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THE FACES OF VERIFICATION:
STRATEGIC ARMS CONTROL FOR THE 1980s

Robert Perry

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I. INTRODUCTION

Arms control agreements that do not provide for means of verifying compliance with whatever are the agreed limitations are of two kinds. In the first case, the signators sufficiently trust one another. In the second, violations will either be so obvious or their consequences so unimportant that no verification effort seems necessary.

Neither of those perceptions applies to the several U.S.-USSR arms limitations agreements generally treated as "SALT I"--the 1972 ABM treaty and interim strategic arms agreement, and the Vladivostok protocols of 1974. The signers do not trust one another and at least one party, the United States, holds that violations, whether obvious or not, can be of vital importance. Thus, from the American view, verification is "the critical element of arms control."¹

Yet so comingled are the many aspects of verification--technology, qualitative and quantitative offsets, the spirit and the letter of the terms, the feasibility and the mutual acceptability of alternative verification options, the perceptions of risk, the near- and long-term goals of the signers, and the political and military institutions of the participants (and their allies)--that distinguishing among them becomes an irksome task with few obvious rewards. Still, it is necessary to separate the

* This paper, concerned with arms control issues "Beyond SALT II," reflects views and judgments of the author; they are not necessarily shared by The Rand Corporation or any of its clients. The paper was prepared for and presented to a conference at Great Windsor Park, near London, on 13-15 May 1977, under the sponsorship of the International Institute of Strategic Studies. The author is indebted to several Rand colleagues who read and commented on earlier drafts and related papers, but particularly to Abraham S. Becker and Nancy Nimitz, whose ideas and expositions have become so familiar to the author that he is not always able to certify their origins. The pages that follow contain a somewhat abbreviated version of a longer draft, shortened here at the suggestion of the conference sponsors.

¹ACDA, *Verification: The Critical Element of Arms Control*, Publication No. 85, March 1976.

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constituents of verification from one another and to address them separately before attempting to assess the prospective influence of various trends on the future of strategic arms control.¹

When agreements to limit the numbers and kinds of strategic weapons first became more than theoretical and idealized goals, and verification had to become more than a debater's abstraction, what were the assumptions, the reservations, the objectives of negotiators? Once verification had been so incomprehensively defined, what were the expectations of the participants? After the verification process had been tested, what realities altered those expectations? In the backlight of two decades of diplomatic skirmishing over issues of control and verification, what are the present expectations of those who have undertaken to negotiate confining limits on nuclear weaponry, old and new? How have the perceptions of verification needs been altered by recent experience? To what extent has the probability of a new and more comprehensive arms control agreement been either diminished or enhanced by ongoing changes in national institutions, in technology, and in the shifting balance of world power--all of which have affected the capabilities, vulnerabilities, and credibility of verification devices? And finally, is it possible to distill from oddments of fact, conjecture, anticipation, misperception, and experience useful indications of how the terms of future arms control agreements may be influenced by the credibility, adequacy, and political acceptability of various verification measures?

¹Although many of the issues, techniques, and applications discussed hereafter have obvious implications for regional arms agreements, for force reductions involving conventional weapons, and for "tactical" nuclear weapons, this discussion is almost entirely concerned with limitations on the strategic nuclear weapons of the Soviet Union and the United States.

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II. CAPABILITIES AND VULNERABILITIES, PAST AND PRESENT

It is advisable at the onset to put the arms control agreements of 1972 and 1974 in historical perspective. They were the products of negotiating initiatives of the early 1960s which acquired form and substance in the late 1960s and were formalized nearly a decade after the weapons to which they applied had been developed and to some extent deployed. The processes of verification so precisely unspecified in the various instruments of agreement were of similar vintage. Thus the verification measures adopted in 1972 and 1974 were those deemed adequate, largely on the basis of experience in the late 1960s, to confirm mutual compliance with agreements limiting the numbers and quality of strategic weapons from the era of the mid-1960s.

Well before there were any strategic missiles to count and evaluate, verification issues had been tentatively addressed. In the course of a late 1958 Geneva conference of Western and Soviet Bloc representatives that concerned reducing force levels in Europe, the USSR proposed a warning system involving aerial reconnaissance plus observation posts along the East-West border. In subsequent discussions, "the technical possibilities of photographic and radar reconnaissance by orbiting space satellites were first explored."¹ The phrase "existing means of detection" entered discussions of a ban on atmospheric nuclear tests in 1961, to become "national technical means" (NTMs) in the Limited Test Ban Treaty of 1963. The qualifier "technical," which could mean so little or so much, was of Soviet origin.

In all Soviet-U.S. discussions about arms limitations from 1946 to 1970, the United States insisted that verification provisions must extend to some form of on-site inspection, and the Soviet Union usually but not invariably responded that any inspection in advance of general and complete disarmament was unacceptable because it was neither more nor less than an excuse for espionage. That impasse extended through discussions of nuclear test bans, troop reductions in Europe, and the prohibition of weapons in space (although, as eventually became apparent, the USSR had no philosophical objection *per se*

¹ACDA, *Verification: The Critical Element of Arms Control*, p. 12. But note also that as late as 1960 Soviet spokesmen were proclaiming that "efforts...to employ artificial satellites for the collection of intelligence data are unlawful." See G. Zhukov, "Space Espionage Plans and International Law," *International Affairs* (Moscow), 1960.

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to on-site inspections of other states' national territories).

As early as 1965, some elements of the U.S. arms control community concluded (and argued) that treaty limitations on the numbers and kinds of Soviet and American missile launchers could be adequately verified without on-site inspection. In October 1967, then-Assistant Secretary of Defense Paul Warnke publicly suggested that the United States could avoid tripping over the inspection issue by agreeing to rely on "our own unilateral capability" for verification of Soviet compliance, and after July 1968 the United States was privately prepared to accept arms control without close inspection.¹ Nevertheless, until 1970 it remained official American policy to press for on-site inspection privileges. In that year, the USSR unambiguously rejected any further consideration of the option.² The Soviets in 1970 also made it plain that they intended to differentiate between permissible "national means" and "espionage," although no formal treaty language defining the distinction ever appeared. All that emerged was an informal Soviet representation that the U-2 overflight program was an example of espionage, although it was never established whether the USSR objected to the means (overflight in the atmosphere) or the realizable detail of the U-2 operations. The carefully ambiguous working of the eventual verification clause in the ABM treaty resolved no uncertainties. It seemed conceivable that the USSR considered the "national technical means" available to the United States in 1970-1972 to be inferior in one respect or another to 1960-vintage U-2 capabilities--which cultured the possibility that after indulging in unilateral redefinition of "permissible" NTMs the USSR could at some future time allege that certain of them were espionage devices not protected from interference. The U.S. delegation did not inquire too closely into the fine implications of the Soviet position.³

The formal language embodied in the ABM treaty and in the 1972 interim agreement limiting strategic offensive arms specified that "assurance of compliance with the provisions of this Treaty" would be provided by each party's use of "national technical means of verification...in a manner consistent

¹ John Newhouse, *Cold Dawn: The Story of SALT*, New York, Hold, Reinhart and Winston, 1973, p. 99.

² Although a carefully limited in-site inspection privilege was admitted into the Peaceful Nuclear Explosions agreement somewhat later.

³ Robert Perry, "Breakout Warning: A Problem of Verification," unpublished paper, The Rand Corporation, February 1977.

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with generally recognized principles of international law." A second clause prohibited interference with NTMs "...operating in accordance with Paragraph 1 of this Article," and a third outlawed "deliberate concealment measures which impede verification"--except that "current construction, assembly, conversion, or overhaul practices" which might be interpreted as having concealment implications were exempted from the prohibition.¹

However they were negotiated, those terms implicitly expressed both American assumptions about the adequacy of NTMs for the purposes specified in the agreements and Soviet understanding of what constituted "acceptable" NTMs. Both sets of perceptions have presumably changed since 1972; that much is suggested by the U.S. perception that the Soviets have taken unfair advantage of the "grandfather clause" on concealment measures and by American reactions to other allegations of Soviet evasions.²

The eventual consequence was a more realistic American appreciation of the literal way the USSR interpreted the terms of the agreements and the associated protocols, bilaterals, and unilateral interpretations attached to the main documents. As then-Secretary of Defense James R. Schlesinger remarked in response to Senator Henry Jackson's suggestion that Soviet ICBM changes represented a "clear violation" of the Vladivostok understanding: "...the point is, we can say there is violation of our interpretation of our unilateral statement, but I am not sure what binding force that has on the Soviets."³

¹*Arms Control and Disarmament Agreements: Texts and Histories of Negotiations*, ACDA, Washington, D.C., 1975, pp. 135, 140. Except in substituting "interim agreement" for "Treaty," Article V of the agreement was identical to Article XII of the Treaty.

²The literature on the "evasion" furor of early 1975 is voluminous, but the heart of the controversy is summarized in *Hearing before the Subcommittee on Arms Control of the Committee on Armed Services, U.S. Senate, 94th Congress, First Session, March 6, 1975: "Soviet Compliance with Certain Provisions of the 1972 SALT Agreements."*

³*Ibid.*

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As for capabilities and anticipations, John Newhouse expressed it well:¹

The Americans can neither propose nor accept anything that cannot be verified with reasonably high confidence. The problem is less severe for the Russians. Their detection systems, like America's, are constantly improving and may have achieved comparable performance. Their advantage is that of a closed society competing against an open society. It is a major advantage. Their aversion to on-site inspection is doubtless genuine, but apart from a passion for secrecy, their position owes something to the small benefits they would obtain from having direct access to what the United States does, not much of which is concealed.

In addition to a passion for secrecy, Russian history also testifies to a tradition of deception and mistrust on those occasions when Russians must have official commerce with other countries. To what extent, then, did the U.S. assume that the "national technical means" authorized in the arms agreements would provide credible verification of Soviet compliance? The answer can be summed in three assumptions:

- (1) U.S. NTMs can provide conclusive evidence of non-compliance with the terms of the agreements.
- (2) No expansion of Soviet strategic capabilities could be concealed long enough, or well enough, to support the development of a serious Soviet threat to the established strategic balance.
- (3) So long as the Soviet Union credits those assumptions, no serious effort to evade the terms of the arms limitations agreements will occur.

The third of those assumptions is self fulfilling so long as the first two remain valid. But the first two reflect premises--first of American NTM capabilities, second of Soviet deception talents, and third of the stability of weapons technology--which, if even modestly discredited, could tumble down the entire structure.² Finally, only weapons and

¹Newhouse, p. 14.

²Another little-considered problem is that the United States must be prepared to *disclose* its knowledge of Soviet violations if the desired effect is to bring them to a halt. Source sensitivity is a non-negligible problem. ACDA has openly posed the question of whether the value of revealing evidence of a violation, or even the fact that the evidence exists, is worth the cost of compromising the intelligence techniques that must be disclosed if knowledge of the violation is publicized. ACDA, *Verification: The Critical Element of Arms Control*, pp. 29-30.

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activities explicitly defined in the bodies of the agreements and the jointly accepted protocols are controlled, and (as Secretary Schlesinger's observations make plain) in the future that may be an insufficient condition of agreement for the Americans.¹

Neither the Soviet Union nor the United States has officially discussed what qualities lie behind that interesting phrase "national technical means."² Nor have officially uninformed or unofficial statements been much more helpful. Consider only a few of the more widely circulated unofficial evaluations of what are fundamentally verification capabilities. Ted Greenwood's *Adelphi Paper* of 1972, John Newhouse's 1974 book, the CIPRI articles of 1975-1976, and the frequently cited Philip Klass book of 1971 variously contradict and reinforce one another to the ultimate confusion of the uninitiated.³ The enticements of speculation, the dearth of hard information, and the slight chance of being challenged have encouraged the publication of wildly varying estimates of capabilities. There is little value to assessing their credibility once one proceeds past the starting point of assuming that whatever the capabilities, they are (or were) sufficient to satisfy the perceived needs of the Americans and not so marvelous as to sensitize a Soviet perception that the borderline between verification and espionage has been critically breached. But one may also adduce from the evidence of ongoing discussions and from the recent American furor over alleged Soviet violations that existing capabilities,

¹Fred C. Ikle, Director of the ACDA, in "Arms Control in an Election Year," speech, 26 April 1976, in *Survival*, July-August 1976, effectively specifies that the U.S. will not settle for ambiguities and unilateral statements in future agreements.

²There have, of course, been numerous public or semi-private but informal comments by various spokesmen on both sides. The first, apparently, was Khrushchev's suggestion to Belgian Foreign Minister Paul Henri Spaak in July 1963 that satellite observation should be used instead of on-site inspection to verify a nuclear test ban. See W. H. Schauer, *The Politics of Space*, New York, Holmes and Mier, 1976, pp. 42-43, 254, citing C. H. Sheldon II, "The Challenge of International Competition," 6 November 1964 address to AIAA/NASA, printed in *International Cooperation and Organization for Outer Space*, Staff Report for Committee on Aeronautics and Space Science, U.S. Senate, 89th Congress, 1st Session, Document No. 56.

³Ted Greenwood, *Reconnaissance, Surveillance, and Arms Control*, *Adelphi Paper* No. 88, June 1972; *SIPRI* (Stockholm International Research Institute), *Yearbook 1975*, *Yearbook 1976*, MIT, Cambridge, Mass., 1975, 1976; Philip J. Klass, *Secret Sentries in Space*, New York, Random House, 1971; *Aviation Week and Space Technology*, 1957-1977, almost weekly.

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whatever they may be, may not have the potential of acceptably assuring U.S. authorities of Soviet compliance with future arms limitation agreements that extend to newer, more readily concealable weapons. Thus one may credibly evaluate NTMs in terms of their known achievements and shortcomings.

The capabilities of NTMs are inseparable from their vulnerabilities and in all circumstances perception of capability--or vulnerability--may be more important than the reality. It is the Soviet perception of American NTM capabilities measured against Soviet deception capabilities, or ability to degrade NTM performance, that will be taken into account if an evasion effort is proposed. If the rewards for successful tampering are great, the probability of being caught slight, and the prospective penalty small, evasion becomes increasingly attractive.

From the American side, it is essential to obtain early and unambiguous warning that an evasion effort is underway. Ambiguity is the key. Protracted, small-scale, low-profile indicators will be difficult to detect, identify, and interpret. Lacking an unambiguous indicator, the United States may not be able to respond promptly, positively, and effectively to a suspected violation. The political and economic inhibitors to--for example--quickly investing in a major arms buildup are substantial. Actual military operations, even on a small scale, may be very difficult to stage if there is grave doubt about their justification.¹ For such reasons, *Assured Detection* is likely to be as fundamental to American concepts of strategic deterrence in the 1980s as was *Assured Destruction* in the 1960s.

"National technical means" are--by definition--vulnerable to measures that may *degrade* their assumed effectiveness, *interrupt* their functioning, or *prevent* their operation. Such limitations of capability can be extended by *active* or *passive* interference or any effective combination of the two. Passive interference could take many forms. The concealment of weapons which do not require extensive site preparations is a prospectively feasible passive measure, as are concealment measures justified under the construction processes clause or which can masquerade as innocuous building activities.

¹The Cuban missile crisis of 1962 provides an instructive example of the effects of ambiguous indications on U.S. responses to a perceived but (at least temporarily) unconfirmable challenge. Such ambiguity clogs the decision processes in a democracy.

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Some events may go unremarked merely because they seem unremarkable; they have prosaic "signatures." A unilateral Soviet redefinition of what is a "permissible" species of NTM (passive, legalistic) could exclude some "means" from whatever nominal protection is afforded by the curiously worded non-interference clauses (leading to active interference). And in the late aftermath of the 1974 agreement it became apparent that the phrasing of the agreements permitted some missile development and deployment activities which the United States apparently believed to have been effectively precluded. All of which might suggest that in 1972 and 1974 the USSR had a nice appreciation of what American NTMs could and could not detect. Later changes in silo dimensions, for example, seem to have been relatively slight, but the USSR obviously assumed that they would be noticed and reported. Many interesting clues to Soviet perceptions of the vulnerabilities and capabilities of U.S. NTMs may be buried in the finely worded clauses of the agreements themselves.

With the exception of the final stages of most weapons acquisition programs (operational testing and training), few of the essentials of developing, producing, and deploying a new strategic weapon are intractably unconcealable. If detection can only be postponed and eventually is assured, is that necessarily a substantial objection to attempting concealment? Given the considerable lead times and enormous costs of introducing new weapons, being found out after having largely developed and partly deployed some new weapon might be as advantageous (or disadvantageous, depending on one's viewpoint) as a completed deployment without detection. Weapons imbalances can be as useful for deterrence and coercion as for war fighting, a circumstance both the USSR and the U.S. have recognized and exploited (or attempted to exploit) in the past.¹

In sum, it may be assumed that the "national technical means" permitted by the ABM treaty and the interim agreement, and incorporated by assumption in the Vladivostok understanding, are indeed generally capable of confirming national compliance with the terms of *quantitative* limits on specified weaponry and have at least some ability to detect significant *qualitative* changes.

The continuing controversy about the capability of the Backfire bomber and expressions of American disquiet about the ability of the USSR to quickly convert IRBM-class SS-20 mobile missiles to an ICBM configuration suggest the limits of qualitative assessment. There appears to be no question about the

¹Again, the Cuban missile crisis of 1962 is a stellar example.

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ability of "national technical means" to distinguish MIRVed missiles from similar single-warhead missiles or to detect the replacement of single warheads with multiple-warheads: it is nonexistent.¹ Therefore, the effective capability of "national technical means" must lie somewhere within those difficult to define limiting parameters.²

¹Thomas W. Wolfe, *The SALT Experience: Its Impact on U.S. and Soviet Strategic Balance and Decisionmaking*, R-1686-PR, The Rand Corporation, September 1975, p. 217, reports that the U.S. agreement to accept the placement of MIRV warheads on "some" SS-18s was based on a Soviet commitment to "display certain specialized MIRV-handling equipment alongside those missile sites where MIRVed launchers were being installed--as an aid to verification by U.S. reconnaissance satellites." He cites various articles in the *New York Times*, *Washington Star*, and *Aviation Week & Space Technology* in May and June 1975 as his sources.

²On the MIRV issue, see Herbert Scoville, Jr., testimony before the Senate Foreign Relations Committee, April 1970, quoted in Newhouse, p. 16; Colin S. Gray, "A Problem Guide to SALT II," *Survival*, September-October 1975, treats MIRV and similar uncertainties of verification in some detail; J. I. Coffey, *New Approaches to Arms Reduction in Europe*, Adelphi Papers No. 105, 1974, addresses the broader issue of what kinds of weapons can be verified without recurrent on-site inspection; capabilities assumed by various unofficial estimates are adequately represented by Newhouse, Klass, Greenwood, and the CIPRI articles previously cited. Notably, few of those evaluations give much weight to the normal and natural obstacles to verification--bad weather, night, equipment failure, periodicity of coverage, and the transient nature of many potentially significant indicators. The potential and implications of deception have been little addressed.

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III. SALT II AND AFTER

In the aftermath of the Moscow agreement of 1972 and (particularly) the Vladivostok agreement of 1974, the United States learned a great deal about the value of unilateral interpretations of negotiated arrangements. That the lesson was not entirely lost on the incoming Carter administration is certainly implied by the nature of the initial U.S. proposal for a new SALT treaty. Moreover, both the substance of those proposals and the reception accorded them by the USSR suggest that a combination of institutional, technological, and political considerations not much heeded before 1974 may have strikingly altered earlier assumptions about the acceptable scope and compass of a new strategic arms limitation treaty. Although most commentary in the immediate aftermath of the March 1977 meeting in Moscow focused on the arms balance implications of the Vance proposals, the American offer must also be considered in terms of verifiability, the military relevance of unverifiable or marginally verifiable provisions, and the significance of constraints clearly very difficult or flatly impossible to verify.

The American proposals reportedly extended to: (1) reducing the number of strategic launchers from the 2400 ceiling agreed at Vladivostok to perhaps 1800; (2) reducing the number of permitted "heavy" Soviet ICBMs from 300 to about half that total; (3) reducing the ceiling on MIRVed launchers from 1320 to a reported 1000; (4) imposing limitations on the deployment and development of improved strategic weapons, continuing the freeze on new silo construction, limiting flight tests (and presumably also operational training launches) to a small annual set for each type of ICBM, and banning the test and deployment of new ICBMs; and (5) banning land-mobile ICBMs, limiting cruise missiles to a range of 2500 kilometers, and obtaining from the Soviets "a list of measures to assure that the Backfire would not be used as a strategic bomber."¹

It may safely be assumed that many of the numbers, details, and specifications were intended to be negotiable, but nevertheless that is an intriguing list of limitations, as much for what is not mentioned as for what is actually proposed.

¹*The Times* (Los Angeles), 24 March 1977, quoting Secretary of State Cyrus Vance.

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In that set of limitations, what is verifiable? The aggregate numbers of strategic launchers, the numbers of "heavy" Soviet ICBMs, new silo construction, ICBM tests, and new ICBM developments can be confirmed through the "national technical means" permitted by earlier protocols and treaties. The MIRV genie has been out of his bottle for five years, so whatever consequences are implied by the possibility of adding warheads without increasing throw weight have presumably been taken into earlier account. The Backfire guarantees would seem to be nearly valueless; they are not obviously verifiable by NTMs, in any event. A total ban on land-mobile ICBMs, which the U.S. has consistently sought, may be credibly verifiable, although a numerical limitation is unlikely to be confirmable. As for ICBM "improvements," masked changes may be difficult to detect and interpret unless they extend to new construction (which would be separately banned). That cruise missile range limitations are specified, rather than a ban on cruise missiles, has several implications, but in fact the range of a cruise missile cannot be credibly determined by any feasible inspection although a ban could conceivably be policed if the absence of test and training activities were accepted as positive evidence of compliance.

In that set, then, are three kinds of limitations: (1) controls which merely continue existing practices and extend earlier assumptions (mobile and fixed-site ICBM constraints and launcher counting); (2) nominal limitations with more political than military significance (MIRV and Backfire clauses); and (3) unverifiabilities with potentially major implications for the strategic balance (cruise missile range limitations and ICBM "improvements").

On the surface, at least, the Backfire assurances and limitation on cruise missile range would appear to have much in common: both put more weight on trust than verifiability.¹ Although the role of the Backfire can be even less credibly verified than a cruise missile range limitation, it seems improbable that Backfire could become a major strategic threat to the United States in the short term. In theory, the United States could

¹For Backfire, no more than tanker support and adequate training would be essential, and neither is difficult to acquire; for a cruise missile it is necessary only to add about 15 or 20 centimeters of additional fuselage length for fuel tankage; see *Aviation Week & Space Technology*, 21 March 1977 for a brief description of how to go about converting a 650-mile missile into one with a 1,300 nautical-mile range.

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clandestinely develop a true intercontinental cruise missile from one with a 2,500-kilometer range limitation, but in fact that is a most remote contingency. Except in the operation of intelligence machinery, and there inconsistently, the United States seems incapable of devising and carrying out large-scale development or deployment programs without great public clamor.

Striking for its omission from the American proposals is mention of the problems presented by "exotic" weapons. They have been the subject of occasional comment, mostly of the "pointing with alarm" kind, but in fact precedent for dealing with "exotic" weapons was established in 1972. The ABM treaty covered "conventional" systems and included an "agreed interpretation" which provided for future discussion of "specific limitations" on systems "...based on other physical principles and including components capable of substituting for ABM interceptor missiles, ABM launchers, or ABM radars..." The experts on both sides obviously agreed that it was impossible to conceal a conventional ABM system and also impossible to define controls applicable to an unconventional, unspecifiable system.¹ There is no reason to challenge the soundness of that basic judgment or its relevance to other "exotic" weapons.

From time to time since 1946, several alternatives to "national technical means" have been proposed for verifying compliance with arms agreements.² Although more or less consistently refusing to consider on-site inspection, the USSR at one stage in the Helsinki meeting of 1968 informally advised American negotiators that it was not categorically ruled out. But in the course of that meeting the categorical was enunciated, and since that time it has not received serious consideration.³ A prohibition on certain categories of research and development has also been suggested, but without

¹ACDA, "Text and History of Negotiations," pp. 134-136.

²In what follows, there is no consideration of "verification" based on conventional espionage or defector-provided information. Credibility--the ambiguity problem--is the sticking point.

³Newhouse, p. 174. It is interesting that the complete rejection of the on-site inspection option by the Soviet Union followed closely on the internal, unannounced decision of the Johnson administration that while the Americans should continue to hold out for that verification mode they could, in the end, accept arms limitations verified by "unilateral capabilities."

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recurrent close inspection it is fundamentally unverifiable. Size constraints, chiefly for ICBMs, were discussed at Vladivostok (and earlier); for a time the U.S. apparently believed that although the USSR had not acceded, a unilateral U.S. statement of what constituted "acceptable" size growth in ICBMs would be honored. As earlier noted, the Soviet Union ignored the U.S. interpretation and proceeded to carry out a missile replacement program which had presumably been ready for implementation at the time of the talks. Size is, to some extent, verifiable by "national technical means." That is apparent from public statements by U.S. spokesmen about the dimensions of the new Soviet SS-18s. But observable size has little to say about several vital aspects of performance (MIRV capability, guidance accuracy, silo and missile hardness, command and control arrangements, reload potential, and so on). Indeed, without making critical assumptions about throw-weight tradeoffs, it is not possible to extrapolate confidently from external dimensions to missile range or warhead size.

Calculations of maximum aircraft range have been worthless since the first demonstration of aerial refueling in the 1940s. The credibility of estimates based on tanker numbers and performance has been doubtful for nearly two decades; readily obtainable conversion kits can quickly transform almost any large civil or military aircraft into a tanker. Counting tankers is not a promising approach to controlling strategic bomber inventories.

Monitoring military budgets to verify arms control agreements has been suggested since the Hague Peace conference of 1899. The USSR advanced more than 20 such proposals between 1946 and 1977, but in all instances means of verification were either unspecified or were so vague as to be unacceptable to the West. The objection to budget monitoring has been most aptly expressed by Sir Donald Maitland; in November 1973 he asked the U.N., "Who will take us seriously if our suggested starting point is arbitrary and unverifiable deductions from an unknown quantity?"¹

Skepticism about the motives of the USSR in repeatedly urging budget reduction as a disarmament device arises mostly in the fact that Soviet military expenditures have never been public detailed and in the widespread conviction that the announced totals exclude substantial concealed outlays

¹Quoted in A. S. Becker, "Soviet Proposals for International Reduction of Military Budgets," The Rand Corporation, P-5837, March 1977.

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elsewhere in the Soviet budget.¹ Indeed, although one 1955 Soviet proposal on budget limitations provided for a control commission with "unimpeded access" to budgetary records, that access was conditioned on the prior acceptance of general and complete disarmament by all major nations.

The likelihood that limitations on or reductions in the size of a national military budget may become an important element of arms control is proportional to the willingness of the USSR to make detailed budgeting information accessible to international inspectors. Although such an arrangement would, in effect, disclose less about the nature of military hardware than most other verifiable arms control measures, it would also violate fundamental Soviet behavior patterns. Without a major change in the traditional Soviet refusal to release any military information, no proposal to limit military expenditures can receive serious consideration in the West.

A prohibition on missile R&D testing or operational testing, or stringent limitations on their frequency and scope, has interesting implications for arms control. ICBM test controls were part of the Vance package rejected by Moscow in March 1977. They are obviously verifiable, at least for ballistic missiles of the present sort, although accuracy, range, throw weight, and MIRV capability will not necessarily be disclosed in the course of an artfully conducted test program. If adopted, such controls would complicate if not preclude the development and introduction of new ballistic missiles. But the unqualified assertion that "no nation would replace existing reliable missiles and consider initiating a nuclear war with a missile which had only partly been tested"² is at least a slight exaggeration and in any case is contradicted by history.³ Testing a ballistic missile at full range may be desirable, particularly from the viewpoint of prospective operators, but it is not essential to individual tests of key subsystems or to their successful integration; a two-stage MRBM can rather easily become a three-stage ICBM. It is conceivable

¹A. S. Becker, *Soviet National Income 1958-1964*, University of California Press, Berkeley, 1969.

²Scoville testimony, quoted in Newhouse, p. 16.

³Both the U.S. and the USSR have in the past deployed "operational" missiles which had not been fully tested--and other, if less complex systems, also. In that connection the 1944-1945 practices of the Germans deserves some attention; responding to the perceived needs of the time, they operationally deployed and used several technically advanced and incompletely tested systems, to the occasional distress of the Allies.

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that various atmospheric missiles, aircraft, submersibles, and "exotic" devices with application to strategic warfare could be extensively tested without attracting attention. The Soviets are past masters in the art of *maskirovka*--cover and deception. Although investing in a covert development which did not permit full scale testing might be difficult for the USSR, the chief difficulty is likely to lie with the institutional predelictions of the Soviet R&D bureaucracy rather than with an inherent operational or technical obstacle. The *willingness* of Soviet military institutions to risk the operational use of a partly proven system may be insufficient even if the risk seemed slight.¹

A prohibition on mobile ballistic missiles would be verifiable to the extent that any concealable missiles can be found, counted, and evaluated. A mobile missile is by nature composed of elements small enough to be transportable over ordinary road and rail networks, so it is far from certain that a carefully masked deployment would be noticed or, if indications were at all ambiguous, that effective counteraction could follow.

On-site inspection, highly touted in the days when there appeared to be no other meaningful alternative, last received serious consideration in 1968 during early discussions of a MIRV ban. It may be doubted that the Americans would have accepted such controls in the end, given that Soviet inspectors could then have moved from silo to silo, tipping up the nose cones on missile warheads and viewing the details of the interior fittings at close range. Random, unannounced, total access to all national installations will not lightly be conceded to one state by another, and inspection that requires routine announced-in-advance notice may not uncover much that the inspected party is anxious to conceal.²

¹But it may also be true that Soviet military officials are so accustomed to receiving imperfect operational test articles that their experience would totally condition them against accepting any such risk.

²Coffey, *loc cit*, does not entirely accept this argument, but most commentators have acknowledged the inherent shortcomings of a constrained on-site inspection process. An inspection of production facilities would provide considerable, though perhaps insufficient, assurance that no major evasion of a weapons limiting treaty was in progress *if* access to all suspect production sites were permitted, if the suspect article were so conspicuous that it could not be built in bits for later assembly in out-of-the-way installations, and if the inspectors were permitted to make surprise visits. Whether the United

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Permitting reconnaissance aircraft to fly freely over the territory of an inspected nation is a verification mode that has been mostly ignored since the early 1960s. Doubtful political acceptability weakens its prospects. Yet the Soviets were willing to entertain such a scheme in early discussions of tactical arms control measures, and the "Open Skies" approach first suggested to President Eisenhower in 1953 has some singular attractions for a world of MIRVs, land-mobile ICBMs, cruise missiles, and other strategic gadgetry of a nuclear age. It lacks some of the more intrusive aspects of on-site inspection, promises a prompt and direct view of a suspect activity, and still can be conducted without directly exposing the military hardware of the host to the close scrutiny of an inspector. Concealment of any major weapons activity would be difficult because reconnaissance aircraft need follow no set path, must conform to no schedule, and are not necessarily inhibited from performing their assignments by night or bad weather. Securing acceptance of the notion and working out operating details would be troublesome. But as a verification mode inherently less objectionable than most others involving inspection and characteristically less vulnerable to cover and camouflage than "national technical means," it would provide high assurance that almost any sort of limitation--on mobility, on new developments, on numbers of missiles or bombers or tankers, on ICBM size--could be verified with high credibility. Moreover, it would be comparatively cheap, which creates the possibility that many nations could participate actively in arms control agreements without having to rely on the good will of one of the superpowers for verification assurance. If no more acceptable alternative can be constructed, aerial reconnaissance may come to represent the only feasible way of verifying limits on many of the troublesome new weapons made possible by technology.¹

States, much less the Soviet Union, would consent to such inspection by unfriendly foreign nationals is very doubtful. A most comprehensive analysis of on-site inspection was available as early as 1961; see B. T. Feld, "Inspection Techniques of Arms Control," in D. G. Brennan (ed), *Arms Control, Disarmament, and National Security*, New York, Brasillier, 1961, pp. 317-333. Not much of substance has been added to the discussion since then.

¹The literature on aerial reconnaissance, "Open Skies," and related issues is vast. Probably the best brief overviews are A. H. Katz, *Some Notes on the History of Aerial Reconnaissance*, P-3310, The Rand Corporation, April 1966, and *Selected Hearings in Aerial Reconnaissance*, P-2762, The Rand Corporation, August 1963. In the latter, the short articles by Colonels R. S. Leghorn and R. W. Philbrick are of particular interest.

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Such aerial reconnaissance would indeed be productive of information that could be exploited for tactical, technical, and strategic intelligence purposes. But so, presumably, can information derived from "national technical means." The difference is largely one of perception and acceptance--the perception that without means of providing credible verification capabilities there may be *no* agreements to limit some of the new weapons; and acceptance of the notion that if the price of adequate and acceptable verification capabilities proves to be *mutual* abandonment of some treasured elements of secrecy (not necessarily security), it may have to be paid.

Given the increased sensitivity of the U.S. to possible Soviet violations of a new and enlarged arms agreement and the suspicion engendered by Soviet actions (which, if within the letter of the arms agreements, plainly were contrary to their spirit *as represented to Congress by the American arms negotiators*),¹ it seems unlikely that uncertainties of verification acceptable to some technical experts and arms control specialists will survive Congressional objections.

One other matter requires attention: the growing divergence of Russian and American views on what should be controlled and how. It is not so much numbers that are in dispute, or even types of weapons, although both present difficult negotiating points. The fact is that the USSR once more finds itself in grave danger of becoming inferior to the U.S. in strategic weaponry, after having invested more than a decade and enormous resources in attempting to overcome a comparable disparity of the mid-1960s. The difficulty is that the U.S. is once more on the point of introducing a new and potentially destabilizing weapon into the strategic equation and once more the Soviet Union cannot readily match or offset it.

The United States came away from SALT I bothered, in Thomas Wolfe's words, "by differential quantitative levels intended to compensate the Soviet Union for a notable, but not necessarily permanent U.S. technological lead, while the Soviet side's concern to close the qualitative gap in certain strategic technologies, especially in MIRV, have not been met."² Either side had the right to improve the quality of its strategic arms within the limits imposed by the agreements, and the Vladivostok agreement provided, at least

¹See Gray, *Survival*, September-October 1975.

²Wolfe, R-1686-PR.

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tentatively, that both land-mobile ICBMs and strategic bombers would be counted in an eventual limitation on launchers. The USSR has proceeded, as obviously was planned at the time, to upgrade its strategic missile force, to improve its quality. The American bomber fleet is vintage-1950 design updated with vintage-1960 munitions and electronics and there is not much national enthusiasm for spending some \$20-plus billions to replace it. The still-embryonic M-X missile to supplant Minuteman faces similar objections. Were the U.S. to postpone action on the B-1 and the M-X, a Soviet ICBM improvement program would in the long term become an increasingly credible threat to Minuteman and would make SLBMs the only U.S. retaliatory force neither obviously threatened nor approaching obsolescence. But the introduction of air-launched cruise missiles would entirely upset that calculation, potentially extending the useful life of the U.S. strategic bomber fleet by another 20 years. A land mobile cruise missile would alter the accounts still more thoroughly (particularly if adopted by the NATO nuclear powers), and sea-launched cruise missiles promise to expand the strategic potential of submarines at slight cost. The painfully accumulated Soviet counterforce capability, if that is what the ICBM improvement program portends, would be severely straitened, a circumstance that American planners could not but find comforting.

Nor is there an easy and effective Soviet response. The underlying Soviet dilemma was indirectly expressed by Brezhnev's June 1975 proposal to ban the development and production of "new types of weapons of mass destruction, and ... new delivery systems for those weapons." The same theme appeared again in a 1976 report of the Central Committee of the Communist Party of the Soviet Union to the 25th Party Congress.¹ Coupled to the persistent Soviet reluctance to constrain *improvements* to existing weapons, that theme comprehends a fundamental Soviet handicap in efforts to obtain and preserve equivalence (or superiority) in strategic arms. The difficulty arises in marvelously complex institutional problems that have no obvious relevance to arms control objectives, the ability of the U.S. or the USSR to pay the growing bill for new strategic weapons, or the scientific and technical competence of either. In simple terms, the history of the past 30

¹See discussion in M. A. Milstein and L. S. Senejko, "R&D Through Soviet Eyes," *Bulletin of the Atomic Scientists*, February 1977, pp. 33-38.

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years suggests that the R&D institutions the Soviets have built at such great cost are incompatible with their needs for strategic weapons development. In what must now be acknowledged to be the most important aspect of strategic weapons development, the ability to exploit newly emergent technological opportunities, the Soviet Union seems unable to compete with the United States.

Why?

The USSR ordinarily invests in an R&D process that relies on incremental, sequential improvement of previously developed and deployed weapons--with certain important exceptions--and the United States normally prefers technological thresholding--also with some significant exceptions. Though individually important, the exceptions require painful departures from normal practices and cannot become "normal" in either country within the next decade or two. Conventionally, the Soviet Union begins weapons development from a baseline of adequate but comparatively inferior technology and builds toward a substantial inventory of gradually improved, specialized weapons. The United States, acting from a different institutional base and impelled by perceptions and budgetary procedures very different from those of the Soviets, classically invents a weapons approach, rapidly perfects it, and deploys what are perceived to be adequate quantities of the resulting systems--and then usually forgoes improvement efforts in favor of new investments in new and different weapons technologies, systems concepts, or operational applications.

Such differences in process, procedure, and institutional predilections have been sometimes remarked in the past, but generally because the Soviet approach seemed advantageous. The advantages of sequential, incremental development have been urged on the American defense establishment for several years: as compared to the preferred American technique for developing tanks, aircraft, and certain other kinds of weaponry, they appear to afford good opportunities for reducing development costs, abbreviating development schedules, and substantial lessening development risk.¹ But the advantages

¹Arthur J. Alexander (*R&D in Soviet Aviation*, The Rand Corporation, R-589-PR, November 1970, *Weapons Acquisition in the Soviet Union, United States, and France*, P-4989, March 1973, and *Armor Development in the Soviet Union and the United States*, R-1860-NA, September 1976) and Robert Perry (*A Dassault Dossier: Aircraft Acquisition in France*, R-1148-PR, September 1973, *System Acquisition Strategies*, R-733-PR/ARPA, June 1971, and "Two Approaches to Aircraft Development: The USA and Europe," *Interavia*, 4/1973) argue for applying the sequential, incremental development approach to U.S. military aircraft and armored vehicle programs.

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of a sequential, incremental improvement strategy may have important limitations that have not been examined in sufficient depth. There is evidence that in some, though not necessarily all types of weapons, incremental processes will ultimately become ineffectual, generating technically interesting but operationally marginal improvements, unless new and potentially risky technology is periodically infused. In weaponry development (and some other high technology enterprises, for that matter), incrementalism copes badly with rapid or radical changes in the technology base. Armored vehicles benefit greatly from incremental improvement because strikingly new concepts appear infrequently and attempts to accomplish radical advances seem fated to great difficulty, high cost, and small certainty of success. Most aircraft probably are in the same category, although technological brinkmanship occasionally pays major dividends (the SR-71, for example). But in fields where concepts may change quickly, where technological innovation can radically alter the basic nature of application and operation, incrementalism and sequential improvement seem to be less appropriate.

All of this may appear to be totally irrelevant to questions of verification and future arms control. But it is not. Both Soviets and Americans habitually indulged their preferred development strategies without regard for differences of risk or advantage in various areas. The Soviets after 1948 invested heavily in ICBM development and achieved an impressive early lead. Not until the opening of the Sputnik era did the Americans make a similar commitment, but they invested massively in accelerated development and within four years had not only overtaken a perceived Soviet lead, but were deploying more and better strategic missiles than were the Soviets.

What then? Starting almost anew in 1963, the Soviets committed still more heavily to ICBMs. But with few exceptions they continued to rely mainly on sequential and incremental development for both defense and offense: Backfire, the SS-11 through SS-20 missiles, the Galosh ABM, and their SLBMs all built on earlier weaponry--skillfully, artfully, ingeniously, and with increasing success, but nonetheless incrementally. The Americans, operating from a very different base of tradition, institution, and motivation, continued to put most of their emphasis on new technology and radical weapons innovations: solid-fuel ICBMs, SLBMs, MIRVs, and (most recently) cruise missiles are representative examples. Each of those weapons innovations has gravely complicated the Soviet's problems. One can almost

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sympathize with the frustrations of Soviet weapons planners; having put billions of rubles into development and production programs which made their weapons qualitatively and quantitatively competitive with weapons in the American strategic inventory, the Russians observe that the Americans have anticipated them in the development and deployment of some new strategic device that will, if widely deployed, substantially invalidate the hard-won Soviet force equivalence--or superiority. The cruise missile, again, is but the latest and one of the most obvious instances of that trend. It is as though the USSR invited the U.S. to a soccer match with their championship team and the Americans chose to appear wearing heavy pads and helmets, carrying an ovoid rather than a spheroid, and bringing their own referees.

Why cannot the Soviets merely abandon their commitment to incrementalism in strategic weapons development and match the Americans, innovation for innovation? It certainly is not for lack of scientific enterprise or success in mastering the basic sciences. Nor can it be unwillingness to invest resources. The central difficulty of Soviet strategic weapons development would appear to be incapacity to match the doctrinal and procedural flexibility--and the sometimes perplexing variability--that is a normal concomitant of American military research and development. Notwithstanding its notorious flaws, which the American political establishment has thus far put up with, the American R&D system is surprisingly capable of accommodating to rapid starts, stops, and changes of direction. American economic, political, and military institutions operate in a ferment that encourages rather than impedes such "instability"--to the considerable annoyance of many who would prefer less turmoil and greater institutional security. But if policy instability tends to disrupt progress toward one goal or another, it also ensures that new initiatives, alternative goals, different allocations of resources, and new technology are periodically given serious consideration. And that is not automatically provided by the more rigid institutions of the USSR.

In order to compete successfully with the Americans on similar terms, the Soviets must change not merely their design and development preferences, but their political and ideological institutions. Technological progress of the sort characteristic of American strategic weapons development is incompatible with a structure that consists of monolithic, intricately interconnected planning and production commitments, abhorrence of labor reallocation

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measures, long production runs interrupted only by the occasional introduction of "improved models," separately compartmented civil and military R&D establishments inhibited from effective interchanges of technology, and doctrinally dictated management processes.¹

The American system thrives on high risk and high, if uncertain, payoff. The Soviet system is committed to risk aversion and seems more assured, if lower-value, payoff. Those are not the consequences of economic constraints alone; they arise in institutional factors that have ideological bases and are not easily abandoned.

Soviet awareness of and attempts to exploit Western-style R&D and industrial management processes have recently been pronounced. It is also true that the Soviet military R&D sector seems to be somewhat less inhibited by institutional rigidity than the civil sector. Nevertheless, the differences between standard Soviet military R&D approaches and standard American R&D approaches remains so large, and the products of the differences so great, that the Soviets are continually reconfronted with the necessity of acknowledging and wearily renewing the pursuit of a substantial American lead in important aspects of strategic weapons technology.² So long as that situation persists, so long as the Americans maintain a lead in important elements of strategic weaponry, the Soviets cannot hope to achieve the stable strategic balance (or advantage) that they have so assiduously pursued for the past 20 years.

¹It is an interesting commentary on institutional preferences that the American military hierarchy and the arms industry appear to prefer the Russian model because it promises continuing, high-rate output, steady employment, and recurrent "modernization" of weapons inventories--all of which are perceived to be Soviet advantages.

²If the U.S. has not yet noticed these circumstances, it remains that the Soviets have for several years expressed concern about them. Consider the observation that "the reliability of the existing [arms limitations] agreements may be considerably reduced if the United States continues its policy of achieving scientific and technological superiority in strategic arms developments..." K. U. Kulish, in *Survival*, Vol. 15, No. 5, September/October 1972. The comment appears to have been motivated by the outcome of the earlier MIRV "revolution," but it certainly is as relevant to cruise missiles and other new devices of weaponry.

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IV. CONCLUSIONS

Soviet military doctrine incorporates a concept of, and the USSR has sought, strategic superiority--the possession of vastly superior forces coupled with an ability to strike first, thus limiting damage to the USSR. Soviet leaders appear to be structuring their forces not merely to survive and retaliate for any attack, but to exploit--by coercion, for deterrence, or if necessary by war--any opportunity that the acquisition of strategic superiority might present. Verification of Soviet compliance with the agreed terms of a strategic arms limitation agreement is, therefore, an obvious and necessary but not sufficient condition for U.S. confidence that major asymmetries in the strategic balance will not occur.¹ The goal of the United States is to obtain credible assurance that the USSR cannot clandestinely acquire destabilizing strategic capabilities. While there remains any substantial doubt of U.S. capabilities to detect Soviet deceptions, the U.S. will balk at accepting unverifiable Soviet assurances. So long as the Soviet Union views all non-client states as potentially malevolent, the Soviets will resist verification processes that enlarge U.S. knowledge of their strategic capabilities. That is the dilemma of arms control.

Three principal outcomes seem possible. One is to continue the present uneasy mutual accommodation, applying arms controls only to those older weapons which can be found and counted by "national technical means." Newer weapons, not accountable by those means, probably would proliferate. A worst case involves breakdown of arms control negotiations, which not only invokes the prospect of a large-scale arms buildup on both sides but conceivably could encourage the Soviets in the belief that because they cannot win a technological competition they might as well seek immediate advantage by coercion and intimidation, risking nuclear war, in order to prevent the development of a situation increasingly unfavorable to them. The best conceivable outcome might be an agreement that further reduced present levels of nuclear weapons and effectively restrained the introduction of new systems--but that cannot occur unless there is concurrent agreement on verification measures that provide high assurance of compliance. Some form of close

¹A. S. Becker, "Strategic Breakout as a Soviet Policy Option," unpublished manuscript, 1977.

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inspection may be the *sine qua non* for the United States, perhaps as a reinforcement of "national technical means," perhaps as a replacement.

Whether the U.S. Congress could be brought to accept a complete ban on the introduction of new delivery systems without insisting on greater credibility of verification is uncertain. The argument that as détente progresses greater uncertainties of verification can be accepted¹ is attractive in the abstract, but it may be inconsistent with the realities of American politics and the inventiveness of military designers. "National technical means" have been defined by the U.S. government as invoking "sophisticated methods of data collection which do not operate from installations in the territory of the parties being monitored..."² If what is wanted is a means of verification that provides greater assurance than "national technical means" and is less intrusive than on-site inspection as traditionally defined, then a fundamental alteration of earlier verification concepts must follow. It seems apparent that "national technical means" do not provide the assured detection capabilities the U.S. Congress wants and which the USSR will not tamely permit.

At least some senior officials of the Soviet Union are sure to be aware of the technological and institutional paradoxes that inhibit the USSR in its competition with the United States for strategic advantage. Without a major overhaul of Soviet political and industrial institutions, which would discomfit Soviet leadership, no effective remedy can be applied. A reasonable, if not wholly painless Soviet alternative would be to forgo an unpromising new arms race by making verification concessions to the United States in return for a mutual ban on the development of new weapons--particularly the cruise missile, but also the land-mobile ICBM. The *quid pro quo* for the United States is not inconsiderable: abandonment of development of a weapon which promises, relatively inexpensively, to negate the increasingly threatening Soviet counterforce potential.³ That concession is certain to be

¹Jam M. Lodal, "Verifying SALT," *Foreign Policy*, No. 24, Fall 1976, pp. 40-64, summarizes that viewpoint.

²ACDA, *Verification: The Critical Element of Arms Control*, p. 15.

³It is not obvious that the U.S. can restrain its allies from developing cruise missiles, which may further complicate the arms control negotiations and even make multi-national rather than bi-national agreements--and verification--essential. But that is a topic for another paper and another time.

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