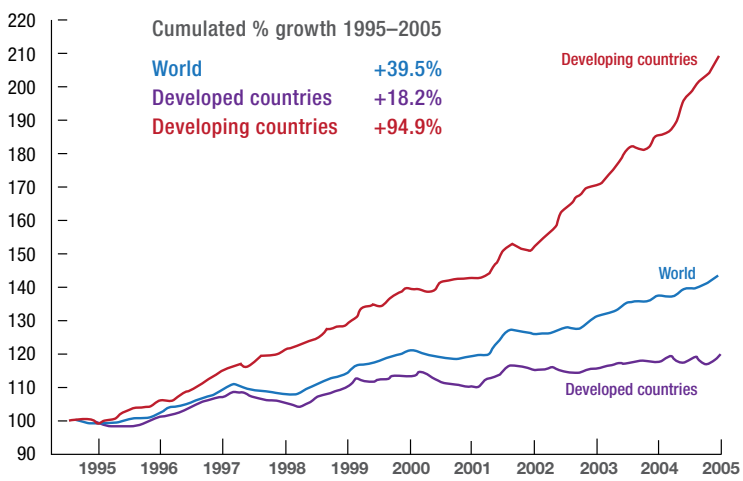
Proliferating Nuclear Programs

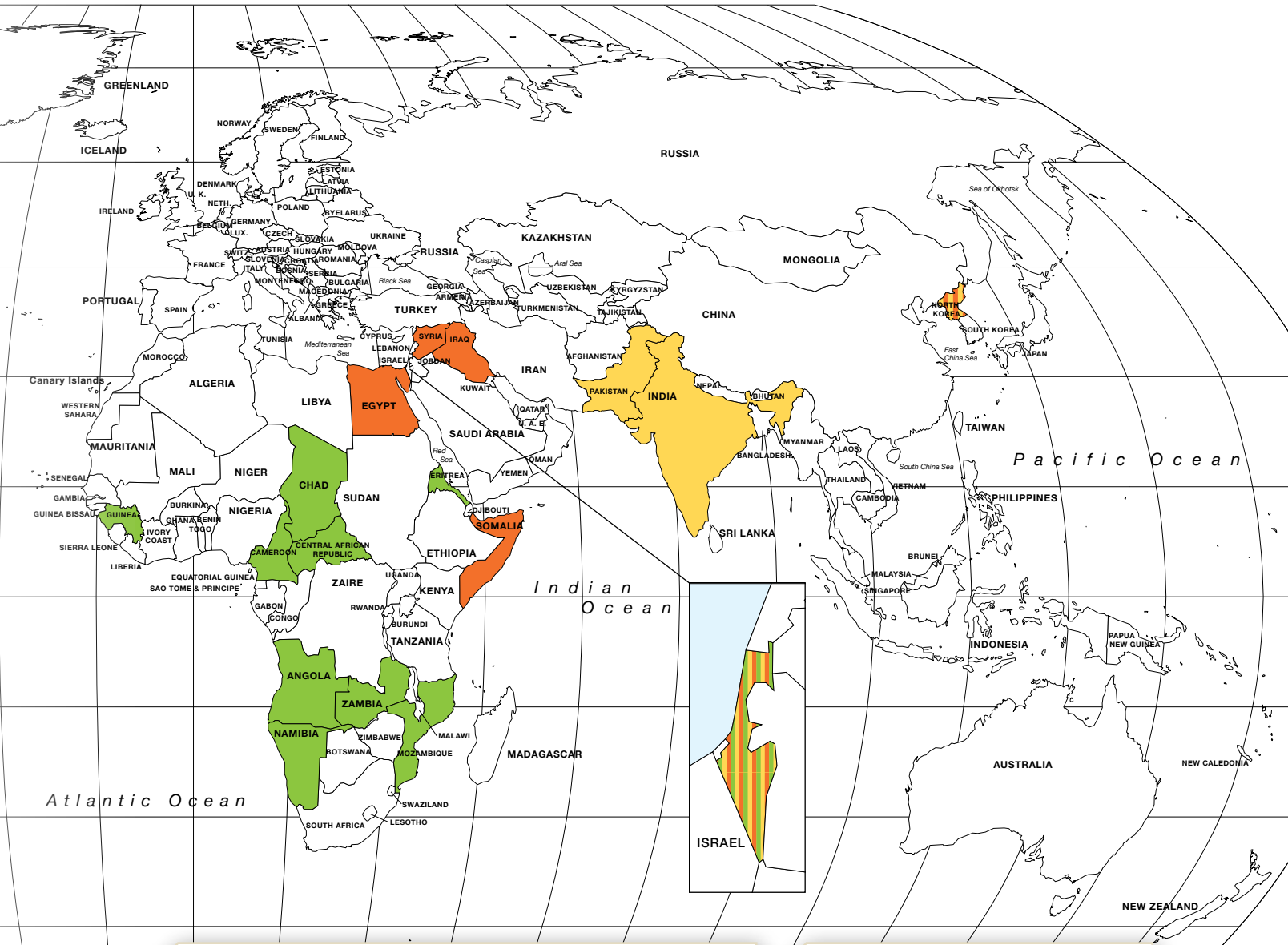
Category	Countries
Nuclear Non-proliferation Treaty–recognized nuclear weapons states	**5** China, France, Russia, United Kingdom, United States
Other declared or suspected nuclear weapons states	**4** India, Israel,* North Korea,† Pakistan * Israel has not acknowledged its nuclear weapons status †North Korea has asserted that it possesses nuclear weapons and has tested a nuclear device
Other states with enrichment/ reprocessing facilities	**5** Brazil, Germany, Iran,* Japan, The Netherlands *Iran is under UNSC sanctions for NPT compliance issues
Other states planning enrich-ment/reprocessing facilities	**2** Argentina, Canada
Other states with civilian nuclear energy programs	**17** Armenia, Belgium, Bulgaria, Czech Republic, Finland, Hungary, Lithuania, Mexico, Romania, Slovakia, Slovenia, South Africa, South Korea, Spain, Sweden, Switzerland, Ukraine
Other states expressing interest in establishing civilian nuclear energy programs	**29** Algeria, Australia, Azerbaijan, Bahrain, Belarus, Chile, Egypt, Estonia,† Georgia, Ghana, Indonesia, Jordan, Kuwait, Latvia,† Malaysia, Morocco, Namibia, Nigeria, Norway, Oman, Poland,† Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, Venezuela, Vietnam, Yemen †In conjunction with Lithuania to support the replacement of a reactor scheduled to be shut down in 2009 due to safety concerns.

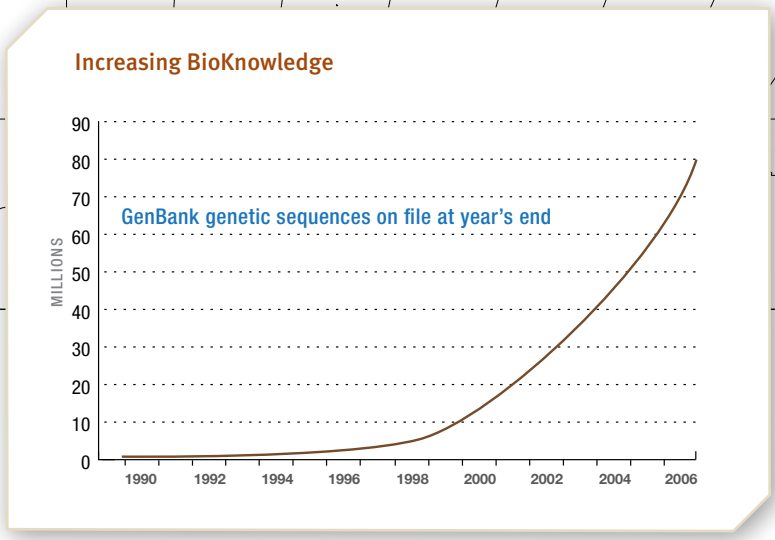
Sources: IAEA, Israel Atomic Energy Commission, United Nations, U.S. Department of State, International Security Advisory Board, IISS



* Excluding pharmaceuticals

Source: René Van Sloten, "How to ensure that Europe remains a leading chemicals production platform in 2015"





Source: Genetic Sequence Data Bank, NCBI-GenBank Flat File Release 166.0

- Non-signatories to Nuclear Non-proliferation Treaty
- Non-signatories to Biological Weapons Convention
- Non-signatories to Chemical Weapons Convention[1]

[1] Iraq has declared its intent to accede to the Chemical Weapons Convention

Sources: United Nations, Organisation for the Prevention of Chemical Weapons, U.S. Department of State

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United Nations Institute for Disarmament Research proposed the following definition:

A space weapon is a device stationed in outer space (including the Moon and other celestial bodies) or in the earth environment designed to destroy, damage or otherwise interfere with the normal functioning of an object or being in outer space, or a device stationed in outer space designed to destroy, damage or otherwise interfere with the normal functioning of an object or being in the earth environment. Any other device with the inherent capability to be used as defined above will be considered as a space weapon.[35]

This definition seems clear and comprehensive; it focuses on devices stationed in space or on Earth capable of creating weapons effects in space and devices stationed in space capable of creating weapons effects in the Earth environment. Closer examination, however, reveals significant, and perhaps irresolvable, points of contention within this definition.

The first of these contentious points relates to the lack of clarity regarding where space begins and the meaning of the word *stationed*. Since neither of these terms is defined, this approach does not provide much assistance to analysts attempting to draw distinctions between space weapons and other types of weapons based on where they are located or normally operate.

A second and even more pervasive and contentious point is raised by the last sentence of the definition that considers any other device with the inherent capability to create weapons effects to be a space weapon. This seems to be an extremely low threshold for a device to cross to be categorized as a space weapon, and it is doubtful whether it would create a useful analytical category. Consider, for example, that every satellite capable of maneuvering or transmitting has the potential to interfere with other satellites, or that a backhoe cutting the fiber optic cable from a satellite control ground station has surely interfered with the normal functioning of an object in the Earth environment; are every satellite and every backhoe to be considered a space weapon?

Other approaches to defining space weapons attempt to resolve the scope problem highlighted above by focusing on distinctions between dedicated weapons and systems with residual or latent capabilities. For example, Michael Krepon and Michael Katz-Hyman define *space weapons* and *offensive space warfare initiatives* as "terrestrially based devices specifically designed and flight-tested to physically attack, impair, or destroy objects in space, or space-based devices designed and flight-tested to attack, impair, or destroy objects in space or on earth." This definition respects the distinction between capability and actuality; and it excludes residual or latent space warfare capabilities, such as ballistic missiles. Also excluded in this working definition are satellites that provide essential military functions but do not serve as weapons platforms. In other words, the definition used here clarifies the essential distinction between the current primarily passive military uses of space, and the flight-testing and deployment of space weapons that some wish to pursue in the future. This definition also excludes activities that are specifically designed to interfere with the uplinks or downlinks of satellites. Jamming is treated separately from direct physical attacks against satellites because jamming has long been considered a part of warfare, whereas direct attacks in or from space would be consequential firsts in the history of warfare.

Of course, there are also potential problems with this more pragmatic definition. In general, because it excludes so many of the ways in which already-deployed or readily available capabilities could easily interfere with space systems, it is questionable whether controls based on this definition would provide sufficient transparency, build confidence, or create much security for space systems. A related problem is the fact that many spacefaring actors already have numerous technologies that are capable of interfering with satellites, and so would not need to test or deploy such systems as dedicated weapons.

These longstanding problems with seemingly simple definitional issues, such as where space begins or what constitutes a space weapon, help to explain why it has been so difficult to develop many formal arms control measures for space, or even to advance less formal transparency- and security-building measures. When thinking about how to proceed in these areas, it should be instructive that decades of previous work have produced very little fruit. Major previous efforts that lack specific results include the focused superpower antisatellite arms control negotiations in 1978–1979 and the Defense and Space Talks begun in 1985, as well as many years of multilateral efforts at the Conference on Disarmament and elsewhere. **gsa**

NOTES

[1] The United States-India Nuclear Cooperation Approval and Non-proliferation Enhancement Act was signed into law on October 8, 2008.

[2] National Intelligence Council, *Iran: Nuclear Intentions and Capabilities, National Intelligence Estimate*, November 2007, available at <www.dni.gov/press/releases/20071203_release.pdf >.

[3] The transcript of the U.S. intelligence briefing on the Syrian nuclear site is available at <www.dni.gov/interviews/20080424_interview.pdf>. The outside analysis referred to is that of David Albright and Paul Brannan at the Institute for Science and International Security, in particular to their April 24, 2008, and May 12, 2008, publications; available at <www.isis-online.org/publications/syria/SyriaUpdate_24April2008.pdf> and <www.isis-online.org/publications/syria/SyriaReactorReport_12May2008.pdf>.

[4] For example, on October 13, 2006, South Korean parliament member Kho Jo-heung remarked, "We have to make the U.S. military bring back tactical nuclear weapons or possess our own nuclear weapons." See "S. Korea Divided over Redeployment of U.S. Tactical Nuclear Weapons," Yonhap, October 19, 2006. On October 15, 2006, Shoichi Nakagawa, chairman of the Japanese Liberal Democratic Party's policy research council, stated that Japan needed "to find a way to prevent Japan from coming under attack" and that "nuclear weapons are one such option." See Reuters, "Japan Should Reexamine Its Nuclear Weapons Ban, Ruling Party Official Says," *The Washington Post*, October 16, 2006, 16, available at <www.washingtonpost.com/wp-dyn/content/article/2006/10/15/AR2006101500657.html>.

[5] For example, "Japan 'is absolutely not considering' building a nuclear arsenal in response to the North Korean nuclear test, Japanese Foreign Minister Taro Aso said Wednesday, moments after Secretary of State Condoleezza Rice reiterated that Japan was protected by the American nuclear umbrella." See Glenn Kessler, "Japan, Acting to Calm U.S. Worries, Rules Out Building Nuclear Arms," *The Washington Post*, October 19, 2006, A24. Regarding U.S. extended deterrence guarantees, Secretary Rice stated, "First, we are strengthening our strategic relationships in Northeast Asia. I made it clear last week that the United States has both the will and the capability to meet the full range, and here I stress, the full range, of our security and deterrent commitments to allies like South Korea and Japan." Condoleezza Rice, Annual B.C. Lee Lecture, The Heritage Foundation, Washington, DC, October 25, 2006.

[6] These 13 nations are Algeria, Azerbaijan, Bahrain, Egypt, Jordan, Kuwait, Morocco, Oman, Qatar, Saudi Arabia, Turkey, United Arab Emirates, and Yemen.

[7] The United States and the International Atomic Energy Agency Director both advocate, albeit by different means, changes to the current nuclear nonproliferation regulation to end the proliferation of enrichment and reprocessing capabilities to countries that do not already possess such capabilities, regardless of the purposes for which they seek it. Such efforts have met considerable resistance from some states that do not yet have such capabilities.

[8] Only seven nations—Angola, Egypt, Iraq, Lebanon, North Korea, Somalia, and Syria—are not signatories to the Chemical Weapons Convention, and Iraq has indicated its intent to accede. Syria and North Korea long have been assessed to maintain major chemical weapons stocks for offensive purposes. Twenty states remain outside the Biological and Toxin Weapons Convention, most of which are small countries in Africa or the Pacific; Israel is the only major nonsignatory state.

[9] For example, see U.S. Department of State, "Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments," August 2005, available at <www.state.gov/documents/organization/52113.pdf>.

[10] As the director general of the Organization for the Prohibition of Chemical Weapons noted in his opening statement to the Second Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention:

Important changes are taking place. The layout, design, and characteristics of plant sites are under continued review by industry. Very importantly, globalization is bringing about a massive redistribution and regional migration of chemical production and trade in the world. In parallel with these movements, there has been an exponential growth in the number of declared Other Chemical Production Facilities (OCPFs). …Due to their technological features ... a number of [these facilities] could easily and quickly be reconfigured for the production of chemical weapons. ...This is all the more pertinent in view of the evolving threat posed by terrorism.

See <www.opcw.org/index.php?eID=dam_frontend_download&fileID=1874>.

[11] The February 2008 Report of the Scientific Advisory Board on Developments in Science and Technology for the Second Special Session of the Conference of the States Parties to Review the Operation of the Chemical Weapons Convention, available at <www.opcw.org/index.php?eID=dam_frontend_download&fileID=1871>, noted, "New biologically active molecules are being discovered at an unprecedented rate. The tools for such techniques are becoming widely available and could be selectively target at toxic materials."

[12] Ibid., 11.

[13] Alexander Kelle noted, "The chemistry of the 21st century is a far cry from the one of the 1980s. . . . The new chemistry is utilizing other scientific disciplines and technologies to a much higher degree in its quest for new chemical compounds. Alexander Kelle, ed., "Introduction," *The Changing Scientific and Technological Basis of the CBW Proliferation Problem*, report of the workshop on Preventing the Misuse of 21st Century Chemistry: State of the Art of Drug Development and Delivery, and Selected Enabling Technologies, Belfast, Ireland, January 13–14, 2006, 7,

available at <www.brad.ac.uk/acad/sbtwc/ST_Reports/ST_Report_No_7.pdf >.

[14] Department of Defense, Joint Publication 1–02, *Dictionary of Military and Associated Terms*, April 12, 2001 (as amended through October 17, 2008), available at <www.dtic.mil/doctrine/jel/new_pubs/jp1_02.pdf>.

[15] "The West" is used here to signify Western-oriented states; the term includes South Korea, Japan, Israel, and other states aligned with the United States and other allies.

[16] Paul Bracken, "Net Assessment; a Practical Guide," *Parameters* (Spring 2006), 92, 93.

[17] The investigation carried out by Admiral Kirkland Donald for Defense Secretary Robert Gates in spring 2008 found, among other problems, a decline in nuclear expertise through the Air Force. Other studies have come to similar conclusions regarding the status and expertise of nuclear forces.

[18] Gordon Craig and Alexander George, "Force and Statecraft," in *Deterrence in the Second Nuclear Age*, ed. Keith Payne (Louisville: University Press of Kentucky, 1996), 45–46.

[19] As Soviet archives are opened to historians, we are discovering that many of our basic understandings of Soviet intentions were badly flawed.

[20] For example, the *Boston Globe* discussed classified briefings for U.S. policymakers on North Korean assistance to Syria on April 24, 2008 ("U.S. Says North Korea Gave Syria Nuclear Assistance.")

[21] An example is "A Tantalizing Look at Iran's Nuclear Program," *International Herald Tribune*, April 29, 2008.

[22] Michael Levi, *On Nuclear Terrorism* (Cambridge: Harvard University Press, 2007), 144.

[23] Tricky, but it can be done. Mononuclear combat may affect the nuclear equation if both sides withhold and one side starts to lose. If Red can be predictably assumed to withhold until the tide becomes adverse, then that becomes fodder for assessment. A thorough knowledge of Red's nuclear and conventional doctrines and policy is required, which is intrinsic to the assessment process.

[24] If experience is any guide, more than one game will be necessary to explore possible Red and Blue options.

[25] Levi, 35.

[26] National Intelligence Council, *The Terrorist Threat to the U.S. Homeland*, National Intelligence Estimate, July 2007.

[27] The White House, *National Strategy for Homeland Security*, October 2007, 3.

[28] Joint Publication 3–27, *Homeland Defense*, July 12, 2007, A–3.

[29] Department of Defense, *Strategy for Homeland Defense and Civil Support*, June 2005. This strategy provides guidance, objectives, and direction for Defense's role in the civil support component of homeland defense.

[30] *Homeland Defense*.

[31] *Strategy for Homeland Defense and Civil Support* reinforces the "Lead, Support, Enable" organizing construct.

[32] U.S. Pacific Command has responsibility for civil support for incidents in Hawaii and the Pacific territories.

[33] Phillip C. Saunders and Charles D. Lutes, *China's ASAT Test: Motivations and Implications*, Institute for National Strategic Studies Special Report (Washington, DC: National Defense University Press, June 2007).

[34] See <http://history.nasa.gov/1967treaty.html>.

[35] Bhupendra Jasani, ed., *Outer Space: A Source of Conflict or Co-operation?* (Tokyo: United Nations University Press, 1991), published in cooperation with the Stockholm International Peace Research Institute, quoted in David Webb, "On the Definition of a Space Weapon (When is a Space Weapon Not a Space Weapon?)" The Praxis Centre, Leeds Metropolitan University, available at <praxis.leeds-met.ac.uk/praxis/documents/space_weapons.pd>.

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