

# THINKING ABOUT THE UNTHINKABLE

## Unreasonable Exuberance?

*Andrew L. Ross*

*The reasonable man adapts himself to the world; the unreasonable one persists in trying to adapt the world to himself. Therefore all progress depends on the unreasonable man.*

GEORGE BERNARD SHAW

**T**hinking about the unthinkable just ain't what it used to be. Such is the Cold Warrior's lament (that, and not having the Soviet Union to kick around anymore—after all, Russia, China, Iraq, Iran, and today's other assorted “states of concern” are poor replacements for the old bad bear). The Strategic Arms Reductions Talks (START) process is slowly but thus far surely shrinking the U.S. nuclear arsenal. Nuclear-capable bombers have been taken off day-to-day alert. Land-based and submarine-based intercontinental ballistic missiles have been “detargeted.” Nuclear modernization has been abandoned in favor of “stockpile stewardship.” Throw-weight (payload) and circular-error-probable (accuracy) calculations, and nuclear net assessments more generally, have virtually fallen by the wayside. Nuclear duty assignments, which the armed forces

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once restricted to active-duty personnel, have been opened to members of the reserves and the National Guard. Now a retired four-star admiral, writing not in the pages of the *Bulletin of the Atomic Scientists* but in the *Naval War College Review*, proposes that the United States needs neither the 3,000–3,500 nuclear warheads allowed under START II nor even the 2,000–2,500 warheads envisioned under a prospective START III, but only two hundred. There is more: those two hundred warheads, along with the two hundred nuclear warheads retained by each of the other seven members of a nuclear “condominium,”

would be placed in “strategic escrow,” subject to international monitoring and verification. Implementation of the escrow scheme would, as intended, amount to the near abolition of nuclear weapons—to the further dismay, no doubt, of the ghost of General Curtis LeMay, who led the Strategic Air Command in its glory days.

For Herman Kahn and other classical purveyors of nuclear theology, “thinking about the unthinkable” meant thinking about nuclear war.<sup>1</sup> Given the catastrophic consequences of nuclear war, how could they have avoided thinking about it? Not to think clearly, rigorously, and systematically about how to deter—and, if necessary, to fight and win—a nuclear war would have been irresponsible. Nuclear weapons and the prospect of their use, however remote, demanded the attention of defense planners.

Today, ironically, advocates of deep nuclear cuts and even nuclear disarmament can also lay claim to Kahn’s infamous phrase. Thinking about dramatically reducing or eliminating nuclear weapons constitutes thinking about the unthinkable no less certainly than does thinking about fighting and winning nuclear wars—and it is no less bold. Given the potentially catastrophic consequences of nuclear war, how can we not think about slashing the world’s nuclear arsenals and perhaps even eventually eliminating them? Not to think clearly, rigorously, and systematically about whether to reduce and even eradicate nuclear weapons would be irresponsible. Serious nuclear arms control (that is, well beyond START I, II, and III) and nuclear disarmament, however remote their prospects, now demand the attention of defense planners.

Here and elsewhere, Admiral Stansfield Turner has sided with those who have challenged the conventional, and original, meaning of “the unthinkable.”<sup>2</sup> Indeed, by endorsing nuclear disarmament as a “desirable goal,” he joins a small number of prominent retired officers—most notably General Lee Butler (the first commander in chief of the U.S. Strategic Command), General John R. Galvin, General Charles A. Horner, and General Andrew J. Goodpaster—who have “come out of the closet” to reveal themselves as nuclear abolitionists.<sup>3</sup>

The admiral’s essay will be greeted coolly by those who have not yet revisited the meaning of thinking about the unthinkable. His proposal to slash the U.S. nuclear arsenal to two hundred warheads and place them, along with the warheads of the other nuclear powers, in strategic escrow until nuclear abolition is practical will encounter serious resistance—when it is not simply dismissed or ignored. The nuclear force–structure implications of the admiral’s implicit assertion that usable strategic forces are composed of conventional rather than nuclear weapons are sure to be contested by the nuclear priesthood. Too few defense planners share the admiral’s quite explicit concern about the dangers inherent in the “conventionalization” of nuclear weapons—the notion that they

can be used in war as if they were merely more effective conventional weapons. Even fewer will applaud him for taking the Senate to task for failing to ratify the Comprehensive Test Ban Treaty or for his championing of an Anti-Ballistic Missile (ABM) Treaty under assault by misguided advocates of national missile defense. “Radical” is one of the more polite terms that will be used to characterize Admiral Turner’s proposal.

The admiral’s proposed course of action raises questions and poses certain risks. It would not be difficult to deconstruct his proposal, contest and parse its

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assumptions, and dwell at length on its difficulties and risks. Why, for instance, has he settled upon two hundred warheads? Why not one hundred, or five hundred? Will the Russian response to a

unilateral American drawdown indeed be governed by reciprocity? How would the other nuclear states be persuaded to deposit their warheads in an internationally monitored strategic escrow and establish a condominium of nuclear powers? Will the rest of the world have confidence in international monitoring of that nuclear escrow of the UN Security Council’s five permanent members? Can we expect nonnuclear powers to welcome a nuclear condominium? Would such a condominium serve only to institutionalize further the divide between nuclear haves and have-nots? How will its members hedge against a breakdown of the envisioned regime? Might seemingly prudent hedges in fact contribute to the regime’s breakdown? How will the conflicting principles underlying a realist major-power condominium and a liberal international nuclear-monitoring regime be reconciled? Are there other, perhaps more practical, alternatives for achieving the admiral’s objectives?

Such questions deserve more attention. Details—about the dynamics of a reciprocal nuclear drawdown; the standard operating procedures for a strategic escrow; the establishment, maintenance, and management of an eight-power nuclear condominium—matter. Yet the details of the process Admiral Turner seeks to set in motion should not be allowed to obscure the grand purpose of the process and its significance. He is on the right track. The stockpiles of nuclear weapons accumulated during the second half of the twentieth century, particularly by the United States and the former Soviet Union, should be dramatically reduced, though not yet eliminated. The strategic value of nuclear weapons and their impact on international security affairs should be minimized. The call for nuclear marginalization should be heeded.<sup>4</sup>

## DEEP REDUCTIONS

For the United States, the costs and risks of dismantling the bulk of its nuclear arsenal are minimal. The significance of nuclear weapons for the United States today should not be exaggerated. When the rest of the world looks to the United States for leadership, it does so because of the full panoply of resources the country can bring to bear and its continuing commitment to an open, liberal world order—not because of any specific regard for its nuclear prowess. Nuclear weapons are the linchpin neither of the U.S. position in the world nor of its security. America’s preeminence, its status as a “full-service” superpower with global diplomatic, economic, and military reach, is not dependent on the size of its nuclear arsenal. The foundation of U.S. preeminence is a wide array of tangible and intangible (“hard” and “soft”) power resources:<sup>5</sup> the world’s benchmark economy—a strong, dynamic engine that outperforms all others and to which all seek access; incomparable scientific and technological capabilities; a system of higher education that is the envy of the world; a growing information, and knowledge, edge;<sup>6</sup> the fundamental soundness of America’s ideas, values, political and economic liberalism, and culture—and their nearly universal appeal, making them the standard against which all others are judged; and finally, but not least, an overwhelming conventional military superiority. Unilaterally reducing the nuclear arsenal of the United States to a thousand warheads and pursuing limited further reciprocal reductions would do little, if anything, to diminish the nation’s preponderance. Further, it would enhance the credibility of the U.S. nonproliferation posture.<sup>7</sup>

During the Cold War, nuclear weapons were accorded a central role in U.S. strategy. In those years they were thought to provide an effective counter to not only the nuclear capabilities of a rival superpower but the apparent quantitative conventional superiority of that rival and its allies. The perceived asymmetrical deterrent and warfighting value of nuclear weapons contributed significantly to the nuclear buildup rued by Admiral Turner. Notably, extended deterrence, though not necessarily fundamental deterrence, relied on the idea that the United States might use nuclear weapons first—even against conventional aggression. The intended message was: These are weapons, like any other, to be used.

Less is expected of nuclear weapons today. Their role is far less central, if not yet peripheral. The appropriately residual role for nuclear weapons in U.S. strategy is deterrence of nuclear use.<sup>8</sup> That is not a terribly demanding task; it requires primarily that the United States retain a nuclear retaliatory capability that is secure, credible, and essentially countervalue (i.e., aimed at social and economic targets—especially cities—rather than military forces). Such a capability need not be as large as it is today. The balance of terror, to the extent it still exists,

is not terribly delicate. Whatever the historical merits of the warfighting capabilities sought by the nuclear-utility theorists (NUTs) responsible for the

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conventionalization of nuclear weapons rightly denounced by Admiral Turner, there is little requirement for such capabilities today. The minimal requirements postulated by an assured-destruction

posture can be easily met by a thousand-warhead force.<sup>9</sup> There is nothing that can be deterred with START III's proposed 2,000–2,500 warheads that cannot be deterred with one thousand.

As long as nuclear weapons remain in the U.S. inventory, their existential contribution to the deterrence of conventional and biological or chemical warfare challenges cannot be ruled out. But there is no longer reason to raise explicitly the specter of a nuclear response to conventional aggression. Whatever the deterrent merits of the threat of nuclear escalation in the past, the conventional challenges existing today do not warrant a nuclear response—and only inexcusable complacency by the United States would necessitate one in the future.

Similarly, despite the alleged advantages of a posture of calculated strategic ambiguity, the threat of overwhelming conventional retaliation should prove an effective deterrent to the use of biological and chemical weapons. Deterring attacks by these two kinds of weapons of mass destruction does not necessitate threats to retaliate with the only kind the United States has not foresworn. Explicitly leaving the door open for a nuclear response to the use of biological or chemical weapons places a higher value than necessary on nuclear weapons. That is the wrong message to convey to nuclear aspirants and others around the world.

Instead, limitations on the strategic and military utility of nuclear weapons should be emphasized.<sup>10</sup> After all, the flexible strategic power that can actually be employed to advance and protect American interests resides less in the nation's nuclear arsenal than in its overwhelming conventional military superiority. The impressive U.S. reconnaissance-strike complex—primarily C4ISR\*, precision guided munitions, and defense-suppression systems—on display during DESERT STORM and ALLIED FORCE is no less strategic, and demonstrably more usable, than the U.S. nuclear arsenal.<sup>11</sup> Continuing improvements in the precision and lethality of conventional systems promise to erode further the nuclear stranglehold on things “strategic.” The force-structure implications of this

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\* Command, control, communications, computers, intelligence, surveillance, and reconnaissance.

transformation were recently captured in the title of an insightful article by Andrew F. Krepinevich and Steven Kosiak: “Smarter Bombs, Fewer Nukes.”<sup>12</sup>

## NUCLEAR-FREE VISIONS

In an implicit affirmation of the limited utility of nuclear weapons, joint and service visions of what is commonly referred to as, variously, the “military after next” and the “revolution (or less radically, transformation) in military affairs” are strikingly nuclear-free.<sup>13</sup> For the Joint Chiefs of Staff, in their *Joint Vision 2020*, the key to the “full-spectrum dominance” that is to be provided by “dominant maneuver,” “precision engagement,” “focused logistics,” and “full-dimensional protection” is information, not nuclear, superiority.<sup>14</sup> The technologies upon which the transformation foreseen by U.S. Army statements and concepts like *Army Vision 2010*, “Force XXI,” and the “Army after Next” depend include the likes of global cellular communications, smart pagers, manned and unmanned sensors, digitization, artificial intelligence, data compression, stealth, “bril-

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liant” munitions, ceramics and other advanced materials, micro- and nanoelectronics, electromagnetic firing systems, robotics, and directed energy—virtually everything and anything but nuclear

technology. Similarly, the twenty-first-century aerospace force posited by the U.S. Air Force’s Scientific Advisory Board would be built upon breakthroughs in unmanned combat and reconnaissance aerial vehicles (UCAVs and UAVs); high-power, short-wavelength lasers; active and infrared stealth; distributed satellite constellations; automated, reusable space launch vehicles; human-machine interactions; high-power radio-frequency-attack cruise missiles; and information munitions.<sup>15</sup>

Figuring prominently in the Navy’s vision of network-centric warfare (NCW) is an expeditionary grid of networked space, air, sea (surface and subsurface), and ground sensors, weapons, and platforms. This network is to be populated by the likes of “micro” and “nano” sensors; unmanned aerial and underwater vehicles (UAVs and UUVs) and UCAVs; and modular surface and subsurface vessels with, perhaps, virtual command posts. There are to be smart ships, all-electric ships, and fast ships. “Nuclear” appears to be absent from the NCW lexicon.<sup>16</sup>

Similarly, the nine broad technology areas identified by the National Research Council’s Naval Studies Board as forming the naval technology base for the period 2000 to 2035—computation, information and communications, sensors, automation, human performance, materials, power and propulsion,

environments, and enterprise processes—are nuclear-free. The board’s list of “exciting new technologies” also omits nuclear technology. Its examination of weapons requirements includes nuclear weapons, but it explores alternatives to nuclear weapons as well.<sup>17</sup>

Neither joint nor specifically Army, Air Force, or Navy visions feature nuclear capabilities. Instead, it is C4ISR that is technologically critical to military transformation, and at the heart of C4ISR lie information and communications technologies, both hardware and software. For military visionaries, nuclear technology is no longer where the action is. The technological future lies in digitization, intelligent software, and rapid data fusion and display; information architecture, networks, networks of networks, and systems of systems; bandwidth, and computational processing power and speed; sensors; information and cyber operations; distributed, or virtual, command posts; and self-synchronization and autonomic systems. Keeping the U.S. military edge requires little exertion on the nuclear front.<sup>18</sup> The nuclear age, it would seem, is being superseded by the information age (and perhaps also the “nuclear umbrella” by an “information umbrella”). The centrality of atomic fission and fusion is giving way to the collection, processing, fusion, and dissemination of information. Moore’s Law and Metcalfe’s Law rule.<sup>19</sup>

#### AN UNREASONABLE EXUBERANCE FOR NEAR ABOLITION?

Of course, exuberant military visionaries and proponents of a revolution, or transformation, in military affairs recognize that nuclear technology will always be with us. It is, after all, now over fifty years old. They have (intentionally or not) demoted nuclear technology, taken it off its pedestal, but they have not abolished it. Nuclear abolition may well be, despite its allure, not only impractical but undesirable. Dropping to two hundred warheads by 2006, as proposed by sober critics like Admiral Turner (in his table 2), is problematical as well. Halving the force envisioned under a START III to a thousand warheads, even unilaterally, as a prelude to additional limited and reciprocal reductions, is not.<sup>20</sup>

Relative numbers of nuclear warheads are indeed of little consequence at the levels attained by the United States and the Soviet Union during the Cold War and maintained by the United States and Russia since. The smaller the arsenals, however, the more that numbers of warheads are likely to matter. At a thousand warheads apiece, the United States and Russia would still be essentially immune to “breakout”—deployment of additional weapons—by the other. Nuclear breakout could be significant politically, but not militarily. Further, the United States could be confident of retaining a credible deterrent even if it reduced its arsenal to a thousand before Russia dropped to that level.

Immunity to breakout would seriously deteriorate at levels substantially below a thousand. Abolition would make the world not only a bit too safe for

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conventional war but highly vulnerable and sensitive to the covert deployment of nuclear weapons. At zero, nuclear breakout would be enormously consequential, not only politically but militarily. The

perpetrator would gain an absolute, and usable, military advantage. Given the potential payoff and the likely uncertainties about the intentions and behavior of others, the temptation to break out and build even a small nuclear arsenal would be difficult to resist. This security dilemma would be operative as well at the way station of two hundred warheads, even assuming strategic escrow. At two hundred weapons, unlike the situation at a thousand, absolute advantage would be within reach—or, perhaps more importantly, perceived as being within reach.<sup>21</sup>

Reduction to two hundred warheads would have the additional disadvantage of lowering the bar for other actual and potential nuclear states. It is not entirely clear why the United States, or Russia for that matter, should accept parity with China, Britain, France, Israel, India, and Pakistan. Also, the potential of achieving parity with the current members of the nuclear club may only further whet the appetites of nuclear aspirants around the world. The contribution that deep cuts in existing nuclear arsenals would make to the cause of nonproliferation should be exploited, but the restraining influence of abolition or near abolition on nuclear ambitions should not be exaggerated.

#### UNTHINKABLE AND UNREASONABLE?

The contemporary version of the unthinkable—nuclear abolition or near abolition—should be contemplated no less warily than the original. Deep cuts are indeed warranted; an American nuclear arsenal of a thousand warheads would yield the most important advantages of a two-hundred-warhead force without its disturbing disadvantages. But deep cuts are not enough. They should be accompanied by a serious arms control agenda in Washington that: reverses the Senate's misguided rejection of the Comprehensive Test Ban Treaty; unambiguously supports the Nuclear Nonproliferation Treaty; calls for continued cooperation to prevent the accidental use of nuclear weapons and to ensure, through such vehicles as the Cooperative Threat Reduction Program, the safety of Russian nuclear weapons and fissile materials; formalizes moratoria on the production of fissile materials; offers a no-first-use pledge—either an unqualified no-nuclear-first-use pledge or a no first use of weapons of mass destruction (WMD) pledge; maintains space as a sanctuary with respect not only to WMD,

as provided for by the Outer Space Treaty, but to all weapons; urges a broadening and deepening of the Missile Technology Control Regime; and declares that the United States will not unilaterally abrogate the ABM Treaty. This agenda would contribute to both Admiral Turner's objectives and the security component of an open, liberal international order.

The United States cannot seriously expect others to embrace restraint, nuclear or otherwise, if it fails to do so itself. Defense planners are necessarily attuned to the risks that may accompany restraint. Yet at times, to borrow a marketing slogan employed by a prominent insurance and financial services group, "The greatest risk is not taking one."<sup>22</sup> Indeed, the risks of not implementing deep nuclear cuts and embracing calculated restraint are greater than the risks of doing so.

While the argument for deep nuclear cuts is compelling, defense planners will not rush to embrace Admiral Turner's nuclear-escrow scheme. They can still, however, benefit from the counsel of this most "unreasonable" and thoughtful of men. Such is the source of progress.

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#### NOTES

1. Herman Kahn, *Thinking about the Unthinkable* (New York: Horizon Press, 1962).
2. Stansfield Turner, *Caging the Nuclear Genie: An American Challenge for Global Security* (Boulder, Colo.: Westview Press, 1997), and *Caging the Genies: A Workable Solution for Nuclear, Chemical, and Biological Weapons* (Boulder, Colo.: Westview Press, 1999).
3. See George Lee Butler, "Time to End the Age of Nukes," *Bulletin of the Atomic Scientists*, March–April 1997, pp. 33–6; "A Voice of Reason," *Bulletin of the Atomic Scientists*, May–June 1998, pp. 58–61; and "Zero Tolerance," *Bulletin of the Atomic Scientists*, January–February 2000, pp. 20–1 and 72–5. See also Henry L. Stimson Center, "Generals Speak Out on Eliminating Nuclear Weapons," *Eliminating Weapons of Mass Destruction*, retrieved from the World Wide Web: <http://www.stimson.org/zeronuke/generals/index.html>.
4. For an insightful discussion of nuclear marginalization, see William Walker, "Nuclear Order and Disorder," *International Affairs*, October 2000, pp. 703–24.
5. For a discussion of the dimensions of power and the changing relationship between hard and soft power, see Joseph S. Nye, Jr., *Bound to Lead: The Changing Nature of American Power* (New York: Basic Books, 1990).
6. Joseph S. Nye, Jr., and William A. Owens, "America's Information Edge," *Foreign Affairs*, March–April 1996, pp. 20–36.
7. That nonproliferation serves American interests cannot be seriously questioned. The hyperrealist notion that "more may be better," though an intriguing, even beguiling, intellectual construct, is not a sound basis for the U.S. stance on nuclear proliferation. See Kenneth N. Waltz, *The Spread of Nuclear Weapons: More May Be Better*, Adelphi Paper 171 (London: International Institute for Strategic Studies, 1981); Scott D. Sagan and Kenneth N. Waltz, *The Spread of Nuclear Weapons: A Debate* (New York: W. W. Norton, 1995); and John J. Mearsheimer, "Back to the Future: Instability in Europe after the Cold War," *International Security*, Summer 1990, pp. 5–56. Encouraging, rather than discouraging, the acquisition of nuclear

- weapons by others, even selectively, is an experiment the nation should not want to run.
8. The military implications of nuclear technology were astutely discerned by Bernard Brodie at the dawn of the nuclear age: "Thus far the chief purpose of our military establishment has been to win wars. From now on its chief purpose must be to avert them. It can have almost no other useful purpose." Bernard Brodie, "Implications for Military Policy," in *The Absolute Weapon: Atomic Power and World Order*, ed. Frederick S. Dunn, Bernard Brodie, Arnold Wolfers, Percy E. Corbett, and William T. R. Fox (New York: Harcourt, Brace, 1946), p. 76. A reappraisal of the issues addressed in *The Absolute Weapon* can be found in T. V. Paul, Richard J. Harknett, and James J. Wirtz, eds., *The Absolute Weapon Revisited: Nuclear Arms and the Emerging International Order* (Ann Arbor: Univ. of Michigan Press, 1998).
  9. The United States is still better off MAD (that is, adhering to "mutually assured destruction") than NUTs.
  10. As a former chairman of the Joint Chiefs of Staff, General John Shalikashvili, has noted, "Given our overwhelming conventional superiority, assigning a broader role to nuclear weapons would cause far more problems than it would solve." John M. Shalikashvili, "The Test Ban Solution," *Washington Post*, 6 January 2001, p. 21.
  11. On the elements of the reconnaissance-strike complex, see Ashton B. Carter, William J. Perry, and John D. Steinbruner, *A New Concept of Cooperative Security* (Washington, D.C.: Brookings Institution, 1992).
  12. Andrew F. Krepinevich, Jr., and Steven M. Kosiak, "Smarter Bombs, Fewer Nukes," *Bulletin of the Atomic Scientists*, November–December 1998, pp. 26–32. See also Andrew F. Krepinevich, Jr., "Forging a Path to a Post-Nuclear U.S. Military," *Issues in Science and Technology*, Spring 1997, pp. 79–84.
  13. The emphasis on other than nuclear technologies is evident as well in analytical treatments of the emerging revolution in military affairs. See, for instance, Eliot A. Cohen, "A Revolution in Warfare," *Foreign Affairs*, March–April 1996, pp. 37–54; Lawrence Freedman, *The Revolution in Strategic Affairs*, Adelphi Paper 318 (Oxford, U.K.: Oxford Univ. Press, 1998); Andrew F. Krepinevich, Jr., "Cavalry to Computer: The Pattern of Military Revolutions," *National Interest*, Fall 1994, pp. 30–42; and Michael O'Hanlon, *Technological Change and the Future of Warfare* (Washington, D.C.: Brookings Institution, 2000).
  14. U.S. Joint Staff, *Joint Vision 2020*, retrieved from the World Wide Web: <http://www.dtic/mil/jv2020/jvpub2.htm>.
  15. U.S. Air Force, *New World Vistas: Air and Space Power for the 21st Century* (Washington, D.C.: Scientific Advisory Board, December 1995).
  16. Discussions of network-centric warfare are remarkably nuclear-free. See David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 2d rev. ed. (Washington, D.C.: C4ISR Cooperative Research Program, Department of Defense, 1999); Arthur K. Cebrowski [Vice Adm., USN] and John J. Garstka, "Network-Centric Warfare: Its Origin and Future," U.S. Naval Institute *Proceedings*, January 1998, pp. 28–35; and Committee on Network-Centric Naval Forces, Naval Studies Board, National Research Council, *Network-Centric Naval Forces: A Transition Strategy for Enhancing Operational Capabilities* (Washington, D.C.: National Academy Press, 2000).
  17. Panel on Technology, Committee on Technology for Future Naval Forces, Naval Studies Board, National Research Council, *Technology for the United States Navy and Marine Corps, 2000–2035: Becoming a 21st Century Force*, vol. 2, *Technology* (Washington, D.C.: National Academy Press, 1997), and vol. 5, *Weapons* (Washington, D.C.: National Academy Press, 1997).
  18. Note the lack of attention accorded U.S. nuclear capabilities in Ashton B. Carter and John P. White, eds., *Keeping the Edge: Managing Defense for the Future* (Cambridge, Mass., and Stanford, Calif.: Preventive Defense Project, 2000).
  19. Gordon Moore posited in 1965 that each successive generation of computer memory chip has twice the capacity of its predecessor and appears within two years of it, and that accordingly computing power rises exponentially; "What Is Moore's Law?" *Processor Hall of Fame*, retrieved from the World Wide

Web: <http://www.intel.com/intel/museum/25anniv/hof/moore.htm>. Metcalfe's Law (named for Robert Metcalfe, founder of the 3Com Corporation and designer of the Ethernet protocol) states that the usefulness, or utility, of a network equals the square of the number of users; Charles Boyd, "Metcalfe's Law," *Management Issues*, retrieved from the World Wide Web: <http://www.mgt.smsu.edu/mgt487/mgtissue/newstrat/metcalfe.htm>. See also Alberts et al., *Network Centric Warfare*, app. A.

20. The choice is most assuredly not one, as Jonathan Schell, in "The Folly of Arms Control,"

*Foreign Affairs*, September–October 2000, pp. 22–46, would have us believe, of uncontrolled proliferation or nuclear abolition. There are always choices other than "all or nothing."

21. The precise thresholds above which immunity to breakout exists and below which it does not are, obviously, difficult to determine. But at a thousand warheads, we can be confident of breakout immunity; at two hundred we cannot.

22. AIG (the American International Group).