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Future intercontinental and Theater Missile Systems

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by

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Two perspectives in the continuing development of theater and intercontinental weapon systems in the United States and the Soviet Union may soon converge. One is represented by the ascendancy and dominance of highly accurate, sea-launched, ballistic missiles (SLBM); the other by the ascendancy and dominance of a mixture of long-range cruise missiles (CM), medium-range ballistic missiles (MRBM), and small intercontinental ballistic missiles (SICBM). The last is a type proposed in April 1983 by the US President's Commission on Strategic Forces. It seems likely that a transformation to the new typologies will have occurred by the year 2000—perhaps as early as 1993-1995.

The large, land-based, multiple-warhead, intercontinental missiles (ICBM) will decline in numbers and deployment sites over the next several years, owing primarily to improvements in their accuracies as measured in circular error probabilities (CEP). The US Minuteman is roughly 60 feet high (CEP 700′) while the Soviet SS-19 is about 80 feet (CEP 1200′). These are large, immobile missile systems which yield high equivalent TNT megaton explosions that compensate for their relatively poor, though improving, accuracies. Their past and current accuracies, which have made them useful for counterforce targeting, are better than necessary for countervalue targeting but are not good enough for a new, emerging targeting philosophy—one which can be termed "countermeasures targeting." Counterweapons (i.e., counterforce) targeting, useful when CEPs drop below 1,000 feet, is an approach to theater and intercontinental warfare that comes unhinged because of the immobility of large, fixed missile installations. Slowly and somewhat imperceptibly the major powers are moving away from the counterweapons deadlock, which has the effect of moving the world away from the spectre of nuclear holocaust. As accuracies improve, allowing nuclear yields to lessen, nuclear overkill and conflagration will become archaic terms. This trend and new technologies revitalize the importance of conventional munitions, an idea eloquently expressed by the current Nato Commander, General Bernard Rogers.[1]

The 1980s is a time of rapid transition and readjustment to technological changes in missilery. On the horizon are stealth-type bombers launching stealth cruise missiles (ALCM) and precision-guided munitions (PGMs), further obviating the role of ICBMs. Scientific and technological achievements in guidance, navigation, aerodynamics, electronic circuitry and componentry, and in warhead yields-per-warhead-weight appear to be leading rapidly to a down-turn, perhaps to an eventual demise of the once-ascendant and now dominant ICBMs of the period 1960 to 1985. This trend holds both in the United States and in the USSR. It is apparent that highly improved accuracies are causing and will continue to cause changes in policy, strategy, employment and deployment of theater and intercontinental missile weapons systems. This previews some fundamental changes that must be considered in future missile strategies.

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The state of affairs which currently conditions thought about long-range missiles is that as ICBM accuracies improve, each side's deployed ICBMs are in ever greater jeopardy of being neutralized by a destructive first strike. Both the United States and the USSR recognize this condition and plan for it. Perceptions on both sides have been that, with decreasing CEPs, such a first strike can be totally crippling.[2] Whether this would be true in practice is nontestable as nuclear warfare still remains hypothetical. The atomic bomb attacks on Japan in 1945 were *primitive,* manned-bomber operations in contrast to what has been conceived and planned since 1960.

Political manifestations of this technological state of affairs are represented by such constructs as: windows of vulnerability, zero options, and, recently, ICBM basing arrangements; such as race-track, deep-earth silos, dense-pack and space-vehicle basing, all of which appear to various factions as being innocuous, inordinately expensive or prejudicial to other national interests. Sociological manifestations are even more compelling, e.g., the Catholic Bishops' letters, pressures for a total nuclear weapons freeze, ban-the-bomb movements, and generally increased tensions and levels of fear.

The combined effects of the technologies for improved lethalities of theater and intercontinental nuclear missiles threaten political controls and

Future Missile Systems

social orders—the need for change knocks loudly at the door. The incipient requirement to change, to break out of a deadlock, is the necessity which mothers invention. Through 1982, debate in the United States over ICBM basing options and modes became increasingly embroiled, prolonged, and devoid of consensus. However, the report of the President's Commission on Strategic Forces broke new ground in setting the tone of the future. Even if Soviet missiles are not as accurate as those of the United States, nor as accurate as they are measured to be in the United States, something original and concrete must be done to protect the US retaliatory capability because the US strategic rationale is to retaliate if attacked by the USSR.

Given possible and practical prospects, and the fact that small ICBMs have been discussed for several years, two somewhat different alternatives emerge: (1) further development of and greater reliance on SLBMs and, (2) development and proliferation of a set of accurate, small, land-based missiles of the ground-launched cruise missile (GLCM), MRBM, and newly conceived SICBM varieties. At this juncture it is reasonable to consider that both prospects may occur in parallel, along convergent tracks of development and acceptance. Both are expensive, perhaps more expensive to own and operate than are large ICBM systems. However, versatility of employment and survivability in wartime are options which garner the attenrion of the nuclear strategist and the war planner. The strategist sees the process as potentially increasing the deterrent threshold while the war planner is witnessing a move from counterforce toward a new and uncertain process of countermeasures—where the object is to attack the opponent's *control measures* for operating his forces. This nascent trend of taking tactical and strategic countermeasures against enemy command, control, communications and information/infrastructural (C^3I) centers is a form of maneuver warfare. The ability to own and operate small, mobile, highly accurate missiles suggests that C^3I countermeasures (C^3ICM) warfare could dominate futnre theater and long-range warfare.

It would be illogical to believe that large nuclear armaments, as a whole class of weapons, will wither before the year 2000. Improving accuracies in SLBMs, in particular, will make submarine-launched intercontinental missiles increasingly attractive to policy makers. The guaranteed second strike and reserve options of SLBMs would not be changed by their employment in selected cases as first-strike weapons. Additionally, it may be that SLBMs lend themselves to alternative and revised basing modes more readily than do ICBMs; hence they should be seen as *sea*-launched missiles, rather than exclusively as *submarine*-launched missiles. They can be launched from surface ships, from other sea platforms or, as once proposed by the US Navy's Project Hydrus of the 1950s, directly from the water. In the 21st century the emergence of SLBMs as the principal long-range nuclear weapon of the United States and the USSR would change long-range nuclear warfare

Naval War College Review, Vol. 37 [1984], No. 1, Art. 8

insofar as it would call for major changes in the countermeasures and counteractions, e.g., in antisubmarine warfare (ASW) programs and operations.

The improved accuracies of today's land-based, somewhat scaled-down theater and intercontinental nuclear weapons make them attractive for employment as counterforce weapons but, more recently and more importantly, as countermeasure weapons. When employed as countermeasure weapons, the effects of mass destruction, indiscriminate overkill, and large collateral destruction would most likely be minimized, possibly abrogated. For example, Pershing II, a theater nuclear weapon that is accurate to 130 feet at 1,200 miles, is appealing; Tercom-guided cruise missiles are even more accurate. Such accuracies strongly suggest that these weapons should be employed as counterforce and countermeasures weapons against enemy command and control (C^2) points, leadership centers, and the infrastructure in general. Western comments about propelling cruise missiles through the windows of the Kremlin (theoretically possible) in a counter-C^2 attack on the USSR quite understandably agitates Soviet leaders, particularly because neither side has adequate defenses against such weapons. It is such weapons which are likely to supplant the heavier, larger, less accurate missiles of the past and present.

On the horizon we see the development of hypervelocity weapons which, currently, exist in concept, research and development, and as prototypes. Importantly, hypervelocity weapons lend themselves to very precise use as both counterforce and as countermeasures weapons, sharply truncating collateral damage because they can be nonnuclear. They may become a third type of weapon system for theater and intercontinental warfare. Nonnuclear, hypervelocity missiles (HVM) have interesting prospects and possibilities for employment from space. They achieve their great explosive power from the tremendous kinetic energy released when they hit their target at a speed of Mach 15 or higher. Some of them are making excellent RDT&E progress, and potentially their accuracies are better than those of the best conventional and nuclear weapons we have or anticipate having soon. A US HVM test missile recently demonstrated that it could be "guided through the exhaust of a hypervelocity flight regime."[3]

In 1983, there has been a spate of public and government concern in the United States as to whether or not the USSR is "cheating" with respect to the SALT II limits on intercontinental missile types, size and numbers.[4]. Soviet deception and denial of critical information has been alleged. There has never been any serious doubt that the USSR deceives and denies information about their defense and weapon programs. The Soviets do this because it serves their highest state interests. That they "cheat" is harder to establish—not always hard to prove, but hard to render believable. If they are cheating, it is more likely that they are doing so with respect to size, yield, and types of new missiles, rather than with respect to numbers, but it is not clear that they are cheating at all. However, a much more important question is whether they are deceiving, denying, and manipulating with respect to missile *accuracies*. Inaccuracies abound in most new missiles and some persist in some older ones. What will really be needed over the next several years, as we enter the "countermeasures era," is a detailed, comprehensive, highly structured assessment of Soviet missile accuracies and lethalities. Some of the problem areas are known, and have been discussed in recent public literature, but there has been no systematic study of the USSR's ability to wage "strategic" countermeasures warfare.

The scientific and engineering problems associated with assuring a desired degree of accuracy are very complex. Murphy's "law"—what can go wrong will go wrong—has ample chance to be proven correct over many events. One writer states: "Periodically the worst suspicions of strategists are confirmed when new and complex strategic systems fail to perform satisfactorily in controlled test conditions or routine peacetime operations."[5] Ballistic missile flights are subject to a variety of nature's "biases" which, singly or in combination, cause deviations in the flight paths of the missiles such that they can miss their intended targets by distances only partly predictable. These geodetic and meteorological biases have been studied at great length, but they still are not completely understood. Timing itself is the key. An official of the US Naval Observatory recently said, "Get your time wrong and your missiles fall on the wrong people."[6] Dr. J. Edward Anderson, an authority in guidance technology has been quoted to the effect that "an average error of 4.2 parts per million in computing the gravitational forces over the entire course of the missile's flight would...cause an erosion in accuracy of 300 feet."[7]

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The combination of less-than-perfect design and construction of missiles, the natural factors of gravity, weather, and electromagnetism and actual small, but significant, uncertainties about launcher and target locations merge into what engineers call the "error budget." The smaller the error budget the greater the missile's accuracy.[8] At the moment, error budgets for both US and USSR ballistic missiles are smaller than they have ever been, but they are not yet insignificant. One naval expert has said recently that the Soviet error budget is such that as few as 25 percent of all the targeted US missiles (all basing modes) could be hit on a first strike.[9]

During the 1970s, methods and procedures were developed to compensate for and decrease the error budgets inherent in ballistic missiles. These include better terminal and homing guidance, mapping of the earth's gravitational field with geodetic satellites, use of global positioning satellites for missile navigation, and precise surveys of intended launch locations. The most dramatic improvement, however, has been the departure from ballistic missiles to terrain-contour-matching subsonic cruise missiles. Missiles combining ballistic and cruise technologies also have been suggested. Pershing II is a particularly sophisticated, terminally guided ballistic missile system, relying on radar matching correlations for terminal guidance. Most ballistic missiles are inertially guided to a presumably correct altitude during about the first three minutes of their flight. After that, a ballistic missile is in free flight subject to natural phenomena which bias its trajectory. Cruise missiles, on the other hand, "learn" (in a nominal way), as they fly by updating their flight path en route to their targets. If that "learning process" is interfered with the missile's accuracy will be harmed.

The accuracy of sea-launched ballistic missiles is being improved by means of more nearly exact launcher locating means and by new terminal guidance features. The forthcoming US D-5/Trident II SLBM system "will . . . be used to put some portion of Soviet hard targets at risk, a task for which the current TRIDENT I (C-4) missile is not sufficiently accurate."[10] The goal CEP for D-5 is "a few hundred feet." The CEP of the C-4 SLBM is about 1,400 feet.

Finally, advances in missile terminal guidance are having substantial, lasting influence on accuracies. Pershing II is one example. The "Midgetman" SICBM's key component will be a light-weight, terminal guidance system weighing under 100 lbs. For a 5,000 NM SICBM trajectory, a 100-foot CEP is technically contemplated. Adaptations of at least three different existing terminal fixing systems are being investigated. The maneuverable reentry vehicle would be designed to fly in the target area until it "mills out" guidance errors by using an onboard sensor and processor and by known, exact reference points on the earth's surface.[11]

Besides "error budget," other, more pedestrian problems affect missile accuracies; significant problems not well appreciated outside the small community of those who build and operate theater and intercontinental missile systems. Sometimes, they are neither well understood nor recognized even *inside* of that community. These are the problems of maintenance, reliability, component life, servicing logistics, environmental control, personnel morale, and procurement and life-cycle costs. All of those problems affect postlaunch missile accuracy as well as prelaunch reliability during years of maintenance. These are problems experienced daily in the military services and the defense industries of the United States and the USSR. Old missiles, large missiles and, especially, old, large missiles are more likely to have their accuracies impaired by those kinds of problems than are newer, smaller missiles. Overall, these kinds of "health and maintenance" problems probably affect the Soviets' missiles more severely and to a greater extent than they do the Americans', but they are not insignificant in US missiles. An "inside" source has characterized the Soviet reliability problem as: "not one of them is of really good quality. Some lack accuracy, and have too low a payload and too short a range, but are kept in service because they are more reliable than other types. Others are retained because their accuracy is more or less acceptable. Others are neither accurate nor reliable but have a good range."[12]

Because a missile is small, it is not necessarily cheap. A US Midgetman force of 1,000 SICBMs is estimated to cost, in FY84 dollars—$46.2 billion to acquire, $3 billion to operate per year for a total of $107 billion for a 20-year life. About 50,000 people would be needed to operate, maintain and guard a 1,000 SICBM force.[13] Nevertheless, small-missile systems have long-term operational (war-fighting) and logistic (war-sustaining) advantages that tend to offset their initial high costs: they are harder to target and kill than are large missile systems; they are more accurate and selectively lethal; they are easier to employ and maintain; and, because of their small size, they can be made mobile and that can drive enemy missile error budget somewhere above the maximal.

Small, new, highly accurate missile systems result from technology's responses to policy makers' impasses. When in doubt policy makers turn to scientists, engineers and technologists for solutions, a routinely accepted practice since the Russian Civil War (1919-1922). In the Soviet Union, many top policy makers were educated and saw early employment as engineers.

Technology's response to such pervasive conundrums as nuclear parity, nuclear no-win holocaust, arms negotiations deadlocks, and popular and specialized peace and disarmament initiatives is to change the fundamental nature of theater and intercontinental warfare by changing the major weapon systems with which such war might be waged. Neither policy makers nor technologists are necessarily aware of what, why or how this is happening.

This essay's characterization of our time (1980-2000) as the "countermeasures age" of theater and intercontinental warfare is intended to connote distinctions among current counter-C^3I warfare and earlier periods of counteraction, countervalue, and counterforce warfare. Table 1 summarizes these epochs and eras, as man proceeds across the millenium.

The Soviets are profoundly troubled by Nato's new land-based MRBMs and CMs because present and planned US theater and intercontinental missile systems have, for them, potentially dire C^3ICM consequences. It is worthwhile to consider what C^3ICM actually means. A long-range C^3ICM ability holds at risk not enemy population centers or enemy forces but, rather, enemy leadership and elites—enemy political and social fabrics, the virtual measures of control and organization. It does so because of the

Table 1
Primary Trends and Developments in Large-Scale Warfare—The Millenium

1000-1800	1800-1980	1980-2000	2000-?
Counter-Action Warfare	**Counter-Value and Counter-Force Warfare**	**Counter-Force and Counter-Measures Warfare**	**Counter-Velocity Warfare?**
Consists primarily of countering the enemy's actions and positions on the surface of small battlefields and sea domains. Only incidentally involves civilian populations and power centers. More maneuver than attrition.	Consists primarily of countering the enemy's forces, regardless of their actions and positions and of holding civilian power centers at risk. Includes large air, sub-surface, and some near space domains. More attrition than maneuver.	Consists primarily of threatening, countering, at risk enemy military and civil government elites, control centers, and political and social infrastructures. Tends to obviate distinction between maneuver and attrition.	Uncertain. Tends to concentrate warfare in as yet unclear areas.

accuracy, precision, acuity and relatively small sizes of missile systems. The Soviets sharply perceive that the countermeasures era is better in hand in the United States than in their own country. They also probably perceive what defenses they have against countermeasures weapons that can be vulnerable to an unborn generation of HVMs.

Thus far, Soviet counter-strategies have consisted of public and private propaganda, playing for time in arms talks and threats of a new weapon—a quantity response to a weapons quality threat. They realize that these are temporary responses against a time (1988-89) when they might begin to respond in kind, if they can produce small, reliable, highly accurate, long-range missile systems.

The Soviet Union has gone to great lengths to prevent the deployment of new US MRBMs and GLCMs in Europe precisely because those weapons are the first operational Nato systems for controlled countermeasures attack on Warsaw Pact military and civil infrastructures and command centers. This is a fundamentally different threat from countervalue or counterforce threats. Countermeasures capabilities can be developed rapidly and promise to mature over the next few years. But the Soviets are not prepared to deal with this new threat.

Pershing II's long range, short flight time, and high accuracy have been cited repeatedly by Soviet officials as the basis for their objection to its deployment. "Pershing II, they insist, is a strategic first-strike weapon capable of destroying virtually all Soviet command and control points throughout European Russia."[14] The Soviets' continuing incentive to devise an adequate counter-strategy arises from a mix of technological and political imperatives centering on the accuracies of US missiles in comparison to that of their missiles.[15] Because they are primarily tooled up to produce only large and medium ballistic missiles, they must buy the time they need to develop their own cruise missiles and accurate small ballistic missiles. The technologies they will need to catch up are those of: high-resolution sensors, artificial intelligence (especially pattern recognition), microprocessors and precision guidance.[16] They must also be prepared in the immediate future to defend their C^3I under residual counterforce warfare conditions wherein, according to one report, were the United States to apportion intercontinental weapons for an attack that would concentrate 3,400 US nuclear warheads on 1,400 Soviet ICMB silos, 600 US warheads would still be available to attack hardened Soviet command-and-control points.[17]

Strategic C^3ICM is not a new concept for waging theater and intercontinental warfare. New, though, is the actual means in hand and on the horizon to accomplish it and to measure results. The US Department of Defense, earmarking some $211 billion to modernize its long-range nuclear forces between 1984 and 1988, has included in that modernization, plans to greatly improve "intelligence capabilities to determine the status of targets, detect and locate surviving air defense systems, and detect and locate mobile targets.[18] "At one level, all American targeting plans since the dawn of the nuclear age have targeted Soviet command centers. What is new in the 1980's is the open discussion of targeting Soviet elites, and the seemingly official declaratory approval given this idea."[19]

In conclusion, what can be foreseen of the future of warfare from looking at the transformation from the countervalue and counterforce era of present and past to the countervalue era of the present and future? What is the long-term significance of what is happening, as analyzed above?

First, note the words of the science fiction author, Robert Silverberg, when he has his character, Carjaval say: "I prefer to think of all events as simultaneous, and what is in motion is our perception of them, that moving point of consciousness, not the events themselves." Further, "the future isn't a verbal construct. It's a place with an existence of its own."[20]

A "moving point of consciousness" would suggest that two major trends of warfare are in simultaneous motion: (1) the trend to countermeasures targeting, supported by a new capability, and (2) a trend called, ubiquitously, "star wars," that will have the effect of transferring some portions, at least, of theater and intercontinental warfare from this planet to space. Because both of these trends are fundamental transformations, they will have the long-term consequence of changing basic thought patterns about global warfare. The countermeasures trend means that the spectre of the nuclear holocaust, which has hung over mankind for nearly forty years, will slowly recede and could finally wither away as the actual ability to target enemy control structures precisely (not cities or military forces) is refined and confined. Complementing this trend, the transfer of some, as yet undefined, portion of warfare to the reaches of space, away from the immediate earth, will have the eventual effect not just of widening battlefields but, more positively, of removing scenes of conflict from their historic, terrestrial arenas.

Perhaps arms control negotiations of the future will change from bargaining only in like nuclear weapons systems to negotiating on the basis of *countermeasures capabilities,* regardless of how and where they are generated and manifested. In that way, we may be able to keep pace with our rapidly changing capabilities to make war in new forms. It is the only way we can reasonably expect to hold out the possibility of world peace and order.

Notes

1. See Ulman and Mossberg, "NATO Chief Supports Nuclear Cuts," *Wall Street Journal,* 18 July 1983, p. 23.
2. The Soviets have said much less than have Americans about disarming first strikes. This is typical of Russia's usual profound reluctance to discuss her vulnerabilities. However, the Soviet leadership is deeply troubled by recent trends in nuclear warfighting, in spite of the conviction that nuclear wars can be waged and won. See Leslie H. Gelb, "Soviet Marshal Warns the U.S. On Strategic Missiles," *The New York Times,* 17 March 1983. The Chief of the General Staff has said that, "the idea of nuclear warfare has never been tested" and has acknowledged publicly the USSR's vulnerability to a first strike.
3. *Defense Electronics,* April 1983, p. 27.
4. A particularly damning report on recent Soviet "cheating" is found in Evans and Novak, "The Cheating on PL-5," *Washington Post,* 29 June 1983, where it is reported as proven that they have increased throw-weight by 200 percent.
5. Thomas A. Fabyanic, "Strategic Analysis and MX Deployment," *Strategic Review,* Fall 1982, p. 32.
6. Ken Ringle, "Slowdown on Earth," *Washington Post,* 1 July 1983, p. 1.
7. Andrew Cockburn, *The Threat: Inside the Soviet Military Machine* (New York: Random House, 1983), p. 209.
8. Jerry Pournelle, "To Provide for the Common Defense," *Analog,* July 1983, p. 81.
9. Paul Schratz, *Shipmate,* April 1983, quoted in *Seapower,* May 1983, p. 29.
10. Brent A Scowcroft, et. al., *President's Commission on Strategic Forces,* 6 April 1983, p. 10.
11. *Aviation Week & Space Technology,* 21 February 1983, p. 16; *ibid.*, 6 June 1983, p. 15; and Walter Andrews, "Air Force Must Keep Midgetman Light," *Washington Times,* 27 June 1983, p. 2.
12. Viktor Suvorov, *Inside the Soviet Army* (New York: Macmillan, 1982), p. 58.
13. This is a cost announced by the Congressional Budget Office (CBO) said to be based on USAF calculations. See George C. Wilson, "Small Missiles Scrutinized by the CBO," *Washington Post,* 3 May 1983, p. A9.
14. Dusko Doder, "Soviets Zero in on Pershing II," *Washington Post,* 24 January 1983, p. A16.
15. Elizabeth Pond, "Timing and Technology Work Against Weapons Controls," *Christian Science Monitor,* 23 June 1983, p. 1.
16. Norman Augustine, "Brilliant Missiles on the Horizon," *IEEE Spectrum,* October 1982, pp. 96-97.
17. Jack Anderson, "U.S. May Have Secret Plans for a First Strike," *Washington Post,* 19 May 1983, p. C19.
18. Clarence A. Robinson, "Technology Key to Strategic Advances," *Aviation Week and Space Technology,* 14 March 1983, pp. 23 and 31.
19. Paul Bracket and Martin Shubik, "Strategic War: What are the Questions and Who Should Ask Them?," *Technology in Society,* Vol. 4, No. 3, pp. 168-169.
20. Robert Silverberg, *The Stochastic Man* (New York: Fawcett, 1975), pp. 100 and 117.

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