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ABSTRACT

The current use and potential of technology for achieving security and peace are explored. Section 1 traces the use of technology for warfare through the mastery of ocean-going sailing, the maturation of the airplane, and the development of nuclear weapons. This section suggests that these developments have led to a loss rather than an increase in security. Section 2 discusses the "transparency revolution," which refers to the military reconnaissance, sensing, command, and communication systems literally wiring the earth with a web of electronic intelligence. Section 3 focuses on current military strategies: mutually assured destruction (MAD), nuclear utilization theories (NUTS), and, according to the author's personal projection, destruction-entrusted automatic devices (DEAD). The differences in these strategies are explained: to start a war in the MAD era would have required a major political misjudgment; in NUTS, a major human error; in DEAD, a major machine malfunction. Section 4 outlines elements of planetary security. It suggests that the same transparent technology now pushing superpower military competition to its most dangerous level can be used to construct an alternative security system. Section 5 promotes good neighbor politics. The final section concludes with the notion that while technology may have overwhelmed human ethical capabilities, it has not overwhelmed our passion for security. (KC)

Whole Earth Security: A Geopolitics of Peace

Daniel Deudney

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Introduction

The first photograph of humanity's home, the earth floating in the void of space, alone and fragile, has changed forever how we think about our species' interaction with the natural world and how we manage our population, resources and environment. Curiously, this new way of looking at ourselves has yet to significantly affect thinking about security. Security systems today are more appropriate to the long but now departed past when societies were isolated and only occasionally in contact with one another, rather than neighbors in a closed, crowded "lifeboat" earth.

"Lifeboat ethics," a powerful meditation on the meaning of the whole-earth picture, asks the profoundly practical question: What is minimally acceptable behavior for group survival on a lifeboat? How long can "the war of all against all" continue in a lifeboat when antagonists use hand-grenades to secure themselves against their similarly armed neighbors? The choices available in a lifeboat—and on the planet—are simple and stark: catastrophe, tyranny, a precarious stand-off or accommodation. The superpowers, hedging against the fear of world tyranny with almost unlimited resources, have produced weapons of almost unlimited destructiveness. The time has come to reduce superpower insecurity, rather than build ever smarter, more capable weapons as hedges against it.

The image of great nations becoming "Republics of Insects and Grass," the grisly visage of 30 million burn victims slowly dying without medical treatment, and political leaders seriously discussing fighting and winning a nuclear war with tens of millions of casualties have made real to many people what seemed quite abstract before. To contemplate the rising threat of nuclear war is not to indulge in apocalyptic fantasizing but to keep in focus the greatest—and entirely man-made—threat to human survival. As nuclear war has become a

I would like to thank Jack Cushman, Richard Falk, Richard Garvin, Willis Harman, William McNeill, Jay Ogilvy, Peter Scharfman, Paul Stares and Tom Wilson for reviewing the manuscript, John Pike and Wesley Warren for many hours of dialogue on these issues, and John Foggle, Susan Hill and David Macgregor for assistance in preparing this publication.

graphic possibility people have become alarmed, and, at least for the moment, nuclear armament has assumed its rightful place at the center of the political agenda.

An appreciation of the problem at its true scale— geopolitics—can provide a "big picture" chart on which to plot our escape. Since the final days of World War II, an unheralded geopolitical revolution has transformed forever the relationship between weapons and security. It has rendered obsolete the foundations of present security strategies. With the atomic bomb, the ballistic missile, and now with earth-spanning sensing, communication and computing networks, the ability to destroy, transport and target has become planetary in scale. With the advent of planetary warmaking, security strategy has been based on the militarization of the commons—the ocean depths, the atmosphere and orbital space. With the enclosure of the planet by warmaking systems, security itself has become indivisible, a commons in its own right. Common security has ceased being utopian and unnecessary and become both possible and necessary.

The same technologies of planetary information that brought us an image of the whole earth are propelling the current arms race. But these technologies could also form the core of an alternative security system. Understandably preoccupied with weapons of awesome destructiveness, we have overlooked the increasingly central role of nonweapon, sensory, communication and computing technology in the strategic balance. Applied to the task of illuminating the planetary terrain, these technologies have created a transparency revolution that is pacing progress in the whole-earth sciences and shaping the deployment of weapons like the MX, the cruise missile and the missile-firing submarine. Like scopes on a high powered rifle, these information technologies have altered the threat of existing weapons—making both sides less secure—and precipitated an entirely new arms race. At the same time, these technologies create a unique but perhaps perishable opportunity to have comprehensive, verifiable control of planetary-scale weapons.

Ironically, the technologies that make possible an alternative security system are bringing the present weapons-heavy security system to its

"The arms race only appears intractable and unsolvable because practical solutions have been rendered taboo by the prevailing—but obsolete—ways of thinking."

nost unstable and perilous state. To preserve the traditional basis of)eace—deterrence— in the face of lightning fast, absolutely accurate veapons of unlimited destructiveness, military strategies demand greatly multiplied numbers of weapons. And the authority to launch hem must be delegated to field commanders and machines. In com-)ination these changes create a fatal loss of control. Attempting to ompensate for this loss by expanding the strategic warning and ommunication system only creates the illusion, not the reality, of greater control. These technologies could help restrain the planetary-cale warmaking machines, but they will not allow the military to ight controlled war.

With these shifts in scale, the previous time-tested and time-honored ways of thinking and acting are dangerous anachronisms and blocks o improved security. In this new world the previously unthinkable— nformation exchange, limits on technological innovation and scien-ific cooperation—enhance rather than jeopardize security. The new)lanetary information technologies must be expanded, sanctified and)rotected against destruction to comprehensively verify weapons imitations. The present—and failed—efforts to control existing veapons must be supplemented with wide-ranging test bans on new weapons. And the race to discover new fundamental forces of nature ınd harness them for weapons must be replaced by "open abs"—comprehensive scientific cooperation. In addition, the vast luid realms of air, sea and space where these weapons lurk must be ystematically pacified as part of an ongoing effort to build regimes or the global commons. The arms race only appears intractable and ınsolvable because practical solutions have been rendered taboo by he prevailing—but obsolete—ways of thinking.

Strategic nuclear theory and modern weaponry are subjects of mind-numbing technical complexity and galvanizing ideological ferocity. Heated debates rage over positions that are barely distinguishable rom each other while the critical background assumptions remain ınexamined. Some weapons are scrutinized, but there is no sense of where the strategic juggernaut as a whole is headed. Lost in the ophisticated and increasingly partisan debate is the big picture, the)road outlines of this giant subject.

Without a rebirth of grand strategy resting on a new and sounder view of the underlying forces at work, the loss of proportion, perspective and direction in relations between nations will grow. Without a sound chart of the waters for the ship of state, the increasing sense of drift will engender senseless tests of will and bold moves in the wrong direction. Positive security initiatives fall outside the traditional national security sphere and so have not received the kind of attention they deserve. These measures are unexplored territory compared to the effort spent designing scenarios of confrontation or even arms control.

There are no technological fixes to the planet's security impasse, only ways to build common security. In the pursuit of security on "Spaceship Earth," there is no substitute for a realistic good neighbor policy. The scale of the American and Soviet arsenals bears no relation to the real differences between these nations, but only to the potential of modern weapons science. Unfortunately, the superpowers are dominated by illusions and misconceptions—about the nature of the competition in which they are enmeshed, about the utility of the weapons they possess, and about their control over events—that are a recipe for self-extinction. Instead of treating political conflict as a given and armament as a solution, the superpowers must seek salvation from their overmuscled arms in political reconciliation.

Fortunately for human survival, the control of nuclear armament requires neither a transformation of human nature, an abolition of the nation-state nor an outburst of universal good will. Rather, the ancient, still immensely powerful desire for security must be serviced in a more intelligent way. Since the foundations and nature of strategic power have shifted profoundly, a new strategy for security must be fashioned. The most basic and universally shared desires of both individuals and states demand that the physical powers of planetary dimension now at human disposal be used to enhance rather than jeopardize security.

Planetary Geopolitics and National Insecurity

A musty old science, geopolitics is the foundation of sound security strategy. An odd mixture of historical fact, immutable truths and

"The scale of the American and Soviet arsenals bears no relation to the real differences between these nations, but only to the potential of modern weapons science."

ıntestable judgment, geopolitics is often loftily invoked to sanctify trategies, but seldom seriously studied. In thinking of the value of ;eopolitics it is worth recalling Aristotle's observation that each body of knowledge has a level of precision appropriate to it, and that the nost important truths are not always subject to the most exact formu- ation. In our age, when precise analytical thinking dominates, even a ıasic way of looking at the world like geopolitics is in danger of ıecoming neglected—at our great peril. To grasp the true outlines of ıur security predicament in the age of nuclear weapons and space ravel, a rethinking of geopolitics is essential.[1]

At its simplest geopolitics looks at the political consequence of geog- raphy, or the relationship between territory and power, which in turn ıinges on technology's ability to traverse the terrain. Geopolitical reality is the background of geography and technology that shapes, channels and prejudices the exercise of political power in much the same way that ridges, bridges and fortifications affect armies locked n battle. They do not fully determine the outcome, but they favor different strategies and capabilities unevenly, and they set the requirements of victory. The geography of the earth, of course, does not change. But the significance of the natural features of the planet for the struggle for military dominance and security are altered by technological shifts in human ability to destroy, transport and communicate. Without a keen sense of technology geopolitics degenerates into land mysticism.

The accidental but inescapable facts of geography generate recurring events to which states must adapt to survive—events that over the centuries constitute a nation's basic history. Differences in geography explain many of the great internal differences between the United States and the Soviet Union. The natural insecurity of the Russian geopolitical situation was as formative of the Soviet state as natural security was to the United States. Lacking natural borders Russia suffered from catastrophic invasions by the Mongols in 1237, the Poles in 1609, the French in 1814, and the Germans in 1914 and 1941. On each occasion only a dogged refusal to give up, combined with the vastness of inhospitable terrain, saved the Russians. Their tra-

dition of secrecy, centralized rule, fear of dissension and over-armament is a harsh but necessary adaptation to centuries of invasion. In contrast, the American political culture's emphasis on plurality, free exchange of information and toleration of diversity is a luxury made possible by the isolation afforded by the vastness of the ocean approaches.[2]

For most of human history, civilizations rose and fell largely in isolation from each other. War was both a viable and largely inescapable way to settle disputes and divide resources. As humanity in the modern era has learned to master inanimate nature, the scale of war has changed. In an interrelated process, the power of weapons, the extent of the contested terrain and the size of the belligerents have each grown. More destructive weapons, with larger range and requiring more extensive economic resources, have expanded the minimum size of militarily viable society. The modern age has thus witnessed the progressive absorption of all the earth's surface into smaller and smaller numbers of military security blocs. These blocs have come to contest the fluid and hard-to-partition realms of common space, such as the ocean, the atmosphere and outer space, that touch on most or all countries, and whose fate is therefore of life or death concern for all peoples. Although the size of the contested terrain has dramatically expanded, the speed of transit has grown even more, making a larger but closer world. These modern shifts in the scale of war first created the era of global geopolitics, spanning roughly from the European exploration of the ocean to the end of World War II. These configurations of security have in turn been dwarfed by the atomic bomb and the opening of space, the basis of today's largely uncharted planetary geopolitic.[3]

Earth is a water world, and the globalization of military power first occurred on the oceans. Since three-quarters of the earth's surface is water, and the continents are really but large islands surrounded by ocean, ships made possible the first circumnavigation of the earth and the creation of the first global transportation and communication network. The explosive rise to world hegemony of the European nation-states between 1500 and 1900 was the product of the European mastery of ocean-going sailing technology, a mastery that eventually

"Great Britain first experienced the security problem—now at the center of superpower insecurity—posed by the fluid commons."

became largely concentrated in British hands. Needing to secure an ocean it could never annex by means of naval supremacy against all possible combinations of contenders, Great Britain first experienced the security problem—now at the center of superpower insecurity—posed by the fluid commons.[4]

The emergence of a worldwide balance of power resulted from and stimulated industrialization, the harnessing of ever greater inanimate sources of power. It was no accident that England dominated the oceans and was also the seedbed of industrial society. Before the industrial revolution—that is to say for most of history—material wealth was as much a security liability as an asset. As long as the security of even the most powerful states rested on armies engaged in hand-to-hand combat, the physical strength and courage of warriors was militarily decisive. Urban, commercial societies presented not only valuable targets for conquest and plunder, but they seldom produced warriors as fierce as societies living at the margin of survival. With the advent of inanimate sources of power, wealth more directly influenced military power, and the long cycles of conquest, decay of martial spirit and reconquest gradually ended. Even the most populous and resource-rich nations found themselves repeatedly overwhelmed by smaller countries that had industrialized. Thus, during the heyday of great-power global military struggle, a leader could accurately assess his nation's military potential by consulting steel, coal, oil and rubber production trends.[5]

By the end of the nineteenth century political thinkers recognized that most of the earth's surface had been "closed," by either the ocean-going ship or the railroad. Henceforth there would be only one balance of power and all future wars would either be world wars or related to gradual shifts in the global balance of power. The first to chart the geopolitics of this global realm was an English geographer and politician, Halford Mackinder. Looking at the globe with an eye to what he called "the big lines of the big picture," Mackinder noted that the "World Ocean," recognized since the global reconnaissance of the sixteenth century, was matched as a central figure in the earth's geography by the "World Island"—the Eurasian land mass and its "Rimland" peninsulas such as Europe, India and China—that

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together held nine-tenths of the world's population. Where geographers of the previous ocean-oriented centuries had seen the center of Eurasia as an inaccessible region where hinterlands converged, Mackinder saw that the railroad's ability to transport industrial goods over land made this area a "Heartland" occupying a pivotal strategic position in the World Island. In 1904 Mackinder foresaw an eventual struggle for control of the Rimland, and thus ultimate global hegemony, between a Heartland land power, inviolate from land attack, and a "Maritime Alliance" of outlying areas (such as England, North America, Japan and Australia) protected by the oceans.[6]

This rough global geopolitics helps explain why of all the great powers, the United States and the Soviet Union, sitting on the opposite high grounds of the global terrain, emerged from the two world wars as the only serious rivals for global hegemony. But Mackinder mistakenly expected that a few continent-spanning powers could achieve a modicum of security by rooting their defense in the most massive features of the earth's surface geography. Instead, the submarine gave the land power a relatively inexpensive tool for at least stalemating maritime power, and the airplane's ability to fly over mountains, the Arctic ice cap separating North America and central Eurasia, and the oceans diminished the defensive value of these natural features. Even more than the ocean, the atmosphere became an avenue of attack to all points on earth.[7]

Apocalyptic trepidation and utopian expectation are high whenever the horizon of military performance shifts suddenly. To visionary military thinkers of the early twentieth century, the airplane promised to radically transform—or perhaps even abolish—war. The Italian military thinker Emilio Douhet regarded the airplane as an invincible tool of war and envisioned the day when the airplane's new capabilities for destruction would make war too terrible to conduct. Another group, "air age globalists," predicted that rapid and cheap civil air transportation would knit the world together into one society, breaking down the barriers of ignorance and isolation that breed war. To emphasize the revolutionary impact of the airplane on the barriers and contours of the earth's surface, the air age globalists

"The United States and the Soviet Union, sitting at the opposite high grounds of the global terrain, emerged as the only serious rivals for global hegemony."

rafted globes that were grids of the airfields of the world super-mposed on featureless spheres.[8]

he maturation of the airplane as a tool for war deflated the extrava-ant hopes for its new role. Far from being invincible, the airplane ould be countered by other airplanes or ground fire. And though uite destructive, the airplane became accepted and widely used for ombing cities. The visions of the air age globalists were dealt a lecisive setback when the 1944 "Law of the Air" Conference in Chi-ago rejected President Roosevelt's call for an "open skies" regime. he foundation of aeronautical law, the Chicago Convention made irspace an extension of national "territory" rather than an ocean-like one of international free passage. Aircraft had almost rendered war oo terrible to wage, nearly eliminated the advantages of geography, nd made a security order built around an internationalized global ommon plausible enough for a leader to seriously propose. Common ecurity, once utopian, had become possible, but avoidable. Soon it vould become inescapable.[9]

By the end of World War II the process of globalization begun in the ifteenth century had been largely completed. The earth's land, vaters and atmosphere had been colonized by weapons. The war had been fought over much of the face of the earth: on remote seas, in leserts and junges, and in the clouds. Those areas not actually part of the battlefield were drawn into the war production effort of one or nother of the belligerents. The war had shown that the minimum ize of a militarily viable state was larger even than the largest of European powers. With the partitioning of the German Third Reich nd the Japanese Co-Prosperity Sphere, the world lay divided into wo vast alliances, one centered in Mackinder's Heartland, the other n his alliance of maritime powers, each unassailable except through a ong war of industrial attrition.[10]

ust when the international order had become organized around the lictates of global geopolitics, the invention of nuclear weapons and he opening of outer space dwarfed even the victors of the global war. The features of global geopolitics endure, but have been sup-plemented by an even more fateful planetary geopolitics. Our lan-

guage implicitly reflects this watershed event, for we speak of "superpowers"—contenders for planetary hegemony—rather than the "great powers" that vied for global dominance. With the new scale of destruction and the size of the new terrain of competition, not even the largest agglomerations of nation-states could be militarily secure. Unfortunately, the security strategies of the most powerful human societies have yet to reflect these new realities in any fundamental way. Failure to grasp the reality of the new planetary landscape perhaps accounts for the increasingly abstract and ideological character of contemporary geopolitical thinking.[11]

With nuclear explosives, the upper end of militarily useful destructive power has been reached—and passed. Today the United States and the Soviet Union have enough explosive power to wreak a World War II level of destruction every minute for two weeks—some four and a half tons of TNT equivalents for every person on the planet. Nothing in modern historical experience remotely approaches the loss of human lives likely in large-scale nuclear war. During World War II the Soviet Union lost approximately 20 million lives, or 11 percent of its population, while the United States lost a half million, or three-tenths of one percent of its population. Projections about the casualties in a nuclear war hinge on many unknowable factors, but if only 10 percent of the strategic nuclear warheads in the superpower's arsenals were delivered against each other's population centers, some 80 million Soviets and 130 million Americans would die from short-term blast effects. And unlike the cockpit of fiercest violence in previous wars, which could be reclaimed in short order upon the return of peace, the zones where multi-megation bombs were tested—places like Bikini Atoll in the Pacific and at Soviet sites in central Asia—are still too radioactive to permit human habitation. No one knows what the detonation of a large share of the superpower nuclear arsenals would do to the planet, but the destructiveness would be so massive that to find analogies scientists must study the most titanic natural events—dust clouds from volcanic eruptions, electrical storms caused by solar flares, and the impact craters from ancient asteroidal collisions.[12]

When suitcase-size devices can obliterate the largest population

"The volume of space stretching out somewhat past the moon is best thought of as a part of the planet earth."

centers and industrial complexes, the security of societies rests on the ability to avoid war rather than defend against attack. The unlimited means of destruction has ceased being useful for the limited objectives of war carried on as an extension of diplomacy. Instead of securing, weapons have become a threat to survival, and the two strongest powers on earth are the least secure and most vulnerable. Many nations with the potential to acquire nuclear weapons have avoided doing so, perhaps realizing they too would be drawn into the vortex of diminished security if they possessed them. On the other hand, those nations that field nuclear weapons, such as Britain and France, have the ability to wreak tremendous damage on countries much bigger than themselves. Indeed, a nuclear terrorist group operating with no national base or even any political agenda could kill more Americans than died in all previous wars combined. With nuclear weapons, war between the leading countries has passed from being an increasingly destructive means of resolving political disputes into what Andrei Sakharov, the inventor of the Soviet H-bomb, recently called, "collective suicide."[13]

The opening of outer space has also dwarfed the traditional land, sea and air battlefields. The key to understanding how space technology has and is likely to affect the strategic balance is the "geopolitics" of space—the topography of the "terrain" and how it shapes the contest of force there. Although outer space is infinitely vast, alien and harsh, the volume of space stretching out somewhat past the moon is best thought of as a part of the planet earth. Far from being a featureless void, space around the earth is "shaped" by the planet's gravitational, magnetic and radiation fields.

The four most telling characteristics of the geopolitics of space are its proximity to all points on earth, its empty vastness, its ascendancy over the rest of the earth and its unity. Space is so alien that it is easy to forget how close it really is. The atmosphere trails off to almost nothing within a hundred miles of the ground, meaning that space is closer to most people than they are to their national capitals. On a planet 25,000 miles in circumference, the thin smudge of gases clinging to the planet are akin to the fuzz on a peach. Though proximate, the earth's space is vast. The volume of the spatial sphere cir-

cumscribed by the moon's orbit is several tens of millions of times larger than the volume of the atmosphere.[14]

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The ascendant and integral character of space stems from the one force giving unity and shape to this empty expanse—gravity. Within the earth-moon system, the surface of the earth is at the bottom of a "gravity well" that requires great expenditures of energy to climb out of. To avoid being drawn by gravity into collision with the earth, objects must travel at least 18,000 miles per hour. The variety of paths—or orbits—determined by the interaction of the earth's pull and the satellite's inertia is almost infinite. Despite this, space cannot be divided into two or several parts. Space is like a ball of string; wrap the threads around in any pattern, but cut the ball in half and its value is lost. Attempts to rule the oceans and atmosphere have confronted limited forms of this paradox. The oceans wash the shores of most countries and the atmosphere touches all, but a ship or airplane can make use of these fluid realms without passing near the national territory of other countries. In near space, however, an object launched from one nation will inevitably and soon pass over another country.[15]

As with the oceans, space is most important as an avenue for attack. Because objects travelling through space are not slowed down or burned up by air friction, bombs can travel from the center of one superpower to the heart of another in about a half hour, creating the age of "push button," almost instantaneous war. The October 1957 launch of Sputnik is generally regarded as the beginning of the space race. But the real race began three months earlier with full-scale testing of what Stalin had dubbed his "intercontinental artillery," later used to launch Sputnik into orbit. "Sputniked" American leaders in 1957 worried most about the weight of the satellite—184 pounds—which proved that the Soviets had rockets powerful enough to hurl atomic bombs across the oceans, making the United States vulnerable as never before to a devastating attack. The United States fielded a reliable nuclear rocket force before the Soviet Union, but by opening this new terrain, the Soviets could outflank American domination of the air achieved during World War II. Reflecting these original roles, the Soviets continue to think of rockets as a kind of

"Effective control of space by one state would lead to planet-wide hegemony."

very long-range artillery, while the U.S. treats its missiles as an extension of air power.[16]

Near orbital space has also been aptly called the "high ground" of the planet. Like a hill on a battlefield or a mountain range between nations, space is both the ideal vantage point for observing, and potentially an easily defended location from which to launch an attack. Not surprisingly then, the second most important military use of space is for information-producing satellites, ranging from surveillance, navigation, communication, damage assessment and early warning. The United States benefits most from space as a vantage point because satellites provide the U.S. military with otherwise unavailable information about the extent and deployment of Soviet military forces.[17]

The first groping moves to exploit space for military advantage have decisively shaped superpower military competition for the last quarter century. But technology has not yet revealed the long-range political consequences of space's "geography." One preliminary conclusion, however, seems sound: effective control of space by one state would lead to planet-wide hegemony. Because space is at once so proximate and the planet's high ground, one country able to control space and prevent the passage of other countries' vehicles through it could effectively rule the planet. Even more than a monopoly of air or sea power, a monopoly of effective space power would be irresistible. Thus far, the difficulties in overcoming gravity and maintaining life in space have, combined with the still two-sided rivalry, obscured this potential. But as long as the military potential of space technology remains unrestrained, the political fate of space will hang like a cloud of uncertainty over the future of all independent societies on earth.[18]

With the advent of planetary-scale warmaking, links between material wealth and military power have grown more tenuous. Although the machines that stand poised to wage planetary war are individually quite expensive, their cost does not loom large either in the military budgets or gross national products of the superpowers.[19] And the technologies of planetary warfare involve such concentrations of energy and speed that they are far removed in scale

from civilian industrial relevance. One major attempt to reforge the link between military and wealth-producing technology, the "Atoms for Peace" program, has done little if nothing to fire economic revitalization.[20]

Science and technology have become so central to the contemporary strategic balance of power that the novelty of this relationship since World War II is easy to forget. New understanding of natural principles and new techniques have throughout history dramatically changed the military balance and often been stimulated by it. But only during this century, and particularly since the outbreak of World War II, have scientific discovery and new technology been systematically applied to warmaking. Although some innovations stand out, the real breakthrough was the sustained process of invention and the systems management approach needed to put the complex pieces together. The mobilization of science and the frenzied application of technology to warfare have now become permanent fixtures of superpower politics, with between a third and half of the world's scientists and engineers at work on weapons projects.[21]

The decisive encounters in a planetary-scale war could occur in very little time, reflecting the growing speeds of travel possible on the increasingly empty battlefields. Circumnavigation of the earth by ships is measured in months, by airplanes in days and by missiles in minutes. The colonization of space by directed energy weapons could culminate this trend as a terrain awesomely vast by terrestrial standards will be traversed by destructive forces travelling at the speed of light. The speed with which planetary-scale warfare would be waged has forced the superpowers to remain at a state of permanent mobilization that by traditional standards is a continuous state of war alert. Speed also makes any industrial or scientific assets that had not been previously deployed by the superpowers irrelevant to the outcome. Thus, unlike World War II, where the two largest industrial powers, the United States and the Soviet Union, came into the war largely unprepared but were able to mobilize the industrial means to win, a scientifically advanced nation like Japan would be utterly helpless today if brought into a nuclear war.

"The security of nations depends on their ability to garrison the planet's commons."

Another consequence of planetary geopolitics is that the security of nations no longer depends on forces they marshall within their own territory, but rather on their ability to garrison the planet's commons. Unlike World War I, where combat occurred on a rigidly defined battleline, or even World War II, where lines of battle were fluid and shifting, the battlefield in a war for planetary hegemony would be the entire planet. With their survival riding on access to these fluid regions beyond their real control, the superpowers are forced into a permanent position of fundamental insecurity. They face the Sisyphean security task of permanently patrolling vast regions they cannot annex.

Because of the new strategic importance of international space, border conflicts between nations that previously led to war have been eclipsed by conflicts over the borders of global commons. Although land disputes have not disappeared, they no longer have the strategic military implications for the superpowers that they once had for the great powers. A large number of international crises involving U.S. strategic forces—the U-2 incident in 1960, the *Pueblo* incident in 1968, the conflict with Libya in the Gulf of Sidra in 1982—to name a few, stem from ambiguous or conflicting interpretations of where national territory ends and international space begins. As the extension of national sovereignty 200 miles into the oceans is more widely regarded as legitimate and backed by extensive sea-bed activities, disputes will arise about overlapping claims and ownership of remote rocks and reefs. In the heavens, no upper limit on national air space exists, but this has so far been academic since the highest flying aircraft reach 110,000 feet while the lowest satellite passes at 400,000 feet—leaving a convenient buffer zone. This "no-man's land" will disappear as aerospace planes—such as the U.S. shuttle—begin to operate in orbital space as well as the atmosphere.[22]

The most fundamental lessons of planetary geopolitics are the obsolescence of security pursued only on national terms and the indivisibility of superpower security. Security that could formerly only be partially acquired by the strong in an inherently competitive environment must now be pursued cooperatively or it will elude all. The indivisibility of security in the age of planetary power reflects the

inability, short of world tyranny, for one nation alone to secure itself against nuclear explosives or to control the common determinants of security—the oceans, space and science. No single nation can control these commons because they are fluid, cannot be effectively incorporated into national territory and are not uniquely accessible to any one country. In short, security is something no nation can have without controlling the earth's commons, and no one nation can control the commons without ruling the earth. If security in the age of global power was divisible, it has become indivisible, perhaps permanently, in the age of planetary superpowers.

The Transparency Revolution

Today warmaking capability on a planetary scale is in the throes of a third upheaval—the transparency revolution—that is as far reaching as the atomic and space revolutions. It has become commonplace to observe that the superpowers are now in a qualitative, not quantitative, arms race. Yet unrecognized is that apparently piecemeal improvements in weapons performance are rooted in the application of information technologies to warmaking. Advances in information technology—sensors, communication and processing—have created a rudimentary planetary nervous system, fragments of a planetary cybernetic. At the heart of the transparency revolution is the militarization of another natural feature of the planet lying beyond the effective sovereignty of the nation-state—the electromagnetic spectrum.

The far-flung military reconnaissance, sensing, command and communication systems that have sparked the transparency revolution are a literal wiring of the earth, a planetary-scale web of electronic intelligence that alters the potency of weapons as well as the incentives for using them. This revolution has shifted the strategic balance away from the power or speed of weapons to the ability to detect and target the enemy's forces and to hide and communicate with one's own. The transparency revolution means that the traditional struggle between offensive and defensive military force has been transformed into a competition between the visible and the hidden—between

"The traditional struggle between offensive and defensive military force has been transformed into a competition between transparency and stealth."

transparency and stealth. Transparency technologies make possible both the coordinated, highly accurate targeting of weapons and the comprehensive verification of arms limits. Planetary-scale information systems bring the strategic competition between the superpowers to its least stable and most dangerous state. At the same time these systems make planetary-scale security possible for the first time in human history. Within the planetary war machine at its most advanced, unstable state may lie the embryo of a new security order.

The advances made in sensing and navigating during the last two decades are not the first time such capabilities have lagged behind destructive or transportation technologies, nor the first time they have decisively shaped geopolitical competition. The European voyages of discovery in the fifteenth and sixteenth centuries that changed forever the human perception of the earth were greatly aided by advances in sensing and mapping technology. For the first time, mariners could leave sight of land without becoming hopelessly lost. Indeed, recent historical evidence about pre-Columbian voyages to the New World by Viking, Chinese and Roman ships underscores the revolutionary importance of the Spanish and Portugese ability to find the way home, not simply to get there. Then, as now, the advances in micro-engineering—materials processing and precision mechanics—expanded the capabilities for macro-orientation. Renaissance technology—compasses that worked on rolling ships, telescopic "spy glasses" that tripled a ship captain's ability to see his immediate surroundings, and then clocks that kept time at sea—made possible the scientific conquest of global spaces.[23]

Today's transparency revolution is closely linked to the tremendous strides made over the last two decades in the sciences of the earth as a whole: oceanography, geophysics, aeronomy and astrophysics. In the last several decades, earth exploration has far surpassed in scope the European voyages of discovery in the sixteenth century. Although no new continents or oceans have been found, major features of the planet—the floating continental plates, the Van Allen radiation belts, the jet streams and the protective ozone layer—have been discovered and charted. This planetary cartography has mapped the new terrains where superpower war would be waged.[24]

The military's interest in colonizing the planetary commons has propelled the advances in these natural sciences. Before weapons can be launched into orbit or hidden securely in oceans, military planners must know more fully the natural processes that shape these vast fluid realms. And detection and tracking requires intimate and continuous knowledge of the natural phenomenon against which weapons must be distinguished. The elaborate and expensive instruments scientists use to chart these realms—oceanographic research ships, space satellites, aerial observation platforms and pressure-resistant deep sea vessels—increasingly demonstrate important military capabilities.[25]

The three information technologies that compose the transparency revolution— sensory, communication and computing—have also been driven and harnessed for military purposes. *Time* magazine's "man of the year" for 1982—the computer— has influenced preparations for strategic warfare as much as it has influenced civilian life. Computers were changed from intriguing oddities into useful devices when they were first used to process radar signals and plot bomb trajectories. Military and intelligence agencies sponsored much of the early work in computers, and the switch from vacuum tubes to transistors was driven by the military's desire to put greater computing power in the cramped nosecones of missiles. Dr. Herman Goldstine, a computer pioneer, recently observed that "The tremendous advances in radar and fire control work changed electronics from a hobby into a great industry."[26]

Today's thumbnail-size "chips" have the power of a room-size 1950 computer, but the trend toward miniaturized electronic components has by no means ended. The U.S. Defense Department is now developing very high speed integrated circuits 75 times more compact than existing microcircuits. With these new circuits, airplanes can carry computers that formerly filled whole buildings and missiles can be equipped with computers that once filled entire airplanes.[27]

At the core of the most secret and sensitive national security organizations are computers with immense memory and "number crunching" capability. The National Security Agency (NSA), the branch of

"The computer has influenced preparations for strategic warfare as much as it has influenced civilian life."

the U.S. intelligence system responsible for making and breaking codes and intercepting Soviet communications, reportedly maintains a dozen acres of the largest computers linked together to make billions of calculations per second. Known for its "vacuum cleaner" approach to intelligence, NSA maintains electronic files of every electronic signal ever recorded of the Soviet Union.[28]

No less far-reaching have been the strides in communications technology, which have traditionally shaped the balance of force. Rome's extensive road network was the indispensable nerve system of a far-flung, many-frontiered empire. Britain's control of the undersea cable network in the late nineteenth century enabled its limited fleet to deploy the right amount of force at the right place anywhere in the world ocean. Today a truly planetary-scale technology—communications satellites—connects the superpower's far-flung forces with central command centers. These satellites, first used only two decades ago, now carry two-thirds of the U.S. military's long-distance communications. The U.S. "World Wide Military Command and Control System" employs satellites, computers and ground receiving stations to provide a degree of centralized information unimaginable in the past. For most of human history, leaders learned of the outcomes of battles days after the event, and major battles were sometimes fought after treaties ending wars had been signed. But during the Vietnam War, when the first ocean-spanning satellites were in place, President Johnson personally picked out bombing targets in the morning and then saw photo reconnaissance images of the results in the evening.[29]

The raw materials for these increasingly powerful transmitters and processors are provided by sensors that detect increasingly small sources of energy—heat, light, radio waves, sound and pressure—at ever greater distances. Under ideal atmospheric conditions, some infrared sensors can detect the heat from individual human bodies hundreds of miles away and resolve objects only a few degrees different from their surroundings. Heat sensors are particularly useful because any machine with engines for propulsion—trucks, tanks, missiles or submarines—emits waste heat that makes it stand out against most backgrounds. Microwave and radar detection penetrate

the fog and clouds that foil infrared and optical sensors. The two superpowers keep the capabilities of these systems highly classified, but a far from state-of-the-art radar carried on the U.S. civilian SEASAT showed wave height differences down to a few inches from a vantage point 500 miles away through thick clouds. A major force in increasing imaging power are computers that "enhance" raw data to produce more sharply defined images. In this technique, images are reduced to dots that can then be recombined to reveal information not otherwise evident.[30]

The transparency revolution has been more successful in some planetary spaces than others. The atmosphere, orbital space and the ocean surface have been illuminated far more completely than has the earth's surface, which in turn is more transparent than the ocean depths or the earth's crust. The rate at which these realms have been unveiled has been uneven, and important, sometimes unexpected, breakthroughs have swiftly altered the "intelligence" balance of power. Each realm has its own surprises and frustrations for the technologists of planetary illumination.

Long-range detection of objects in the atmosphere by radar—sending out radio signals and then detecting echoes of the waves bouncing off distant objects—matured rapidly during World War II. Today giant radars scan vast areas of the atmosphere and near space, enabling the superpowers to monitor each other's tests, and to track aircraft, missiles and satellites. The most advanced system, the U.S. Ballistic Missile Early Warning System, scans the aerospace approaches to the North American continent for missiles and aircraft. To detect the formidable U.S. attack bomber force, the Soviet Union has deployed some 7,000 radars of all sizes, including the giant "Hen House" radars the size of two football fields set end to end. Special aircraft, known as AWACS (for Air Warning and Air Control), carry radar capable of simultaneously tracking hundreds of aircraft within 200 miles in all directions. Other systems scan near space, keeping tabs on all satellites orbiting earth. So powerful are these sensors and their support systems that the North American Aerospace Defense Command (NORAD) has tracked objects in orbit as small as an astronaut's lost glove and keeps simultaneous track of 4,500 objects in orbit.

Supplementing these radars is a system of ground-based 40-inch telescopes and infrared sensors that reportedly can see objects in earth orbit that are an inch and a half in size. Shipborne radar and electronic listening devices are also used.[31]

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To scan the earth's surface, airborne and space-based sensors provide highly detailed observation of military facilities anywhere on earth. Military aircraft were first used during World War I for reconnaissance, and today the highest, fastest flying airplanes at the the edge of technology are still spy craft. Since the mid-fifties the U-2, a glider-shaped jet aircraft that flies at altitudes of 70,000 feet (13 miles), has been the basic workhorse of U.S. aerial reconnaissance. The most advanced reconnaissance aircraft, the SR-71, known as the "blackbird" because of its black, heat-dissipating skin, flies at close to four times the speed of sound at altitudes of over 110,000 feet (21 miles) and holds the trans-continental and trans-Atlantic speed records.[32]

Because airspace is controlled both legally and—since the advent of surface-to-air missiles—practically, by the nation beneath it, near orbital space is now the favored vantage point for earth observation. Both superpowers maintain a stable of "sky spies" using optical, infrared and radar detectors, as well as active microwave and radar sensors. No exhaustive cataloging of these orbiting eyes and ears is possible here, but a few examples of U.S. technology illustrate the sophistication of these transparency technologies. From the very low earth orbit of as low as 150 miles the KH "keyhole" 11 satellites, each the size of a railroad boxcar, take detailed visible and infrared photographs of the Soviet Union. In somewhat higher orbit are weather satellites that tell the reconnaissance satellites where to peer through clouds, as well as ocean surveillance satellites. Hovering at 22,500 miles are the early warning and electronic and radar detection satellites. With an even broader vista at 70,000 miles, the Vela Hotel satellites watch for nuclear blasts. Plans are under way for even more sophisticated sensing satellites: 100-foot radar receivers, infrared detectors capable of tracking airplanes and perhaps cruise missiles, and on-board computers able to interpret the flood of data.[33]

The lithosphere—the solid mass of the earth—has also been partly illuminated by mechanical sensing devices that detect pressure, or seismic waves and vibrations. During the late fifties, when the superpowers considered an underground nuclear test ban, scientists could reliably pick out only the largest nuclear explosions against the background noise of natural earthquakes. After a large research effort, geologists learned a great deal about how pressure waves travel through rock and about their interaction with the giant plates of rock that form the earth's crust. Today a worldwide network of seismic listening stations for earthquake research doubles as a monitor for underground nuclear tests. So sensitive are these stations that in certain rock strata, activities such as oil drilling can be heard hundreds of miles away. As a legacy of the Apollo moon missions, seismic receivers on the moon continue to transmit records of moonquakes and meteorite collisions—or clandestine atomic tests.

One part of the earth traversed by weapons not yet fully "transparent" is the ocean. Electromagnetic radiation does not pass through water very well. As a result, submarines loaded with long-range ballistic missiles can hide, largely safe from preemptive attack, in the vast expanses of the ocean. The importance of opaque oceans to the stability of the balance of power would be difficult to overestimate. Long awaited, much sought and more feared breakthroughs in strategic anti-submarine warfare would be particularly troublesome for the United States because some 75 percent of its strategic warheads are deployed in submarines.[35]

Efforts to detect objects in the ocean have centered on sound, a form of mechanical energy that travels well through water. A major military research and development effort has gone into acoustic oceanography, and capabilities hardly imaginable twenty years ago are now real. The key to ocean detection is arrays of underwater "hydrophones" linked by cable or radio to centralized processing points, where increasingly powerful computers sift for the needle of a submarine "signature" in the haystack of oceanic cacophony. In a landmark 1960 experiment, sensors off Bermuda identified the sound of a depth charge detonated off Australia's Great Barrier Reef.[36]

"The importance of opaque oceans to the stability of the balance of power would be difficult to overestimate."

Nevertheless, important blind spots and weaknesses in this technology remain, particularly in shallow, rocky and turbulent waters, as Sweden recently discovered to its embarrassment when it tried to flush a small submarine out of an inlet only a few miles across. Despite limitations in acoustic detection technology, the United States has deployed vast underwater networks of microphones across critical straits and around important islands. One acoustic array stretches from Greenland, to Iceland, to Scotland, "a choke point" that the main Soviet submarine fleet must pass through to reach the open ocean. Similar top-secret underwater listening networks are said to exist at the entrance to the Mediterranean and around major naval facilities in Guam, the Azores, Hawaii and Diego Garcia. So potent is the U.S. submarine tracking system that the Soviet navy has largely withdrawn its missile-firing submarines into the protected waters of the Barents Sea, Sea of Okhotsk and under the Arctic ice pack.[37]

Will the oceans become transparent? Predicting the evolution of a complex technology so shrouded in secrecy is not easy, but transparent oceans should be achieved eventually, either through incremental improvements in acoustic detection or some entirely new technology. According to defense analyst Norman Friedman of the Hudson Institute, ".... the ultimate remote ASW [anti-submarine warfare] surveillance system will, in time, be satellite-based and employ some type of nonacoustic sensor." To expand the present regional acoustic detection barriers into a net covering the entire ocean, satellites would have to collect data from large numbers of free-floating, ship-towed and bottom-anchored hydrophones. Among the more exotic possibilities are lasers designed to penetrate sea water, super-sensitive detectors of magnetic anomolies caused by submarines' metal hulls and satellite sensing of extremely slight alterations in ocean heat layers caused by passing submarines. Soviet researchers are even said to have an active program of psychic detection.[38]

Over the last decade, the harnessing of information technology to military tasks has emerged as the principal driving force in the evolution of weapons design and the shaping of the strategic balance. This

has happened in three ways. First, some weapons have been given new potency through sensing and computing technology. Second, other weapons caught in the inescapable glare of transparency—and hence assured of targeting and destruction—have been rendered militarily obsolete. Third, designers have increasingly sought to make smaller, more mobile and harder-to-detect weapons to hide them from the expanding transparency revolution.

Although the transparency technologies are not themselves weapons, they act as "force multipliers" to dramatically amplify the potency of some weapons. Information technologies are harmless in themselves, but make weapons evermore deadly. Accurately sighting a target, guiding a weapon to it and then performing damage assessment greatly reduces the number of weapons needed to destroy a given target. The newest large missiles in the superpowers' inventories can land within a few hundred feet of their targets after flying intercontinental distances. These missiles are a thousand times more accurate than the first long-range rocket, the Nazi's V-2, an increase about as great as early nuclear bombs over conventional explosives. Soon extreme accuracies will become the rule rather than the exception as the superpowers put into orbit almost identical networks of navigation satellites. These systems, NAVSTAR and GLONASS, will enable submarine-fired missiles to become nearly as accurate as those fired from land and will improve the accuracy of weapons launched by aircraft, ships and ground forces. In short, the application of transparency technologies and planetary cartography has brought about the fast-approaching world of "absolute" accuracy. This improvement in accuracy has yielded weapons so much more potent that the United States has reduced the aggregate explosive power of its nuclear arsenal to half the level it was during the early sixties.[39]

On the conventional battlefield, these transparency technologies have ushered in the age of precision warfare. Fighting between Israel and Syria in Lebanon in 1982 indicates how sensory, communication and computing technologies can be combined to affect the outcome of battle. Israel's fighter planes, provided by the United States, have roughly the same performance characteristics as Syria's, provided by the Soviet Union. Yet in several days of intense aerial combat and

precision bombardment, Israel shot down 80 Syrian planes and destroyed several dozen surface-to-air missile batteries, while not losing any fighter aircraft. The keys to this one-sided outcome from comparable weapons were Israel's use of airborne radar-equipped command centers to provide overall direction to its forces, drone aircraft for reconnaissance and electronic jamming, and munitions made extremely accurate through the use of miniaturized laser sensors and computers. For the future, the U.S. Army's "AirLand 2000" study envisions a "swirling battlefield" where fixed fronts will disappear and where any object that can be located can almost immediately be destroyed. These applications of transparency technologies to the conventional battlefield only hint at the transformation in the strategic, planetary battlefield that is now under way.[40]

Advances in mapping, sensing and information processing technologies also account for the cruise missile's phoenix-like return to prominence in the strategic equation. Essentially a small drone aircraft, the cruise missile first appeared as the German V-1 "buzz-bomb" in World War II, but guidance difficulties held back the technology. The cruise missile's new role as a strategic weapon is in large part due to new guidance technology, rooted in satellite sensing and microelectronics. The brain of the new long-range cruise missile is a guidance system called TERCOM (for Terrain Contour Mapping) allowing missiles to fly thousands of miles at tree-top level with a 50 percent chance of landing within two hundred feet of a target. As the missile flies along, it periodically scans the terrain below, comparing the image to an electronically "memorized" map of the terrain. Costing a billion dollars to prepare, the TERCOM set of maps is the most expensive ever devised. The Defense Mapping Agency employs satellites to obtain detailed maps of vast stretches of the Soviet interior. The multiplication in numbers of warheads in the eighties will be largely due to the superpower plans to mount thousands of long-range cruise missiles on submarines, surface ships, aircraft and mobile trucks.[41]

As strategic weapons have been made far more accurate and thus militarily capable, the fixed-basing of weapons has become increasingly obsolete. Perhaps the most dramatic impact of the transparency.

revolution on the present military balance of power is the obsolescence of land-based intercontinental ballistic missiles. Because of ranging and targeting technology, the accuracy of intercontinental ballistic missiles has now reached the point where even the most "hardened" facilities are vulnerable. Not only can missiles in underground silos of steel-reinforced concrete be destroyed, but command centers deep undergound also can be destroyed. No fixed, locatable object—no matter how well fortified—is more than a half hour away from destruction by nuclear attack. This vulnerability—shared by the Soviets—is what various MX basing schemes such as President Carter's proposed "shell game" or President Reagan's "dense pack" have sought—unsuccessfully—to eliminate.[42]

The growing superpower reliance on planetary information systems also makes first strikes more tempting in crisis situations. Much attention has rightly been given to the way multiple warhead missiles cause such crisis instability, but the fragility of transparency technologies has received little attention. Of all the superpowers' strategic assets, the transparency technologies are the most vulnerable and quick to deteriorate. The sensors themselves are easily smashed or blinded and the links to processing centers and users are easily severed. Nor will the "background" against which sensors must detect be normal in wartime. Surviving sonar systems will be deafened by "blue-out"—the reverberation of nuclear explosions through the oceans. Infrared, optical and radar systems will be unable to detect objects amid the maelstrom of fire, dust and electrical turbulence. Missile guidance systems are also likely to deteriorate in such environments. Such systems will be of greatest advantage to the side that strikes first and uses them while they are intact.[43]

As the transparency revolution has unfolded, weapons scientists have sought techniques of deception, less visible "stealth" weapons and weapons tailored to destroy sensors. The inception of radar in World War II spawned immediate efforts to deceive and confuse it with chaff, propagation of false images and jammers. These techniques of "electronic warfare" were decisive in the Allied bombardment of Germany, the air war over North Vietnam and the Egypt-Israeli war in 1973. American bombers and submarines carry

"U.S. leadership in both the transparency technologies of finding and hiding seldom appears on standard comparisons of strategic strength."

special missiles and torpedoes that generate false electronic and acoustic "signatures." Stealth is the old practice of camouflage extended across the electromagnetic spectrum. Cruise missiles are favored because they present a radar image one two-hundredth that of a heavy bomber. An elaborate attempt to make stealth submarines by engineering vibrationless machinery has yielded ever quieter and thus less acoustically visible ships. And the as yet unveiled "stealth bomber" will reportedly be covered with radar wave absorbing paint and sculpted to minimize the sharp angles that reflect radar waves. At the frontier of anti-transparency research are directed energy weapons—lasers and particle beams—that seem well-suited to blinding energy-sensitive sensors.[44]

As the competition between transparency and stealth comes to determine the strategic balance, the numbers and size of weapons become a less reliable indicator of strength than in the past. U.S. leadership in both the transparency technologies of finding and hiding seldom appears on standard comparisons of strategic strength, and this leadership helps explain why the United States maintains parity with fewer weapons and superiority with equal numbers. In the oceans, for example, the Soviet Union has more attack submarines than the United States, but American submarines have a significant stealth advantage—they are quieter. And American submarines have better ears—passive sonar. Thus, American submarines can detect Soviet submarines at four times the distance that Soviet submarines can detect American ones—a decisive advantage in submarine warfare.[45]

Looking at transparency technologies as the center of superpower strategic competition, it is no surprise that some of the most explosive crisis situations of the cold war have resulted from attacks on sensory platforms—particularly aircraft and ships—in legally ambiguous or overtly provocative situations. Throughout the fifties, superpower tensions were kept on edge as the United States flew groups of bombers into Soviet airspace to trigger air defense radars. Sometimes, when the Soviets shot down these planes, the United States would maintain that they had been attacked over Allied airspace—fanning the public view of Soviet aggressiveness. When a U-2 high altitude

reconnaissance craft was shot down deep inside the Soviet Union and the pilot captured, an international crisis ensued and the 1960 summit between Eisenhower and Khrushchev was cancelled. In 1965 the vessels whose attack by North Vietnam prompted the Gulf of Tonkin Resolution were collecting electronic intelligence, as was the *Pueblo*, seized off North Korea in 1968. And Soviet forces went on their first worldwide "red alert" since World War II when a U-2 reconnaissance plane unintentionally strayed over Soviet air space during the 1962 Cuban missile crisis. The Archduke Francis Ferdinand of World War III may well be a vital aerial or low-orbit sensory platform shot down in some ambiguous situation during a superpower crisis.[46]

Military Strategy on the New Terrain

The ancient Greeks believed that a human possessed of divine powers would be driven first to madness and then to self-destruction. The modern nuclear commander-in-chief, equipped with an arsenal of lightning bolts that would have made Zeus green with envy, faces a similar tragic fate. Unable to relate weapon improvements to increased national security, military officials responsible for actual deployments have been forced to embrace increasingly—and self-proclaimed—crazy doctrines in order to avoid a holocaust. As the scale of military force becomes unhinged from political objectives, strategy becomes merely a rationalization of weapons capability. With each wave of technological "improvement" security planning becomes more volatile, more contradictory and more transparently mad.

First, in response to the atomic revolution, came Mutually Assured Destruction (MAD). Then, to cope with the new versatility and quickness of nuclear strike forces, have come today's Nuclear Utilization Theories (NUTS). Looking ahead, the application of transparency technologies to the strategic forces will increasingly require delegation of decision making to machines—the least stable prelude to planetary self-immolation. The acronyms MAD and NUTS were coined by analysts trying to discredit the deterrence and warfighting approaches to nuclear strategy. Nevertheless, these terms have be-

"As the scale of military force becomes unhinged from political objectives, strategy becomes merely a rationalization of weapons capability."

come the currency of discussion even among adherents of these doctrines—a powerful testament to the hopelessness and irrationality underlying national defense in the age of planetary warfare.[47]

Under the all too revealing acronym of MAD, the deterrence theory of nuclear weapons has dominated the atomic age, providing a touchstone for the construction and deployment of weapons. Compared even to the unprecedented destruction caused by aerial bombardment in World War II, the nuclear bomb seemed to be an "absolute weapon" that rendered its use "unthinkable." Faced with the awesome destructive power of atomic weapons, strategists realized that the only sane military use for such weapons would be to deter their use. "Peace," in the words of Winston Churchill, "would henceforth be the sturdy child of terror. . . ." Although "assured destruction" blurs the inescapably absolute character of atomic weapons with an unconscionable legitimization of genocidal war planning, "mutual" is a first recognition that unilateral security is obsolete.[48]

Deterrence may be a sound doctrine for determining what to do with nuclear weapons—nothing—but it is silent about the value of new technologies or the arms race itself. The technology of planetary warmaking, of course, did not stop evolving with the invention of the atom bomb. Miniaturized thermonuclear devices and rapid-fire ballistic missiles gave military commanders an apparent alternative to complete destruction and a way to once again use weapons for limited, coercive purposes. As weapons became faster and more accurate, a surprise attack against an opponent's weapons became increasingly plausible. To ensure that a worst-case surprise attack would not limit the ability to retaliate and thus deter an attacker, forces had to be multiplied and dispersed, and detailed plans had to be devised for using the weapons. Information technologies that provide accurate targeting data have also played a role in this shift from the "city-busting" war plans of the fifties to the "counterforce" strategies of the seventies. Thus, the doctrine of mutually assured destruction gradually became supplemented, and then supplanted, by nuclear utilization theories and strategies—known among nuclear strategists as NUT or NUTS.[49]

Herman Kahn, a founder of the Hudson Institute, inaugurated the NUTS era when he dared to "think the unthinkable," and then proceeded to lay out 44 discrete "rungs on the escalatory ladder." Planning for limited nuclear war, protracted nuclear war and preemptive nuclear war are all examples of NUTS. The recent widely publicized and highly controversial statements by the Reagan administration about fighting nuclear war are at the same time a logical outgrowth and complete contradiction of MAD. With the current generation of weapons, securing deterrence seems to require a willingness to plan for a protracted nuclear war.[50]

Central to the use of nuclear weapons in anything but a spasm of complete destruction is the ability to exercise precise control over dispersed nuclear forces once war is under way. But human psychology and technical limitations make it unlikely that a nuclear war will remain either controlled or limited. Once nuclear bombs begin exploding the most basic and irrational fears—terror, self-preservation and revenge—are likely to overtake even the most well-informed leader. Keeping command centers operating and lines of communication open against a determined opponent also presents extreme, perhaps insurmountable difficulties. Because the most militarily valuable and vulnerable target is the command and control system, leaders of the superpowers seeking to limit an exchange and arrange a cease-fire after the shooting starts will almost certainly find the means of communication destroyed or severely degraded. And once mobile and dispersed forces are out of contact with national leaders, these forces are likely to slide to the lowest rung in their target ladder—cities and industrial centers.[51]

Perhaps most disastrous, control will be increasingly lost as the communication system becomes more sophisticated. To wage nuclear war and keep tabs on dispersed forces, the superpowers have invested heavily in recent years in what the military calls C^3 ("C cubed"), for "command, communication and control." As so often happens in contemporary strategic thinking, the acronym has become a substitute for thought. C^3 mixes together two very different ideas—the expansion of data channels and human ability to meaningfully command and control. The multiplication of options, the expansion of communication contacts, and the availability of infor-

"C^3 mixes together two very different ideas—the expansion of data channels and human ability to meaningfully command and control."

mation as events are happening reduces rather than expands control of the far-flung war machine. Unfortunately, interposing increasingly sophisticated computers between human operators and smarter, more versatile weapons provides the illusion, not the reality of control. Instead, the sheer complexity of expanded communications systems is likely to overwhelm meaningful control.[52]

This paradox was revealed by the first global communications network—the telegraphs and submarine cables of the late nineteenth century—used to manage military forces in the far-flung British empire. Like the satellite-computer-sensor networks of today, the cables were widely seen as enhancing the ability of officials in London to better control far-away events. However, in a detailed analysis of the British Colonial Office, historian R. V. Kubicek concluded that the new communications technologies ". . . intensified involvement but denied its corollary, control." Events of local character could quickly become global incidents that precipitated global crises, and local administrators could manipulate resources and support from those at the center of the network by dispatching alarming reports. In a nuclear war, where the "fog of war" would be much greater and the forces to direct far more numerous, dispersed and deadly, a single nuclear unit deviating from a controlled escalation or cease-fire plan could make the difference between a "limited" nuclear war of World War II proportions and the self-destruction of civilization. Surely unsettling is the example of the Mayaguez crisis, often cited as a model of C^3 effectiveness in military literature, where bombing runs against mainland Cambodian targets were launched a half hour after President Ford ordered an end to strikes. NUTS makes war more likely in exchange for a largely illusory ability to control wars once they have begun.[53]

Control will be increasingly lost as the further miniaturization, multiplication and dispersal of nuclear warheads makes accidental detonation or theft more likely. To preserve a retaliatory capability in an era of highly accurate, almost instantaneous nuclear strike forces, a country must field more and more weapons. The destruction of 95 percent of a nation's nuclear forces in a surprise attack is surely a more grievous blow when 2,000 weapons have been deployed than when

20,000 are available. Part of the appeal of the long-range cruise missile is that it can greatly—and cheaply—multiply both the number of warheads and the number of launching platforms. This approach has grave risks, since the "leakage" of nuclear weapons and the chance for accidents grow in some rough proportion to their total number. An inventory and security system that is 99.9 percent effective still leaves an imposing nuclear arsenal unaccounted for on any given day if the arsenal includes 20,000 weapons. Furthermore, as the weapons become more dispersed and mobile, diversion by third forces, mutiny or unauthorized launch become easier to accomplish and harder to detect and reverse.[54]

The speed with which strategic nuclear war would occur and the need to deploy mobile weapons in evermore exotic environments have also gradually eroded tight civilian control over nuclear weapons. At the beginning of the nuclear arms race, the U.S. and Soviet governments made sure that civilians, rather than the military, had physical control over nuclear weapons. The Atomic Energy Commision in the United States and the KGB in the Soviet Union were entrusted with this critical guardian role. Bombs were separated from delivery systems and joining them required explicit civilian authority. Today various electronic codes have replaced this physical separation. (Apparently more skeptical of the loyalty of the military and the effectiveness of electronic controls, the Soviets maintain their forces on a much tighter leash and on much lower alert status than does the United States.)[55]

What doctrines and military strategies will emerge as planners adapt to the realities of the transparency revolution? Confronted with detection, targetability and speed approaching the absolute, planners hedging against surprise attack will be forced to entrust the command of weapons to automatic devices and to delegate authority to use weapons to dispersed military command centers. In the tradition of strategic warfare acronym coining, I foresee the emergence of a new doctrine—destruction-entrusted automatic devices (DEAD). Self-directed strategic weapons will constitute doomsday-entrusted automatic devices. Just as the transparency revolution concerns the cybernetic function, so too DEAD strategies involve evolution in the

"As the weapons become more dispersed and mobile, diversion by third forces, mutiny or unauthorized launch become easier to accomplish and harder to detect and reverse."

command and control of nuclear weapons. The loss of control, the unplanned but inevitable flaw in NUTS, will be explicit and intentional with DEAD. As with MAD and NUTS, technological advance is the driving force toward DEAD. Military leaders are now only reluctantly adopting its logic, but a quick look at several controversial new weapons will show how DEAD is inexorably emerging in response to the strategic imperatives of the transparency revolution.[56]

Perhaps the most widely discussed strategem involving DEAD is "launch on warning." As the chances for destroying even the most hardened missile silos grow in probable success, the superpowers are strongly tempted to prepare launching the vulnerable missiles before the barrage of attacking warheads arrive. With between 15 and 30 minutes warning and response time for intercontinental ballistic missiles, the civilian leadership is, as they say in Pentagon jargon, "out of the decision loop." In simple terms, military leaders would have the authority as well as the ability to fire a salvo of nuclear missiles in response to radar and computer images of attack. Thus far neither the United States nor the Soviet Union has adopted—at least publicly—a launch on warning strategy, although U.S. military planners speak of such a posture to make the MX "survivable." Soviet leaders have threatened to place their forces on such hair-trigger alert if NATO deploys the Pershing II missile, capable of striking hardened targets deep within the Soviet Union in five to eight minutes. "Speed," observes U.S. Defense Department official Fred Iklé, "is the tightening noose around our neck."[57]

To shoot down on-coming nuclear missiles, and not simply retaliate, control would have to pass out of human hands altogether and be delegated to machines. The need for this evolution in strategy was perceived as early as the late sixties when the United States, after acrimonious internal debate, decided to build a limited anti-ballistic missile system. At the time, critics of the plan pointed out that the nuclear anti-missiles would have to be fired without Presidential authorization and, in the case of close-range "terminal defense," without human intervention. The superpowers agreed not to deploy missile defenses in the Anti-Ballistic Missile Treaty of 1972, but the

recent vulnerability of land-based missiles, combined with hopes for space-based lasers, has revived interest in anti-missile technology.[58]

Before a network of space-based battle stations equipped with either small missiles or energy beams able to shoot down attacking missiles could be deployed, enormous, probably insurmountable technical, financial and strategic obstacles have to be overcome. But one thing is clear: such a system must have an automatic control system. Speaking to a Congressional committee investigating lasers, Dr. George Millburn, a research analyst in the U.S. Department of Defense, observed that, "We would have to delegate the decision making to the weapon system itself and we have had no experience in that type of operational system." With less than five minutes for the space battle stations to detect, target and engage a launched missile, humans would be relegated to passive observers—and perhaps victims—by an autonomous system.[59]

Another DEAD strategy that may gain appeal as the transparency revolution on earth moves toward completion is the placement of nuclear weapons in deep space. General Bernard Schriever, long-time head of Advanced Space Programs for the U.S. Air Force and known informally in U.S. defense circles as the "General of Outer Space," has proposed—and prophesied—such an ultimate deterrent. In the vastness of space beyond the immediate vicinity of the earth, weapons could be hidden, safe from preemptive attack. Such weapons would be programmed to return to earth and land on preselected enemy targets. Their return to earth could be triggered either by a positive command or a failure to receive periodic "stay the course" messages. Thus, a surprise attacker's destruction would be more assured as his assault became more encompassing. Such a scheme attempts to "outflank" the closure of the earth and the transparency revolution by opening interplanetary space to weapons deployment. The loss of control in such schemes is precisely the appeal—and the peril.[60]

Dispersed nuclear forces and the need for quick, controlled reaction have made "human engineering" critical. Submarine officers and missile launch crews undergo elaborate psychological screening pro-

"Military planners envision 'brilliant' weapons capable of targeting themselves."

cedures in the hope that they will not fire their weapons unless authorized and will "release" them—and thus kill millions of people—when commanded to do so. And on the automated conventional battlefield, extreme speeds, mobility and accuracy of firepower make human performance the limiting factor. Pilots and tank crews train in evermore realistic simulators to substitute conditioned response for the natural but fatal pause for reflection in a complex situation or for terror at the noise, speed and havoc. One U.S. Department of Defense psychologist notes that the mind-set necessary for the automatic battlefield will resemble that needed to survive torture as a prisioner of war. To maintain peak performance and motivation in such daunting environs, military psychologists are mining the "human potential movement"—Transcendental Meditation, EST and psychoactive drugs. Military pilots and electronics officers may be among the first to receive direct brain-machine connections.[61]

Efforts to robotize humans have been paralleled by attempts to make machines more flexible and autonomous. "Smart" weapons, such as the Exocet missiles used in the Falklands war, already can locate a target and hone in with devastating effectiveness. As sensors improve and the amount of computing power contained in a missile nosecone grows, military planners envision "brilliant" weapons capable of targeting themselves. Launched in the general direction of an enemy that may well be hundreds of miles "over the horizon," a brilliant weapon could pick out and strike a moving target such as a tank, aircraft or missile. Mines, long used in naval warfare, are growing more sophisticated, and may soon be placed in space. Autonomous weapons are also attractive as the links to controllers become vulnerable to various forms of electromagnetic jamming.[62]

Four decades of technological innovation in the implements of planetary warfare have intensified, not repealed, the obsolescence of traditional national security. In the vain hope of closing the gap between the imperatives of planetary geopolitics and the aspirations for national security, the superpowers have opened a gap between mechanical intelligence and human intent. With each successive stage of technological "progress" the difference between defensive and

offensive activities, between peacetime mobilization and all-out war, has shrunk—as has the margin of allowable error. With MAD, defense required the maintenance of forces able to deter, with NUTS, to fight and with DEAD, to initiate nuclear wars. To start a nuclear war in the MAD era would have required a major political misjudgment, in NUTS, a major human error, and in DEAD, a major machine malfunction. Within less than a century the world has passed from an era where weapons could plausibly secure nations to one where they are passing out of human control.

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Elements of Planetary Security

The same transparency technologies now pushing the superpower military competition to its most dangerous level can be used to construct an alternative security system. A new security system does not require the abolition of nation-states or the formation of a world government. Instead, the superpowers must take seriously the lesson of planetary geopolitics—that superpower security is now indivisible and beyond the unilateral attainment of any one country—and mutually regulate their common threat. Arms buildups has failed to improve security because weapons innovation can intensify—but not repeal—the basic lessons of planetary geopolitics. Similarly, arms control has failed because the real locus of strategic competition—science and technology, information and the commons—has been ignored or treated as incidental. Security can be enhanced, and the way paved to reduce existing arsenals, by four steps: a new, more open information order, limits on weapons innovation, cooperative science and the pacification of the commons.

"It is easy," observed Aesop, "to recommend impossible remedies." The four elements of planetary security are neither a comprehensive blueprint nor a cure-all. They are elements of an alternative security system more narrow in scope than world government, but broader than traditional arms control. Building a new security system will require long-term changes in direction. Yet some of the first steps toward an alternative security system, such as submarine sanctuaries, missile flight bans, cooperative space ventures and controls on

"With MAD, defense required the maintenance of forces able to deter, with NUTS, to fight and with DEAD, to initiate nuclear wars."

weapons in space, are easy-to-implement solutions to some of the superpowers' most pressing security problems.

One obvious path to a new security system would be a world government matched to the scale of technologically attainable security. Yet this solution has the potential for world tyranny and oppression. As Richard Falk recently observed, "A world superstate would almost necessarily have to be highly repressive." The sovereignty of nations is a guard against world tyranny, just as individual sovereignty limits the power of the state. The task, then, is to find a guarantee against the use of planetary-scale weapons without having a worldwide police force. The choice need not be between a totally ordered or totally destroyed planet. A new security system should be a middle ground between tyranny of a world regime and unrestrained military competition of leading states.[63]

Although a new security system would require the regulation of the largest-scale systems of human creation, this could be done within a minimalist world order. A new security system need cover only those problems that are irreducibly planetary in scale, not the host of critical but smaller-scale problems of local or regional origin. Problems that affect everyone are not necessarily global or planetary. To return to the lifeboat analogy, the current global debate focuses on matters such as seating arrangement, provisions and neighborhood quarrels, rather than the two superpowers building bigger bombs at either end of the boat.[64]

Nor would a new planetary security system require "world federalism" or a "preferred world order." World federalism is an attempt to check the centralizing tendencies of a world state with a legal-judicial order that preserves pluralistic representation. This republican principle would certainly be preferable if a world state were inevitable. But world federalists have never convincingly shown how principles of acceptable representation can be fashioned or how the system would guarantee against bureaucratic tyranny or military control. A world federalist state requires a high degree of homogeneity among its constituents and a shared experience of republican civic practices, neither of which is in sight. And by requiring states to delegate their

sovereignty, the task of getting from here to there is made all the more impossible. World federalism could even generate political conflict as it invariably drifts into redistributing things that are not necessarily common, as the United Nations has tended to do. The most frequently proposed world orders embrace resource, food, environmental and cultural dimensions. Such universal harmonics involve a mixture of things common and uncommon, but this mixing can be an obstacle to problem solving. Problems that people everywhere are struggling with, and that can best be solved at their level of origin, instead become part of a thoroughly over-burdened worldwide agenda. These problems need more attention but do not have to be solved at a global level to have a planetary security system.[65]

Traditional arms control, on the other hand, suffers from the opposite flaw of insufficient breadth. The piecemeal approach to arms control practiced over the last two decades has failed, glaringly. Today the superpowers have more of every significant kind of weapon than before, and many types of weapons that did not exist before. Arms control negotiators have limited what is most visible and politically unpopular—atmospheric nuclear tests and nuclear anti-ballistic missile batteries around cities—while the evolution of offensive nuclear strike forces remains largely unaffected. More damningly, the arms control process has accelerated the innovation of more deadly weapons by closing off "wasteful," that is to say, militarily ineffective, channels of spending. The arms control process has rationalized, not retarded, arms innovation by closing off blind alleys and eliminating inefficiencies typical of most large-scale human endeavors. The arms control process has also stimulated weapons innovation by encouraging the search for new "bargaining chips" to be traded off at the next round of negotiations. Less able to express itself with quantitative growth, the military turned with renewed vigor to qualitative growth and to areas of weapons technology beyond the existing, restraining treaties. Superpower arms control to date is like treating an infection with just enough antibiotics to make the grosser symptoms disappear, soothing the patient's worries, but driving the remaining, now strengthened contagions into more vital, less accessible organs.[66]

"The arms control process has rationalized, not retarded, arms innovation by closing off blind alleys and eliminating inefficiencies."

Why this dismal record? Basically, the superpowers have not sought comprehensive controls and have not sought to fashion an alternative security system. Arms control has been piecemeal and reactive, an addendum to, rather than the centerpiece of, security strategy. The superpowers have as much sought to stabilize and refine nuclear weapons as tools and instruments of foreign policy as to reduce them. The result has been more refined, differentiated and streamlined weapons, and less security. All the innovation has not altered the basic fact that nuclear weapons are largely useless. The superpowers have refused to embrace comprehensive controls, controls that go to the root of the problem, because leaders still expect that the next round of innovation will somehow yield an advantage that can be exploited for political gain.[67]

At first glance a more comprehensive approach to arms limitation would seem to suffer from a fatal flaw: complexity. But the inherent complexity of weapons technology is not what has undermined arms negotiations. Rather, the superpowers have pursued several—and conflicting—objectives. Most arms negotiating proposals set forth by the superpowers have been fairly transparent attempts to gain advantage by constraining only weapons the opponent enjoys a lead in. Such negotiating postures, intended primarily as propaganda, lead nowhere. Even when the superpowers accept a principle of mutual advantage and negotiate seriously, they have typically sought treaties with loopholes for continued innovation in armaments (euphemistically called "modernization"). These loopholes make for longer negotiations, more complex agreements and ambiguous verification. SALT II is the most famous mutant offspring of such dual agendas. For example, to modernize missile forces, the superpowers agreed that one type of "new" missile would be allowed. Defining when a missile was "new" rather than an improved version of an older model in such a way that verification could be assured has proved complex and ambiguous. Ironically, those who most loudly demanded room for modernization in SALT most adamantly insist that the treaty cannot be verified.[68]

Reducing weapons while preserving national sovereignty will require the creation of an alternative security system. For even when

weapons no longer provide security, nations are unlikely to disarm unless some alternative exists. The same powers and terrains that now threaten can be reorganized to secure, something that was partly recognized at the beginning of the atomic age. Since their creation nuclear weapons obviously challenged the system of national military rivalry that had given them birth. Realizing that another catastrophic war could be avoided only by bold new approaches to these larger than life forces, American leaders advanced two visionary ideas: the Baruch Plan to internationalize atomic energy and the "Atoms for Peace" plan to harness the power of the atom to remove want as a cause of war. The Baruch Plan floundered on mutual suspicion and the peaceful atom's cornucopia proved illusive, but the basic thrust of these initiatives—transnational institutions to harness planetary-scale forces, terrains and technologies for peaceful purposes—remains sound. Ironically, the second technology of planetary-scale warfare, the rocket, was harnessed for war and national competition with little hesitation, even though it could have been easily internationalized and dedicated to peaceful purposes. After all, promoting mutual understanding through planetary-scale information and defusing confrontation through space ventures is far more realistic than eliminating the causes of war with abundant energy.[69]

Planetary-scale information technologies could be the centerpiece of a new security system. There is a vital need for the superpowers to begin thinking about alternative information regimes and the effect they could have on their security. An effort by several nations in the United Nations to define the possible contribution of an International Satellite Monitoring Agency is the one international attempt to think practically about an alternative information order, but the superpowers have vigorously opposed even a study and have refused to participate in it. Ideally, a more open international information order should be constructed. At the same time, the strategic importance of information technologies means that a more open information order is not as simple as it might seem. Secrecy in some areas now generates far more insecurity for those who are kept in the dark by it than security for those who practice it. But the technologies of remote information acquisition are so powerful and have stripped away so much secrecy that some of the remaining secrets are very critical to

"Verification, never a blanket proposition, is rather like fishing with a net: how big and numerous are the objects one is trying to catch and how fine is the mesh?"

the stability of the present stand-off. Suddenly turning up the lights could be as dangerous as turning them all off.[70]

The central role that information must play in the construction of an alternative security system is reflected in the primary role that "verification" has played in the arms control talks of the superpowers. To verify a treaty means that cheating can be observed with sufficient assurance. Verification, never a blanket proposition, is rather like fishing with a net: how big and numerous are the objects one is trying to catch and how fine is the mesh? Techniques of verification fall into three broad classes: remote observation, on-site observation by mechanical means and human on-site inspection. These three means of verification are complements, not substitutes for each other. The techniques of remote observation—by satellite, seismic stations and aerial platforms, are the most highly developed. They are the principal means used by the superpowers to verify the nuclear test ban treaty, the nonproliferation treaty and the strategic arms limitation treaties. They are also the most important, for they alone detect sites of interest for on-site inspection. A great deal of attention is paid to the need for on-site inspection, particularly in the United States. However, on-site inspection of strategic weapons would yield little that is unobtainable by remote observation unless it were allowed everywhere. Furthermore, many of the benefits touted for on-site inspection come only from examining the inner workings of weapons. However, if innovation makes weapons of intercontinental range smaller, a more elaborate monitoring capability—either more sophisticated remote sensing or extensive on-site inspection—will be required to control them.[71]

Satellites, the key technology used for verification, are also important sources of targeting and warfighting information. This dual role helps explain why the superpowers tend to seek weapons that are less targetable—and thus less verifiable. A cynic might suggest that the military's enthusiasm for the cruise missile reflects a desire to build a weapon that no one can take away. But an indisputable appeal of the cruise missile is the difficulty with which it can be located and targeted. The recent support given by the U.S. Commission on Strategic Forces (the Scowcroft Commission) to a small mobile ICBM, dubbed

the Midgetman, is the most recent example of playing verification and warfighting ability against each other. In the late sixties the United States feared that the Soviets were about to test the SS-16, a small (by Soviet standards) mobile ICBM, whose numbers could not confidently be verified. The Soviet agreement not to test such a weapon was considered a major accomplishment of SALT I. Now that the Soviets too use satellite verification technology to target American ICBMs, strategic analysts in the United States are enthusiastic about building such an untargetable, and thus, unverifiable, Midgetman. As long as the act of detecting and locating is a key link in the act of destruction, verification may be losing the race against weapons innovation. Perhaps the only escape from this dilemma is to abolish all ICBMs and revert to bomber airplanes.[72]

A major obstacle to a more open information order is the Soviet's obsessive secrecy. What have been the costs and benefits of Soviet secrecy? The Soviets have a long history of promulgating various forms of disinformation. For example, the Soviet Union seldom provided maps of its country, and those available were filled with deliberate inaccuracies. The West regards this as a sign of Soviet untrustworthiness, but it helped the Soviets by making more difficult the task of locating targets for the 1200 American bombers at bases surrounding the Soviet Union. Indeed, during much of the two decades between 1945 and 1965, the difference between an American first strike with a high chance of success and one with a complete chance of success would have been the information provided by on-site inspection of Soviet facilities.[73]

Despite real benefits, Soviet secrecy and strategic deception has probably done more harm than good to Soviet security since the war. Soviet secrecy has fed American fears and stimulated tremendous American arms buildups. During the fifties the Soviets were far behind the United States, first in bombers and then in missiles. Khrushchev's inflated claims substituted for military hardware. Skillful Soviet presentation of the few weapons they did have led American intelligence to vastly overestimate Soviet strength. This deception had the short-term advantage of making the Soviet Union appear formidable, but it quickly became a disadvantage when the United

"As long as the act of detecting and locating is a key link in the act of destruction, verification may be losing the race against weapons innovation."

States embarked on a massive bomber and missile buildup. The Soviet Union soon found itself even further behind. And when new satellite reconnaisance technologies in the early sixties suddenly revealed the weakness of the Soviet strategic forces, Khrushchev desperately gambled with intermediate-range missiles in Cuba to redress the balance and to gain leverage against American missiles in Turkey.[74]

Would a more open information order constitute a planetary-scale "Big Brother" system? Certainly a systematic abolition of all secrecy would eliminate privacy and completely submerge the individual. But national security is the main rationale for spying on people. George Orwell coined the term "Big Brother" in his dystopian novel *1984*, which portrayed a world where the individual was absolutely controlled by various information and mind control technologies in the hands of a government eternally at war. Under constant siege, the USSR seems to have as perhaps its most central organization a vast intelligence apparatus, the KGB. Certainly the far more restrained CIA and FBI would be under much fuller restraint if not for their national security missions. The choice is whether information systems are used to control war or whether they will allow nations perpetually at war to subordinate all else.[75]

Limits on innovation in weapons technology form the second pillar of an alternative security system. Technological innovation—occurring in secret—is the heart of the arms race. The unregulated advance of innovation makes both sides less secure because neither can be sure what the next innovation will be or who will obtain it. Controlling the advance of technology seems far more difficult than reducing the arsenals of weapons. However, no serious effort to control weapons innovation has been made. Indeed, arms control efforts thus far have been carefully crafted to permit continued innovation, and as a result, have been failures.[76]

Fueling the technological arms race is the deeply held hope that somehow innovation will yield a decisive superiority that can be exploited for political gain. Behind this motive lurks the fear that the other side will move ahead unless the race is run at full speed.

However, the record of technological innovation over the last three decades shows that the same laws of physics in the United States hold sway in the Soviet Union. With every major innovation in strategic weaponry since World War II, the narrow gap opened when a weapon was first deployed was soon closed by the other side. As long as both sides are feverishly at work, weapons innovation extends the stand-off, at ever greater cost and uncertainty.[77]

A comprehensive ban on the testing of nuclear weapons would be the logical centerpiece of an agreement to control innovation. Since 1963, the Soviet Union, the United States and Great Britain have abided by a ban on tests of nuclear weapons in the atmosphere, the oceans and outer space. Testing underground, however, has continued unabated, with more than 800 tests conducted since. Had a comprehensive test ban been enacted in the early sixties, or even better, during the early fifties, the second generation of miniaturized nuclear weapons would not have been produced, and the world would have been spared the multiplication of warheads over the last decade. A comprehensive missile test ban is also needed to freeze the evolution of evermore reliable systems.[78]

Military objections to bomb and missile test bans come from two contradictory directions. First is the claim that test bans would be "closing the barn door behind the horse"—ineffective because technology has advanced so far that not much remains to improve. Although a ban would no doubt stop much less now than a ban twenty years ago, a comprehensive ban would still bring important security gains. The supposed irrelevance of a bomb and missile test ban is belied by the military's insistence that "reliability testing" is needed to ensure that existing inventories of bombs and missiles still work as they age. However, a vice to military readiness may be a virtue to human survival. By reducing confidence in the reliability of existing nuclear strike forces, a comprehensive ban on bomb explosions and missile flight tests would be a quick and simple way to close whatever "windows of vulnerability" exist and thus make a first strike less thinkable.[79]

Could a ban on bomb and missile testing be verified with a high

"The Atlas rocket that carried John Glenn into orbit was almost identical to those in the U.S. Air Force ICBM inventory."

degree of assurance? The answer is an unambiguous yes. Since the early sixties, when bans on bomb tests were first proposed, seismic monitoring has advanced and expanded dramatically. Geologists Lynn Sykes and Jack Evernden conclude, "We are certain that the state of knowledge of seismology and the techniques for monitoring seismic waves are sufficient to ensure that a feasible seismic network could soon detect a clandestine underground testing program." With contemporary radar and satellite observation systems, the detecton of missile launches is even more certain.[80]

A critical verification problem for test bans is not the difficulty in detecting tests, but the similarity of certain peaceful technologies. With nuclear weapons, a peaceful nuclear blast and a weapons test cannot be distinguished. Fortunately, using peaceful nuclear explosions for megaconstruction projects holds little interest in the United States, and the idea has been losing favor in the Soviet Union as well. Recognizing that peaceful blasts are a potential loophole in the Threshhold Test Ban Treaty (no blasts above 150 kilotons), the superpowers have negotiated the Peaceful Nuclear Explosions Treaty (PNET). Unratified because of opposition from anti-arms control members of the U.S. Senate and the Reagan administration, this treaty provides both for on-site monitoring and limits in yield. Another verification problem is the similarity between rockets used in civilian space programs and missiles used by the military to hurl nuclear bombs over intercontinental distances. The Atlas rocket that carried John Glenn into orbit, for example, was almost identical to those in the U.S. Air Force ICBM inventory, and the Soviet Union continues to launch satellites from early versions of ICBMs. Fortunately, this problem has diminished, as neither the United States nor the Soviet Union makes much civilian use of their newer, more powerful ICBMs.[81]

Would controls on innovation and weapons testing limit the advance of science? In 1963 Princeton physicist Freeman Dyson vehemently criticized the atmospheric test ban treaty for blocking the advance of knowledge. Not having a large-scale nuclear war will forever deny scientists a chance to study the impact on the earth's ecosystems of a large radionuclide release combined with massive injections of dust

into the atmosphere. But society has always legitimately demanded limits to experimentation by scientists. Although Francis Bacon, the influential early prophet of modern science, spoke of the need to "torture nature" to gain scientific knowledge, society does not permit the torture testing of humans. Science has and can continue to advance through observation, nondestructive testing or surrogate testing.[82]

Though the Soviet Union has excelled at secrecy, the United States has led, with few exceptions, in new weapons technology. Stressing innovation and exploiting it for military advantage has been as deeply rooted in American culture—and central to America's arms strategy—as secrecy is to the Soviet Union. The Soviet Union has mounted a determined effort to take the lead in weapons innovation—spending twice as much on military R&D as the United States, Western Europe and Japan combined, and employing twice as many engineers and scientists on military R&D as the United States does. Nevertheless, the U.S. lead appears to be holding. Richard DeLauer, the Pentagon's top scientist, recently estimated that the United States equals or surpasses the Soviet Union in 19 of 20 basic technologies that will influence the balance of power over the next 10 to 20 years. Among the areas where DeLauer says the United States leads are computers, electro-optical sensors, microelectronics, guidance and navigation, optics, propulsion, radars, signal processing, computer software, stealth technology, submarine detection and telecommunications. The Soviets are said to lead only in conventional explosives.[83]

Innovation has its useful limits and costs for American security much as secrecy does for the Soviet Union. Because the Soviets have come to fear the unexpected consequences of American innovation for their security, they go to great lengths to build more of the systems that they do have—thus creating exactly the threat that American innovation tries to overcome. And once an innovation is incorporated into a weapon, its secret is out and can then be copied. As Hans Bethe observed, "The secret of the atomic bomb was that it could be done." Innovations also result in unexpected consequences, often rebounding to the disadvantage of their creator. Multiple warhead technology (MRV, MIRV and MaRV) pioneered by the United States,

"Since innovations and secrets are information, an apparently important advantage can, and on occasions has, disappeared overnight."

played to Soviet advantage because of the larger lifting power of Soviet missiles. The terrible irony is that the Midgetman, the United States' technical fix to the problems caused by multiple warheads, may also play into the Soviet's long suit of concealment.[84]

It is no accident that the Soviets lead in keeping a secret but lag in innovation while the United States has a hard time keeping a secret but is always innovating. Secrecy stifles innovation, and innovations seldom remain secret. Secrecy is maintained by retarding the flow of information, keeping activities compartmentalized and giving people information only on a "need to know" basis. Innovation, on the other hand, derives from unexpected insights at the boundaries of scientific fields, and thrives on the environment of free exchange of information. A growing threat to American leadership in innovation is "national security" restrictions on more and more areas of science.[85]

Both the United States and the Soviets cherish their freedom to innovate and the right to keep secrets. But the record suggests that these advantages largely cancel each other out, have important liabilities and heighten the sense of insecurity that is the root of the problem. Furthermore, since innovations and secrets are information, an apparently important advantage can, and on occasions has, disappeared overnight. Instead of running this evenly matched, fruitless and dangerous race, both sides would gain by linking an open skies/open labs agreement to a restraint on weapons testing.

Making science cooperative rather than competitive, international rather than national and open rather than closed could yield far-reaching security benefits. Scientific investigation is at the root of new technology with potential application to war. Despite the universal validity of scientific discovery, much of the world's basic science is performed in secret laboratories of the superpowers for weapons application. Central to a new security order is Edward Teller's two-decade-old call for "a gradual and well-planned abandonment of all secrecy concerning technical and scientific facts." If both superpowers, joined as much as possible by other countries, agreed to conduct all research in certain fields on a cooperative and open basis, then neither side would have to fear—and hedge against—

unexpected breakthroughs in weapons potential. Furthermore, comprehensive scientific cooperation in key areas could powerfully reinforce the bans on weapons innovation.[86]

Across the board scientific cooperation between the superpowers is probably infeasible, at least at the start, so certain kinds of scientific research should be chosen first. The highest priorities are the planetary-scale energies and terrains that have influenced the strategic balance and are likely to continue doing so. High energy physics and sciences of the earth as a whole—oceanography, space sciences and aeronautics—are logical starting points.

The first candidate for broadbased cooperative scientific research is fundamental physics. History shows that weapons emerge from new powers that physics unveils. Furthermore, both sides could be confident that a blanket open-labs agreement would indeed be all-embracing. The research apparatus in the esoteric disciplines of physics is increasingly massive, distinctive in appearance and expensive, and the number of trained scientists is limited. In particular, research into directed energy—both fundamental and applied—should be cooperative across the board. Research into high energy lasers and particle beams for weapons application appears to be at a fever pitch in both the United States and the Soviet Union, fueled in both cases by the knowledge that the other side is active in this area. Many defense analysts have been dazzled by the potential of directed energy weapons to transform war. After all, directed energy is just a more refined way of achieving what military innovation has always sought: concentrated, moveable and controlled destructive quantities of energy. If directed energy weapons work and are deployed, their ability to cover ground quickly will make near-space even more closed than it is and perhaps make a first strike more appealing. On the other hand, if turning the electromagnetic spectrum into a weapon can be prevented, this ethereal common resource would continue to be available to police arms limits.[87]

Not all physics experiments could or should be done cooperatively, and a way must be found to identify only those experiments with a quick spill-over into weapons capability. Fortunately, there is a

"No further tests of lasers or particle beams above a certain size should be conducted except on a cooperative basis."

simple, easy to distinguish test—the quantity of energy needed to power the experiment. Thus, for example, small-scale laser work could be hidden, but the critical scale-up of lasers into systems actually capable of destruction—very problematic at this point—would be virtually impossible to cloak because of their size and power requirements. A limited number of facilities are doing this work and both superpowers know where they are. The U.S. airborne laser lab (ALL) and the laser test facility in White Sands, New Mexico, should be open to Soviet scientists in exchange for U.S. access to Soviet energy beam facilities in Saryshigan and Semipalatinsk. No further tests of lasers or particle beams above a certain size should be conducted except on a cooperative basis.[88]

A high priority for scientific cooperation in the commons is manned space flight. Joint U.S.-Soviet manned space missions are a low-risk, high payoff avenue for cooperative science that could begin almost immediately. The only joint mission thus far and a spin-off of detente, the Apollo-Soyuz rendevous in 1975 marked the highpoint of U.S.-Soviet space cooperation. The United States has resisted further cooperation in space with the Soviet Union because it regards Soviet space technology as inferior. The United States also fears that the Soviets will cooperate only long enough to acquire U.S. technology and then cease cooperating or divert the technology to other military missions. These problems can be minimized by a treaty requiring that most manned missions over an extended period take place in tandem. Joint Shuttle-Salyut missions would yield important civilian scientific payoffs and give both countries insight into the space activities of the other. Perhaps most important, they would build on-site inspection into future space development, thus closing off an entire avenue of future weapons development. Both sound technological and political reasons for joint missions exist now. The programs complement each other because the U.S. shuttle has advanced space transportation capability while the Soviet Salyut stations are proven space bases.[89]

Another important force for ensuring cooperation in the militarily important sciences are the scientists themselves. Scientists have long felt a greater kinship with each other than with various national

ideologies. The strongly internationalistic character of the scientific community has prompted many scientists to speak out against weapons development. To reinforce these already powerful attitudes among scientists themselves, a register and time accounting system could keep track of all scientists in certain fields trained above a certain level. With this combination of open exchange and mutually monitored activity, hiding a highly trained team of scientists—if cooperative ones could be found—for any significant period of time would be as difficult as hiding a major new weapon, but far less attractive, since testing would still lie ahead.[90]

One of the peculiarities and opportunities of planetary geopolitics is that military competition is taking place beyond the borders of the nation-state, in the vast, fluid and otherwise uninhabited realms of water, air, ice and space. For both superpowers the pacification of the earth's commons would bring important security benefits. It would help restore the security they enjoyed in the age of global geopolitcs, but lost in the era of planet-spanning weapons. Technology has turned barriers into corridors of attack. Diplomacy must now use technology to make these regions sanctuaries and buffer zones.[91]

Over the last several decades, the commons have been gradually enclosed— parcelled into various extensions of the abutting nation-states. Where the fluid nature of the commons makes parcelling impossible, agreements have been sought to establish internationally recognized regimes of rights, rules and, on occasion, managing institutions. Unfortunately, various conferences and treaties have centered too much on resources and not enough on information and weapons access.

Advances in military technology have played a major but little recognized role in the enclosure of the commons, and the various schemes to regulate the commons have in turn had unanticipated military ramification. The three-mile territorial sea limit enshrined in the seventeenth century by Hugo Grotius, the father of admiralty law, was roughly the outer limit of shore-based cannon. And the 200-mile limit of the "exclusive economic zones" in the recently negotiated Law of the Sea Treaty has been traced by historians to President Roosevelt's

"For both superpowers the pacification of the earth's commons would bring important security benefits."

declaration of a 200-mile submarine-free zone in the early days of World War II.[92]

The continent of Antarctica is the only part of the world that has been totally and effectively demilitarized. To avert land-claim conflicts 13 countries active in Antarctica agreed in 1959 to bar weapons from the area and dedicate the region to scientific investigation. So that no military activities occur, a treaty also provides on-site, short-notice inspection of all facilities. This sweeping pacification and dedication of a whole continent to open science was undoubtedly made easier by the absence of either resource exploitation or military facilities. Although the U.S. Army's "Operation Highjump" in 1946 was in part a war exercise to acquaint U.S. forces with the type of climate they would confront if fighting in the Soviet Union, Antarctica has little military potential. By linking a ban on weapons with cooperative science, the Antarctica Treaty nevertheless stands as a vital model for the other commmons.[93]

The Greek philosopher Archimedes reportedly said, "Give me the point of my choosing and I will leverage the world." The Archimedian leverage point for the new security system is clearly near orbital space. Even more so than the ocean, space laps upon all shores of all nations, making it a feared corridor of attack or a comforting buffer zone and sanctuary. But unlike the oceans or the atmosphere, space has yet to be colonized by weapons. Space today is much like the atmosphere in the early days of World War I, when artillery shells passed through it and reconnaissance pilots carried handguns. Controls established now can prevent deployment of weapons in space and avoid the vastly more difficult task of regulating them once they are there. A ban on weapons in space would put a literal ceiling on the arms race. Neutralization of space would not only prevent a costly and destabilizing new theater for arms competition, but—perhaps more important—it could preserve the incomparable vantage points of space for the monitoring platforms and joint scientific enterprises that form the core of an alternative planetary security system.[94]

Space cooperation, now regarded as irrelevant or at best symbolic of other changes, can defuse superpower conflict. When the most tech-

nically advanced sectors of over-armed societies together pursue goals that transcend national differences, the thorny questions of verification and peace conversion will be much more tractable. The Soviets take the exploration of space seriously and regard it as one of the few unambiguously positive accomplishments of the October Revolution. And despite relative official neglect in recent years, the high frontier holds a powerful spell on the American psyche. The vast symbolic and popular appeal of space exploration means that significant space cooperation could develop a political constituency in both countries that more traditional and esoteric arms control has so disastrously lacked.[95]

The oceans present a far more complex problem. They are extensively militarized by many countries, and the nuclear missile-carrying submarines deployed there are the most secure and hence stabilizing part of the superpower's arsenals. As a result, comprehensive demilitarization would be horrendously complicated, and as an isolated step, destabilizing. Still, establishing limited submarine-free zones and submarine sanctuaries could be done quickly, yield important security benefits and constitute a first step toward more comprehensive ocean regimes. Today American security planners fear that the few Soviet submarines patrolling in North American waters could launch the first phase of a surprise attack with so little warning time that even bombers on alert would be destroyed on the ground. Soviet planners, on the other hand, fear that the coastal seas harboring most of their missile-firing submarines will be penetrated by American anti-submarine forces, thus jeopardizing the most invulnerable part of their deterrent. A combination of defined submarine-free zones and submarine sanctuaries would benefit both countries and provide a cushion against a sudden and destabilizing breakthrough in submarine detection technology.[96]

Nuclear-free zones are another variation of geographical pacification that can help avert superpower collision. Such zones have been proposed by various national leaders for Latin America, the Middle East, Africa, the Indian Ocean, the central Pacific, Scandinavia, the Balkans and central Europe. Creation of zones where nuclear weapons are banned can be tricky because accidents of geography make symmetri-

"Space cooperation could develop a political constituency in both countries that more traditional and esoteric arms control has so disastrously lacked."

cal and fair disengagements difficult to achieve. For example, the "Nordic nuclear-free zone" proposed by members of the European peace movement would have to encompass the Kola peninsula, geographically part of Scandinavia, politically part of the Soviet Union, as well as Norway and Denmark (Finland and Sweden have no nuclear weapons on their soil). Otherwise such a zone would only neutralize NATO's northern flank. A nuclear-free zone in central Europe embracing at least East and West Germany would remove stockpiles of weapons from a periodic crisis zone, reduce the provocative deployment of forces on the East-West frontier and give NATO added time to mobilize against a Soviet invasion. Ideally such a zone would include a reduction of conventional forces as well.[97]

Another promising candidate for a nuclear-free zone is the Indian Ocean. Bordered by neither superpower nor any country with an operational nuclear arsenal, the Indian Ocean can be denuclearized far more easily than the Pacific or the Atlantic. Many of the states in the region favor such a zone, and the superpowers briefly held negotiations on the matter in 1978. The United States has opposed the idea, fearing Soviet advance through Afghanistan and Baluchistan to a long-coveted warm water port. However, a mutual withdrawal of forces now would turn a Soviet arrival into an intrusion on a demilitarized zone rather than another phase of an ongoing U.S.-Soviet buildup.[98]

Toward Good Neighbor Politics

The relationship between military power and national security has changed, but alas, the attitudes of governments toward weapons—and each other—have not. For all their efforts to improve security, the governments of the United States and the Soviet Union are failing miserably. To begin fashioning a real security system, the superpowers must abandon their outdated and illusory attitudes about military security. But a new security system cannot be constructed in a political vacuum. The superpowers will have to build improved political relations with each other. Real improvement will require efforts from both, but the risks if one side takes the lead are low. An

informed public in the industrial democracies and those "in-between nations" that together make up the Third Force have key roles to play.

Realism requires that the superpowers put their supreme interest in mutual survival above many lesser but more visible and traditional competitive interests. Realism demands that the superpowers try to eliminate the common threat to their security rather than threaten to eliminate each other. A good start would be putting a tenth as much effort into finding solutions and new ways to relieve tensions as is spent devising new weapons. Both sides have overwhelming self-interest in freezing or halting competition before their security is eroded any further. And both have the incentive and means to eliminate the problem without eliminating each other. But the superpowers have so completely failed to absorb the lessons of planetary geopolitics that advocates of more weapons are regarded as realists even though the overbuilt weapons system is the principal threat to the security of the superpowers.[99]

Unfortunately, the fog of ideology, disinformation and propaganda obscures the superpower's overriding interest in accommodation. Like Big Brother in Orwell's *1984*, the superpowers whole-heartedly believe their own lies. Their leaders seem mesmerized by the drumbeat of their own incessant propaganda campaigns and have lost sight of reality. In both the U.S. and Soviet Union, elites well-versed in hysterical ideological critiques create a confrontational attitude, and refuse to look critically at their own motives.

Much of the mutual ignorance is self-imposed. The Soviets systematically shelter themselves from perspectives deviating from the "official line." Americans, who pride themselves on open-mindedness, rarely study Soviet life or learn Russian. For example, President Reagan's top Soviet affairs adviser during the crucial Brezhnev-Andropov transition was a 32-year-old international affairs "expert" who has never been to the Soviet Union. And as Jeremy Stone, director of the Federation of American Scientists, has recently observed, few of the U.S. Senators who must ratify treaties have been to the Soviet Union or learned much about the Soviets. The national

"The United States appears unable to choose unless faced with crisis, and seldom stays a course, once embarked upon."

security bureaucracies in each country can breed their own ignorance too. Only the assuredly loyal can see the secrets, and espousing the hard line proves that one is a trustworthy agent of state struggle. Perhaps these self-imposed blinders are psychologically useful; possession of absolute weapons and routine preparation for unprecedented genocide requires the image of an absolutely evil adversary.[100]

During the seventies the superpowers took first steps toward better relations through "detente," but relations have since slid back toward cold war. Much of the American disenchantment with detente has been caused by "linkage," a plausible idea that Soviet actions in Afghanistan, Poland or Angola, for example, must be linked to the state of U.S.-Soviet relations generally. However, on closer inspection "linkage" amounts to a U.S. requirement that the Soviet Union not intervene militarily beyond its own borders while the United States continues to do so. Instead of shrill denunciations of Soviet imperialism, the United States should propose a nonintervention treaty. And if the United States is unwilling to itself accept nonintervention beyond its borders, then it should abandon this aspect of linkage. Particularly oblivious to the laws of realpolitik are those who insist that the Soviet Union adopt an American imposed "code of behavior" in its principal sphere of influence, Eastern Europe. Having been invaded by Western powers twice this century through Eastern Europe, the Soviets will relax their hold, not from American threats or pressure, but from an improved sense of security. Americans who insist that their government promote freedom abroad might set their sights on another long-oppressed region closer to home, and where American influence is stronger—Central America and the Caribbean.[101]

A major obstacle to superpower reconciliation is U.S. volatility and instability. The United States appears unable to choose unless faced with crisis, and seldom stays a course, once embarked upon. This is particularly apparent in the SALT negotiations, which the United States eagerly sought but now holds in an ambiguous limbo. Lack of perspective and proportion abounds, especially in those who loudly proclaim themselves realists. As a result, events are blown out of

proportion, as when a brigade of Soviet troops in Cuba dealt a fatal blow to a strategic arms control treaty that had been in negotiation for five years.

The record thus far, as well as deeply engrained characteristics of the American political order, raise doubts about the United States's ability to participate reliably in arms control. In the United States, only presidents can initiate the process of negotiated reconciliation, but presidents face reelection every four years before voters not centrally concerned with U.S.-Soviet relations. Furthermore, presidents only serve eight years at most. Compounding this instability is the tendency for each administration to set off in new directions, with little or negative regard for what came before. Also operating against reconciliation are the many well-entrenched groups with varying degrees of veto power over the extent of agreements. If anti-conciliation groups in the U.S. can force an almost continuous plebescite on the entire U.S.-Soviet relationship, while demanding that each stage of each avenue of accommodation yield a visible net U.S. gain, then reconciliation is hopeless. The United States may face the worst of two worlds: a geopolitical situation that requires extensive foreign entanglements—economic, political and military—but a constitution designed to make the stable and prudent management of such complex relations all but impossible.

The Soviet Union's behavior is equally at variance with its objective security requirements. Unlike America's vacillation and inability to maintain perspective, the Soviet Union's security strategy displays a deeply conditioned inertia that seems oblivious to changing circumstances. Long threatened by their neighbors, the Soviets understandably have difficulty seeing themselves as the source of threat. The Soviet's real and justifiable fear of encirclement has produced an overinvestment in weapons that now diminish Soviet security. This overinvestment has led in part to the two biggest setbacks to Soviet security interests since World War II—the rearmament of West Germany and the loss of China. Soviet naval expansion in the Far East now threatens to push Japan into extensive remilitarization, an event with far-reaching implications for the Soviets, given Japan's long hostility, greater technological acumen and unsatisfied territorial

"The Soviet Union's security strategy displays a deeply conditioned inertia that seems oblivious to changing circumstances."

claims. (Japan and the Soviet Union are still technically at war with each other.)

The Soviets should not expect that general war can be avoided while chronic, subversive and conventional war is waged successfully against the West. In contemplating its supreme state interests, the Politburo should never forget that creeping victory through subversion and conventional war at some point will almost inevitably provoke a bold American attempt to even the score with nuclear weapons. Similarly, the United States should have no illusions about dismantling the Soviet Union and relegating Communism to "the ash heap of history" with military force. In contemplating the utility of nuclear superiority it again seeks, the United States should remember that the most desperate and dangerous event of the nuclear era—the Cuban missile crisis of 1962—was essentially a bold attempt to preserve minimum Soviet deterrence in the face of overwhelming American first-strike capability. Should the Soviet Union again be in a position like that of 1962, when the United States had a significant edge, a dangerous gamble or even a preemptive Soviet first strike is certainly possible. In short, return to some semblance of nuclear superiority could well be disastrous for American security.

A new realism is just the beginning. The ultimate goal of superpower realpolitik must be the construction of human bridges between the two countries. America's long and misdirected effort to "contain" the Soviet Union has only isolated the Soviets from a world more interdependent in every other important respect. This contrast between physical proximity and security interdependence on the one hand and the isolation of the people on the other breeds precisely the intemperance, ignorance and suspicion that will trigger World War III. The "ultimate" objective of bringing the two peoples together must be pursued immediately, unconditionally and with at least as much energy as is currently put into weapons production. The most notable human bridges are annual summit meetings between leaders, regular meetings between military chiefs, expanded economic interdependence, youth exchange programs and widened cultural exchange. The Soviet Union's great self- and outside-imposed isolation must be brought to an end. The goal of the Western alliance must be

the integration, not the containment, of the Soviet Union. In this way, human interdependence will match security interdependence of the two superpowers.

Annual summit meetings between the heads of state that include private discussions as well as public events should be held regularly, whether relations are good or not. Indeed, summits are more important when relations are strained than when an agreement has been reached. Richard Nixon, the U.S. president with the most success in controlling nuclear weapons and dealing with the Soviets, has strongly urged increased summitry. As long as the leaders of the superpowers are holding civilization hostage to their differences, they can at least sit down together each year. These attempts to solve common problems will betray the brittle ideology of inevitable and irreconcilable conflict preached by war parties on both sides.[102]

Changing the direction of present weapons-heavy security systems will require an intelligent, broadbased and sustained mass "peace movement." Critics of the peace movement rightly point out that no extra-governmental groups pressure for restraint in the Soviet Union. Partially compensating this absence is the Soviet government's deep fear of war and Soviet memories of World War II, though these will inevitably fade with the passing of those who experienced the Nazi onslaught. The absence of a strong peace movement in Soviet bloc countries means the peace movement in the West must be stronger and more intelligent. A strategy beyond unilateral disarmament is critical, for if the peace movement only weakens the West, the chances of peace will be diminished, not advanced. One does not have to be rabidly anti-Soviet to recognize that the leaders of the Soviet state, like leaders of any state, will welcome and support, however ineptly, popular movements to weaken their military competitors.[103]

One hopeful sign is that Christendom in the West, both Protestant and Catholic, has begun to support alternative security arrangements. Although individual Christians have spoken out against nuclear weapons in the past as a matter of personal conscience, the church hierarchies have begun to proclaim the unambiguous immor-

ality of nuclear weapons. At the root of the new church activism against nuclear arms is the recognition that fallible humans have appropriated God-like powers over the fate of the earth and routinely contemplate the mass murder of millions of innocents for reasons of state. Roman Catholics have the added impetus of the Second Vatican Council and the *De Vita Humina*'s reaffirmation of the ethical centrality of life's right to survive against the claims of social, state or technological convenience. Where reasonable people can differ as to the extent of the human embryo's right to life, the planned incineration of hundreds of millions of innocent children, women and men is undoubtedly the most acute right to life challenge of our age.[104]

The basic moving force for a new security system is an informed and active public. Unfortunately, nuclear war seems an abstract, far-away possibility to even educated members of society—something that, like death and taxes, has become a background, invariant feature of modern life. Since the atomic age began the peril of nuclear war has only twice come close to its rightful place at the center of the public policy agenda—during the late fifties and during the last year. In both cases the public was aroused by symptoms, and concern faded with the enactment of comestic changes. The "ban the bomb" movement of the fifties emerged because of widespread fears of poisoning from the atmospheric tests of nuclear weapons. Current protests and public anxiety have been provoked to large degree by loose talk of nuclear war coming from the Reagan administration. To raise public awareness about nuclear war, the peace movement has conceived of a fascinating array of public relations gimmicks, ranging from mass marches and rock concerts to media tours of hypothetical blast zones in major cities. Yet these activities may well become ineffective or fail to maintain momentum should the Reagan administration become somewhat more circumspect in its public pronouncements.[105]

Locally organized civil defense exercises are an overlooked tool for nuclear education. Efforts to establish rudimentary civil defense programs in the United States have met with swift and vehement opposition from peace activitists who fear that civil defense preparations will reinforce the dangerous illusion that nuclear wars are winnable and so make war more likely. Because civil defense planning is per-

haps the only part of the Reagan administration's preparations for protracted nuclear war that can be resisted at the local level, it has been a prime target. Yet a democratic government has the responsibility to actively inform its citizens of their hostage role in its nuclear gamble. Civil defense exercises involving tens of millions of otherwise uninformed, uninvolved individuals could be a hard-to-ignore lesson in the reality of nuclear war. People cannot escape nuclear war by not thinking about it, nor can cities escape nuclear annihilation through civil defense planning. But civil defense could prod a passive public into the political awakening that can alone secure civilians, cities and civilization.[106]

Much of the public's unease about superpower insecurity has been channelled into opposition to military expenditures. Sensing the continued decrease in security and seeing the vast financial resources poured into the military, a vocal group of politicians, defense analysts and publicists has sought to make the military more efficient, reform the way weapons are procured and reorganize the military—in general get "more bang for the buck." This approach favors smaller budgets but still supports the military's desire for better weapons. Although well-intentioned, this critique intensifies the technological arms race, furthers the illusion of the usability of weapons and obscures the need for more fundamental alternatives. The superpowers' growing insecurity does not lie in the incapability of their weapons. Weapons can already do more than we would ever want them to do. Indeed, the greatest threat is that our weapons will take another leap in potency. Nor is insecurity caused by a lack of "readiness." The effort to reduce the likelihood of nuclear war by improving conventional forces has done much more to legitimize conventional war than to reduce the chances of nuclear war. The solution to national insecurity is not to reform the military but to reform the security system that makes such an overgrown force necessary.[107]

An alternative security system should not be the sole province of the superpowers. The "in-between nations" have much at stake—and more to contribute than they realize. Japan, one of the most prominent, today stands at a crossroads and must either re-arm or develop a bold new security strategy. Japan has been pressured hard by the

"Either Japan will help shape a world order where the peace constitution can thrive, or the peace constitution will wither and die."

United States to begin a rapid buildup of military forces. But Japanese rearmament is greatly feared by East Asian neighbors who bore the brunt of Japan's militarily imposed Co-Prosperity Sphere during World War II. Japan's economic growth, long unburdened by military costs, would also be jeopardized. The constitution imposed upon Japan by the United States after World War II clearly forbids a strong military. Despite its foreign authorship, this constitution has strong support in Japan and will make rearmament domestically divisive.[108]

Both superpowers should fear a remilitarized Japan. Official Washington policy today holds the peace constitution in contempt, but like the Marshall Plan and the United Nations, it is one of the greatest security accomplishments of America's most costly war, and should be treated accordingly. A Japan with a military scaled to its economic power would not be likely to follow Washington's grand designs. Ultimately the United States could be burned by Japanese rearmament just as the Soviet Union was by its support for Chinese military development. For the Soviets, a rearmed Japan could be a major threat to its inherently weak grasp on its far eastern provinces.

To avoid being drawn into the no-win vortex of superpower military competition, Japan will need a strategy for propelling the values of the peace constitution into world affairs. Either Japan will help shape a world order where the peace constitution can thrive, or the peace constitution will wither and die. Japan has unique leadership potential. Its advanced technology could provide crisis-monitoring satellites for the U.N. Security Council or verifiable submarine-free zones. Growing foreign aid and a reservoir of respect in the Third World are unexploited diplomatic resources.

Fragments of Whole-Earth Thinking

The inhabitants of earth face many threats to their survival, but none greater than their own ignorance about each other and their machines. Humans increasingly live in a world they have created but do not control, a world designed but not known. Unless the hardware of planetary interdependence is soon matched by an appropriate soft-

ware of thought, "lifeboat earth" may well sink. The realities of this new world challenge many of this age's most cherished and axiomatic assumptions about progress, science, technology, historical change and moral responsibility.[109]

For most of human experience thoughtful people believed that progress did not occur, that ceaseless cycles of effort, decay and rebirth dominated all things human. Since the Enlightenment, and dominant since the nineteenth century, the belief that technological advance has and will result in real betterment of the human condition has gripped the most energetic human societies on earth. Has the pursuit of evermore powerful technology improved the human condition? Certainly modern science and technology have bettered humankind in many marvelous ways. Yet, for every wondrous miracle of modern technology, a more clever, deadly bomb is poised somewhere to negate the accumulation of technological improvements. Until the fate of the planetary war machine is resolved, whether science and technology will be ultimately beneficial remains an open question.

Doubting the inherent virtue of modern technics falls prey to what Herman Kahn has aptly called "the failure of nerve." But this instinctual recoil against impending self-immolation may not be sufficient to avert disaster. A powerful technological fatalism grips the species. Once opened, conventional wisdom has it, the genie's bottle cannot be corked; knowledge, once learned, cannot be thrown away. Given the human race's proclivity to stupid, barbarous acts and the total unforgivable power of modern weapons of mass destruction derived from modern science, the inability to cork the genie's bottle may well be the species' epitaph. This frightful truth has become not the source of prudence but an axiomatic apologia for an indiscriminate orgy of cork opening. We might not be able to re-cork a genie's bottle, but we can stop paying the elite of the world's scientists and engineers to seek out every conceivable genie's bottle and, with virtually unlimited financial resources, apply each new genie's power to war-making.

Military utopianism fires this furious embrace of technical innovation. For as long as people have thought about the future, they have

"Once opened, conventional wisdom has it, the genie's bottle cannot be corked; knowledge, once learned, cannot be thrown away."

conjured up utopias where the problems that plague humanity have been abolished. While granting great power to the empire of things, neither Marxist materialism—particularly in its Russian variations—nor American pragmatism forgets that people, their prudence and their social relations are of decisive influence. Utopian schemes of social engineering have largely lost their luster, but technological utopianism still governs one major realm of human affairs: the military. Fueled by the utopian belief that complete security or usable superiority resides in the next innovation, the superpowers put a curiously naive faith in the progress of technology. In the early twentieth century the prophets of air power preached the heady doctrine, as do the space war advocates today. History shows, and logic dictates, that the promise of superiority over the horizon never materializes. The arms race is fueled but not solved, the stand-off is extended, not transcended, by this indiscriminate embrace of technological innovation.

The traditional indices of responsibility have been forever transformed by the shift in the scale of consequence. Some people have always had power to affect others without other's approval. But never before has such a small group of people (possessed of such dubious views of reality) held so much power over so many of the living as well as the unborn. The next several hundred, if not thousands, of years of human history could be decisively shaped in little more than an hour. The time span of decision making has become shorter at the point of inception and longer at the point of consequence. Only by dismantling the technical apparatus of planetary holocaust can the scale of consequence be brought into line with the responsibility.

"War," observed Karl Marx, " is the midwife of history." And rare indeed has been the advance or change in the human condition that did not stem from or trigger a war. The unique challenge of this age is to significantly change the international system using the threat of suicidal war rather than war itself as the catalyst. This will require nations to secure themselves against what they have always relied upon for security—their weapons. Throughout history changes in the scale of securable terrain have driven former warring neighbors into

common cause against a new, bigger threat. Fortunately, a new security system does not have to completely replace the old one. Rather, it is contained within the old one, though awkwardly and dangerously, and needs only the dextrous hands of a midwife to come to life.

Given the unchecked momentum of the nuclear juggernaut, is human survival likely, or even plausible? Never have weapons, once built, not been used in war, except those made obsolete by more powerful weapons that were used in war. Nearly incessant warfare of progressively greater violence has been waged since the dawn of the human species. Never has arms control more than temporarily slowed the rush to rearm and fight more war. And despite two decades of politically difficult and time-consuming effort by the leaders of the superpowers to control nuclear weapons, the tide of increase has yet to be measurably slowed. There are, however, grounds for hope. The scale of our practical technological capabilities has dwarfed the scale of human ethical capabilities. But technology has not necessarily overwhelmed our prodigiously clever passion for security.

Life has survived and prospered on earth because of success in adapting to conditions and shaping the planet to make it more habitable. In a twinkling of an eye humanity has emerged to occupy a position of unprecedented dominance within the myriad hierarchies of life, but it has also fashioned tools of titanic destructiveness with which all could be undone in an instant. Humanity faces the seemingly novel evolutionary task—not of adjusting to environmental change or competing with other species—but of adapting to and controlling our own artifacts and limiting the scale of our mistakes. Avoidance of war between the superpowers would seem to be such an epocal event as to entail a basic change in the human species.

Yet this evolution is occurring right before our eyes. Virtually all human evolution for the last several hundred thousand years has been exosomatic—outside the body. Tooth and nail became knives and then guns, and society changed its ways to accommodate. As human extensions have come to embrace the whole earth, the scale of their consequence has also expanded. This new form of planetary-

scale life is intelligent enough to survive if it can make its extensions serve rather than threaten its well-being. Humanity may survive its overmuscled, spastic arms, but only if the species' electronic common senses secure the whole earth.

Notes

1. Geopolitics has suffered from the academic compartmentalization of its constituent fields—history, politics, geography and military strategy. Three recent contributions that bridge these artificial gaps are Robert Gilpin, *War and Change in World Politics* (Cambridge, England: Cambridge University Press, 1981); Edward N. Luttwak, *The Grand Strategy of the Roman Empire From the First Century A.D. to the Third* (Baltimore, Md.: The Johns Hopkins University Press, 1976) and Harold Sprout and Margaret Sprout, *Toward a Politics of the Planet Earth* (New York: Van Nostrand Reinhold, 1971).

2. For the roots of these contrasting political cultures, see Richard Pipes, *A History of Russia* (Cambridge, Mass.: Harvard University Press, 1960) and Louis Hartz, *The Liberal Tradition in America* (New York: Harcourt Brace Jovanovich, Inc., 1962).

3. For the broad patterns of human historical development, see William H. McNeill, *The Rise of the West: A History of Human Community* (Chicago: The University of Chicago Press, 1963), particularly Chapter XIII and the conclusion, and William H. McNeill, *A World History* (New York: Oxford University Press, 1967) particularly chapters XXVI through XXVIII. For the role of evolving military technology in shaping the international order, see William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society Since AD 1000* (Chicago: University of Chicago Press, 1982) and Bernard Brodie and Fawn M. Brodie, *From Crossbow to H-Bomb*, revised edition (Bloomington, Ind.: Indiana University Press, 1973).

4. The fundamental work on maritime geopolitics is Alfred Thayer Mahan, *The Influence of Sea Power Upon History 1660-1783* (Boston: Little, Brown and Company, 1890). For the role of mechanization in seapower and the geopolitics of naval power, see Bernard Brodie, *Sea Power in the Machine Age* (Princeton, N.J.: Princeton University Press, 1941) and John Philips Cranwell, *The Destiny of Sea Power and Its Influence on Land Power and Air Power* (New York: W.W. Norton and Co., 1941). For the history of British naval power, see G.S. Graham, *The Politics of Naval Supremacy: Studies in British Maritime Ascendancy* (Cambridge, England: Cambridge University Press, 1965) and Paul M. Kennedy, *The Rise and Fall of British Naval Mastery* (New York: Scribner's, 1976).

5. The superiority of martial societies over commercial ones is a major theme of premodern political thinkers. See in particular Montesquieu, *The Spirit of the Laws* (Berkeley, Calif.: University of California Press, 1977). For military

competition's role in industrialization, see Edward Mead Earle, "Adam Smith, Alexander Hamilton, Friedrick List: The Economic Foundations of Military Power" in E.M. Earle, ed., *Makers of Modern Strategy: Military Thought from Machiavelli to Hitler* (Princeton, N.J.: Princeton University Press, 1943). and John Nef, *War and Human Progress* (Cambridge, Mass.: Harvard University Press, 1950). For the role of industrialized warfare in European imperialism's success, see Daniel K. Headrick, *The Tools of Empire: Technology and European Imperialism in the Nineteenth Century* (New York: Oxford University Press, 1981).

6. Mackinder's most important works are *Democratic Ideals and Reality* (New York: Henry Holt and Co., 1919) and "The Round World and the Winning of the Peace," *Foreign Affairs*, July 1943. Mackinder believed that the Heartland power would have a decisive advantage against the Maritime Alliance. Operating within Mackinder's overall framework, Nicholas Spykman claimed the opposite. Spykman, an emigre Dutchman, was an influential proponent of the U.S. commitment to lead the Maritime Alliance. See Nicholas J. Spykman, *The Geography of Peace* (New York: Harcourt Brace & Co., 1944) and Nicholas J. Spykman, *America's Strategy in World Politics: The United States and the Balance of Power* (Hamden, Conn.: Archon, 1970). For the role of the railroad in industrializing land warfare, see Thomas H. Thomas, "Armies and the Railway Revolution," in J.D. Clarkson and T.C. Cochran, eds., *War as a Social Institution* (New York: Columbia University Press, 1941).

7. Submarines proved an extremely effective counter to traditional naval power. In World War II a hundred Allied airmen and seamen were needed to counter each U-boat sailor. For discussions of the role of submarine warfare, see Drew Middleton, *Submarine: The Ultimate Naval Weapon—Its Past, Present & Future* (Chicago: Playboy Press Books, 1976); Robert F. Burgess, *Ships Beneath the Sea: A History of Subs and Submersibles* (New York: McGraw-Hill, 1975) and Norman Polmar, *The American Submarine* (Annapolis, Md.: The Nautical and Aviation Publishing Company of America, 1981). For the role of airpower in altering the strategic landscape, see Alan K. Henrikson, "The Map as an 'Idea': The Role of Cartographic Imagery During the Second World War," *The American Cartographer*, April 1975 and Stephen B. Jones, "Global Strategic Views," *Geographical Review*, October 1955.

8. For air power visionaries, see Guilio Douhet and Dino Ferrari, translator, *The Command of the Air* (New York: Coward-McCann, 1942); Major Alexander P. De Seversky, *Victory Through Air Power* (New York: Simon & Schuster, 1942); Edward Warner, "Douhet, Mitchell, Seversky: Theories of Air War-

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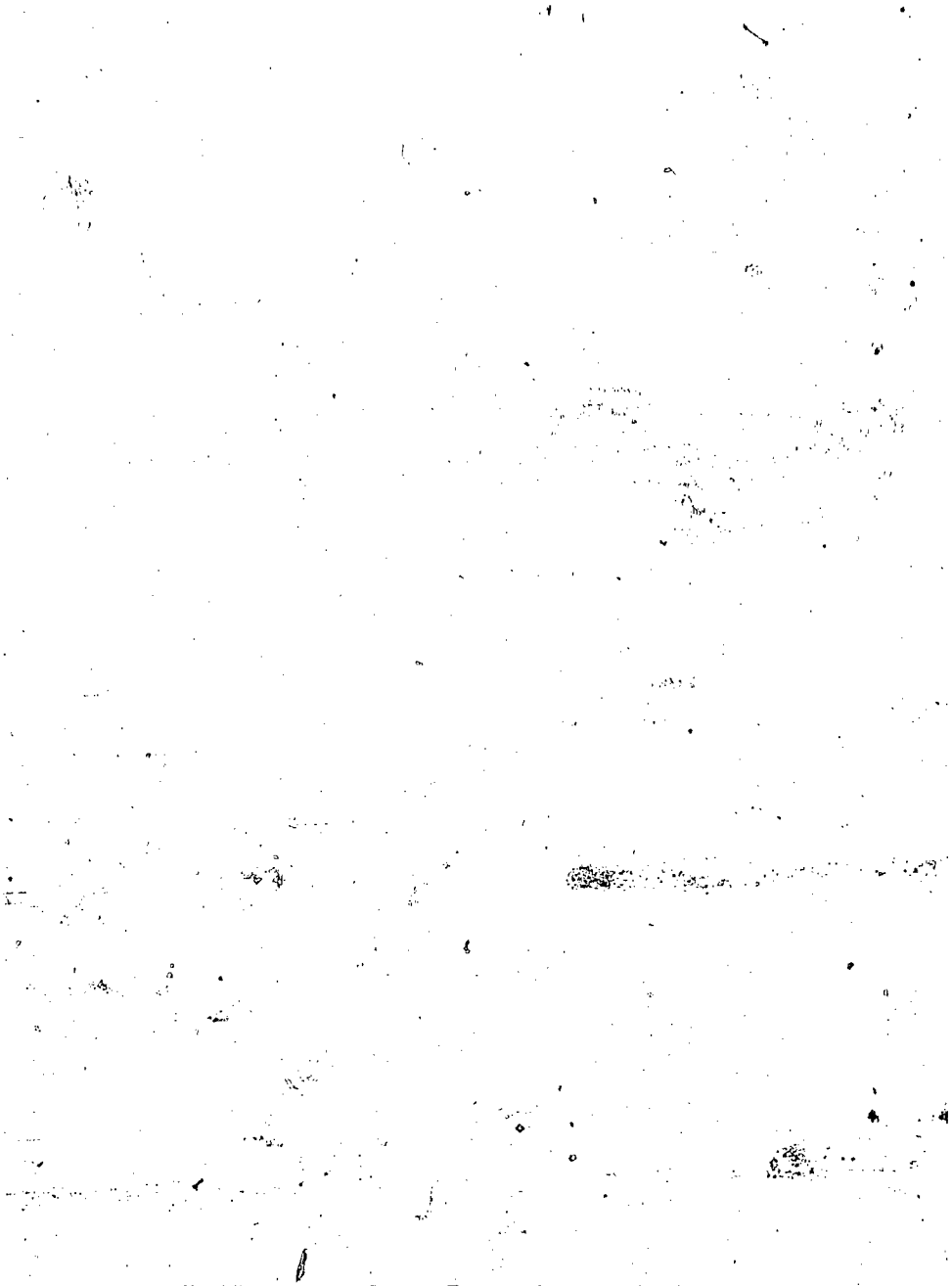

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