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STUDY PROJECT

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A NEW PARADIGM FOR UNDERSTANDING NUCLEAR STRATEGY

BY

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release Distribution is unlimited		
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
4. PERFORMING ORGANIZATION REPORT NUMBER(S)			7a. NAME OF MONITORING ORGANIZATION Strategic Studies Institute USAWC		
6a. NAME OF PERFORMING ORGANIZATION USAWC		6b. OFFICE SYMBOL (if applicable)	7b. ADDRESS (City, State, and ZIP Code) Carlisle Barracks, PA 17013-5050		
6c. ADDRESS (City, State, and ZIP Code) Carlisle Barracks, PA 17013-5050		9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER			
8a. NAME OF FUNDING / SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (if applicable)	10. SOURCE OF FUNDING NUMBERS		
8c. ADDRESS (City, State, and ZIP Code)		PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) A New Paradigm for Understanding Nuclear Strategy					
12. PERSONAL AUTHOR(S) LTC Joe C. Dixon, USAF					
13a. TYPE OF REPORT		13b. TIME COVERED FROM _____ TO _____		14. DATE OF REPORT (Year, Month, Day) 91/04/04	
				15. PAGE COUNT 28	
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP			
19. ABSTRACT (Continue on reverse if necessary and identify by block number) <p>With the end of the Cold War as we have known it since the late 1940s and the apparent success of U.S. containment policy, old, familiar questions demand answers in a new and unfamiliar context. The Cold War is over but the Nuclear Age is not; nuclear weapons cannot be disinvented. Collapse of the Warsaw Pact and dramatic reduction of tensions between the United States and the USSR compel re-examination of fundamental strategy issues. What is the purpose of nuclear weapons? How should we plan for their use? What kinds of weapons and delivery systems should we develop and deploy? How many should we have? Why have any?</p> <p>This essay does not seek to provide a comprehensive review of nuclear strategy since 1945, nor does it provide detailed recommendations for future strategy. Rather, it introduces a new paradigm, a new structure, a new set of lenses, which permits the strategist to seek old familiar information in a different context. Taking strategy to include ends, ways, and means, the new paradigm introduced herein interprets the past 45 years as three discernible time periods, each with a different characteristic: 1945-1962 was (over)</p>					
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a. NAME OF RESPONSIBLE INDIVIDUAL COL David Jablonsky			22b. TELEPHONE (Include Area Code) 717-245-3275		22c. OFFICE SYMBOL AWCI

19. (contd)

dominated by debate and decisions about means; 1962-1989 was dominated primarily by debate and decisions about ways; the present era is described as one in which debate and questions about ends emerge as predominant. Arms control efforts provide a background theme throughout all three periods, but especially in light of dramatic achievements realized in the 1980s, when viewed through the new paradigm, arms control activity becomes increasingly significant as part of nuclear strategy formulation.

The author concludes that questions and answers about nuclear strategy are crafted most usefully in the context of a new paradigm. Future strategy formulation can be more intelligently shaped by using the vocabulary and insights derived from the new paradigm and by analyzing the recent transition from an era of "ways" to an era of "ends."

A NEW PARADIGM FOR UNDERSTANDING NUCLEAR STRATEGY

AN INDIVIDUAL STUDY PROJECT

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91 4 22 142

ABSTRACT

AUTHOR: Joe C. Dixon, Lt Col, USAF

TITLE: A New Paradigm for Understanding Nuclear Strategy

FORMAT: Individual Study Project

DATE: 4 Apr 1991 PAGES: 20 CLASSIFICATION: Unclassified

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This essay does not seek to provide a comprehensive review of nuclear strategy since 1945, nor does it provide detailed recommendations for future strategy. Rather, it introduces a new paradigm, a new structure, a new set of lenses, which permits the strategist to see old familiar information in a different context. Taking strategy to include ends, ways, and means, the new paradigm introduced herein interprets the past 45 years as three discernible time periods, each with a different characteristic: 1945-1962 was dominated by debate and decisions about means; 1962-1989 was dominated primarily by debate and decisions about ways; the present era is described as one in which debate and questions about ends emerge as predominant. Arms control efforts provide a background theme throughout all three periods, but especially in light of dramatic achievements realized in the 1980s, when viewed through the new paradigm, arms control activity becomes increasingly significant as part of nuclear strategy formulation.

The author concludes that questions and answers about nuclear strategy are crafted most usefully in the context of a new paradigm. Future strategy formulation can be more intelligently shaped by using the vocabulary and insights derived from the new paradigm and by analyzing the recent transition from an era of "ways" to an era of "ends."

T. S. Kuhn introduced the notion of paradigm as a way to explain how science makes new discoveries and how scientists frame their research questions.¹ For example, the Copernican shift in thinking from a Ptolemaic earth-centered universe to a sun-centered theory opened up whole new vistas of research, and, more importantly, provided a simpler and more complete explanation of known phenomena. Kuhn calls that new view of the world a paradigm. His scheme for understanding scientific revolutions seems deceptively simple. It represents, however, a fairly sophisticated epistemological argument that helps clarify what we know and how we know it.

This concept of "paradigm" has considerable utility both as an explanatory device and as a framework to guide research and analysis. According to Kuhn, scientists spend most of their professional research activity within the confines of an accepted paradigm; within a given set of assumptions, theories, and beliefs, scientists try either to solve puzzles presented by new data or measure old data and information to confirm and articulate the paradigm itself. Scientific revolutions are spawned when new information, which does not fit the paradigm, puts pressure on old assumptions and theories. The Copernican shift is one such example, with pressure coming primarily from dramatic discoveries made possible by Galileo's invention of the telescope. In such cases, creative imagination leads to the

elaboration of new paradigms to accommodate newly developed or discovered information.

Kuhn's notion of paradigm, developed to explain scientific revolutions, has applicability outside the realm of natural science.² The schools of thought and assumptions implicit in various views of national security strategy, for example, constitute a comparable kind of epistemological landscape as that formed by different scientific schools of thought.

In the largely uncharted environment of the post-Cold War world, political-military changes as dramatic and rapid as those witnessed since 1989 pose tremendous challenges for today's national security strategists. The Great Revolution of 1989 has freed eastern Europe from Soviet domination; Germany has been reunited; the Warsaw Pact has collapsed; NATO has declared the Cold War over and has renounced first-use of nuclear weapons in Europe. As a result, the containment paradigm, developed by George Kennan in 1946-1947 and articulated more fully by NSC-68 in 1950, has become--almost overnight--inadequate, incomplete, even obsolete.³ Old, familiar issues have assumed a strange new complexity. U.S. national security strategy has lost its Cold War foundation; the Soviet threat to Europe and to the United States has changed dramatically.⁴

The challenge to strategists is an intellectual one. How should we think about the world? What is true? What is our

purpose? What should America's security strategy be? The problem, difficult for all areas of security strategy, is particularly acute in the area of nuclear strategy. The Cold War may be over, but the Nuclear Age is not.

The issue of nuclear strategy in the post-Cold War world turns on two factors: nuclear weapons cannot be disinvented and the avowed purpose of nuclear weapons--to deter the Soviet Union--has lost its urgency with the end of the Cold War. Arguments about strategic modernization programs, especially in light of dramatic breakthroughs in arms control agreements and the Great Revolution of 1989 in eastern Europe, reflect growing public and professional military uncertainty surrounding nuclear strategy. What is the purpose of nuclear weapons? How should we plan to use them? What kinds of weapons and delivery systems should we develop and deploy? How many should we have? Why have any?

These questions, given a new sense of urgency against the backdrop of U.S. budget problems, can lead us in logical circles and present us with insoluble dilemmas if we view them through the old Cold War lenses, through the old paradigm. Just as Galileo's telescope added troubling new information which could not be accommodated by the earth-centered Ptolemaic world-view,

the end of the Cold War presents the strategist with new information which cannot be easily accommodated by the old paradigm. A new paradigm is needed.

The strategic model developed by Colonel (Ret) Arthur Lykke, constructed for the benefit of an entire generation of students at the US Army War College, provides a superb framework for a new paradigm.⁵ Simply put, Lykke's model demonstrates that strategy at any level includes ends (or objectives), ways (or concepts), and means (or resources). In this context, the model provides structure for a paradigm that helps us see how nuclear strategy, as a subset of national military strategy, has evolved since 1945. Like the paradigm associated with the Copernican revolution, the new construct can provide a simpler and more complete explanation of known historical phenomena. By using this new paradigm to view the past and present, we should be able to see more clearly how to develop coherent, sensible nuclear strategy for the 1990s.

This essay does not attempt to provide a comprehensive review of nuclear strategy since 1945, nor does it provide detailed recommendations for future strategy. Rather, it introduces a new paradigm, a new set of lenses, that permits the strategist to see old familiar information in a different context. The new paradigm introduced herein leads to an interpretation of the past 45 years as three discernible time

periods, each with a different characteristic. The first two periods include the Cold War era. The third examines the transition period since 1989. The new paradigm offers an explanation of the past and provides a new set of lenses through which to see the present, thereby helping to chart the course for future U.S. nuclear strategy.

* * *

The Era of Means: 1945-1962

Nuclear strategy in this period can be seen to rest on all three elements of the new paradigm structure--ends, ways, and means. But developmental efforts and innovations before 1962 focused predominantly on means. Questions about how nuclear weapons should be used and lingering doubts and divergent opinions about their ultimate purpose were subordinated to questions about what should be built. Policy decisions about means, as viewed through the lenses of the new paradigm, drove and shaped the other two elements of the strategy equation.

Seen from this viewpoint, the effort to develop an atom bomb during World War II was primarily a matter of overcoming technical problems. Few people raised questions about how (ways) and for what purpose (ends) the new weapon would be used. Driven by concern that Germany might develop an atomic capability before the allies, American and British officials pressed

forward in order to have a more effective means to conduct their strategic bombing campaign, designed to destroy the enemy's will by raids on industrial and population centers.⁶

Once the atom bomb was used, however, two schools of thought emerged about the new weapon. Because it caused such unprecedented destruction for a single weapon, and because it led so quickly to Japan's surrender, some analysts saw the Bomb as different in kind from previous weapons. Strategists struggled to adjust theories and thinking to the new technology: many--notably Bernard Brodie--concluded the Bomb made previous thinking about strategy obsolete. Atomic weapons were not to be used in war, he argued, as previous weapons had been, but served instead to prevent war.⁷

Others, though, like General Curtis LeMay, persisted in viewing atomic weapons as simply more efficient and more effective devices, to be used for the same purposes and in the same ways as "conventional" bombs.⁸ This vision of the purpose for nuclear weapons, which one could categorize as the "warfighting" school, prevailed among those policy-makers and military planners responsible for implementing American nuclear strategy. Brodie's notion of "pure deterrence" found an increasingly receptive audience among academics, but not so among day-to-day planners.⁹

These divergent views on ends were quickly overshadowed, however, with the onset of Cold War competition, as American planners focused on means in their drive to develop better nuclear weapons and more effective delivery systems. Making a deliberate decision about resources, the Eisenhower administration stimulated development and deployment of nuclear weapons in place of more expensive conventional forces. The administration's doctrine of Massive Retaliation was designed to deter Soviet aggression, whether conventional aggression in Europe or a nuclear attack against the U.S. or its allies. The limiting factor for American planners was basically money; whatever the United States could afford, and whatever could be developed technologically, should be acquired for a growing nuclear arsenal.

The American monopoly on atomic weapons had been broken in 1949 when the Soviets detonated their first atomic device. The United States, however, maintained its predominance in both weapons and delivery systems throughout the 1950s. The development of thermonuclear bombs (by both sides) and the concomitant reduction in bomb weight logically led to a proliferation of delivery systems. Early bombs were huge, to be delivered only by heavy bombers. By the end of the 1950s, technological breakthroughs pointed to intercontinental delivery by missiles and even battlefield delivery by artillery. In 1960, the United

States could deliver nuclear weapons from aircraft, from land-based ballistic missiles in the United States and Europe, and from its first Polaris ballistic missile submarine. At the same time, the Soviet Union continued to build a force of intercontinental missiles, albeit less rapidly than feared in the late 1950s, complemented by bombers and submarines.

In this environment, whether viewed through the lenses of the old Cold War paradigm or those of the new structure, the picture invariably was one dominated by means. Increasing numbers of weapons on both sides stimulated thinking and worrying about an "arms race." For many observers, particularly those most horrified by the prospect of nuclear war, the arms race, means-driven and characterized by never-ending cycles of action and reaction, constituted the major nuclear strategic problem. Advocates of arms control and disarmament--no less than policy-makers responsible for strategy formulation--focused on the size and power of nuclear arsenals (i.e., means) rather than deliberately pursuing serious and thorough analyses of ways and ends.¹⁰

To interpret the period 1945-1962 as an Era of Means should not seem remarkably novel for those whose view of nuclear strategy has been learned in the context of the paradigm which emerged during the period and took form around the concepts of containment, Cold War, and a nuclear arms race.¹¹ That old

paradigm was reasonably satisfactory for understanding much of the Cold War world. As the focus shifts to later eras, however, the effectiveness of the old paradigm diminishes and the efficacy of the new paradigm becomes more apparent.

* * *

The Era of Ways: 1962-1989

John Kennedy waged his presidential campaign partially around a perceived "missile gap" between the Soviet Union and the United States. The issue was one of means: America didn't have enough. But shortly after his election, when he discovered there was no missile gap, and particularly after the Cuban missile scare, Kennedy's administration shifted attention from the size of the nuclear force to questions about how it should be used.

With Robert McNamara at the helm as Secretary of Defense, military planners in the Kennedy and Johnson administrations developed a variety of options short of Massive Retaliation.¹² Certainly questions about what kinds of weapons to build persisted during the sixties, but these matters of means became dependent upon policies regarding ways. Weapons development had to fit policy decisions about concepts, that is, ways weapons would be employed. In this regard, the policy of Flexible Response, which replaced Massive Retaliation, was based on a concept of nuclear capability across much of the conflict

spectrum. As a result, American planning included strategic nuclear weapons, delivered by long-range missiles and bombers, intermediate-range weapons, and tactical nuclear weapons, delivered by in-theater systems.

By 1968, both Soviet and American nuclear arsenals had grown. The Soviets possessed some 900 intercontinental ballistic missiles, 135 submarine-launched ballistic missiles, and 155 long-range bombers. American forces grew considerably during the Kennedy-Johnson years: intercontinental ballistic missiles, from 12 to 1054; submarine-launched ballistic missiles, from 48 missiles to 656 missiles; and bombers, from 450 to 650, now all second-generation B-52 bombers. In Europe, which featured the main arena of tension, the United States deployed some 7000 "tactical" or "battlefield" nuclear weapons to the NATO theater.¹³

The transition from a doctrine of Massive Retaliation to Flexible Response did not happen overnight. Robert McNamara and other American leaders argued and cajoled for some time--five years--before the NATO Military Committee officially adopted the new way of using nuclear weapons in NATO document MC 14/3.¹⁴ The strategy changed from reliance on U.S. bomber-delivered nuclear weapons to a combination of conventional forces, short-range and intermediate-range theater nuclear forces, and, if necessary, U.S. "strategic" systems. The spectrum of

conflict, from low-level insurgency to full-scale nuclear war, was seen as one continuous, seamless web.

Developments during the Nixon, Ford, and Carter administrations occurred against the backdrop of robust Soviet military growth which eventually compelled American planners to admit nuclear "parity" between the two adversaries. Technologically, comparisons were complicated by deployment of multiple independently targetable reentry vehicles (MIRVs) which put multiple warheads on single delivery systems, and by deployment of Anti-Ballistic Missile (ABM) systems. Viewed through the lenses of the new paradigm, the achievement of nuclear parity seemed to shift the policy-makers' articulation of the purpose of nuclear strategy from "warfighting" ends to "deterrence" ends. But that subtle, almost unconscious shift was hardly detectable at the time, because the paradigmatic lenses through which strategy had come to be viewed focused on the arms race.¹⁵

The ABM controversy during the Nixon years, from the perspective of this old paradigm, was a disagreement about force structure (means) and the arms race. In the context of the new paradigm, the controversy demonstrated how debates about force structure really turned on strategic concepts (ways).¹⁶ The debate was not a fundamental disagreement about technological possibilities. Nor was it about purpose--there was tacit,

albeit somewhat obfuscated agreement that the goal was deterrence and prevention of nuclear war. Rather, the disagreement concerned how peace and deterrence should be secured. ABM opponents argued that the way to maintain deterrence was to maintain mutual vulnerability. Advocates argued that the way to maintain deterrence was to complicate an aggressor's task enough so the uncertainty would prevent an attack.¹⁷

That the controversy was finally settled through an arms control agreement, and that the ABM Treaty was grounded on strategy arguments about ways (mutual assured destruction), demonstrated in terms of the new paradigm how the nuclear strategy equation had come to be driven by concepts rather than resources.

The highly publicized Reagan build-up in the early 1980s did not reverse earlier policies. Programs begun in the 1970s were accelerated in the 1980s; ideas born in the 1970s were realized in the 1980s. The Reagan administration did, however, articulate strategic concepts more explicitly and advocate procurement more vociferously than its predecessors. As a result, long dormant contradictions between "warfighting" and "deterrence" frequently appeared in public exchanges. But seen from the perspective of the new paradigm, the fundamental nuclear strategy equation developed during the previous two decades remained intact. U.S. nuclear strategy drew its credi-

bility from a concept of targeting Soviet forces across the full spectrum of possible conflict.

Using the new paradigm to view this period as an Era of Ways, arms control activity also assumes greater significance in the strategy equation than those using the old paradigm may have appreciated. Attempts at arms control, of course, predate the nuclear age. With the explosions over Hiroshima and Nagasaki, however, arms control efforts seemed more important than ever. President Truman even hoped for a time to put the atom bomb under control of the United Nations. But little progress was achieved before the 1970s.

Only with SALT did the world see significant agreements between the Soviet Union and the United States concerning nuclear weapons. Then, much to the surprise of critics and friends alike, President Reagan initiated arms control proposals --coupled with increased military spending and inflammatory rhetoric--which culminated in the INF Treaty and CFE agreements, and which hold considerable promise for agreement in a START treaty.¹⁸

Nevertheless, arms control initiatives and processes have not always had immediate connection or relevance for nuclear strategy. In some circumstances the two have sought incompatible ends; some arms control enthusiasts hope for complete disarmament, while nuclear strategists frequently advocate

modernization and build-up. But in the late 1980s, with evidence of real progress in arms control discussions, arms control and nuclear strategy intersected and became inextricably bound together. This development complicated even further the problem of studying and understanding nuclear strategy, but seen from the perspective of the new paradigm, it also offered a clear and promising way out of the dilemmas posed by nuclear weapons as the Cold War came to a close.

Thinking about nuclear strategy certainly took some twists and turns between 1962 and 1989.¹⁹ Technological developments raised old issues in new contexts: MIRVs, mobile ICBMs, SLCMs, ALCMs, neutron bombs, stealth bombers, SDI, SALT, INF, START, and many others. But the issues, including those concerning arms control, were addressed by debates centered on how best to accomplish the goal. How could means best be linked to ends?

The end, that is, the purpose of nuclear weapons, came under little direct scrutiny. Perceptions of the purpose of nuclear weapons no doubt changed subtly between 1945 and 1989, but they changed as a function of changes in means and ways. Only since 1989, under the impetus of arms control breakthroughs and the dramatic end of the Cold War, has the question of ends re-surfaced. Through the lens of the new paradigm, analysts can perceive that this issue has become the dominant variable driving the strategic equation.

* * *

The Era of Ends: Since 1989

With the end of the Cold War signalling success of America's containment policy, the basis for the old paradigm crumbled. That paradigm evolved during the Era of Means. It served tolerably well during the Era of Ways, although it frequently masked controversy about concepts (ways) by using the vocabulary of means. For example, budget deliberation and debates over choices between weapon systems, ostensibly questions about resources, in fact usually revolved around policy differences concerning how to use nuclear weapons. But--like the Ptolemaic world-view during Galileo's boyhood--the old paradigm served reasonably well to define issues and guide analysis throughout the Cold War.

After Galileo, discovery of the outer solar system and the universe beyond compelled all but the die-hards to embrace the new Copernican paradigm of a sun-centered solar system. Only a new world-view could accommodate the new data. In the same way, only a new paradigm for nuclear strategy will accommodate the new facts of a post-Cold War world.

These facts have changed profoundly the nature of the nuclear strategy issue. Questions about means and ways pale

before the question "Why?" What is the purpose of nuclear weapons? If arms control promises to curtail the arms race, there is no need to match Soviet capabilities, because they will be constrained by agreement. If the Cold War and the concomitant threat of Soviet aggression is behind us, nuclear employment concepts lose their *raison d'être*. The 45-year old issue concerning the purpose of nuclear weapons, long obscured by questions about means and ways, has risen to the surface.

American policy-makers seem to have publicly concluded that Brodie was correct: nuclear weapons have no useful purpose as an instrument of war. At least since Soviet achievement of nuclear parity, this has been the fundamental attitude toward so-called "strategic" weapons. Now, with the recent NATO decision to classify nuclear weapons as "weapons of last resort," the policy of using nuclear weapons as part of Flexible Response has been overturned.²⁰ Nuclear weapons are held only to prevent the other side from using them. Nuclear weapons are not seen as credible means for achieving military ends. Their very purpose, in light of the new paradigm, requires clarification.

Yet, clearly, nuclear weapons cannot be wished away. Both the United States and the Soviet Union possess vast arsenals of weapons. Numerous other countries have nuclear weapons, and more may acquire them despite non-proliferation treaties and policies. What is to be done?

The full answer goes well beyond the scope of this essay. But the paradigm introduced here should contribute to the construction of an answer. We know the nuclear strategy question today includes all three elements--ends, ways, and means--just as in earlier periods. But now, according to the paradigm, questions about means and ways have come to be driven primarily by the issue of ends. Knowing this should contribute considerably to the efforts of strategists to clarify and develop a sensible nuclear strategy for the post-Cold War world.

Adoption of the new paradigm has intriguing implications for viewing any number of contentious issues. The purpose here is not to resolve these issues immediately, but rather to illustrate how this different world-view may lead to resolution. Since arms control activity has become a vital ingredient in the nuclear strategy equation, if not the defining center stage for the whole drama, it may be appropriate to examine some arms control issues which may help illuminate the usefulness of the new paradigm.

On the one hand, arms control negotiations provide an opportunity to deliberately describe and prescribe means and ways in the light of ends. The persistent "means" question, "How much is enough?" at last may produce a less debatable answer than was provided by the old paradigm, however open-ended and arbitrary: whatever limits can be imposed by arms control.

The question of "ways" is also subject to decisions in Geneva, where limits are imposed not only on force structure size but, as recent decisions on SDI demonstrate, on force structure characteristics as well.²¹

This has obvious implications both for START negotiations and for nuclear strategy in Europe. If, for example, the means and ways concerning those particular issues are circumscribed by negotiations, it becomes all the more necessary to elaborate and articulate that part of the nuclear equation dealing with ends. As a consequence, the sometimes uncomfortable tension between "warfighting" and "deterrence" purposes could emerge as a puzzle to be solved within the new paradigm. If the puzzle is solved by embracing Brodie's 1945 answer, pressure would only increase to de-couple nuclear weapons from conventional capabilities--not only in Europe, but throughout the globe. INF becomes, in such circumstances, a small firebreak between nuclear and conventional conflict. If CFE then succeeds in providing sufficient conventional security to widen the firebreak, the result could be the de-nuclearization of Europe, with extended deterrence by punishment completely replacing warfighting deterrence by denial. Seen in this light, rationale for current force structure deployments and concepts for employment would make little sense.

On the other hand, arms control negotiations in light of the new paradigm can also affect the dynamics of nuclear non-proliferation agreements. These agreements, viewed through the old lenses, served to keep the arms race limited by restricting the means available to would-be nuclear powers. In the context of the new paradigm, however, non-proliferation could assume a different complexion. If nuclear weapons are shown to have no demonstrable useful military purpose, or, in the case of terrorism, no effective political end, the very incentive for developing a nuclear capability is undermined.

These examples of arms control issues further demonstrate the utility of the new paradigm. The vocabulary and insights derived from this paradigm, as we have seen, illustrate how decisions about means and ways for achieving related security ends drove previous changes in nuclear strategy. In a similar manner, information provided by the new structural lens can help explain a future in which the threat as well as other signposts on the strategic landscape have changed drastically. Those changes require new decisions about the basic purpose of nuclear weapons--decisions which, in this Era of Ends, will determine nuclear strategy in the post-Cold War world.

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Conclusion

A good paradigm provides an explanation, suggests areas for fruitful exploration and research, and defines the arena in which "puzzles" are solved. The paradigm described here accommodates the remarkable changes of 1989 more comfortably than previous frames of reference. It also provides a more satisfactory historiographical framework to investigate and interpret the period from 1945-1989. It leads observers to ask different kinds of questions than those raised within the context of the Cold War, arms race-oriented paradigm. And it provides a way out of nuclear dilemmas for the strategist who must adjust to new circumstances.

T. S. Kuhn's notion of paradigm and Professor Lykke's vision of strategy provide powerful intellectual tools with which to understand the post-Cold War world. And only through clear understanding can we realize the tremendous opportunity for lasting peace that has been offered to us in the 1990s.

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1. Thomas S. Kuhn, The Structure of Scientific Revolutions, 2nd ed., enlarged (Chicago, 1970).

2. For example, Marxist historiography adopts a particular paradigm that carries assumptions and presumptions about means of production and the class struggle. That paradigm not only changes the way history is interpreted, it directs practitioners to ask very different research questions than those examined before Marx.

3. "The Sources of Soviet Conduct," written by George F. Kennan under the pseudonym "X" and published in the July 1947 issue of Foreign Affairs, is reprinted in Foreign Affairs (Spring 1987) pp. 852-868. "NSC-68, A Report to the National Security Council," dated 14 April 1950, is reprinted in War, National Policy, and Strategy (Carlisle Barracks, 1990) pp. 121-155.

4. Belief that the Cold War has really ended is not, of course, universal, especially after Gorbachev's turn to the "right" since November 1990. Skeptics might refer to some of the following: Jeane J. Kirkpatrick, "Beyond the Cold War," Foreign Affairs: America and the World 1989/90, (February 1990) pp. 1-16; Nicholas X. Rizopoulos, ed., Sea-Changes: American Foreign Policy in a World Transformed, Council on Foreign Relations Press, 1990; Lawrence T. Caldwell, "Soviet-American Relations: The Cold War Ends," Current History (October 1990) pp. 305-308, 343-346.

See also President Bush's comment on the London Declaration at a news conference held in London on 6 July: "For more than 40 years, we've looked for this day--a day when we have already moved beyond containment, with unity on this continent overcoming division...now that day is here, and all peoples from the Atlantic to the Urals, from the Baltic to the Adriatic, can share in its promise." Weekly Compilation of Presidential Documents, (Washington, 9 Jul 1990) pp. 1044-1045.

5. Arthur F. Lykke, Jr., "Toward an Understanding of Military Strategy," in Military Strategy: Theory and Application, ed. by Arthur F. Lykke, Jr., (Carlisle Barracks, 1989) pp. 3-8. See also his "Defining Military Strategy," Military Review, Vol LXIX, No. 5 (May 1989) pp. 2-8.

6. Of the many descriptions of wartime air strategy, perhaps the best summary is by Bernard Brodie, Strategy in the Missile Age (Princeton, 1959) pp. 21-144.

7. See especially Fred Kaplan, The Wizards of Armageddon (New York, 1983), pp. 9-84, for a most readable account of the strategists' struggle to accommodate the new weapon.

8. David Alan Rosenberg, "U.S. Nuclear War Planning, 1945-1960" in Strategic Nuclear Targeting, ed. by Desmond Ball and Jeffrey Richelson (Ithaca, NY, 1986) pp. 35-56.

9. This is, incidentally, a tension that has persisted throughout the

Nuclear Age. We frequently paper over the dilemma by proclaiming the goal is deterrence...but should deterrence fail...the goal is to fight and win.

10. Even though means dominated the nuclear strategy equation between 1945 and the early 1960s, there were some questions and disagreements about ways and ends. Development of the hydrogen bomb is illustrative. Those opposed to the "Superbomb" did not argue that it was technically impossible. Rather, their opposition revolved around concern that thermonuclear weapons would stimulate Soviet efforts, accelerate the arms race, and lead to a more dangerous world.

11. The "emerging paradigm" develops into what is called in this essay the "old paradigm." That is shorthand, however, for a somewhat more complicated concept. Kuhn notes that new paradigms don't always enjoy the benefit of a preceding single generally accepted "old paradigm" (pp. 12ff). For example, before Newton there was no single accepted theory of optics which would have provided a paradigm in which to do "normal science." Instead, there were several different schools of thought, several different theories, none of which enjoyed general enough acceptance to fit Kuhn's definition of a paradigm.

12. Desmond Ball, "The Development of the SIOP, 1960-1983" in Strategic Nuclear Targeting, pp. 57-83.

13. A brief but informative summary can be found in Arms Control and National Security: An Introduction (Washington, 1989) by the Arms Control Association, pp. 17-27.

14. J. Michael Legge, Theater Nuclear Weapons and the NATO Strategy of Flexible Response (Santa Monica, 1983) pp. 7-10.

15. Kuhn makes the point that if a paradigm doesn't focus attention on certain phenomena, or the paradigm doesn't predict certain results, researchers (or analysts) will not even notice things that become apparent, and sometimes central, in a new paradigm.

16. B. Bruce-Briggs, Shield of Faith: The Hidden Struggle for Strategic Defense (New York, 1988) pp. 293-359.

17. Ernest J. Yanarella, The Missile Defense Controversy: Strategy, Technology, and Politics, 1955-1972 (Lexington, KY, 1977) pp. 120-204.

18. Arms Control Association, Arms Control and National Security, pp. 47-65. See also United States Arms Control and Disarmament Agency, Annual Report to Congress, 1989.

Obviously prospects for immediate agreement on START have been dimmed by a change in Soviet attitudes since December 1990. However, in the long run, whether START is signed and ratified or whether each side simply

agrees to "START limits", there will be de facto limits on nuclear weapons.

19. Lawrence Freedman, "The First Two Generations of Nuclear Strategists" in Makers of Modern Strategy: From Machiavelli to the Nuclear Age, ed. by Peter Paret (Princeton, 1986) pp. 735-778.

20. "London Declaration on a Transformed North Atlantic Alliance, July 6, 1990," Weekly Compilation of Presidential Documents (9 July 1990) p. 1043.

21. The quarrel between "broad" versus "narrow" interpretation of the ABM treaty during debates about SDI demonstrates the impact of arms control agreements on force structure decisions. More recently, force structure discussions often include considerations about "military sufficiency" certification, expected to be significant in congressional hearings on START.

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