sion in the yield estimates, has called for an independent analysis of yield estimation techniques by the National Academy of Sciences or the congressional Office of Technology Assessment.

Several of the other "probable" or "likely" Soviet violations listed in the Administration's latest report involve treaty interpretations that also aroused substantial controversy within the government. The report says, for example, that the Soviets have probably violated a provision of SALT I designed to complicate the development of a surreptitious

"If we had ignored [these issues] in the report, the conservatives in Congress would have accused us of a cover-up."

ballistic missile defense. Specifically, the provision bars tests of air defense weapons or components "in an ABM [antiballistic missile] mode." Some Reagan Administration officials, including Perle, believe that the Soviets have violated this provision by operating several small air defense radars during ballistic missile flights at established test ranges on the periphery of the Soviet border. The Soviets, however, maintain that the radars are merely used to check for the presence of aircraft, as a measure of self-defense.

Some Administration officials, who again decline to be identified, agree that the provision fails to bar such operations explicitly. They call the issue "a gray area," and say that the Soviets are exploiting a loophole in the treaty's language. The problem was nearly resolved at a meeting in 1983 of the U.S.–Soviet Standing Consultative Commission, established by the treaty as a forum for resolving compliance disputes. But the new agreement—which places limits on radar operation and requires formal notification—was postponed after the Soviets shot down Korean Airlines flight 007. A final resolution is expected sometime this year at a meeting of the SCC.

A similar dispute lies behind the Administration's allegation that the Soviets have potentially violated a provision of SALT I that bars development, testing, or deployment of ABM systems or components that are mobile, including mobile radars, which are far less vulnerable than fixed radars. No one disputes that the Soviets have constructed a radar, dubbed Pawn Shop by United States, that is small enough to be placed in a large van and moved about. "It was obviously designed with mobility in mind," one official says. But none has apparently actually been moved, or even sighted atop a set of wheels. Consequently, many officials believe that the Soviets have again exploited a loophole created by an undefined treaty provision, amounting to a violation of the treaty's spirit, not its letter.

Finally, the Administration's report states that the Soviets have probably violated a provision of the unratified SALT II treaty that specifically bars deployment of the SS16, a long-range ballistic missile that fared poorly in a series of tests during the mid-1970's. The intelligence community has known since 1979 that a number of SS16's are stored at a Soviet military launch site in Plesetsk, but that also they are not "operational" or ready to be launched. A few officials, including Perle, say that this is irrelevant, because the SS16's could ultimately be made ready for use. But others point out that the treaty never required that the missiles be dismantled, and assert that missiles in storage cannot be considered "deployed" under any reasonable treaty interpretation.

Keeny believes that the inclusion of these charges in a public report, tenuous as they are, interferes with the government's justifiable expression of concern about developments such as the construction of a new Soviet radar at Abalakova (*Science*, 22 March, p. 1442). "We have diminished the significance of our legitimate arguments by hitting some of these issues very hard, when the evidence is sometimes thin and some of the treaties have not even been ratified," he says.

But an Administration official, who is critical of the Pentagon's position on several of these compliance issues, says that the allegations were publicized with qualifiers in an attempt to dampen, not increase, public concern. "It's important that we control how these issues are discussed," the official says. "If we had ignored them in the report, the conservatives in Congress would have accused us of a cover-up." In the official's view, the inability of various factions within the Administration to reach a consensus on the issues left it with no choice but to produce the report that it did.

—R. JEFFREY SMITH

This is the fourth in a series of articles on U.S.–Soviet treaty compliance. The next will examine allegations of U.S. treaty violations.

Academic Consortia Receive First Star Wars Grants

In the first of several major grants to the academic community, managers of the Defense Department's "Star Wars" program have awarded $20 million to a group of five universities for research on space power systems and $9 million to a group of ten universities and five corporations for research on optical signal processing. A third, $15 million grant has also been awarded to a group of eight universities and seven corporations for research on composite materials.

The goal of the first group will be to develop chemical or solar power systems for directed and kinetic energy weapons. The participants are Auburn University, Polytechnic Institute of New York, SUNY, Texas Tech, and the University of Texas.

The goal of the second group is to develop hybrid optical and electronic signal processors, needed for the high-speed computers to be incorporated in advanced ballistic missile defense systems. Such processors would use photons, as well as electrons, to convey data, and would theoretically be highly resistant to radiation created by nuclear explosions. According to James Ionson, a director of the research program, the research will initially be entirely unclassified. The principal participants include Batelle Columbus, Caltech, Carnegie-Mellon, Georgia Tech, MIT, Stanford, Lincoln Laboratories, the Naval Ocean Systems Center, and the universities of Dayton and Alabama.

The goal of the third group is to develop strong, lightweight, composite materials for use in large space structures, such as orbiting weapons platforms and sensors. A premium will be placed on materials capable of damping vibrations generated by particle beam and laser weapons, as well as on materials capable of shielding such weapons from a Soviet attack. The principal participants include Brown University, the Colorado School of Mines, Drexel University, Johns Hopkins, MIT, the National Bureau of Standards, the Naval Research Laboratory, Penn State, Rensselaer Polytechnic, and Texas A&M. Some of this work will be classified, Ionson says, but no work on academic

campuses will be classified "unless the university agrees to it."

The grants will be distributed over the next 3 to 4 years. Two additional awards will be made in coming weeks to academic consortia for research in rocket fuels and optical materials.

—R. JEFFREY SMITH

NRC Tries to Reduce Public Access

A decision by the Nuclear Regulatory Commission (NRC) to reduce public access to meetings and reduce the availability of transcripts from closed meeting is causing a stir in Congress. In late April the NRC voted 3-2 to immediately implement these rule changes proposed by chairman Nunzio Palladino, without first holding public hearings on the matter.

The agency's action comes on the heels of hearings held in mid-April by Representative Edward J. Markey (D–Mass.), chairman of the House Energy subcommittee on conservation and power. At that time Markey characterized Palladino's proposed reorganization plan for the agency as reflecting a "bunker mentality." Besides calling for replacing the present five-member commission with a single administrator, Palladino also has advocated more exemptions from federal public disclosure rules.

Markey criticized the agency's plans to narrow its definition of a "meeting" between board members to exclude briefings and exchanges not related to taking a formal stand on issues before the commission. Congressional and NRC sources say the commission's action was based in part upon a recent U.S. Supreme Court decision involving the Federal Communications Commission (FCC), in which the court found that the Sunshine Act did not apply to all gatherings of FCC members.

Despite the potential fallout in Congress from the effort to crimp the flow of information, the NRC commission, with the exception of Palladino and James K. Asselstine, voted to implement these changes without first taking public comment. However, there is some chance that the agency will reverse itself, sources say, to avoid political backlash.—MARK CRAWFORD

Bok Puts Computers in Their Place

The arrival of personal computers in the office, at home, and on college campuses has been heralded as a wave of new technology that will transform not only the way people work but also the way they learn and think.

Harvard University's Derek Bok has a different idea. In his annual report to the Harvard Board of Overseers, Bok challenged exaggerated claims for computer technology. With reference to computers on campus, he quoted Richard Clark, a leader in evaluating the effects of educational technology

Derek Bok

as saying, "The best current evidence is that media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition."

In a reference to historical technology hype, Bok went back to Edison. "Thomas Edison was clearly wrong in declaring that the phonograph would revolutionize education. Radio could not make a lasting impact on the public schools even though foundations gave generous subsidies to bring programs into the classroom. Television met a similar fate in spite of glowing predictions heralding its power to improve teaching."

Bok gave some ground when he said computers on campus do hold promise of inspiring "work and thought about teaching methods and the process by which human beings learn." Computer assisted instruction, he noted, is often most effective when it consists of carefully worked out teaching programs that may require as many as 200 hours to write. It may be, he suggested, that more effort is devoted to such efforts than to ordinary teaching preparation. "As more people begin to use technology for educational purposes, they are bound to think more carefully about the best ways to help students absorb new knowledge and master new intellectual skills," he said. "One simply cannot produce good software for teaching without paying close attention to the details of how best to present the material to enhance learning and sustain student interest. This is not characteristic of traditional instruction."

However, Bok also said that computers can be seen as limiting students' imaginations because computerized instruction often restricts them to a set of responses that appear on the monitor. Citing law, business, medicine and other sciences as examples of disciplines in which computerized teaching could be useful in carefully chosen cases, he spoke clearly of limits. "With all its powers, the computer cannot contribute much to the learning of open-ended subjects like moral philosophy, religion, historical interpretation, literary criticism, or social theory—fields of knowledge that cannot be reduced to formal rules and procedures."

"Humanistic learning has suffered enough from ill-considered efforts to ape the scientists by concentrating on what is quantifiable, verifiable, and value free," he observed. "Do we not have a foretaste of things to come in the eagerness with which classicists fall upon computers for the analysis of ancient texts and the glee with which music instructors talk about teaching composition by machine?"

All in all, Bok, no starry-eyed convert to the myth that computers relieve one of the need to think, believes that one great benefit of computers to academe may be that they stimulate thinking about education. "It is embarrassing that professors, who spend so much time evaluating and criticizing other institutions, devote so little effort to finding ways to improve their own methods of instruction. . . . If technology can help in encouraging such an effort, that is reason enough to welcome its appearance."

—BARBARA J. CULLITON