

GETTING TO ZERO:

**Is Pursuing a Nuclear-Weapon-Free World Too Difficult?
Too Dangerous? Too Distracting?**

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There is remarkably widespread and growing agreement, at the end of the 1990s, on the desirability and feasibility of many of the nuclear-arms-limitation measures treated in the foregoing chapters: on reductions in the nuclear forces of the United States and Russia going well beyond those prescribed in the START II treaty; on de-alerting measures that would increase the reaction time of nuclear forces from minutes to days; on a thoroughgoing revision of targeting practices in order to eliminate all consideration of massive attacks; on bringing into force the Comprehensive Test Ban Treaty and negotiating a comprehensive cutoff of production of fissile materials for weaponry; and on other measures to reduce the prominence of nuclear weapons in the foreign and military policies of the few countries that possess them and bolster the resolve of the rest to continue to refrain from acquiring them.

As remarkable as the extent of agreement on this range of restraints on nuclear weaponry, however, is the extent of the continuing *lack* of agreement on the desirability and feasibility of achieving a world free of nuclear weapons altogether - or, at least, on trying to achieve a nuclear-weapon-free world (NFWF) on any timescale of practical interest. Notwithstanding the spate of studies and statements, since the Cold War ended, by distinguished groups and individuals arguing that the time has come to address the elimination of nuclear weapons as a practical matter rather than merely a utopian goal, it seems apparent that getting to zero any time soon remains anathema to a majority of the people who populate the national-security establishments of the nuclear-weapon states - or, at least, to a majority of those whose opinions matter most.

NWFW proponents argue that getting to zero is desirable to reduce the horrific risks of intentional or unintentional use of nuclear weapons by the countries that now possess them, to prevent the proliferation of nuclear weapons (as well as chemical and biological weapons) to additional nations and to subnational groups, and to escape once and for all the vexing moral dilemmas of nuclear deterrence; and they argue that getting to zero has been made feasible by the end of the Cold War and by global trends towards democratization, cooperation, and interdependence. The NWFW skeptics, as I will call them, argue (with varying degrees of relative emphasis on the three points), that getting to zero is too difficult (many say impossible), too dangerous (both as a destination and en route), and too distracting from more promising arms-limitation agendas to warrant pursuing it with any seriousness at this time.

In this paper - which I offer as a tribute to the indefatigable and relentlessly effective pioneer among NWFW proponents, Joseph Rotblat - I address these arguments of the skeptics and weigh them against those adduced in favor of getting to zero by Rotblat and other NWFW proponents. At the end, I indicate where I come out myself on some of the major dilemmas and disagreements that characterize this topic. Before turning to these "pro and con" matters, however, I provide some needed background in two parts: a capsule history of the debate about freeing the world from nuclear weapons, ending with the blossoming of attention to the issue following the end of the Cold War; and an attempt to sort out some of the conceptual and terminological ambiguities about the meaning of zero that are the legacy of this history.

A Short History of Zero

As Joseph Rotblat notes in his opening chapter of the 1993 Pugwash monograph on a NWFW, interest in removing nuclear weapons from the control of individual nations - and ultimately banning them altogether - began among Manhattan Project scientists even before the first bomb was tested in July 1945 [1]. Following the use of the bomb against Japan in August 1945 and the subsequent end of the war, discussion of the issue of international control of nuclear weapons and the possibility of banning them blossomed in published essays and public forums engaging a wide cross-section of society.

In one such forum in December 1945, the brilliant and eccentric Manhattan project scientist Leo Szilard called for a treaty banning atomic bombs, to be verified by inspections conducted by the United Nations [2]. In a remarkable book published in January 1946 and titled *Must Destruction Be Our Destiny?*, the young Manhattan project chemist Harrison Brown went further, laying out a painstakingly logical argument that, in the long run, nothing less than a world government would suffice to save the world from nuclear disaster [3]. And, in January 1946 the first resolution of the first meeting of the United Nations General Assembly established a UN Atomic Energy Commission with the mandate to [4] *"make specific proposals ...for the elimination from national armaments of atomic weapons and of all other major weapons adaptable to mass destruction."*

At the first meeting of this new Commission in June 1946, the US representative to the Commission, Bernard Baruch, put forward the initial proposal of the United States for

international control. This called for the creation of an International Atomic Development Authority that would include ownership or managerial control of all nuclear activities potentially dangerous to world security, but its proposals went much further than this [5]:

When an adequate system for control of atomic energy, including the renunciation of the bomb as a weapon, has been agreed upon and put into effective operation and condign punishments set up for violations of the rules of control which are to be stigmatized as international controls, we propose that: (1) manufacture of atomic bombs shall stop; (2) existing bombs shall be disposed of pursuant to the terms of the treaty; and (3) the Authority shall be in possession of full information as to the know-how for the production of atomic knowledge.

This Baruch Plan, as it came to be called, ultimately failed of agreement because of two irreconcilable differences between the positions of the United States and the Soviet Union: the Soviets would not accept the Plan's provision for sanctions against violations without right of veto by the permanent members of the UN Security Council; and the Soviets wanted nuclear weapons outlawed before a verification system was in place, a proviso that the United States would not accept.

Following upon the Soviet Union's successful test of an atomic bomb in 1949, the development of the much more powerful hydrogen (thermonuclear) bomb by both the United States and the Soviet Union in the early 1950s, the worsening atmosphere of confrontation between the Communist and Western blocs during these years, and the associated take-off of the nuclear arms race that any number of commentators had predicted a decade before, there emerged in the late 1950s and early 1960s a resurgence of public, scientific, and to some extent policymaker interest in banning nuclear weapons. In addition to mass movements opposing nuclear testing and calling for nuclear disarmament, manifestations of this resurgence included:

- the issuance in 1955 of the Russell-Einstein Manifesto - signed by Bertrand Russell, Albert Einstein, Joseph Rotblat, and 8 other scientific luminaries from altogether 7 countries - calling for scientists to *"assemble in conference to appraise the perils that have arisen as a result of the development of weapons of mass destruction"* and arguing for both the renunciation of nuclear weapons and, as a necessary accompaniment to that, the renunciation of war as a means of settling disputes [6];
- the statement issued in 1957 by the first Pugwash Conference on Science and World Affairs (held in response to the Russell-Einstein Manifesto), emphasizing that [7] *"war must be finally eliminated, not merely regulated by limiting the weapons which may be used. "*
- the 1959 resolution of the General Assembly of the United Nations declaring general and complete disarmament to be the UN's goal and calling for measures in this direction to be taken in the shortest possible time [8];
- the issuance by the United States and the Soviet Union in September 1961 of what came to be called the McCloy-Zorin Statement, which stated in response to the General Assembly's disarmament resolution that the two countries agreed on the goals of [9] *"elimination of all stockpiles of nuclear, chemical, bacteriological, and other weapons of mass destruction, and cessation of the production of such weapons. "*

The Russell-Einstein Manifesto and the first Pugwash statement launched an independent, international, scientist-led movement whose deliberations and declarations have provided ideas and impetus to nuclear-arms limitation efforts throughout the ensuing four decades [10,11]. The more official UN and McCloy-Zorin statements were less efficacious: resolutions of the General Assembly are nonbinding, and US-Soviet efforts to embody the McCloy-Zorin principles in a treaty collapsed in 1962 over disagreements about timing and verification:

The rest of the 1960s and the early 1970s were marked by official negotiation of a set of "partial measures to alleviate immediate worries", as Rotblat's 1993 account characterizes them [12] - arms control treaties constraining nuclear weapons testing, proliferation, and antiballistic missile systems. These treaties, while doing nothing to reduce the then-extant nuclear forces, nonetheless embodied commitments by the parties to pursue the elimination of nuclear weapons as a long-term goal. Specifically:

- the Partial Test Ban Treaty of 1963 proclaims in its Preamble a commitment to "*the speediest possible achievement of an agreement on general and complete disarmament under strict international control*" and to "*eliminate the incentive to the production and testing of all kinds of weapons, including nuclear weapons*";
- the Non-Proliferation Treaty (NPT) of 1968 states in its Article VI that "*Each of the Parties to the Treaty undertakes to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear*

disarmament, and on a treaty on general and complete disarmament under strict and effective international control";

- the Anti-Ballistic Missile Treaty of 1972, in the Preamble of which the United States and the Soviet Union agreed that *"it is their intention to achieve at the earliest possible date the cessation of the nuclear arms race and to take effective measures toward reductions in strategic arms, nuclear disarmament, and general and complete disarmament. "*

Also in the category of "partial measures" agreed in this period was the Treaty of Tlatelolco (1967). As the first of the major "nuclear-weapon-free zone" (NWFZ) treaties, it banned nuclear weapons in a particular region, in this case Latin America. (Ambassador Alfonso Garcia Robles of Mexico, who was the principal architect of this agreement, shared the 1982 Nobel Peace Prize for his efforts.)

Toward the end of the 1970s, with the US-Soviet nuclear arms race proceeding with little apparent impediment from the above-mentioned treaties, the United Nations attempted to regenerate interest in nuclear disarmament through a special session of the General Assembly devoted to this topic. This First UN Special Session on Disarmament, taking place in May/June 1978 and including many heads of state among its participants, produced a unanimously agreed Final Document stating that *"It is essential to halt and reverse the nuclear arms race in all its aspects in order to avert the danger of war involving nuclear weapons. The ultimate goal in this context is the complete elimination of nuclear weapons. "* The second Special Session on Disarmament (held in 1982) and the third (held in 1988), however, failed to agree on any specific

programs or timetables for moving toward nuclear disarmament; indeed, neither meeting produced agreement on any final document at all. Rotblat attributes this lack of progress to the reluctance of the United States and Russia to concede the United Nations any significant role in what they had come to regard as the mainly bilateral business of nuclear arms control [13].

While the disarmament efforts of the United Nations were floundering, the agitation of publics in the United States and Europe about nuclear-weapons dangers was growing. Driven by militant Reagan Administration rhetoric, concerns that "nuclear winter" could turn any nuclear war into the end of civilization, the deployment of a new generation of Soviet intermediate-range ballistic missiles (SS-20s) threatening Europe, and the prospect of deployment there of new U.S. Pershing II and land-based cruise missiles in response, this agitation manifested itself in the emergence of a "nuclear freeze" movement capable of mustering rallies of half a million to a million people in major cities in Europe and the United States. This movement helped propel the superpowers toward the first treaty banning a whole class of nuclear weapons - the Intermediate Nuclear Forces Treaty of 1987 - as well as encouraging a new round of thinking about more comprehensive approaches to nuclear disarmament.

A noteworthy manifestation of such thinking outside official channels was Jonathan Schell's eloquent and widely read 1984 *New Yorker* essay, "The Abolition" [14]. In it, he argued that elimination of nuclear weapons might actually be facilitated by the unavoidable circumstance that the knowledge of how to build such weapons cannot be eradicated. That is, Schell contended, one does not need to postpone abolition until something akin to a world government is available to deal with the potential for cheating, because cheating would be

deterred even in a world much like today's by recognition that other countries could quickly reconstitute their own arsenals to cancel a cheater's advantage.

On the official side, the next major development in thinking about elimination of nuclear weapons came in January 1986, when the new Soviet leader Mikhail Gorbachev unveiled a plan for a step-by-step process to eliminate nuclear weapons by the year 2000. And, for a brief moment at the Reykjavik summit in October of that year, it appeared that U.S. President Ronald Reagan - to the astonishment of the world and his own advisors - had agreed to this proposal. Indeed, the two leaders agreed at Reykjavik to an even shorter timetable, ten years, than what Gorbachev had first proposed [15]. (Notably, although every U.S. President from Eisenhower onward had affirmed in one way or another a US commitment to elimination of nuclear weapons as an ultimate goal, none had ever specified a timetable.) The apparent accord quickly collapsed over the usual disagreements about details (not so much verification this time, but complications arising from Reagan's ideas about building and sharing a "Star Wars" defense against ballistic missiles), and the superpower nuclear confrontation returned to normal.

This "normality" was to be short-lived. Two years later, in 1989, Gorbachev began dismantling the Soviet empire, and in the space of another two years it was clear to everybody that the Cold War was over. The START I and START II agreements for successive stages of deep reductions in deployed strategic nuclear forces were signed in 1991 and 1993; unilateral commitments by Presidents Bush and Yeltsin began a process of sharp cuts in the numbers of tactical nuclear weapons deployed on both sides; Belarus, Kazakhstan, and Ukraine - former Soviet republics where nuclear weapons had been deployed - returned the weapons to Russia

and joined the Non-Proliferation Treaty as non-nuclear-weapon states; and the process of actual dismantlement of nuclear weapons made surplus by these developments began in both Russia and the United States, even though no treaty required it. To many long-standing proponents of the elimination of nuclear weapons, that hitherto frustratingly elusive and distant goal seemed suddenly to have moved almost within reach; and to some others who had never taken the possibility of elimination seriously at all, it now seemed at least less implausible.

The resulting post-Cold-War outpouring of new analyses and statements relating to the desirability and feasibility of a NFWW has been ably reviewed in a recent article by US Pugwash Committee Co-Chair Steven Miller [16], on which I draw heavily here. Particularly noteworthy in this post-Cold-War phase of the elimination debate have been:

- the 1993 Pugwash volume, *A Nuclear- Weapon-Free World: Desirable? Feasible?*, edited by Joseph Rotblat, Jack Steinberger, and Bhalchandra Udgaonkar, which elevated the NFWW debate both in substantive content and in respectability with its detailed treatments of mechanisms and obstacles by a distinguished international array of authors [17];
- the April 1995 "Abolition 2000 Statement" [18], released in the context of the NPT Review and Extension Conference by a global coalition of nongovernmental organizations, calling for the elimination of nuclear weapons and adoption by the year 2000 of a convention to this effect;

- the statement of "Principles and Objectives" endorsed by all NPT parties as part of the May 1995 agreement to extend the Non-Proliferation Treaty indefinitely [19], calling for *"the determined pursuit by the nuclear-weapon states of systematic and progressive efforts to reduce nuclear weapons globally, with the ultimate goal of eliminating those weapons, and by all states of general and complete disarmament under strict and effective international control."*
- the award of the 1995 Nobel Peace Prize in December of that year jointly to Joseph Rotblat and the Pugwash Conferences [20] *"for their efforts to diminish the part played by nuclear arms in international politics and in the longer run to eliminate such arms. "*
- the December 1995 report, "An Evolving US Nuclear Posture issued by the Henry L. Stimson Center's Project on the Elimination of Weapons of Mass Destruction, which under the chairmanship of General (ret.) Andrew Goodpaster - a former Supreme Allied Commander in Europe - recommended *"a decisive commitment at the highest political level"* to the elimination of nuclear weapons, together with an array of shorter-term measures to reduce the role of nuclear weapons in US security policy [21];
- the July 1996 advisory opinion of the International Court of Justice [22], which in a 7-to-7 split vote decided by the Court's President held that *"the threat or use of nuclear weapons would generally be contrary to the rules of international law applicable in armed conflict, and in particular the principles and rules of humanitarian law"*, with the caveat that *"the Court cannot conclude definitively whether the threat or use of nuclear*

weapons would be lawful or unlawful in an extreme circumstance of self-defence, in which the very survival of a State would be at stake", and which at the same time held unanimously that "there exists an obligation to pursue in good faith and bring to a conclusion negotiations leading to nuclear disarmament in all its aspects under strict and effective international control";

- the August 1996 report of the Canberra Commission on the Elimination of Nuclear Weapons (a group including, among others, the immediate past commander of US strategic nuclear forces, a former French Prime Minister, a former US Secretary of Defense, a former Brazilian Foreign Minister, a former Chief of the British Defence Staff, a former Chinese Ambassador to the United Nations in Geneva, a former Director of the International Institute for Strategic Studies, and Joseph Rotblat), which concluded that [23] *"the opportunity now exists, perhaps without precedent or recurrence, to make a new and clear choice to enable the world to conduct its affairs without nuclear weapons"*, called upon *"the United States, Russia, the United Kingdom, France and China to give the lead by committing themselves, unequivocally, to the elimination of all nuclear weapons"*, and offered a systematic set of rebuttals to the most frequently voiced objections to the desirability or practicality of a NFWF;
- the exceptionally eloquent personal statement by General George Lee Butler, former Commander-in-Chief of the US Strategic Command and a member of the Canberra Commission, to the State of the World Forum in October 1996 [24], in which he explains how his 30-year career with US nuclear forces - first implementing this country's

nuclear weapon policies and later helping shape and defend them - led him finally to the conclusion that those policies must be abandoned and the nuclear weapons themselves abolished;

- the December 1996 "Statement on Nuclear Weapons by International Generals and Admirals" - organized by Generals Goodpaster and Butler - in which some 60 retired senior military officers from 17 countries assert that [25] *"long-term international nuclear policy must be based on the declared principle of continuous, complete and irrevocable elimination of nuclear weapons"* although *" [t]he exact circumstances and conditions that will make it possible to proceed, finally, to abolition cannot now be foreseen or prescribed. "*
- another report of the Stimson Center Project on the Elimination of Weapons of Mass Destruction, issued March 1997 and entitled "An American Legacy: Building a Nuclear-Weapon-Free World", in which the distinguished Stimson group reiterates that [26] *"the ultimate objective of US national security policy should be the elimination of all weapons of mass destruction from all states - not the preservation of nuclear deterrence in perpetuity"* and *"only a serious commitment to cooperative nuclear disarmament is likely to provide the momentum necessary to drive forward the process of eliminating all weapons of mass destruction. "*
- the June 1997 report on "The Future of U.S. Nuclear Weapons Policy", summarizing a study led by General William F. Bums (US Army, retired) under the auspices of the

Committee on International Security and Arms Control of the U.S. National Academy of Sciences, which concluded concerning prohibition that [27] *“for the same reasons that the committee recommends rapid and substantial reductions in the size, readiness, and salience of national nuclear arsenals, the time also has come to begin to devote serious attention to the prospects for prohibiting those arsenals and to fostering the conditions that would have to be met to render prohibition feasible and desirable. ”*

- the February 1998 "Statement on Nuclear Weapons by International Civilian Leaders", organized by The State of the World Forum under the leadership of former US Senator Alan Cranston, in which 117 prominent figures (including 47 past and current prime ministers) from 46 countries declare that [28] *"leaders of the nuclear weapon states, and of the de facto nuclear nations, must keep the promise of disarmament enshrined in the Non-Proliferation Treaty of 1970 and clarified and reaffirmed in 1995 in the language codifying its indefinite extension ... by commencing the systematic and progressive reduction and marginalization of nuclear weapons, and by declaring unambiguously that their goal is ultimate abolition. "*

As Miller points out [16], these developments through the 1990s (and still others mentioned in his survey but omitted here in the interests of brevity) firmly establish that support for elimination of nuclear weapons has expanded in the post-Cold-War period to far beyond the traditional abolitionist constituency; as he also points out, however, this wider support rests on an almost equally wide range of interpretations about what elimination means, implies, and requires.

These variations and ambiguities about the meaning of zero are perhaps an inevitable legacy of a half-century debate, involving a constantly changing cast of characters in a constantly changing world, about an issue that is at once subtle, complex, and complexly connected to the ways the world is changing. In any case, this paper's aim of clarifying some pros and cons of getting to zero requires shedding some light on these differences concerning what zero amounts to, and it is to that task that I now turn.

Shades of Zero: Meanings, Implications, Requirements

The variations and ambiguities begin with the terms employed to describe what is being sought: the "abolition" of nuclear weapons (a term often favored by the more philosophical writers, such as Schell [14]); their "elimination" (the term usually favored by diplomats, from the first UN resolution in 1946 [4] to the Canberra Commission in 1996 [23]); their "prohibition" (a term favored by those of legal bent [29] and, most recently, by the National Academy of Sciences' 1997 nuclear weapons study (27)); and "nuclear disarmament" (which crops up in all kinds of treatments of the subject). Are there actually differences in meaning here, the sorting out of which could add precision or other insight to the discussion of "getting to zero"? Are some of these terms more useful - by virtue of being more precise or appropriate to the use to which they are being put in this context - than others? I believe the answer to both questions is "yes".

Specifically, "prohibit" in this context clearly means to "forbid by authority of law", that is, to make illegal (30). This term is both unambiguous and clearly not synonymous with

"eliminate", which means to cause the disappearance of something, to get rid of it entirely. Thus, for example, the United States imposed a prohibition on alcoholic beverages with the 18th Amendment to the US Constitution (lasting from 1919 to 1933), but these were far from eliminated. A prohibition on handguns, similarly, would represent an attempt to drastically reduce the numbers of these in use by making them illegal, although no one would expect it to quite lead to their elimination.

"Abolish" means to "do away with wholly" or "put an end to". It embodies both the legal connotation of "prohibit" and much of the sense of permanence and comprehensiveness of "eliminate". But it is more often (and some would argue more appropriately) applied to laws, customs, and institutions (such as slavery, capital punishment, or war) than to physical objects (such as nuclear weapons). Moreover, thinking about this word's most familiar usage, which is in relation to the abolition of slavery, suggests some ambiguity about whether complete effectiveness is implied: abolition certainly deprived slavery of its legitimacy, one presumes permanently, and disposed of the institution in its most conspicuous form; but still some forms of slavery persist (such as the selling of girls and young women into sexual slavery, which although illegal occurs quite routinely in a number of societies).

"Nuclear disarmament", finally, is even more ambiguous: it can and often does mean merely reducing or limiting one's forces, not necessarily reaching zero. The usual approach to reducing this ambiguity is to resort to more cumbersome (and nonetheless still ambiguous!) formulations such as "complete nuclear disarmament" or "comprehensive nuclear disarmament".

These considerations figured in the preference expressed in the National Academy of Sciences' 1997 nuclear weapon study for the word "prohibition" to describe an approach to the NFWF issue that ultimately could be accepted as both desirable and feasible. This choice has the attraction of avoiding both ambiguity and the common objection, made against "elimination" or "abolition", that these goals are unattainable insofar as (a) there would never be certainty that every last weapon was gone and (b) the knowledge of how to make nuclear weapons - hence the possibility of reconstitution of nuclear arsenals cannot be eradicated. Prohibition, as a matter of law, is certainly possible in principle; the main argument is about what it would actually accomplish.

There is also the question, of course, of exactly what is to be prohibited or eliminated in a NFWF. The candidates include, in order of increasing comprehensiveness and stringency:

- (a) nuclear weapons deployed with means for their delivery;
- (b) intact nuclear weapons in all conditions and locations;
- (c) (b) plus all nuclear-weapon components;
- (d) (c) plus all military stockpiles of directly bomb-usable nuclear-explosive materials (separated plutonium and highly enriched uranium);
- (e) (c) plus all stockpiles of directly bomb-usable nuclear-explosive materials, civilian and military;
- (f) (e) plus all facilities capable of producing directly bomb-usable nuclear-explosive materials;
- (g) (e) plus all nuclear-energy facilities.

At each of these levels, moreover, there is a choice among: (i) prohibiting/eliminating these items altogether; (ii) prohibiting their possession by states but allowing possession by an international authority; and (iii) allowing their possession by states but only under dual control

with an international authority. And there is the question of what other measures would need to accompany the nuclear prohibition, whatever its details, in order for it to be effective. That is: Is it necessary that chemical and biological weapons also have been convincingly eliminated? Conventional forces (or just the subset of these powerful enough to threaten the existence or independence of states)? All possibility of armed conflict between states? Would deployment of effective national defenses against ballistic missiles help with a nuclear ban, or hurt, or make little difference?

A substantial part of the literature of "getting to zero" has been devoted to the development of these diverse possibilities - and further combinations and variations of them - and to analysis and argumentation about their pros and cons. (See, especially, Harrison Brown's prescient 1946 book [3], Jonathan Schell's *The Abolition* [14], the 1993 Pugwash NFWF volume (17), the "Background Papers" of the Canberra Commission [23], and Steven Miller's recent precis of "The Abolitionist Upsurge" [16].) Many of the relevant issues are treated here in the sections to come on the putative difficulties, dangers, and distractions of getting to zero, but three points need a bit of elaboration first as background for those discussions.

First, progressing through the foregoing hierarchy of nuclear prohibitions from (a) towards (g) brings successively greater barriers against the overt or covert reconstitution of the capacity to deploy and use nuclear weapons, longer time requirements for reconstitution starting from the decision to do so, and more protection against acquisition of nuclear weapons by subnational actors ... but also bigger obstacles to agreement and implementation. While, historically, most proposals to "ban the bomb" have gone at least to level (d), there has been

some recent attention to the possibilities of stopping at levels (a) or (b). Level (a), separating all warheads from their delivery vehicles, is of course not really banning the bomb at all but just a form of de-alerting; it would reduce some of the risks of accidental and inadvertent use, but would do little or nothing to reduce proliferation incentives or the perplexities of nuclear deterrence.

Level (b), which has been advocated recently by Michael Mazarr [31] under the label "Virtual Nuclear Arsenals", would ban intact nuclear weapons while allowing retention of nuclear-weapons components. Intended as a position that might bridge the gap between abolitionists, on the one hand, and advocates of deep cuts and thoroughgoing de-alerting who have not been ready to embrace zero, on the other, this idea has been criticized as "a fake zero" that would encourage countries to position themselves "a turn of a screw" away from operational nuclear arsenals and would do little to delegitimize reliance on nuclear weapons as instruments of national policy. It appears that most proponents of a NFWF would accept the "virtual nuclear arsenals" approach only as a temporary way-station on the road to a destination somewhere between levels (c) and (g). (For an extended discussion, see Jonathan Schell's new essay on abolition, "The Gift of Time" [32].)

Second, there has been a long-running debate within the NFWF community about whether achieving and preserving a world free of nuclear weapons requires placing constraints on civilian nuclear energy activities, that is, requires moving beyond level (d) to somewhere between (e) and (g). This issue, like so many others in the nuclear weapons arena, was already visited by Harrison Brown writing in late 1945 [3]. A good account of the argument that

verification of a NWFW is too hard and break-out from it too easy unless nuclear energy is banned along with the bomb was provided by Lovins in his 1977 book *Soft Energy Paths* [33]. The essence of this case is that the huge stocks and flows of directly bomb-usable material in nuclear energy systems that recycle plutonium make detection of theft or diversion of a few bombs' worth virtually impossible; and that, even in systems without such recycle, intolerably large break-out possibilities would still reside in a civilian nuclear energy system's large numbers of nuclear-skilled engineers and technicians, uranium-enrichment facilities readily adaptable to produce weapons-usable material, and potential for quickly building new facilities from scratch to extract plutonium from spent fuel.

These considerations have convinced many that, at the very least, a nuclear-energy system compatible with a NWFW would need to be confined to the once-through fuel cycle, with all uranium-enrichment plants and spent-fuel storage under international control. Others argue that diversion-resistant closed fuel cycles yet to be developed and/or the co-location of all sensitive materials and facilities at internationally owned and guarded sites could also be consistent with a NWFW [34]. A quite comprehensive comparison of the pros and cons of different combinations of constraint and international control on nuclear energy in the context of a variety of interpretations of "zero" nuclear weapons has been provided recently by Cochran, Paine, and Norris in one of the "Background Papers" of the Canberra Commission [35].

Third, beyond the question of whether international control of aspects of civilian nuclear energy would be a necessary condition for the maintenance of a NWFW, there is an even more fundamental question about whether confining possession or control of nuclear weapons

themselves to an international organization might accomplish many if not all of the aims of a "true" NFWW while being considerably easier to achieve. Most of the early ruminations on how to re-bottle the nuclear genie - both by the nuclear scientists who had developed these weapons and by the diplomats who pondered the matter in the early aftermath of World War II - were in fact focused on eliminating nuclear weapons from national arsenals and placing them under international control, not on eliminating them altogether [1-5]. These considerations presumably were influenced by the clarity with which the early weapons scientists, having just invented nuclear weapons, understood that they could not be un-invented.

In later discussions about complete elimination of nuclear weapons, the question of international ownership of an arsenal of nuclear weapons in a world in which nations had given them up re-emerged as a potential answer to the objection that a NFWW would be excruciatingly vulnerable to domination by a country that succeeded in concealing a small arsenal while others were eliminating theirs, or that subsequently reconstituted such an arsenal. An arsenal in the hands of an international body would provide the means for discouraging such cheating, assuming that the international organization in question was seen to be capable of acting if the need arose. The variant of "dual key" control by an international agency and individual nation-states possessing nuclear arsenals has been suggested as a response to the concern that nuclear weapon states would not be willing to turn over complete control of such powerful weapons to an international body.

But ideas about international control of nuclear weapons, whether this control is exclusive or shared, continue to get mixed reviews. Among those observers who believe a

NWFW is infeasible because of the reluctance of nuclear-weapon states to give up this particular currency of status and power, many argue that these countries' transferring control of nuclear weapons to an international body is not significantly more likely than their agreeing to eliminate them altogether. Among those who *favor* a NWFW, moreover, there are many who feel that allowing an internationally controlled nuclear arsenal to remain after nations had renounced these weapons would be too large a concession to the proposition that threatening the use of nuclear weapons is a legitimate way to deter others from using them. (The differences of view on this point among NWFW proponents are on display in the 1993 Pugwash NWFW book, for example, in which some authors endorse the idea of an internationally controlled nuclear arsenal - at least as an interim measure - while others categorically reject it: contrast [36] and [37] with [38] and [39].)

Is Getting to Zero Too Difficult?

The issues just raised about whether a NWFW would need to include a ban on or international control of nuclear energy activities and whether nuclear weapons themselves might still be possessed, either temporarily or permanently, by international authorities are not only a matter of how a NWFW is defined and understood; they also relate importantly to the more fundamental question of whether a NWFW is feasible at all. It is just on this point of international control, in fact, that some of the arguments of supporters of a NWFW run into the greatest difficulty with the skeptics.

That is, for example, the supporters say "A NFWW is only practical if civil nuclear-energy activities are banned, too, or at least placed under international control." To this the skeptics say "Aha! You have just made clear why a NFWW is not feasible, because the countries of the world are never going to be willing to give up nuclear energy, or even to place under international control an activity as important to their economic well-being as nuclear energy is." Or the supporters say "A true NFWW would not allow any nuclear weapons at all, even in the hands of an international authority"; to which the skeptics respond "Then your NFWW is certainly unattainable, because you have ruled out the only plausible means for dealing with cheating by individual nations." (Of course, to supporters who *favor* retaining a nuclear arsenal under international control, the skeptics say - with even more force than in the case of civil nuclear energy - that countries will never be willing to cede this much power to an international entity.)

Certainly, many of the early thinkers who pondered the perils of nuclear weapons - notably the several groups of Manhattan Project scientists who struggled at the end of World War II with the implications of their invention [1]-[3] and the founders of the Pugwash Conferences a decade later [6]-[7] - reached the conclusion that for a ban on nuclear weapons to be really effective required not only unprecedented international powers of verification but also the abolition of war as a means of settling disputes between states. And quite a few of these thinkers pushed the argument to what seemed its next logical step, namely that the abolition of war could only be achieved in the context of "general and complete disarmament" (GCD), enforced by a close-to-all-powerful world government. These ideas account for the persistent linkage of nuclear disarmament with GCD in most of the declarations, proposals, and treaty formulations

put forward on this topic then and since. They also account for the view of opponents and skeptics of a NFWF that it is a utopian idea in the same class with GCD and world government... and thus will never need to be taken seriously except in the almost unimaginable event that world government becomes a plausible proposition. Indeed, for the opponents of a NFWF, seeing it constantly linked with GCD and world government has undoubtedly been a source of great satisfaction - a way of reminding everybody that it will never happen.

Most proponents of a NFWF now argue, however, that there are worthwhile forms of a nuclear-weapon ban that can be attained without waiting for the arrival of either GCD or world government. Much has happened, after all, since the 1940s and 1950s when these concepts seemed so closely linked. There is now considerable experience, for example, with a step-wise approach of outlawing the most worrisome (or most easily controlled) classes of weapons and activities first, rather than waiting for a comprehensive solution: banning atmospheric nuclear tests before a ban on all testing was possible; banning all testing before a ban on all nuclear-weapon development work was possible; banning biological weapons before bans on chemical and nuclear weapons were possible; banning intermediate-range land-based ballistic missiles between the United States and the Soviet Union before a global ban on these missiles - or on all ballistic missiles - was possible; and so on. If banning nuclear weapons now looks like a sensible next step, the argument goes, there is no reason it needs to wait for GCD.

There is also much experience with building and operating a variety of global institutions that, while falling far short of constituting a world government, have been tailored to specific problems not likely to be adequately addressed by nation-states acting solely as independent

entities. Institutions ranging from the International Atomic Energy Agency to the World Health Organization to the World Bank to the UN Security Council provide an "existence proof" for the capacity of the world community to address complex global problems collectively when the need arises. And the trend in the direction of fashioning diverse institutions of governance to match the scale of the specific problems addressed - local, regional, national, multinational, global - seems likely to continue, suggesting that it may well be possible to craft an international institution (or upgrade an existing one) to deal with' the challenges of creating and preserving a NFWF while appropriating only a modest piece of the traditional prerogatives of nation-states.

Whether a NFWF will prove to be too difficult in relation to the key problem of verification will of course depend on a combination of institutional arrangements and technical capabilities. Some analysts opposed to aiming for a NFWF insist flatly that such a thing could *never* be verified [40]. But technologies relevant to verification are constantly being improved, and few technologists would claim a crystal ball clear enough to know what will be possible with various forms of remote sensing combined with plausible degrees of in-country inspection in, say, twenty years ... not to mention fifty [41]-[42].

On the institutional side, advocates of a NFWF beginning with Szilard in 1945 [43] have pointed to the possibilities inherent in "societal verification" - reliance on a sense of duty to humankind, reinforced by national laws that would be enacted as a part of the commitment of nations to a NFWF treaty, to motivate individual citizens who become aware of prospective violations of the treaty to report these to international authorities. (Joseph Rotblat has been a major contributor to the development and promotion of this idea and has recently described his

view of it both in the Pugwash NFWF volume [44] and in his Nobel Prize acceptance speech [20].) It may be supposed that universal access to encrypted, anonymous communication with international authorities via the Internet - already close to a reality - will helpfully reduce the risks to "whistle-blowers" even where laws encouraging such behavior are not enacted or not respected by national authorities.

Another argument about the difficulty of achieving a NFWF has to do with a possible proliferation dynamic that might arise on the path from here to there. Those who make this point say that the large size of the US and Soviet/Russian arsenals has been one of principal barriers to proliferation, insofar as most other countries could not hope to match these arsenals and would see little gain from creating nuclear forces that would necessarily be small by comparison. They also argue that allies of the United States and Russia falling under the protective "nuclear umbrella" of these two countries' arsenals might be tempted, were the umbrella smaller, to acquire one of their own. In this view, then, any attempt by the United and Russia to move down the path toward zero by drastically shrinking their own arsenals could backfire by lowering the "entry barriers" to other countries' joining the nuclear club. (See, for example, the argument to this effect in the 1997 testimony of Richard Perle [40].)

This argument is at least partly undermined by the experience of nuclear proliferation to date: the third, fourth, and fifth nations to join the ranks of declared nuclear-weapon states - the United Kingdom, France, and China-while not sufficiently reassured by the nuclear umbrellas of the United States (in the case of the UK and France) and the Soviet Union (in the case of China) to refrain from acquiring their own, evidently saw no need to compete with the size of the

US and Soviet arsenals and were not therefore discouraged from going nuclear by their inability to compete in this way. They apparently concluded that whatever they needed in the way of nuclear deterrence did not depend on the relative sizes of arsenals but only on the ability to do an absolute amount of damage that any rational adversary would consider intolerable, for which an arsenal a fraction of the size of those of the United States and the Soviet Union would suffice.

Subsequent proliferation by the undeclared nuclear-weapon states Israel, India, and Pakistan likewise was not discouraged by their inability to compete, in terms of arsenal size, with the superpowers. The idea that a small number of nuclear weapons can act as an "equalizer" in a world of power imbalances seems if anything to be growing stronger over time since the end of the Cold War, not weaker. That is indeed a difficulty on the path to a NFWF, but it is not one that US and Russian reductions are likely to make much worse. This, in any case, was the conclusion of the 1997 CISAC study of US nuclear weapons policy, which found that on balance the proliferation-suppressing effects of a large US arsenal were outweighed in the post Cold-War world by the proliferation-enhancing ones [45].

A last question I want to treat under the heading of the difficulty of a NFWF is whether the advent of effective national defenses against nuclear-armed ballistic missiles would help or hinder progress toward a NFWF. Here one must first distinguish between the situation on the path to zero and the situation at the endpoint. With respect to the path, it is sometimes argued that such defenses would help by devaluing nuclear weapons, making it easier for countries to agree to get rid of them. This position is undermined, however, by the great diversity of ways to deliver nuclear weapons other than by ballistic missiles. Unless effective defenses are available

against *all* of these means of delivery - from aircraft to taxicabs - devaluation via defenses seems a weak effect.

Quite the contrary, the logic behind the Anti-Ballistic Missile Treaty of 1972 holds that deployment of defenses will inhibit reductions in the numbers of nuclear warheads mounted on missiles - thus discouraging progress down the path toward zero - because nuclear-weapon states that continue to believe they need any nuclear weapons at all will want enough to be sure that they can overcome the defenses. As the CISAC study argued, this logic seems no less compelling late in the reductions process (at low levels of nuclear forces) than early [46]. If zero had finally been attained, on the other hand, then deployment of missile defenses could provide a benefit in reducing the gain that a cheater could expect from reconstituting a small arsenal, if these were going to be mounted on missiles. But even in this context of discouraging cheating in a world of zero, the availability of other, difficult-to-defend-against means of delivery might make the benefit of missile defenses seem scarcely large enough to be worth the trouble.

Is Getting to Zero Too Dangerous?

Some skeptics question not only the feasibility of a NFWF but its desirability, arguing that even if it were possible to get there we should not want to do so. Their argument is that getting to zero would make the world even more dangerous than it is now, or more dangerous than it is likely to be in the future in the absence of attempts to get to zero. Some of the dangers they foresee arise on the path to zero, and others reside in the end-state - that is, in living in a world free of nuclear weapons.

The purported problems on the path to zero (besides those already discussed above under "difficulty") have mainly to do with the possibility of instability - that is, with encountering a configuration of forces in which, with numbers of nuclear weapons smaller than today's, the incentives for resorting to their use in time of crisis could be larger than those incentives are today. This could come about, in principle, either because the smaller numbers might make the prospect of nuclear war seem less horrible than with today's arsenals, or because a combination of the smaller numbers and the interaction of counterforce capabilities on one side and vulnerability of the nuclear weapons on the other might make a pre-emptive first strike seem an attractive proposition.

These concerns cannot be dismissed lightly, but neither do they seem persuasive reasons not to try to get to zero. In the first instance, it will remain true throughout most of the path to zero (that is, all the way from today's tens of thousands of nuclear weapons down to the point where "only" a few hundred remain) that the use of any substantial fraction of the stockpiles would destroy much of industrial civilization; thus, to this point, the barrier to nuclear-weapons use posed by the magnitude of the potential consequences will not have been meaningfully lowered. And, even in a world where only a few tens of nuclear weapons remain, any rational leader will surely be restrained by the recognition that use of these would still be a catastrophe beyond any in human history. (That an irrational leader might not be restrained by this recognition is, of course, a problem with even larger potential consequences when the arsenals are larger, as today.) As for potential crisis instability arising specifically from vulnerability of residual nuclear arsenals to pre-emptive attack, this danger can and must be minimized - as the

CISAC study [47] and others have argued - by careful shaping of the reductions trajectory to avoid counterforce/vulnerability problems at every step.

Another concern about the path to zero is that a world of low numbers of nuclear weapons - necessarily a way-station on that path - is a world in which these would be targeted against cities in order to maximize their deterrent value. If one accepts the claim of abolitionists that a major reason for doing away with nuclear weapons is the immorality of deploying weapons so indiscriminately and massively destructive of the innocent, then should one not resist moving to a situation in which these weapons are *explicitly* targeted to maximize the destruction of the innocent, rather than being mainly targeted against the nuclear weapons of the other side, as today? Perhaps the most compelling response to this concern is that the immense destructiveness of nuclear weapons renders almost immaterial the details of how they are targeted: there would be huge civilian casualties even from a "pure" counterforce attack. Combined with the likelihood that any use of nuclear weapons, between two countries that both possessed them, would escalate to an all-out exchange, this means that the probable destructiveness of a nuclear war depends mainly on the sizes of the arsenals involved, not on any other details - a good argument for heading toward zero.

While it is sometimes also argued by NFWF proponents that targeting civilians in a world with small numbers of nuclear weapons is tolerable as long as this condition is only a temporary way-station on the path to a much better world, I would prefer to think it possible that the role of nuclear weapons would already be so greatly diminished in a world with arsenals much smaller than today's that the weapons would not be targeted at all. That is, they would be seen as a largely irrelevant remnant, en route to total disappearance, whose residual interim

deterrent role if any were needed would be amply fulfilled by their mere existence, without need for specification of particular targets or even consideration of that unless and until some almost unimaginable reversal required it. (This is the situation that has been called "existential deterrence", wherein the existence of nuclear weapons exerts a certain deterrent effect that does not depend on any details of doctrine, deployments, targeting, or operational practices [48].)

The dangers generally associated with being in a NFWW - as opposed to the dangers of getting there - are mainly four: the danger of *cheating* (meaning that one or more nations or subnational actors clandestinely retain or reconstitute a number of nuclear weapons); the danger of *breakout* (one or more nations or subnational actors openly renounce the NFWW regime and re-acquire nuclear weapons); the danger that the absence of nuclear weapons will make the use of *biological weapons* more difficult to deter; and the danger that the absence of nuclear weapons will make *conventional conflicts* more likely and less restrained.

The problem of cheating is a matter of the incentives and barriers that bear on its probability, as well as a matter of the consequences that result if cheating occurs. The barriers depend on the adequacy of monitoring and verification - already discussed above under the heading of the difficulty of getting to a NFWW - as well as on the strength of the international norm against nuclear weapons and the consequences of being caught at cheating. The incentives depend on the benefits, to particular national or subnational interests, that are seen to derive from possessing some nuclear weapons in a world where few if any other national or subnational actors do. Inasmuch as I am dealing now with the dangers of being in a NFWW as opposed to the difficulties of getting there, it seems fair to assume for the purposes of this discussion that, a

NWFW having been achieved, the monitoring and verification capabilities in place are at least quite good and the strength of the international norm against possession of nuclear weapons at least quite strong. The consequences of being caught at cheating in such a world could include a variety of economic, political, and military sanctions and countermeasures and would seem likely to be severe. (Of course the cheater might be a superpower, hence not very susceptible to such responses, but it is hard to see why such a power would feel it needed to cheat on the nuclear weapons ban at all.)

Not only would the barriers to cheating be considerable, but the benefits would seem to be quite modest. To get some benefit from the weapons - indeed, in order for their existence to affect the rest of the world at all- the cheater would need to reveal their existence; but, once revealed, they would be a rapidly wasting asset, inasmuch as other actors could use the ineradicable knowledge of how to make nuclear weapons to quite quickly acquire their own. In the variant of a NWFW in which these weapons had been banned from possession by states and sub-state actors but were retained in some numbers by an international body, of course, the benefit of cheating would be even less, perhaps negligible. And even in the absence of an internationally controlled arsenal, what would a cheater do with its temporary advantage? This question relates to the consequences for the world as well as to the incentives for the cheater. It is not easy to write a plausible scenario that amounts to much.

Similar considerations of barriers and benefits apply to the breakout problem, except that capabilities for verification and monitoring are less germane. Both for breakout and for cheating, then, the barriers would be considerable, the incentives and consequences limited. No one can

show that cheating and breakout would be so unlikely and/or inconsequential in a NFWW as to be a non-issue, but neither does it seem persuasive that the risk associated with such developments - their probability multiplied by their consequences - should be regarded as comparable to the nuclear-weapon-related risks in a world from which such weapons had not been banned. (This question of "Compared to what?" is of course crucial in contemplating the problems of a NFWW, and I return to it below.)

Another danger sometimes ascribed to a NFWW is that the absence of nuclear weapons would make the use of other "weapons of mass destruction" - particularly biological weapons (BW) • more likely. (Chemical weapons usually get less emphasis in discussions along these lines, because they are clearly a threat of a lower order, against which it is harder to argue that a nuclear response would ever be warranted.) A variant of this position, which comes up in relation to the shorter-term issue of whether countries that possess nuclear weapons should declare unconditionally that they will not be the first to use them, is that the threat to respond with nuclear weapons is an indispensable deterrent to biological attack and should not be renounced through a no-first-use declaration.

As pointed out in the reports of the Canberra Commission [49] and the 1997 National Academy of Sciences nuclear-weapons study [50], however, there are serious liabilities of insisting that nuclear weapons are the only way, the best way, or even a desirable way to discourage the use of BW. First, the use of nuclear threats to deter BW use is likely to be of limited effectiveness, both because the source of a BW attack may be difficult to ascertain (making it unclear against whom to retaliate) and because the willingness of national leaders to

cross the nuclear threshold in response to a nonnuclear attack may be doubted. Second, insisting that it is sensible to threaten nuclear retaliation against BW attack blurs the many distinctions between these two classes of weapons (among others, nuclear weapons are proven, predictable, and massively destructive of infrastructure and ecosystems as well as of human lives), which may actually encourage the retention or acquisition of BW by countries that think this provides an effective and inexpensive counter to the nuclear weapons of others. Third, if a country as powerful as the United States (for example) insists it needs nuclear weapons to counter BW threats, then many less powerful countries will be tempted to conclude that they have an even *greater* need for nuclear weapons for this purpose ... a clear prescription for nuclear proliferation.

While it is hard to doubt that the threat of nuclear retaliation can provide some deterrent effect against a nation that possesses BW and is contemplating using them, the cost of insisting on this function for nuclear weapons seems very high - the encouragement of proliferation of *both* biological and nuclear weapons and the relinquishment of the possibility of a NFWW. Given that there is already a global convention prohibiting BW, the NFWW proponents argue, it would seem better to work for strengthening its provisions (particularly for verification and safeguards) while trying to create the conditions for a prohibition on nuclear weapons as well, rather than assuming - and thereby guaranteeing - the failure of the BW ban while proposing as the "remedy" the indefinite retention of nuclear weapons.

There is, finally, the danger that prohibition of nuclear weapons would, by eliminating a major source of restraint in international relations, "make the world safe for conventional war". Indeed, that the source of restraint provided by nuclear weapons today would be reduced in a

NWFW is hard to doubt. The issue is the size/importance of the effect, which proponents of a NWFW argue is small and skeptics say is large.

The skeptics say that only the existence of nuclear weapons prevented a Third World War in the period from the end of World War II to the break-up of the Soviet Union 45 years later. NWFW proponents say that a determinative role for nuclear weapons in this outcome cannot be proven, and that many smaller wars and confrontations occurred in this period - including some that engaged the nuclear-armed powers - accompanied by large casualties and, in some instances, risks of escalation to nuclear war that should have been considered intolerable. It could easily have been a combination of good luck and good management, more than any immutable logic of deterrence, that got the world through this period without disaster. If it is conceded, moreover, that nuclear weapons at least reduce the chance of large-scale conventional conflict between nuclear-armed powers, must one then concede also that a world of many such powers would be safer from major conventional war than the world of today? And what does this approach to preventing conventional war do to the probability of *a nuclear war*?

Proponents of a NWFW argue that the restraint against conventional conflict that nuclear weapons provide is bought at too high a price. They also argue that this source of restraint will be needed less and less as time goes on, because global economic integration, the intolerable destructiveness of even conventional conflicts, and other considerations will combine to make major war less and less likely altogether. The 1997 CISAC study, for example, made this point emphatically, listing among other relevant factors [49]

the spread of democracy; the growth of information-based economic systems that do not depend on or benefit from territorial conquest; expanding economic interdependence and integration; the emergence of strong international financial and political institutions, such as the United Nations and the International Monetary Fund; the diffusion of global communications and shared culture, which limit the degree to which governments can control information and propagate negative images of adversaries; the advent of modern intelligence and surveillance systems that facilitate accurate assessments of military capabilities and which make surprise attacks less likely to succeed; the development of collective security arrangements, such as NATO and the Organization for Security and Cooperation in Europe; and, more recently, deployment by the Western powers of modern conventional armaments, such as precision-guided munitions, which improve the effectiveness of defenses against armored attacks.

The CISAC study also made the argument (as Schell had done in 1984 [14]) that even the elimination of all physical nuclear weapons would unavoidably leave behind a residual deterrent effect against large-scale conventional conflict, arising from the understanding that such conflict could lead to the reconstitution of nuclear arsenals and their use. This is a form of "existential deterrence" that depends only on the existence of the knowledge of how to make nuclear weapons, which is ineradicable whether we like it or not; and it would reinforce the other factors mentioned as mitigating the concern that a NFWF would be prone to conventional war.

It has been suggested, on the other hand, that existential deterrence based on the possibility of reconstitution of nuclear arsenals might be less stable in time of crisis than deterrence based on arsenals already in place. The idea here is that a race to reconstitution of nuclear arsenals in time of crisis or conventional war could lead to incentives for the side that thought it was winning the race to use nuclear weapons first, while it had an advantage. Several questions suggest themselves. What would the first-strike incentives really be in a world of only a few weapons? Could a few destroy the resolve of a potential adversary? Or destroy enough of the adversary's (and the world's) military capacity to rule out devastating retaliation? How

would retention of some nuclear weapons in the hands of an international organization change the calculus? And how would these considerations vary as a function of numbers of weapons? These questions surely deserve more systematic analysis; but even as answers are sought it should be kept in mind that their overall importance will depend on other characteristics of a NFWF that, in consequence of the conditions that helped bring it about, could be so different from those of today's world as to make thinking about reconstitution, first strikes, and retaliation almost irrelevant.

Is Getting To Zero Too Distracting?

Many "moderates" on the issue of a NFWF - people who are neither enthusiastic proponents nor committed skeptics - make the argument that, whatever the long-term attractions of a NFWF may be, pursuing this goal too energetically now poses the liability of distracting attention from measures with more immediate benefits (such as de-alerting of and deeper cuts in deployed nuclear forces, entry into force of the Comprehensive Test Ban Treaty, negotiation of a cutoff of production of fissile materials for weapons purposes, and so on). Such distraction could take two forms. First, a debate about banning nuclear weapons might, by focusing attention on a topic on which agreement is difficult, raise the level of contentiousness and confrontation in arms-control discussions to the point where the good will needed to agree on potentially easier points is dissipated. Second, if the human resources at the disposal of governments for analyzing and negotiating arms control are limited, spending too many of them in pursuit of a NFWF could mean inadequate resources for more immediate goals. Both

concerns are captured in the question, "Why spend time and effort disagreeing about the ultimate destination if we can agree on the direction we need to travel now?"

The argument for postponing attention to the pursuit of zero is undermined, say NFWF proponents, by the connections between a commitment to zero and the accomplishment of some of the most important shorter-term arms-control goals. The most important of these linkages is with nuclear non-proliferation. The slow pace of proliferation during the Cold War, the achievement in 1995 of indefinite extension of the Non-Proliferation Treaty, and the signing of a Comprehensive Test Ban Treaty by most countries in 1996 are all good reasons for optimism; but all of this could be undermined sooner or later - and quite possibly sooner - if the nuclear weapons states do not finally make plain, now that the "excuse" of the Cold War is long gone, that they do not mean to maintain their exceptional status as possessors of nuclear weapons indefinitely. And, while it is argued against this that the decisions of states about whether to acquire nuclear weapons depend far more on the local and immediate threats that they perceive than on what the United States and the other declared nuclear-weapon states say about their long-term intentions with respect to their nuclear arsenals, the counter-argument is that the international norm against nuclear weapons matters and would be greatly strengthened by weapon-state declarations that they are committed to prohibition as a practical goal.

It needs to be remembered, in this connection, that decisions of potential proliferator states are likely to hinge on internal debates between "hawks" and "doves", in which the balance could well be tipped in some instances by the clarity of the commitment of nuclear-weapon states

to get rid of these weapons. It also needs to be remembered, as the 1997 National Academy of Sciences study argued [52], that

the short-term and medium-term effectiveness of the global non-proliferation regime requires the full support and cooperation of a large number of non-nuclear-weapon states in the maintenance of a vigorous International Atomic Energy Agency with the inspection powers and resources needed to do its job, the implementation of effective controls on the transfer of sensitive technologies, and the creation of transparency conditions conducive to building confidence that proliferation is not taking place.

Presumably, the commitment to these crucial, collective, nonproliferation efforts by states that are not potential proliferators themselves must eventually be eroded by continuing failure of the nuclear-weapon states to commit to zero nuclear weapons for everyone ... not just for everyone else.

There is, finally, a more general argument supporting the idea of linkage between a commitment to prohibition and the attainment of shorter-term nuclear-arms-control goals. It is that nuclear-weapon states' embracing the clearly defined, final goal of prohibition would invigorate the pursuit of all of the intermediate goals – deep cuts, de-alerting, and so on- by ending official support for the proposition that nuclear-weapons have purposes that will persist indefinitely. This would immediately devalue the nuclear-weapon “currency” and hasten their marginalization in world affairs.

Conclusion

Let me use the conclusion of this essay to make completely clear my own positions on some of the key points at issue in the NFWW debate. To begin, I agree with the conclusion of the 1997 National Academy of Sciences study (in the preparation of which I was much involved) that [53]

the potential benefits of comprehensive nuclear disarmament are so attractive relevant to the attendant risks - and the opportunities presented by the end of the Cold War and a range of other international trends are so compelling - that increased attention is now warranted to studying and fostering the conditions that would have to be met to make prohibition desirable and feasible.

I also find persuasive the argument in the National Academy study in favor of the term "prohibition" to describe what is being sought: it has the merit of being unambiguous, clearly achievable, and consistent with what has already been achieved in the cases of chemical and biological weapons; and it can be seen as a practical means toward the ideal end of "elimination" of nuclear weapons - an end which, as Calogero has pointed out (36), is worth pursuing even if it can only be approached "asymptotically".

I would go beyond what the National Academy group as a whole was willing to endorse, however, in arguing that the nuclear-weapon states should take the position already, today, that prohibition is *clearly* desirable under appropriate conditions, that the indefinite possession of nuclear weapons by any subset of states is *clearly* untenable, and that the nuclear-weapon states therefore commit themselves now to lead the way to achieving the conditions that will make prohibition feasible before another half century has passed. I appreciate, but find ultimately

unconvincing, the arguments that led the National Academy group, as well as the Canberra Commission and the Stimson Center Project on the Elimination of Weapons of Mass Destruction, to refrain from specifying a specific timetable. They are right to argue that the relevant variables are too many and the uncertainties too great to specify a timetable in detail. But an overall target is required to give meaning to the "unequivocal commitment" to elimination of nuclear weapons called for by the Canberra Commission (or the "serious commitment" called for by the Stimson Center group) and to give impetus to efforts to create the conditions that prohibition will require.

Any target will naturally be subject to revision - either more or less time might prove to be required - but there is at least a certain symmetry in the proposition that nuclear arsenals should be able to be built down in about the same amount of time that was used to build them up. (I proposed 2048 as the outer limit for getting to zero in a speech at the 150th anniversary conference of the American Association for the Advancement of Science in 1998 [54], where the theme was looking backwards and forwards fifty years. On the other hand, according to the Natural Resources Defense Council's tabulation [55] - the best unclassified source - global nuclear stockpiles peaked in 1986 at 69,500, declining subsequently to about half that number in 1998; if the entire build-down took only as long the build-up, 41 years, the world would be back at zero by 2027.) There is merit, in any case, in the idea that the target for achieving a prohibition should be within the lifetimes of many people now living.

In my opinion, the prohibition should include, at least, all intact nuclear weapons, all nuclear-weapon components, and all military stockpiles of directly bomb-usable nuclear

explosive materials. I do not see need or benefit in allowing "virtual" nuclear arsenals consisting of weapon components that could be minutes from assembly, except as a form of de-alerting not to be confused with a NWFW. The virtual-arsenals approach fails to deliver the nonproliferation benefits of renunciation by the nuclear-weapon states of their special status, and it fails to relieve the core moral dilemma of nuclear deterrence in the form of choosing to prepare deliberately for the mass destruction of innocents as a means for avoiding it. With respect to both these aspects, there is a crucial difference, between the form of existential deterrence that would result from the ineradicability of nuclear-weapon knowledge (which is *a state* of deterrence arising from unavoidable circumstances) and the virtual-arsenals idea (which is a form of the *practice* of deterrence); that is, knowledge-based existential deterrence is a permanent and universal condition associated with physical realities, requiring no conscious choices to maintain or exercise and not denied to some while allowed to others.

I believe it would be preferable for nuclear weapons, weapon components, and military stockpiles of directly bomb-usable nuclear-explosive materials to be banned altogether - that is, not only prohibited from possession by states but also not retained by any international organization - but I would favor allowing possession by an international agency as an interim measure, if allowing this could bring about a prohibition on possession by states earlier than would otherwise be possible. It is true that retention by an international organization would not represent as thoroughgoing a rejection of nuclear weapons and nuclear deterrence as a total ban would; but, as a way-station toward the latter, it would already achieve the nonproliferation benefit of erasing the distinction between nuclear-weapon states and the rest, and it would take a

great step toward the total delegitimization of nuclear weapons by making illegitimate their possession by states.

I think it is likely to be necessary, in order to get to and remain in a NWF, that those aspects of civilian nuclear energy systems that lend themselves too readily to nuclear-weapons production be foregone or placed under international management. The least problematic approach would probably be restricting reactors to once-through use of low-enriched uranium fuel, with the associated enrichment plants and spent-fuel storage facilities under international management. If economically competitive long-term energy sources that avoid fissile materials altogether are not available before the resources of uranium that are economically usable in once-through fuel cycles are exhausted, making recycle of plutonium appear necessary, this should be done only in internationally managed, integrated nuclear-energy centers (with reactors and reprocessing and fuel-fabrication operations all at the same site), preferably using still-to-be-developed approaches in which the plutonium would never be completely separated from fission products.

I do not think that prohibition of nuclear weapons needs to await or be followed quickly by general and complete disarmament. Nuclear weapons are in a class by themselves in relation to indiscriminate, comprehensive, long-lasting destructiveness - the only weapons now known that could plausibly destroy all of civilization. If chemical and biological weapons can be banned without waiting for general and complete disarmament - as they have been and deserved to be - then so can nuclear weapons. Of course a world that has renounced armed conflict as a means of settling disputes would offer the ultimate security against the remobilization of any of these

kinds of weapons; but even in the interim before this desideratum is achieved, the world will be better off banning nuclear weapons than continuing to permit them.

This brings us back to the question of "Compared to what?" There are real difficulties on the road to a NFWF, and real dangers at the destination. But these are to be compared not to the perfection of a hypothetical hazard-free world, but rather to the risks and difficulties of continuing to live in a world from which nuclear weapons in the possession of states have not been banned and nuclear weapons in the possession of subnational groups cannot be ruled out. Here, it must be emphasized, the proper comparison is not just with today's conditions - with the hazards of accidental, erroneous, unauthorized, or other use of nuclear weapons by any of five declared nuclear-weapon states and at least three undeclared ones - but also with the conditions likely to prevail in the future in the absence of decisive movement toward a NFWF. For the world cannot simply stay where it is. In the absence of a credible commitment by the nuclear-weapon states to relinquish this special status on a timescale of practical interest, the number of nations choosing to acquire nuclear weapons for themselves is virtually certain to grow. Whether other factors affecting the probability of nuclear weapons use will improve rapidly enough to offset the adverse influence of a larger number of nuclear weapon states - and whether these improvements will apply everywhere that nuclear weapons appear - can be doubted.

While there are a few voices arguing that a world of more nuclear-weapon states will simply be a world of more robust and more comprehensive nuclear deterrence, moreover, no one can seriously argue that such deterrence will apply to the growing threat of nuclear bombs in the

hands of terrorist and other criminal groups. That threat, which grows with the number of arsenals and bomb-material stockpiles from which criminals could obtain what they need, could well be the dominant nuclear threat in the next century; and not only is it greatly aggravated by the continued existence of national nuclear arsenals, but nuclear deterrence is likely to be useless against it (because terrorists and other criminals may not be locatable, or if locatable could not responsibly be attacked with nuclear weapons). It is therefore another reason for believing a NFWF is preferable to the alternative.

Would cheating and breakout be possible in a NFWF? They can be made improbable, but not impossible. Would the risks associated with these possibilities - that is, the consequences weighted by the probabilities - be greater than the nuclear risks the world faces today or is likely to face in the future without a NFWF? It does not seem so to me, for reasons adduced in the "dangers" section, above, reinforced by a degree of optimism about potentially helpful technological changes: the evolution of monitoring capabilities (including internet-assisted "societal verification") to improve the capacity to detect cheating or plans for breakout before they come to fruition; and the evolution of conventional-force capabilities to improve the capacity to knock out rogue nuclear capabilities before they can be used (or, at worst, before they can be used more than once). If these capabilities are seen as insufficient in the context of the other incentives and barriers to nuclear weapons acquisition, keeping a small nuclear arsenal under international control as an interim step on the way to a true NFWF should be preferable by far to the hazards of a world with multiple nuclear arsenals in the hands of states.

To those who say that it is "unimaginable" that verification of a NFWF could be good enough, or that sovereign states will ever voluntarily surrender control over nuclear weapons and nuclear-fuel-cycle facilities, I say these are failures of imagination. The rates of change in technology, in politics, and in international arrangements have been rapid in recent decades, and no one is smart enough to be able to confidently place limits on what may be achieved in a few decades more. It is entirely possible, in fact, that another decade or so of cuts in the US and Russian nuclear arsenals, de-alerting of the forces that remain, improved protection of nuclearexplosive materials, a comprehensive cut-off of military production of these, and increased transparency and monitoring to go with it all will put in place a substantial part of the technical, institutional, and political ingredients that would be needed for a NFWF. Let us find out.

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The failures of imagination that appear to afflict many opponents of a NFWF have never been a problem for Joseph Rotblat. He has been imagining the ways to bring about a NFWF for decades, and has done more than anyone living or dead to bring this vision into being. It is has been a privilege to work with him and learn from him, and it is an honor to dedicate this essay to him on the occasion of this ninetieth birthday.

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