Commentary: *Towards Discriminate Deterrence*

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Events in the 1950–1970 period shaped the nation's understanding of nuclear forces and added an experimental dimension to the interaction between the theory and practice. The interplay of external events with the structure and details of strategic forces was central at this early period, as both the United States and the Union of Soviet Socialist Republics (USSR) sought to understand the capabilities and challenges of nuclear weapons and to incorporate these weapons into national strategies.

During the first of these events, in the fall of 1950 when the People's Republic of China (PRC) intervened in North Korea, the United States considered the use of nuclear weapons to destroy the bridges over the Yalu River, but the tactical situation was too fluid for strike planning and delivery to be accomplished. Strikes against Chinese cities in Manchuria were seen as an unacceptable risk. Similar circumstances prevailed when the French asked for military assistance from the United States at Dien Bien Phu in 1954, but nuclear strikes against the rapidly closing perimeter would have decimated the defenders as well. This nuclear planning situation was played out 14 years later in the defense of Khe Sanh in 1968. By this point, apart from collateral damage to defenders, there was the issue of escalation in the face of substantial Soviet nuclear weapons and a now-nuclear PRC. In the case of Suez in 1956, U.S. strategic forces were put on alert but concerns over the possibility of intemperate action by Nikita Khrushchev leading to accidental war provided new appreciation of the downsides of nuclear weapons. Escalation control in Lebanon in 1958 was central to all alerting of nuclear forces, their movements, and attendant public statements. Cuba in 1962 illustrated in detail how actions by nuclear-armed states to secure strategic advantages could escalate to the point of unintended nuclear war. During the attack on the *Liberty* by Israel in 1967, U.S. carrier-based aircraft dispatched to its assistance were called back personally by the Chairman of the Joint Chiefs of Staff and the Secretary of Defense because the aircraft were armed with nuclear weapons and their intentions could have been misinterpreted by the USSR. This same situation was avoided in the *Pueblo* attack by North Korea in 1968 only because all U.S. aircraft in South Korea that could have intervened were nuclear armed and remained on the ground.[1]

While easy to view as a series of theoretical exercises, dependent on cost-benefit analyses, damage optimization, competitive advantage gaming, strategic balance calculations, and other technical factors, strategy is, in practice, experimental in nature and has features in common with biological evolution. The problem of strategy, as Albert Wohlstetter realized, was not optimization of a static system of forces but one of understanding their dynamics over time.

Lacking a calling to pursue technology as a weapon-developer or to employ its firepower as a weapon-wielder, Albert had spent his undergraduate and graduate years steeping in logic and data analysis, and his early professional years grappling with failures of technology to deliver on their promises—experiences which later distinguished him from many of his peers. Arms limitation negotiations that resulted in the Limited Test Ban Treaty in 1963 and the Nonproliferation Treaty in 1968 emphasized that limiting the potential damage from the downsides of nuclear technology was at least as important as realizing its power.[2] Thus limiting collateral damage, both physical and political, seeking stability between nuclear-armed states, and minimizing the risks of accidental war became central features of his strategic thinking.

Technology and Strategy

Albert was intensely interested in new technology. He extrapolated from how the new nuclear technology changed warfare and strategy, to an examination of other areas of technology that could have comparable impacts. It is this extrapolation that characterizes the papers discussed here.

Albert viewed technology as offering what became a favorite word of his, *alternatives*. The process began when he joined RAND and started his extensive work on the basing of bombers and their survivability. In a conversation years later, he noted potential points of failure in the alarm systems that activated bomber crews on strip alert, underlining his detailed concern with critical command and control procedures. During this period, two technological explorations at RAND sharpened his appreciation for the opportunities in command and control they offered. The first was a report in 1946, by a group of 18 in RAND's Missile Division, providing detailed technical studies of earth satellites, which were critical for reconnaissance and global communication.[3] The second came in 1960–64, when Paul Baran and two coworkers

proposed a technology for survivable strategic communication based on digital packet technology.[4] In discussions, Albert often returned to the significance of this technology for strategic communication. This rationale was, in fact, dominant in the funding of the development and deployment of an experimental prototype network, the ARPANET, which I had a role in later in the decade.

These developments are mentioned briefly in the first of Albert's papers in this section of the edited volume.[5] The paper opens by asking, "In what ways will technical change alter the interests that join or divide various nuclear and non-nuclear countries, and how will it alter the likely outcomes of potential conflicts among them? In particular, how will new techniques transform the interest and ability to project strength to distant places, and so the worth of nuclear and non-nuclear commitments there?" Of particular note is his raising the question of the relative value of nuclear and conventional weapons.

Future Conflict

By the late 1960s, the Vietnam conflict stimulated rethinking on the circumstances in which U.S. forces would be committed to combat in the future. While World War II and Korea were "conventional" except for the Hiroshima-Nagasaki interlude in 1945, Cuba was a purely nuclear confrontation, with little room for conventional force considerations. But Vietnam added a new dimension to "conflict space." Nuclear weapons had been considered twice for use there, but their effects did not comport with tactical circumstances. The jungle environment precluded large ground force actions. There were no front lines on a map to measure progress in achieving war aims. What was needed was to locate fleeting targets undistinguishable from the neutral background, to interdict distributed bicycle-based supply lines, to deal with an enemy who occupied not only the surface but the subsurface as well, and to minimize collateral damage to the noninsurgent population. These issues challenged military thinking and the technical innovators who had served the United States so well in the past.

In an attempt to close such capability gaps, U.S. laboratories worked closely with the Department of Defense (DoD) to accelerate needed developments and move them into the theater.

The Office of the Secretary of Defense (OSD) established an office for Southeast Asia, and Military Assistance Command-Vietnam (MACV) was provided with a Science Advisor to define new military needs for the technical community, to suggest how technology could assist operations, and to coordinate trials of new equipments when they arrived.

Many avenues were pursued to improve the effectiveness of U.S. forces. Attempts were made to increase the precision of weapons through wire-guidance, radio-control, and laser target designators. All had their successes but none fully provided the capabilities needed. The war against a few rapidly moving targets embedded among many non-targets was too different from prior military actions. Fixed targets such as roads and bridges were easily reparable and the necessary labor and materials were widely available. Targets consisted of relatively low value components distributed at low densities over large areas. Heavy vegetation obscured both air and ground reconnaissance and impeded communication.

On returning from a tour as Science Advisor to General Creighton Abrams, Fred Wikner proposed to the Advanced Research Projects Agency (ARPA) and Defense Nuclear Agency (DNA) a study of R&D needs to address what were seen as major and long-lasting changes in military affairs. The study, eventually named the Long Range Research and Development Planning Program (LRRDPP), took as its starting point that nuclear parity existed between the United States and the USSR, but that deterring a wider range of more limited Soviet challenges must be addressed, particularly at low levels of conflict.[6] In Albert's terms, these were, in contrast to nuclear strikes, *realistic contingencies* to be addressed. Five categories were considered: (1) Soviet participation in wars between other nations; (2) Soviet aggression against nations peripheral to the USSR; (3) Soviet aggression against a single NATO nation; (4) Soviet aggression against NATO as a whole; and (5) selective Soviet threats against specific targets in the U.S. homeland. The second and third categories had been neglected in then-current political-military planning but would become a foundation for establishing future military requirements.

The methodology employed was to examine selected contingencies in great detail, detail sufficient to understand the forces driving the conflict and to develop requirements for technologies and systems that offered the greatest expectation of containing, and thus deterring, the threat. These contingencies

were: an attack on Norway arising from a Soviet military exercise; an attack on Iran by Soviet and Iraqi forces; a ground and air attack on Yugoslavia by forces from Hungary, Romania, and Bulgaria; and a Soviet invasion of Japan to seize Hokkaido by air, airborne, and amphibious forces again starting from a military exercise. In all these cases, the Soviet objective was to advance rapidly before defensive forces could be mobilized. Several historical cases were also examined, including the Cuban crisis of 1962 and Linebacker II aerial raids on Hanoi in 1972.

The analyses proceeded by identifying military and industrial target sets intended to inflict the greatest damage with minimal forces in a short but decisive time. In all cases the "dual criteria" of killing targets and leaving nontargets undamaged were applied. Defensive weapons systems were of two types: precision conventional weapons and subkiloton nuclear munitions.

The program was organized into three panels supported by four industrial contractors to contribute expertise and advanced concepts in ground, air, and naval warfare, conventional and nuclear munitions, reconnaissance, command and control, and system integration. Albert chaired the strategic alternatives panel, Don Hicks the advanced technology panel, and Jack Rosengren the munitions panel.[7] Senior-level executives from OSD and the Services participated in panel sessions. The team members were selected for their in-depth knowledge as well as their skill in working as a multidisciplinary group, combining history, strategy, technology, military operations, and systems. In addition to Albert's broad skills, his ability to synthesize the essence of a problem and its solution and to communicate it to senior executives and political leaders was invaluable.

For a person of Albert's inclination, it was a superb opportunity to be instructed in the latest emerging technologies by these innovators, recreating his earlier RAND environment; to understand what each technology was, and was not, useful for; and to match offensive and defensive concepts with current needs and, more importantly, with presumed future needs as defined in a context of realistic relationships among nation states ranging from the largest nuclear competitor to the smallest ally or participant. It was a comprehensive military-strategic planning study combining both breadth and depth.

The technological scope of the study matched its strategic reach: precision-delivered ballistic and cruise missile warheads, terminal sensors across the entire electromagnetic spectrum for

night and all-weather capability, low-yield shallow and deep-earth penetrators, microelectronics, data links, artillery-delivered warheads, rapid land and naval mining, and high-mobility ground vehicles.[8]

Albert's role was critical in reorienting thinking in several ways. Technical developers at the time focused entirely on killing targets, not on avoiding killing nontargets. Conflict scenarios were often sketchy, confined to whatever was adequate to justify the intended technical task. Nuclear weapons were seen as effective ways of delivering enormous firepower, with yield making up for poor delivery precision and uncertainties in target location and vulnerability. Development choices were often guided by the issue *du jour* and the evolutionary plans of weapon system suppliers and customers. Consequently new technology of uncertain performance went to the end of the queue in favor of what was familiar, always with the expectation that current deficiencies were fixable and would be fixed. Emerging problems also went to the end of their queue, overshadowed by the Fulda Gap problem and SIOP execution. Albert made it clear that this would simply not do. His quiet voice, distinguished demeanor, and kindly smile as he demolished an ill-conceived argument left many quietly embarrassed. Having gotten this far, Albert did not allow the flock to stray.

Another role of Albert's was shaping external arguments to support the direction the study was taking. The participants were quite prominent in their own right, but years of avoiding bureaucratic minefields had had its conditioning effect. Albert provided the intellectual discipline to see issues posed in terms of unrecognized future needs. More of the same was unacceptable when the same was not working. Albert was the tailor who sought to clothe the emperor.

The technological possibilities and their strategic impact examined in the LRRDPP, though well-founded, might have gone nowhere had they not been elevated for assimilation by higher levels of government. The social network established under the program, and its coverage of so many unexamined issues and opportunities, were factors guiding subsequent decisions to adopt "smart weapon" technology. Their introduction into force structures had a profound impact on the nation's military capability by the late 1980s. Since many of the innovations were based on computing hardware and software, they led to technical competitions with the Soviets where the United States had a

comparative advantage, a view compatible with the developing concept of competitive strategies. While the subsequent story is too long to examine here (it is recounted by Andrew May and Bartlett Bulkley), the systems eventually developed first demonstrated their effectiveness in Kuwait in 1991.

Backing Away from Massive Retaliation

What is important in the present context is the technical ground the LRRDPP put under Albert's own thinking on the questionable utility of nuclear weapons. Albert asked, "Must we aim to kill noncombatants?" and "can we justify aiming our nuclear weapons at civilians simply because they're easy to reach and cheap to kill?"[9] He noted that "even if MAD were a persuasive deterrent to a thoroughly rational decision-maker, such rationality is hardly universal." Albert also quotes from the *Pacem in Terris* Encyclical: "The [MAD] conflagration may be set off by some uncontrollable and unexpected chance" and result in "an unprecedented mass slaughter of unoffending civilians." He concluded by pointing out that "in the long run, mutual threats to kill innocent populations seem an especially poor way of building a community of interests between the Soviet Union and the United States."

Such arguments slowly impacted U.S. strategic targeting doctrine. An early attempt was to offer the President a large number of strategic nuclear response options to a nuclear exchange. They sought to use reduced numbers of weapons to "signal" in an attempt to control and constrain a nuclear exchange. Of course, the scaled-down options remained huge in absolute terms, reflecting, say, a reduction from 1,000 to 500 thermonuclear warheads. The scaled-down options were apparently based on the logic that a smaller fraction of a poor idea might eventually become a good idea.

In the 1980s, a new issue arose to which Albert responded, in part for its own importance but also as an opportunity to continue his assault on massive retaliation. This was the proposal for a new technological approach to strategic defense, the strongly ridiculed and ultimately rejected Star Wars concept.[10] Albert used his effective technique of pointing out the inconsistent, paradoxical, or absurd consequences of the positions taken on both sides of the argument, in this case a pastoral letter on war and peace by American Catholic bishops. This approach has the effect of

clearing conceptual underbrush and defining the playing field. In public policy debates, where there are always strong views on both sides, it is not uncommon for all sides to start with their own preferred solution, often arrived at on political, ideological, theological, or even visceral grounds, and then to work backward from it to establish a supporting case. It is a process that often leads to logical difficulties highly vulnerable to Albert's "controlled burn" approach to strategic forestry.

Reacting to a writer on strategy, Albert notes that espousing massive retaliation while opposing the protection of one's people amounts to saying, "Offense is defense, defense is offense. Killing people is good, killing weapons is bad." Further, at the time he wrote those words there were at least six nations possessing nuclear weapons, and that "hardly anyone seriously expects that each and everyone . . . that have made nuclear explosives will destroy all their nuclear arms irretrievably and verifiably in a future near enough to govern our present actions." Thus alternative strategies were clearly in order. His prescription was to "rely less on threats of nuclear destruction and much more on improving conventional defenses; discourage the spread of nuclear weapons; and continue making nuclear weapons less vulnerable to attack, safer from 'accidental' detonation, and more secure against seizure and unauthorized or mistaken use."

Conventional Weapon Ascendancy

The prescription set forth above segued directly to new and unexploited technological opportunities. Since collateral damage increases with inaccuracy, not only will "[i]mproved accuracies make feasible greater discrimination as well as effectiveness in the use of nuclear weapons," but "they also make possible more extensive replacement of nuclear with conventional weapons," and thus greatly reduce unnecessary killing of bystanders. Albert argued that, against a small fixed target, an improvement in accuracy by a factor of 10 provided the same effectiveness as an increase in yield by a factor of 1,000. Put another way, exploiting the new technologies of precision allows drastic reduction in nuclear yields, and even brings needed capabilities into the range of conventional explosives. As John Foster once observed to me in a discussion of silo hardness, "10 kilotons on the roof does it every time." While not arguing for the complete replacement of nuclear with conventional weapons, Albert maintained that the effect will

be to make it "more feasible to avoid crossing the divide between conventional and nuclear weapons. They give us choices."

The next paper in this section, Albert's final aria in the MAD opera, is an excerpt from *Discriminate Deterrence*, the report of the Commission on Integrated Long Term Strategy (CILTS).[11] CILTS, which Albert co-chaired with outgoing Undersecretary of Defense for Policy, Fred C. Iklé, started its deliberations in 1986 and published its report in early 1988. The opening paragraphs of the excerpt echo many of Albert's concerns, the first mentioned being technology, followed by basing, conventional arms in concert with nuclear arms, Third World conflicts, and low-intensity high-probability conflicts. It speaks to lesser powers acquiring advanced weaponry. A "wider range of contingencies," "discriminating non-nuclear force," "conventional and nuclear posture . . . based on a mix of offensive and defensive systems," "survivable communications and control of forces," and "discriminate nuclear attacks," are all pure Wohlstetter. It asks, "Can NATO rely on threats of escalation that would ensure its own destruction (along with that of the Soviet Union) if implemented?" The report broaches the possibility of economic collapse of the Soviet Union, increasing proliferation of nuclear weapons, and insurgencies and organized terrorism. It makes the case that gains in accuracy strongly support the case for discrimination.

But it argues for a Third World strategy where a combat role for U.S. armed forces is to be viewed as an "exceptional event." Its encouragement of support for anti-communist insurgencies, reflecting then current support in Afghanistan, misses the point of what happens when such friends, having vanquished one superpower, then turn on the other. The report worried greatly about a growing Soviet role in the Third World, and it speaks warmly of using Saudi bases. It points out the large disparity between U.S. and Soviet procurement of major weapon systems, the Soviet's increasing research, development, and testing expenditures, their greater pace of satellite launches, and their greater military capital stocks, compared to those of the United States.

As is typical of "commission reports," it is a compromise between sometimes opposing views, such as those of the Wohlstetter canon and those of the Soviet-oriented defense establishment. This is not to be critical. Even if the CIA had opened its files to CILTS, it would not have helped. The CIA also missed the impending dissolution of the USSR, which happened 2

years later. On the other hand, its plea for an integrated strategy is probably more relevant and important now than when the report was written. The Soviet Union did impose a degree of political and intellectual coherency on U.S. national strategy. As many security analysts have bemoaned, at least then we knew who the enemy was. The current uncertainty of who and where the enemy is has replaced the Cold War's simpler focus on what and when to strike. The Commission's prescriptions are still sensible.

In the final paper of this section, Albert returns, 24 years later, to the subject of his 1968 RAND publication dealing with technology.[12] In the interim a great deal of invention had occurred, particularly with respect to conventional weapons, some traceable to the LRRDPP in the early 1970s. A revolution had occurred in the acquisition, storage, analysis, and distribution of information, and these changes further shifted the balance from nuclear to conventional weapons. Large nuclear weapons, seen as far too large to be useful in realistic contingencies, now compete with far more acceptable precision conventional weapons, augmented by such technologies as stealth and networked battlefield surveillance. The consummate nuclear strategist says, "The technical changes [of the Information Revolution] are larger, and their effects more ramified, more closely interconnected, and much more important than the changes worked by fission and fusion." Albert recognized that rapidly increasing accuracy enabled by technology was far more important than the relatively slow growth in yield.

The paper is an indicator of where Albert would have gone in developing a strategy for precision weapons, networked military operations, and ubiquitous surveillance, all comparable to his earlier work in the 1950s on nuclear weapons. His difficulties with nuclear weapons that are so large and powerful as to cause as much damage to their user as to the targets have been noted earlier. From the standpoint of the 15 years that have elapsed since this presentation, the Information Revolution has gone far beyond that which provided the basis for Albert's assessment of the disutility of nuclear weapons. But he clearly appreciated that what he was seeing in the evolution of conventional weapons was only a start, and that many more evolutionary orders of magnitude, some of which have now been realized, lie in store.

Albert speaks positively of the implications of the wide dissemination of information, not only on the battlefield but also in the world of social and political discourse and economic development. He notes that decentralization results in competition

and establishes a basis for the spread of democratic processes that can replace the more arbitrary and less stable decisions of dictators.

Unexplored Downsides

In writing about the impacts of rapidly changing technology, Albert had the benefit of demonstrated capabilities, such as the development of the Internet, use of precision weapons in Operation DESERT STORM, and the collapse of the closed USSR in the face of vibrant open economies. But in part because he died a few years later, he did not have an opportunity to learn the downsides of the Information Revolution he was so enamored of.

He appears unaware of some of the other results of computer and communication-based networking. Computers and networks can be penetrated by adversaries as easily as armor-piercing ordnance can penetrate a tank. Malicious software can be introduced into systems to subvert their intent, and their content can be stolen or changed. Communication and sensing satellites can be jammed, their uplinks captured, and they can be destroyed in orbit. Networks can be saturated by computer-generated traffic, and the practical and technical overhead of encryption and access controls limit their wide adoption in real-time situations. Software is a beautiful logical construct, but the systems based on it are of such complexity that they defeat the full understanding and control by their designers and operators. And in networking all aspects of modern societies we create attractive new targets capable of system-wide failures.

Albert's final assessment—that "man is the species that can use information, reasoning, and insight to improve the odds [of avoiding an apocalyptic end]"—may be optimistic. In transforming nuclear confrontation to the domain of information, we are returned to the stage of nuclear strategy at the beginning of the Cold War. Albert was fortunate to be able to read the end of the "book" he started 40 years earlier, though what might have been the final chapter has not yet been written. Albert wanted to extend the concept of deterrence to the realm of conventional warfare. The Defense Nuclear Agency's New Alternatives Panel was one way to keep the idea alive, and some were considering a CIOP, a Conventional Integrated Operational Plan based on a one-to-one relation between a smart warhead and a pre-identified target.

While nuclear strategy emerged as Albert joined RAND, it is far from its end as a domain of central importance to the security of all nations. In 1950 the "nuclear problem" was one of managing U.S. strategic nuclear forces. Today the corresponding nuclear problem is that of "managing" a set of global nuclear powers, real and "virtual," the latter reflecting the circumstance that nuclear weapons and national nuclear forces not yet in being are as worrisome as those that are.

The focus of nuclear concerns changed in Albert's closing years. The collapse of the Soviet Union took the edge off the U.S.–USSR nuclear confrontation. Although strategic force levels did not change immediately, the shift to cooperation, even in such sensitive matters as the safeguarding of Russian nuclear materials, made much of past postures less relevant. Precision conventional weapons were used on numerous occasions in largely non-nuclear circumstances. Operation JUST CAUSE in Panama in 1990, Operation DESERT STORM in 1991, and various "peace operations" in Iraq, Somalia, Macedonia, Haiti, Bosnia, and Kosovo provided numerous opportunities to hone doctrine in the areas of precision weapons, net-centric operations, and coalition warfare.

During this period where explicit nuclear confrontations diminished, the global nuclear weapon landscape was "enriched" by the emergence of new nuclear nations. While South Africa dismantled its nuclear force in 1991, Iraq's nuclear program was an active concern until 2003. India had exploded a "peaceful" nuclear weapon in 1974 and both India and Pakistan announced their full nuclear status with back-to-back nuclear test series in 1998. Libya's nuclear ambitions were known, and it did not terminate its program until 2003. North Korea was actively pursuing nuclear weapons, with negotiations during this period to limit its development activities ultimately unsuccessful when it detonated a nuclear weapon in 2006. Iran, as early as the period of the Shah, was on a path to nuclear power and, according to public statements, intimated that nuclear weapons were a possible future goal.

As the domain of nuclear strategy has shifted from the management of credible deterrent forces in a two-sided balance, the lessons painfully learned and the doctrines and strategies put into place no longer suffice. Nuclear weapons have entered a "commodity" period. Pakistan disseminated its weapon

technology as well as Chinese weapon designs. North Korea, Iran, and Syria are engaged in mutually-supporting programs in nuclear and missile technology. Industrial nations, despite the strictures of the *Treaty on the Nonproliferation of Nuclear Weapons* (NPT), provide technologies to would-be proliferators, some dual-use, some the result of inadequate technology export controls, and some simply illegal transactions. Non-nuclear signatories to the NPT engage in clandestine weapon development despite the efforts of the International Atomic Energy Agency (IAEA). Compliant signatories must reevaluate their options in the light of each new nuclear nation.[13]

One now parses the "nuclear problem" quite differently than was the case in 1950 and in the following 40 years. There are four aspects to the transformed problem. First is to reduce the complexity of the scene by discouraging non-nuclear nations from acquiring nuclear weapons, a matter addressed by the NPT, though not entirely successfully in view of the observed rate of one new country every nine years. The second is encouraging responsible stewardship of their nuclear forces by nuclear nations, an issue on which the NPT is silent. The third is devising a path for the complete elimination of nuclear arsenals by nations possessing them. While this is a stated goal of the NPT, it is *terra incognita* in a policy sense.[14] The fourth is preparing a global response in the event that a nuclear weapon is detonated, whether by accident, by unauthorized use, in an accidental nuclear war, or by explicit intent.

Were Albert alive, he would delight in dissecting these issues and nudging us in sensible directions.

Coda: Were Albert to read my introduction, I think he would be pleased. But here is how his reaction to me would be.

He would make some mildly positive statement that would amount to giving me an "A" for effort, or maybe just a "B+" overall. Then he would point out the most egregious error in my logic. There would be more errors in his mind, but he would be too polite to enumerate them, and after all, he would be privately pleased at the progress of a promising student.

ENDNOTES - Lukasik

1. William C. Yengst, Stephen J. Lukasik, and Mark A. Jensen, "Nuclear Weapons That Went to War," SAIC report prepared for the Defense Special Weapons Agency, DSWA-TR-97-25, October 1996.

2. There were a number of arms control agreements reached in this period that reflected widespread concern over the growing threats created by weapons of mass destruction. These included the Antarctic Treaty in 1959, the Moon, Space, and Other Celestial Bodies Treaty in 1967, the Latin America Nuclear Free Zone Treaty in 1967, the Seabed Treaty in 1971, SALT I in 1972, the Biological Warfare Treaty in 1972, the ABM Treaty in 1972, and the Threshold Test Ban Treaty in 1974.

3. *Preliminary Design of an Experimental World-Circling Spaceship*, SM-11827, Santa Monica, CA: Douglas Aircraft Company's Project RAND, May 2, 1946, available from *www.rand.org/pubs/special_memoranda/SM11827/*.

4. For more on Paul Baran's work on survivable strategic communications, see *www.rand.org/about/history/baran.html*.

5. Albert Wohlstetter, *Strength, Interest and New Technologies*, opening address before *The Implications of Military Technology in the 1970s*, the Institute for Strategic Studies' ninth annual conference, Elsinore, Denmark, September 28 to October 1, 1967, D(L)-16624-PR, Santa Monica, CA: RAND Corporation, January 24, 1968, available from *www.rand.org/about/history/wohlstetter/DL16624/DL16624.html*. The address was also published as Wohlstetter, *Strength, Interest and New Technologies*, in *The Implications of Military Technology in the 1970s*, Adelphi Papers No. 46, London, UK: Institute for Strategic Studies, March 1968.

6. The program's name was, in part, chosen to result in the unpronounceable acronym, one so long as to be dull and forgettable, in contrast to most government program acronyms that are chosen to be bold, inspiring, and self-defining, and to encourage funding. In this case the intent was to minimize attention until results were in hand.

7. The reports of the Panel on Remotely Piloted Vehicles, Defense Science Board Summer Study, July 19-31, 1971, and *Final Report of the Task Force on Remotely Piloted Vehicles*, August 1972, were significant inputs to this work.

8. The output of the program exists only in difficult-to-locate declassified documents. Two comprehensive summaries are *Summary Report of the Long Range Research and Development Planning Program*, draft final report prepared by D. A. Paolucci, Falls Church, VA: Lulejian & Associates, Inc., February 7, 1975, declassified by DNA on March 2, 1978; and Andrew May and Bartlett Bulkley, *The Pre-History of the Revolution in Military Affairs*, Unclassified Draft Report, McLean, VA: SAIC, Hicks and Associates' Strategic Assessment Center, February 2004.

9. Albert Wohlstetter's remarks in "The Military Dimensions of Foreign Policy," Fred Warner Neal and Mary Kersey Harvey, eds., Vol. II of four volumes edited from the proceedings of Pacem in Terris III, National Convocation to Consider New Opportunities for United States Foreign Policy, Washington, DC, 1973, Chap. II, "The Debate on Military Policy: How Much is Enough? How MAD is MAD?"

10. Albert Wohlstetter, "Bishops, Statesmen, and Other Strategists on the Bombing of Innocents," *Commentary*, June 1983.

11. *Discriminate Deterrence,* report of the Commission on Integrated Long-Term Strategy, co-chaired by Fred C. Iklé and Albert Wohlstetter, Washington, DC: U.S. Government Printing Office, January 1988, available from *www.albertwohlstetter.com/writings/DiscriminateDeterrence.*

12. Albert Wohlstetter, "RPM, or Revolutions by the Minute," presented at a meeting at the American Enterprise Institute, June 10, 1992.

13. These issues are examined in a working paper by Stephen J. Lukasik, "Dealing with the Proliferation of Nuclear Weapons: Plan B," October 2007.

14. For a recent affirmation of this goal, see George P. Shultz, William J. Perry, Henry A. Kissinger, and Sam Nunn, "A World Free of Nuclear Weapons," *The Wall Street Journal*, January 4, 2007.