Senate Skeptical on SALT Verification

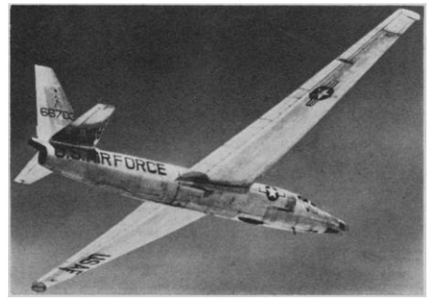
Carter officials say the loss of Iran will not significantly damage intelligence on arms control

In what may be the most important foreign policy proceeding of the decade, Congress began its review of the Strategic Arms Limitation Talks agreement (SALT II) on 9 July in the Senate Foreign Relations Committee. The members will spend all of July, and—after an August vacation—part of September probing for weaknesses in the treaty. The intelligence committee began closed hearings on arms surveillance techniques on 11 July, and the Armed Services Committee plans its own review beginning at the end of the month.

The vote on the Senate floor is not expected until November, after every nit has been picked. Unlike its predecessor, SALT I, which sailed through the Senate 7 years ago 88 to 2, SALT II will be lucky to win the minimum 67 votes needed for passage. If it fails, a new horizon in the arms race will open before the United States and the Soviet Union, whose economies are strained already by energy shortages.

During its summer trial, the treaty will have to overcome two major hurdles. The first is the more comprehensive, having to do with the treaty text itself. Senators will want to know whether the language is well drafted, whether it permits unnoticed exemptions, and whether the restrictions apply with equal stringency to the Soviet Union and the United States. Committed opponents of SALT II—including Senators Henry Jackson (D-Wash.) and Jake Garn (R-Utah)—will stress imbalances in this area that seem to favor the Soviets. For example, the critics plan to make much of the fact that the treaty allows the Soviets to retain 308 very heavy missiles, known to the specialists as SS-18's. The United States has no weapons on this scale because our military planners chose to develop smaller, more versatile missiles.

The second hurdle is the verification problem. Even if it is agreed that the terms of SALT II are reasonable, the Administration will still have to prove that the United States has the means to verify that the Soviets are not cheating. Although this is a narrower and more technical issue, it has become important this year for several reasons. When the Islamic revolution swept Iran in 1978, the United States lost radar and radio reconnaissance bases that were valuable in monitoring test missiles launched from Tyuratam in the southern part of the Soviet Union. Secretary of Defense Harold Brown admitted in April that, as a consequence, the United States lost a degree of certainty in missile monitoring. But, he said, the loss was not significant for arms control and will be made up in any case within a year by other means—apparently with the use of Turkish radar bases, possibly Norwegian radio listening posts, reconnaissance planes, and, within a few years, new radar-carrying satellites.



Early version of the U-2 that may substitute for Iranian surveillance posts.

The verifiability of SALT II has become a key issue for moderate senators who have not yet announced a position and believe they may be taking a political risk at the polls if they support the treaty. They must be assured in strong language that the treaty is verifiable. The loss of the Iranian stations has put the Administration on the defensive on this question in a way it is not defensive about the treaty itself, partly because officials have given ambiguous reports. Before Brown made his reassuring statement in April, the director of the Central Intelligence Agency, Admiral Stansfield Turner, reportedly told the Senate Armed Services Committee in closed session that the United States would not be able to recoup the loss in Iran in time to monitor compliance with SALT II. A National Security Council staff member said: "At first we were worried, but when we read the transcript of Turner's testimony, we discovered that it had been deliberately distorted by a member of the committee who leaked it to the press. There was nothing wrong with it at all." This staffer claimed that Turner's views are identical with Brown's. But the Secretary's clarifications have done little to calm Congress.

Indeed, Senator John Glenn (D-Ohio), a member of the Foreign Relations Committee, has made verification his pet issue. He has been trying for months, without much success, to elicit information on gaps in the monitoring of strategic weapons programs in the Soviet Union. Glenn describes himself as a supporter of SALT II, but he intends to grill the Administration's witnesses about the potential for Soviet cheating. An aide to Glenn said with pride that this exercise could make or break the treaty, for many undecided senators will follow Glenn's lead.

What are the areas in which the Soviets could cheat and gain a significant advantage? A comprehensive list might include the chief worries of Glenn, Jackson, and Howard Baker (R-Tenn.), the Republican leader and self-described "moderate" opponent of SALT II. On 27 June Baker announced he would not support the treaty in its present form and gave as one objection the view that the United States will not be receiving enough data on the Soviets' new missile tests.

Jackson finds many deficiencies in the treaty, and his SALT expert Richard Perle mentioned four verification problems: surveillance of new missile development, monitoring of mobile intercontinental ballistic missiles (ICBM's), and detection of the range of the Backfire bomber and the cruise missile.

Glenn is preoccupied with improvements in missile technology. The Iranian revolution brought a "major loss to our technical capability" to watch Soviet tests, Glenn's staffer said, and the "rules they're using now for monitoring confidence would not have been acceptable a year ago." In Glenn's view, two things

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must be done to make the treaty acceptable. First, a replacement must be found for the Iranian stations. If reconnaissance planes are to be used, the senator would like some guarantee that the Soviets will announce every missile test in advance. (They have agreed in the treaty to announce any test with two or more simultaneous firings.) This would make it possible to move surveillance planes into position to watch most of the missile's launch and trajectory. As things stand, the planes cannot be kept flying around the clock, nor can they become airborne fast enough after a lift-off to record early launch data.

Second, Glenn is unhappy about the section permitting the Soviets to encrypt some missile telemetry (data on performance radioed from the test vehicle to ground stations). The treaty forbids the Soviets to encrypt telemetry in any way that might interfere with verification of SALT II. But the critics and Glenn argue that this is a mistake; it will be difficult to draw the line between permissible and illegal encryption, they say.

Air-launched cruise missile.

Science asked three civilian encryption experts—Augustus Simmons of Sandia Laboratories, Martin Hellman of Stanford University, and George DaVida of the National Science Foundation—whether encryption codes for Soviet telemetry could be cracked. All stressed that they knew little about military techniques, but they said that, if civilian codes are a guide, the encrypted telemetry is probably undecipherable.

Thus, missile testing is the chief worry of those who are concerned about verification. This is appropriate, for the treaty's most ambitious undertaking is to freeze or slow the pace of development of new weapons technologies. The surest way to enforce the freeze is to limit testing, for no strategic planner can rely on a weapon that has not proved itself. Equally important, an untested weapon is an unpersuasive threat to the enemy and is of no practical value in international affairs.

The risk in relying on a test ban, of course, is that if one party were to steal a march on the other in secret testing, it could raise itself to a position of marked superiority.

In the most threatening scenario along these lines, the Soviets might put extra warheads on the SS-18 missile, which now carries 10 warheads—the limit under SALT II. These are known as multiple independently targetable reentry vehicles (MIRV's). The missile could carry 20 to 40 MIRV's but has been tested with only 10 to 12. With more than 300 of these missiles, potentially carrying 6000 large warheads, the Soviets could be confident (especially with more accurate guidance systems in the future) that they could knock out 90 percent or more of the U.S. land-based intercontinental force of 1000 Minuteman missiles and 54 large Titans. This is the backbone of the U.S. strategic force. In order to do this, the Soviets would have to fire first. If they did, and if they were successful in knocking out the U.S. missiles without provoking any U.S. response, they would still have to worry that the United States might strike back later with several thousand warheads launched from submarines and bombers. These and other surviving weapons would have the power to destroy the Soviet Union's 200 cities many times over, making the whole scenario improbable.

Nonetheless, the SS-18 is viewed already as a modest threat in this scenario. The SALT critics charge that, with modernization, this missile could become an assured Minuteman killer. In terms of verification, then, could the Soviets surreptitiously alter and test heavy missiles like the SS-18 to make them Minuteman killers? Could they do this with other systems? Could they introduce entirely new missile killers and do so without U.S. knowledge?

Because the United States would have no foolproof means of verifying them, SALT II contains no restrictions on missile accuracy. This is a pity, said Herbert Scoville, Jr., former deputy director of the Central Intelligence Agency and vice president of the pro-SALT Arms Control Association. Scoville believes it would have been worthwhile to limit accuracy in some way, even at the risk of losing confidence in the verifiability of the treaty. There are ways of detecting improvements in Soviet missile accuracy, he said, but none hard enough to satisfy Senator Glenn. For example, mid-course corrections in the trajectory made by a sophisticated guidance system can be detected.

Accurate missiles are threatening because they can be used to destroy an enemy's ICBM's in a first strike. The more accurate they are, the more threatening. U.S. missiles are more accurate but, according to Scoville and others, the Soviets are catching up and are considered to be a year and a half behind.

Low accuracy can be compensated for with high explosive megatonnage, and this is where the Soviets have put their money. The SS-18, MIRVed or un-MIRVed, carries between 10 and 25 megatons of explosive power, while the Minuteman carries between 0.5 and 2 megatons. The United States also has 54 older Titan missiles, which carry about 9 megatons each, and the Soviets have some new 5-megaton carriers. In terms of "circular error probable"—the radius of a circle around a target within which half the warheads aimed at it would hit—the big Soviet missiles are thought to have an accuracy of around 1200 feet, and the later version of Minuteman, around 750 feet (*Science*, 22 September 1978, p. 1102).

Although the SALT negotiators did not try to limit accuracy itself, they sought to limit changes in other, easily verifiable aspects of technology so that the "essential equivalence" in force between the United States and the Soviet Union would be frozen. No ICBM deployed as of May 1979 may be changed in any of the following respects under SALT II: the number of stages, the type of fuel (liquid or solid) in any of the stages, or—by plus or minus 5 percent—the length, diameter, launch weight, or throw weight. In addition, all weapons "associated" or flight-tested with MIRVed warheads are to be counted as MIRVed weapons. A limit of 820 "launchers" of MIRVed ICBM's is permitted on each side. Other ceilings limit submarine-, sea-, and air-launched weapons. Furthermore, the Soviets are

specifically limited to no more than four MIRV's on the SS-17, ten on the SS-18, and six on the SS-19.

Any modernization that causes a weapon to exceed the limits described above will create a new type of missile or violate the treaty. Only one new type is permitted each side. It must be light (defined as not heavier than the Soviet SS-19). It may not carry more than 10 MIRV's. Other clauses specify what a new type is, freeze its dimensions after 25 launchings, and so on.

This forest of restrictions was designed, according to Spurgeon Keeney, Deputy Director of the Arms Control and Disarmament Agency, to create a narrow passageway through which a new technology will have to move on its way to becoming an accepted feature on the strategic scene. U.S. experts in missilery have already gone part way along a path which they believe the Soviets will have to follow. There are few routes to chose from, and the Americans believe they know the best. For example, U.S. missiles not only have better guidance systems, but they may use a better fuel as well. The new ones are powered with solid propellants, making them stable, reliable, and easy to transport in a launch-ready condition. The Soviets have finished work on just one solid-fuel strategic weapon, the SS-16, and this appears to be a lemon, Scoville said. Because it presented a special problem for verification, the U.S. negotiators sought to have it banned outright. The Soviets acceded, promising not to develop, test, or deploy the SS-16 or any of its unique components for the duration of the treaty (until 1985). It seems unlikely the Soviets would have gone along with this had they considered the SS-16 of any value, said one Pentagon expert.

The new weapons in the Soviets' strategic arsenal all appear to be liquid fueled. They require many valves and high-speed pumps, which can be balky and must be tested periodically. Because of the distinctive noise (in early models) or the telemetry they transmit in launching, they clue U.S. eavesdroppers to the type of fuel being used in tests. These missiles cannot be transported safely when fueled. Fueling requires a considerable logistical effort, which may be spotted from space. Once fueled, they must remain in a vertical position, in a launcher, which may also be spotted from space. (U.S. photoreconnaissance satellites are now thought to be able to resolve objects on the earth's surface within a breadth of 3 or 4 inches. These satellites operate only in daylight, when there is no cloud cover. New radar satellites that may be in place in a few years will probably make it possible to "see" large objects such as missile transporters at night or under cloud cover.) Some of the mechanical problems of liquid fueling could be eliminated, but only if the Soviet missile force were redesigned, and that would require a lot of flight testing.

How might the Soviets cheat on testing? They would be ill-advised to test extra, unauthorized MIRV's, for they would probably be caught very quickly. Every Soviet launch is spotted by infrared-sensitive satellites in outer space, which alert other satellites, reconnaissance planes, ships, and ground radar installations. MIRV testing can be monitored both at the high point in the trajectory, where the launching "bus" maneuvers to eject the warheads, and at the tail end of the test range, where the warheads fall to earth. By tracking the path of the reentry vehicles, the United States can gauge their approximate weight, and thus their rough megatonnage. A measure of the effectiveness of this monitoring was the discovery, leaked to the *New York Times* this spring, that the Soviets in December tested a MIRVed SS-18 with 10 warheads, but maneuvered it in such a way that it could have dropped 12. This test was spotted without the help of the Iranian stations, which were then defunct. This test caused the negotiators to write a new clause into SALT II banning maneuvers like this one that simulate MIRVing above the legal limits.

The loss of Iran means that the United States no longer has direct line-of-sight radar monitoring of the Soviet test site in Tyuratam, and can no longer pick up the telemetry given off during the last moments of the firing of the first missile stage. From Turkey, the United States will be able to focus line-of-sight radar on the firing of the last moments of the second stage. With the help of U-2 spy planes, the United States may be able to push the horizon back almost to the level available in Iran. According to Robert Kaiser in the Washington *Post*, the radar in Iran could pick up missiles after they climbed above 60 miles; Turkish bases pick them up above 250 miles; and U-2's may be able to pick them up above 90 miles. However, the Turks and Soviets have objected to the U-2 flights, a problem that may or may not block their use.

These horizon problems diminish the reliability of our estimates of missile dimensions and throw weight, but the data can be calculated with fair accuracy by watching the speed and trajectory of the missile at other points and by counting and "weighing" the objects that fall to earth. Surveillance of high-altitude events and of the reentry end of the Soviet testing range is excellent.

It would be almost impossible, arms controllers say, for the Soviets to launch a genuinely new weapon without our detecting it immediately. The flight patterns of the already-tested missiles are quite familiar now, Scoville said. Before being deployed, a new weapon would have to be tested about 20 times over a period of 3 to 4 years, Defense Secretary Brown has said. It would be noticed. And the lag between testing and production allows plenty of time to study the data, challenge the Soviets for technical explanations, and invoke sanctions if necessary.

The Iranian revolution brought a "major loss to our technical capability" to watch Soviet tests, Glenn's staffer said

It might be possible for the Soviets to modernize old missiles by small percentages—up to 10 or 15 percent—and not be caught. However, a significant change in throw weight—amounting to 25 percent—would alter the trajectory in some way. That would be caught. If a "modernized" version possesses essentially the same throw weight as an old missile and carries the same number of warheads, Scoville asks, how does it pose a new threat?

SALT critics see another missile verification problem in the SS-20. This weapon has been tested only at a medium range (3000 kilometers) and therefore is not subject to strategic constraints in SALT II, which apply to missiles with a range of 5500 kilometers. It is decidedly not a threat to Minuteman. However, critics suggest that it could become a covert strategic threat to U.S. cities in two ways: (i) if the Soviets stockpiled large numbers of third stages which can be attached atop the SS-20 to convert it to the intercontinental SS-16, or (ii) if the Soviets removed one warhead from the SS-20 to make it lighter and thus give it

intercontinental range. The arms controllers' response to the second scheme is straightforward. They say the Soviets have never tested the SS-20 at an intercontinental range, and thus cannot assume it will fly the extra 2000 miles, certainly not with any assured accuracy. If the Soviets did test it at longer ranges, the United States would see the tests and classify the SS-20 as a new strategic missile. It is unlikely the Soviets would risk making the SS-20 their one new missile under the treaty, particularly in view of the fact that they have agreed to scrap its nearest cousin, the SS-16. Of course, if there were no treaty, the Soviets would be free to do whatever they pleased with the SS-20 and the SS-16.

The other objection—that the Soviets might produce and stockpile SS-16's in secret—presents a hiding and counting problem of a fundamental kind that applies to missile stockpiling in general, to launchers putatively hidden in warehouses, bombers produced secretly and moved about in the dark, and other flagrant violations of the treaty. Arms controllers agree that if the Soviets wished to devote the time and money to it, they could probably conceal a lot of weapons. But missiles, launchers, weapons factories, and transporters are large objects. It is unlikely that, in the time it would take to build up a massive secret arsenal, the United States would fail to spot clues giving away at least one of the offending items. The Soviet landscape has been thoroughly surveyed by now, and changes are not difficult to see.

A violation of this sort would be taken very seriously, leading perhaps to an abrogation of the treaty and an accelerated arms building campaign in the United States. American officials believe the Soviets understand that the risk of detection outweighs any potential gain that might be won by cheating. As one Soviet watcher put it, the problem is not going to be cheating, but incremental chiseling.

Objections to the treatment of the Soviet Backfire bomber are similarly judgmental. Because this weapon is clearly designed for "theater" warfare, as U.S. intelligence informs us, the SALT negotiators did not try to include it in the treaty. In reciprocation, SALT II makes no mention of U.S. nuclear-armed "forward-based systems" in European and other friendly countries near the Soviet Union. Nor does the treaty limit theater nuclear weapons held by NATO nations. SALT critics are correct, however, in pointing out that U.S. surveillance cannot guarantee that the Backfire will not be adapted to a strategic role. For this reason, the United States extracted a pledge from Leonid Brezhnev that his country would not produce more than 30 Backfires a year—a pledge that can be verified with good confidence through satellite photography. Limited to this rate of production, the Soviets, it is said, will have no incentive to thin the ranks of their peripheral defense force by diverting Backfires from a theater to an intercontinental mission, with all the retraining and new support systems the latter would require.

Last and worst are the mobile missile and the cruise missile. Neither type is fully controlled under the treaty, and both will pose grave problems for verification in the future. SALT II permits the deployment of one type of mobile ICBM launcher on each side, but only after 1981 when the protocol expires. Long-range cruise missiles—ground-hugging, radar-evading drones that travel more than 600 kilometers—are permitted if launched from the air or from underwater. They are banned under the protocol from deployment on sea or land launchers, but they may be tested and developed ad nauseam.

Present surveillance methods are inadequate to certify the range of a cruise missile, although the Soviets would have trouble hiding a 1000-kilometer cruise test flight from our cameras. Once a reliable long-range cruise has been developed, monitors will find it next to impossible to determine whether or not the missile has been MIRVed, and if so, with how many MIRV's. Cruises are easier to conceal than ballistic missiles, although the present generation of Soviet cruises are "huge behemoths" (with a short range) according to an arms control specialist at the Pentagon. They might be stockpiled—when they have reached some future stage of sophistication—for quick deployment and launching. In buying this technology, the United States and the Soviets may be adopting a family of rattlesnakes.

Mobile missiles, designed intentionally to play hide-and-seek with spy satellites, will bring other serious verification problems. They are especially worrisome because the new mobile missiles will be lethally accurate first-strike weapons. The exact dimensions of the verification problem remain unclear because no one has a clear fix on what basing systems will be used. The U.S. mobile missile, the MX, still requires years of testing and development before it will be ready for deployment, and the mode of deployment is still uncertain.

The United States is ahead of the Soviets in mobile missilery and in cruise

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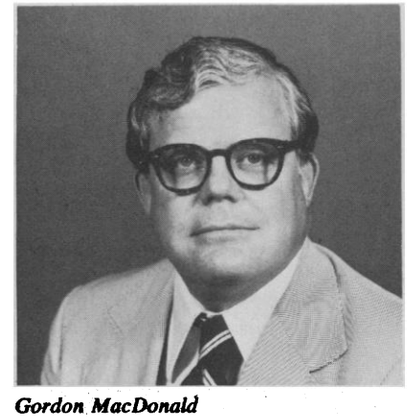
A Warning on Synfuels, CO_2, and the Weather

As President Carter and the Congress move to launch a large synthetic fuels program, four prominent scientists are waving a red flag about synfuels and accelerated use of fossil fuel generally.

In a statement presented recently to the President's Council on Environmental Quality (CEQ), they warn that energy policy makers should consider now—before it is too late—the possibility of a disastrous warming of the atmosphere from the release of carbon dioxide associated with the use of fossil fuels. They note, in particular, that on an energy-equivalent basis a lot more CO_2 is released from production and combustion of synfuels than from the direct burning of coal.



Gordon MacDonald

The four—Gordon J. F. MacDonald, Roger Revelle, George M. Woodwell, and Charles D. Keeling—say that a doubling of the CO_2 concentration may warm the world's climate by as much as 2° to 3°C, with the warming to be greater by a factor of 3 or 4 at the poles than in the tropics. They indicate that such a doubling can be expected sometime during the first half of the next century if worldwide use of fossil fuels continues to grow at the present rate of 4.3 percent a year.

MacDonald, geophysicist, former CEQ member, and environmental studies professor at Dartmouth College, told *Science* that, given this growth rate for fossil fuels, the doubling of the CO_2 concentration will occur by the year 2035 if the present mix of coal, oil, and natural gas remains unchanged. But, he said, if the fuels

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technology, and this may explain why the restrictions on their development are so lax in SALT II. Scoville, for one, would have preferred an outright ban on cruise testing, at least during the treaty's protocol. But this was not achieved. As a result, the verification task of the next SALT team, if there is one, will be considerably greater than the task facing SALT II's enforcers.

A cynical view, expressed by strategic thinker Edward Luttwak, former adviser to James Schlesinger when he was Secretary of Defense, is that as the technology of weapons becomes more complex and the Soviet sophistication grows, American treaty enforcers will find that they have no incentive to point out Soviet violations. The newest and best weapons will be unphotographable, Luttwak claimed. "Some analyst comes up with a fuzzy photo," he said, "and then what does the presidential adviser do? He says, 'It can't be a missile; go back and check it again.' " Once the Soviets have a superior nuclear force—which Luttwak believes SALT II will provide—the United States will not want to publicize treaty violations that will further enhance perceptions of a Soviet advantage. In that situation, according to Luttwak, "We could whine, but we couldn't do anything" about cheating.

Arms controllers vehemently reject this thinking. They deny that the United States will become in any sense a second-rate power, and of course they see no reason for the United States to turn pusillanimous.

Keeney, for example, pointed out that the United States challenged the Soviet Union several times between 1972 and 1974 with infringements of the ban on antiballistic missile (ABM) technology. Bringing the charge required the United States to make a detailed and subtle case against the Soviets' use of a legal radar in an illegal "mode." The Soviets insisted that they had not misused their radar, but according to the formal State Department report: "A short time later, we observed that the radar activity of concern . . . had ceased." The record shows, says Keeney, that the United States enforces its agreements.

However difficult it may be to monitor Soviet activities today, it is clear that the task would be more difficult without an arms agreement. As one expert pointed out, SALT II forces the Soviets to be honest. If they understate their arsenal, they lose some political clout their weapons might otherwise entitle them to. If they overstate it, the treaty forces them to dismantle the surplus. Furthermore, SALT II requires the Soviets to divulge "baseline data" on their weaponry for purposes of verification—information no Russian government has ever shared with foreigners. The treaty compels the Soviets to engage in technical discussions of seeming violations in the Standing Consultative Commission—a good source of insight into the Soviet military system and its technology. The treaty forbids the Soviets from interfering in U.S. reconnaissance programs, and if it is passed, could lead to another treaty outlawing attacks on U.S. satellites. In short, the arms agreement breaches the wall of secrecy between the Soviet military and the rest of the world.

—ELIOT MARSHALL

What Can Government Do for Innovation?

In Administration's domestic policy review of innovation industry makes a strong pitch for reducing "disincentives"

President Carter has been sent an options paper suggesting what the federal government can do to stimulate innovation. The paper, product of a year-long Domestic Policy Review of Industrial Innovation, was forwarded to the White House at the end of June. The hard part comes now, however, for the elements of a federal program which will be effective, economically feasible, and politically palatable are far from self-evident.

It is generally accepted that innovation is a complex process which depends not only on R & D, but on action across the spectrum of financing, engineering, production, and marketing. As to what government can do, there is widespread sentiment that government could help most if it stopped hindering. The blame is put squarely on "disincentives" built up in federal regulatory rules, tax policy, and patent and antitrust laws.

Such an analysis comes through strongly in the reports of the domestic review subcommittees* dealing with major aspects of the innovation problem. Subcommittee members were selected for particular expertise so that each group was fairly homogeneous in background and outlook. As a result, the reports express specific points of view in rather distilled form. And a majority of the reports reflect views dominant these days in industry. Although labor and public interest subcommittees presented views which often contrasted with those of industry, the reports, on balance, offer a powerful admonition to government to get out of the way.

Industry appears to have responded to government requests for cooperation on the review by sending top-rank corporate officials, including high-level research administrators. Having been asked for advice and expended considerable time and effort in giving it, industry now seems to expect that the White House and Congress will take that advice seriously. Letters are beginning to arrive making that point. In other words, the domestic policy review seems to have created a constituency which will demand action.

In what form the industry views were transmitted to the President is not clear, since they went through the mill of the domestic review process. The reports were discussed in draft at a series of symposiums in January. The separate reports were then sent on to a federal interagency task force headed by Commerce assistant secretary Jordan Baruch, who directed the review. The job of the task force was to send the White House a set of options that would be efficacious, consistent with federal policy, and politically acceptable. The task force forwarded its options paper at the end of June. The

*The original subcommittee reports were on Economic and Trade Policy; Regulation of Industry Structure and Competition; Patent Policy; Federal Procurement Policy; Environment, Health and Safety Regulations; Direct Support of Research and Development; and two reports which were statements by the Labor Advisory Subcommittee and Public Interest Advisory Subcommittee. A report on the effects of domestic policies of the federal government upon innovation by small business was completed this spring.

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