EMERGING TECHNOLOGIES IN THE STRATEGIC ARENA: A PRIMER

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PREFACE

This paper was initially written for presentation at The George Washington University, April 1987.

The author gratefully acknowledges the assistance and counsel of Peter A. Wilson in the preparation of this paper.

Readers desiring a more fully developed treatment of the topic are referred to Carl H. Builder, *Strategic Conflict Without Nuclear Weapons*, R-2980-FF/RC, The RAND Corporation, April 1983, and its later revision, *The Prospects and Implications of Non-nuclear Means for Strategic Conflict*, Adelphi Paper number 200, International Institute for Strategic Studies, London, Summer 1985.

INTRODUCTION

The United States' recent use of highly accurate precision-guided munitions (PGMs) to destroy selected targets in Libya while attempting to minimize collateral damage offers a hint of the future of war. A coming generation of weapons, many dependent on so-called emerging technologies, will allow commanders to strike with similar precision at targets located beyond their field of vision, or even at intercontinental range.

This paper will examine some of the implications for global stability of the introduction of such weapons into world arsenals. After an introduction, it will examine just what these weapons are, and how they differ from those that already exist. Consideration of their implications for stability will follow.

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Any discussion of stability must first ask, *Where does instability come from?* A global security system is unstable when one side can gain advantage by starting a war, or one side possesses the ability to use weapons with impunity. In this instance, the discussion will focus on the U.S./Soviet strategic relationship; this system would be unstable if, for example, by a first strike the United States could eliminate the entire Soviet retaliatory force. This country would then have little reason not to fire off its weapons first, as to do so would cripple our chief rival without receiving damage in return. But that is not today the case; the current situation is stable because each side knows that any total war will bring massive damage regardless of which side initiates nuclear use.

The signal paradox of emerging technology weapons is that several trends, each itself beneficial in reducing the hazards of war, may join to drive mankind into a very unstable and hazardous world.

THE TRENDS

TREND 1: INCREASING WEAPON ACCURACY

At the end of World War II, guided weapons for all intents and purposes did not exist. The millions of tons of ordnance dropped by bomber aircraft throughout the war were unguided, relying on calculations of aircraft speed, altitude, and direction, coupled with wind velocity and heading, to determine their accuracy. The resulting imprecision made mass bombing necessary; many bombs had to be dropped to ensure that one would hit the target.

Fighter aircraft carried rocket-propelled missiles by the war's end, but these too were unguided, with pilots often using a stub of broom-handle as an aiming reference. Even the otherwise advanced German V-weapons were unguided; the V-1 buzz bomb flew in a more-or-less straight line until its fuel ran out, and the V-2 rocket followed a simple ballistic arc. Once these weapons had been launched, there could be no correction of their path.

The arrival of the nuclear weapon made accuracy largely redundant. With a destructive radius measured in miles instead of feet, a bomb could miss its aimpoint by several miles and still destroy the intended target. But this changed again with the advent of the theory of flexible response, which endorsed a battlefield role for nuclear weapons. The less-destructive weapons that this implied led to reinstatement of the requirement for accurate delivery, and beginning in the early 1960s, the United States concentrated on bringing down the circular error probability (CEP) of battlefield weapon systems.

As a counterforce doctrine evolved for strategic targeting, it came to include a requirement to minimize collateral damage. This requirement brought accuracy improvements to these systems as well, to the point that from a probable error of several miles in the 1950s, CEPs of intercontinental systems are today in the 200-meter range. This trend is by itself nominally beneficial, as increasing the probability that the intended target--and only the intended target--will be struck minimizes the unintended effects of nuclear weapon use.

Accuracy improvements on conventional weapons--for which accuracy was always more important--proceeded faster, to the point where today a guided "smart" bomb can be delivered from ten miles away with an average error of only 15 meters, and often less. It is this technology which may give the next generation of both conventional and nuclear weapons similar accuracy at intercontinental ranges.

TREND 2: GROWING REALIZATION THAT NUCLEAR WEAPONS MAY BE UNUSABLE

The mid-1960s switch from countervalue to counterforce targeting was the first real indication of official concern about the credibility of threats to use nuclear weapons. By announcing its intention to target primarily Soviet missile silos and other military targets, the United States tacitly admitted that the spectre of Soviet reprisals against U.S. cities made U.S. use of nuclear weapons against Soviet cities incredible.

The problem, simply, is that nuclear weapons are crude instruments. It would be difficult to find an instance in which their use would be to a nation's gain if a) their collateral effects were too great to use them on urban targets, b) their use were to legitimize and even invite a like response, or c) they rendered territory uninhabitable. In fact, all of these conditions are true of nuclear weapons. Yet, if they can't be used, they then threaten no one and thus their presence cannot deter attack.

TREND 3: STEADILY DECREASING AVERAGE YIELD AND TOTAL MEGATONNAGE

The decreasing size and power of nuclear weapons are the result of attempts to keep nuclear weapons usable by minimizing the collateral damage they would cause. The basic thrust has been to keep warheads small while improving accuracy so that those smaller warheads will suffice to kill a designated target. A fourth trend, *increasing numbers of warheads on both sides*, is a direct consequence of keeping warheads small; it simply takes more to do the same job.

These trends have resulted in substantial research in United States weapons labs to find non-nuclear ways of doing the jobs currently allotted to nuclear weapons. Nor are we likely alone in this effort;

Marshal Nikolai Ogarkov, in *History Teaches Vigilance*, urged that the Soviet Union pursue a similar capability, and his subsequent rehabilitation suggests that his appeal was favorably received.¹

This paper will focus on the effects on the global scene should the superpowers realize a significant breakthrough in non-nuclear weapons technology. Accuracies may soon be possible which could enable an intercontinental weapon to, say, destroy one building on a given block and leave the rest standing virtually undamaged. What are these weapons, and how will they change the deterrent equation?

¹ Marshal Nikolai V. Ogarkov, *History Teaches Vigilance*. (Moscow: Voenizdat, 1984.)

POSSIBLE WEAPON OPTIONS

Emerging-technology (ET) weapons fall generally into two categories: nuclear weapons delivered with extremely precise accuracy and conventional weapons delivered accurately over unusually long ranges. An inseparable companion of (and rationale for) most emerging-technology weapons is the strategic concept that because newfound accuracies can result in much higher kill probabilities than previously, conventional weapons can be assigned to do many jobs heretofore reserved for nuclear ones.

Possible weapon options break down into five basic categories:

TAILORED NUCLEAR WEAPONS

These would be nuclear weapons specifically designed for a particular task. They could create large blasts with little radiation, shake the ground, or yield normal nuclear weapon effects limited to a small area. The neutron bomb advocated during the Carter administration, a nuclear weapon tailored to minimize blast effects, was one such device.

EARTH-PENETRATING WEAPONS (EPW)

These would use standard or tailored nuclear weapons in a new way. By burrowing deep into the earth before detonating, a nuclear weapon would create tremendous shock effects--literally shaking buildings down--while minimizing the accompanying blast, radiation, and thermal effects.

TAILORED CONVENTIONAL WEAPONS

Already in development for tactical applications is a system called Assault Breaker, which is a missile carrying numerous small conventional warheads, called submunitions. Assault Breaker is fired toward the center of a group of enemy tanks; the submunitions seek out and attack individual tanks in the formation. One possible adaptation of this new conventional technology to a strategic role would be a version of Assault Breaker which would dispense similar small weapons above a

mobile-missile deployment area. Currently, mobile missiles are believed a viable deterrent because they are likely to survive an initial attack. Attacking them would require an aggressor to expend a large number of warheads in a barrage (since he does not know where, precisely, each missile is), leading to the very unfavorable prospect of trading four or five warheads for one. The super Assault Breaker system could negate this disadvantage to the attacker, and could dramatically lessen the leverage granted by mobility.

INTERCONTINENTAL CONVENTIONAL SYSTEMS

When someone talks about emerging technology weapons, this is one of the two categories to which they are likely referring.

In the near term (say, 1990-2000), the ET systems are fairly well known. They include non-nuclear versions of our current cruise missiles (including the already available conventional Tomahawk), "stealthy" cruise missiles, and the advanced technology (Stealth) bomber. It is likely that in this time frame the United States will possess significant numbers of earth-penetrating nuclear warheads, to be used in combination with any of these delivery means.

In the farther term (post-2000), precisely guided reentry vehicles with conventional (or possibly earth-penetrating nuclear) warheads will allow intercontinental ballistic missiles to achieve the same accuracies as current battlefield weapons, while carrying similar warheads.

KINETIC ENERGY KILL (KEK)

This is the other commonly thought-of emerging technology. The basic principle behind KEK is that, as its name implies, no explosives are used at all; rather, KEK weapons destroy their targets through sheer force of impact. This makes an even more precise kill possible; the effect on a target building is similar to that building collapsing of its own accord, which does much less damage to the surrounding area than were it being blown up by a bomb.

The trick to KEK is that, as one might imagine, it takes a great amount of kinetic energy to damage most structures, most particularly those of military importance. Kinetic energy equals half the mass of an object multiplied by the square of its speed; since any weapon must be

small enough to carry on an aircraft or missile, the best way to increase the amount of kinetic energy in a given weapon is to increase its speed. This is (or will be) done in three ways:

Gravity

The most obvious way to speed up a projectile is to drop it and let gravity do the work. However, the point of KE weapons is to equal the power of bombs without explosive; a KE weapon dropped from a bomber aircraft will have much less power than a similar-size conventional bomb dropped from the same height, as the kinetic energy imparted to them by gravity will be equal while the conventional bomb has the additional power of explosives. To achieve the same effectiveness without explosives, then, one must radically increase the height from which a KE weapon is dropped. It is possible, for example, to imagine increasing that height by placing satellites in orbit which could carry KE weapons.

Boost

Add a motor to a lump of coal and you have a KE weapon. Using a motor to accelerate projectiles permits one to deliver a blow from low altitudes equal in power to a gravity weapon dropped from very high altitudes. This basically allows use of current delivery platforms (particularly aircraft), obviating the need to place weapons in space.

Ballistics

Ballistic delivery may be seen as more a means of attaining the altitude required for gravity-aided weapons than a distinct way to add energy to a projectile. It is in this area, though, that most of the research effort on ET weapons is being spent, in order to create new systems combining the two major technologies (intercontinental bombardment and KEK) into one weapons system. These efforts include both accuracy improvements to allow conventional warheads to be delivered precisely by current ICBMs, and more exotic technologies like electromagnetic railguns, which would provide a sort of intercontinental artillery.

POSSIBLE EFFECTS

This discussion will not try to identify which technologies are more or less useful or likely to appear. Of much more relevance are their implications for the future. Each of these systems allows attack against an enemy homeland target with minimal collateral effects. What will such a world look like?

BEFORE WAR BEGINS

ET systems, depending upon their accuracy, may threaten first-strike stability. If, for, example, each side built intercontinental-range railguns with sufficient accuracy to destroy their enemy counterparts, then the side that went first could seriously cripple its opponent's retaliatory capability. Unlike the current situation, though, in which a missile destroyed is gone for good, lost railgun capability could be restored, facilities repaired, or stockpiled satellites launched, as was appropriate to the individual system.

In a world with or moving toward emerging-technology weapons, the Western technology base gives the United States and its allies great competitive leverage over the Soviet Union. The U.S. and the USSR then have a major advantage over most other nations, as the most technology-intensive options (space-based systems, tailored nuclear weapons, and intercontinental-range nonnuclear weapons) are so costly and difficult to design that they may only be available to superpowers, and are further limited to those nations with both substantial technical and economic power. (In fact, by this definition, the weaker Soviet economy may put the USSR out of the game. The United States may be able to afford both conventional strategic forces and enough nuclear forces to form an effective deterrent. The Soviets may not, both because of the already high percentage of GNP they devote to military spending and because unlike the West, the cost of high-technology development in the Soviet Union is rarely amortized through the development of consumer products from discovered technologies.)

A distinction should be made, though, between system cost and cost-per-shot. Although any of these systems would be quite expensive to deploy (tailored nuclear weapons being the least so), the various kinetic-energy weapons could be quite inexpensive to operate, as they are firing basically unsophisticated chunks of metal. Space-based systems would naturally be more costly and complex to reload than an intercontinental-range railgun based on land.

The development of strategic weapons with controlled effects will blur the difference between strategic and tactical weapons as currently defined. That distinction is already fuzzy (is a U.S. intermediate-range missile based in Europe but with the range to strike Moscow a strategic weapon, a theater weapon, or a tactical one?), and it might be argued that the question of whether these terms still fit is of little importance. Yet, the definitions of different types of weapons affect how planners think about the prosecution of a war and, more importantly, how nations go about negotiating arms control.

By today's understanding, strategic warfare involves long-range missions, usually conducted with nuclear weapons; tactical war is conventional and shorter-range. In the new world, though, the superpowers could carry on a protracted war, including massive attacks on each other's homelands, with conventional "tactical" weapons. In that world, it seems reasonable to define strategic war as a conflict involving attacks upon one superpower's homeland launched by the other, regardless of the weapons used.

One long-standing debate within the arms control community will be settled by ET weapons. Because the new smaller warheads must be used in greater quantity to accomplish particular tasks and because some exotic technologies involve reloadable launchers (such as the aforementioned railguns), controlling arms through limits on the numbers of warheads that each side may possess will have much more leverage than limits on launchers.

Intercontinental artillery with precise accuracy presents a fascinating new arms control problem. The United States might previously have considered using the ICBM/SLBM arsenal in a tactical role, to bombard formations in Europe. A strong argument against such

space by all nations. COPUOS codified the rights and responsibilities of nations and private corporations in the Outer Space Treaty, to which the United States is a signatory. The Outer Space Treaty requires that all uses of space be conducted for the benefit of all countries. It might prove difficult to show that mining the moon for projectile weapon material benefits all countries.

SHOULD DETERRENCE FAIL...

With ET weapons, wars will become easier to begin and harder to stop. These are highly usable weapons. Their existence will lower the threshold for homeland attacks in a major non-nuclear theater war by filling in the existing firebreak between conventional and nuclear forces, thus making escalation easier.

ET weapons will furthermore present a binding dilemma to the nation under attack. Were the United States attacked with conventional weapons fired from the Soviet Union, what would the proper U.S. response be? To respond with nuclear weapons might be disproportional and would legitimize Soviet use of them against the United States. Yet, would the threat of a response with U.S. intercontinental conventional forces adequately deter further attacks? As noted above, such weapons do not hold the intimidating threat of mass destruction on which current nuclear deterrence is based.

The termination of a war once begun will be harder than currently. The pace of a conventional strategic war is much more controllable than that of a nuclear exchange, because conventional systems, being less destructive, pose less of a threat to each other; there is not the same "use them or lose them" imperative as applies to nuclear weapons. A slower pace allows more opportunities for consultation among the warring parties before one or the other achieves "victory"; it might therefore make termination seem easier. But these weapons are quite amenable to long, lazy exchanges, in which the frenzy of a nuclear war is replaced with a slower-paced siege lasting weeks or even months. A war could take the form of one or two warheads landing somewhere in the nation each day. It might not be clear at any given moment whether a state of war continued to exist, much less whether either of the participants was observing a cease-fire. This possibility might also drive the United

States to harden or protect its reconnaissance satellites to permit target reconnaissance in a long war.

It could fairly be asked how this future world would differ from the current one, since today we have intercontinental bombers capable of delivering conventional weapons. There are three major differences: accuracy, survivability, and timeliness.

Gravity bombing has scarcely changed since the Second World War, meaning that strategic aircraft must drop large numbers of bombs--inevitably causing substantial collateral damage--to destroy even a small target. The accuracy of ET weapons at intercontinental distances is expected to be in the class of precision-guided munitions currently available for tactical aircraft.

While there has been discussion of carrying PGMs on strategic aircraft, the survivability of those aircraft is problematical at best. While high losses of aircraft attacking an enemy homeland in a general nuclear war are to be expected (and would be almost insignificant in the context of such a war), those same losses could be prohibitive in a more limited conventional war, and particularly a Libya-style small strike against very few targets. Great public outcry followed the loss of 15 B-52s against the air defenses of North Vietnam during the Linebacker II campaign. Those losses could hardly be expected to decrease against a more formidable adversary.

To attack (or more likely respond against) the Soviet Union with today's conventional weapons would today require anywhere from 8 to 10 hours, using bombers flying from the United States. Conventional strategic weapons could respond within a half-hour. This timeliness is a particularly important consideration when dealing with relocatable targets, such as mobile missiles. If reconnaissance detected a Soviet-style rail-mobile missile launcher moving along a stretch of railroad, it is possible to predict to a useful degree of accuracy where that launcher would be half an hour later. With conventional weapons, it would then be possible to barrage that area with explosives without causing the adverse environmental and other consequences that the corresponding number of nuclear warheads would entail.

ET weapons are quite bound up in the question of whether to build strategic defenses, not least because some of the technologies researched under the Strategic Defense Initiative could conceivably be converted to offensive use. Whether space-based strategic defenses would be effective as a defense against ET weapons cannot be determined until more is known about which systems will be selected for each role.

But the great hidden threat of this coming world is that even with new-technology weapons available, nuclear powers are not likely to cast away their old swords. They will probably retain some part of their nuclear weapons inventory, and they will continue to have the escalatory option. This fact, coupled with the hypotheses that wars would be more likely to begin and that escalation to attacks on the opponent's homeland would be more easily initiated, result in the possibility that the emergence of ET weapons could be the only factor that could lead the world to nuclear war.

SUMMARY

As emerging technology weapons do not deter use of the same class of weapon by another nation, deterrence must still ultimately be provided by nuclear weapons. But the vulnerability of small mobile missiles, which will predominate in the years ahead, to ET weapons requires that any of those nuclear warheads that are to be based on land be placed back in silos or other hardened shelters. In short, we wind up in today's world at best, but likely worse.

A consideration of the effects of new-technology weapons on global stability ultimately leads us to a familiar door. The tough question at the center of modern nuclear force planning is, simply, what deters? Is the world safer with fewer weapons (so that any war will be less destructive), or with more but "usable" weapons (so that an aggressor fearing their use will be deterred from attack)? These emerging-technology weapons belong squarely in the latter category. They do not threaten to destroy the fabric of a society, as do nuclear weapons; in that way, they are much more military tools than political ones. But if they are usable enough to deter, or even if they are not, they are usable enough to start a war. This situation would not provide stability; it would instead resemble the current all-lose situation with one significant difference: because the psychological sanction against using nuclear weapons would be removed, the likelihood of initiation of homeland attacks would be even greater. After that, escalation to nuclear war would be even easier than it is today.