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The Impact of New Technologies

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Ninety percent of arms control is defense management, so we ought to understand what the prospects are for new technology and its contribution to our security. We ought to understand which systems will benefit us, which ones will cost us, and what the balance is. We ought to improve these options; when we have an option good enough to buy, then we ought to buy it, not before. In a democracy we have to understand these problems. The Congress has to make the choices; it makes the law. It gives the authorization and the appropriations. And if the people and the Congress don't understand, the odds are pretty good that the Administration isn't going to understand either and we will get less than adequate security.

First, I want to talk about old technology, which can have enormous impact. Useful technologies or systems include NAVSTAR, small submarines with communications "fish," the Midgetman in silos, bombs that squeak, midcourse correction for reentry vehicles, and automated, remote-managed orbital rendezvous and resupply.

NAVSTAR had a terrible time getting started. We tried to do it in the 1960s, but it was delayed year by year. It will have major and far-reaching applications in the accurate delivery of conventional weapons, in the positioning of strategic submarines, and so on. Some might want to limit NAVSTAR by arms control, but on balance I think NAVSTAR is good for us.

Small submarines were proposed by the Scowcroft Commission as a replacement or eventually a supplement to the Trident submarines, for obvious reasons. You don't want to put 200 warheads in one submarine indefinitely; you should have fewer.

The Scowcroft Commission also proposed a single-warhead Midgetman. It is automatically stabilizing; if forces are equal or comparable in numbers of warheads, the attacker disarms itself more than it disarms the other side in striking a Midget-

man, even in a soft silo. So we ought to buy Midgetmen in silos now, at about $10 million per warhead for investment and 10-year operating cost, instead of $70 million per warhead for a mobile system far in the future.

Our submarines could benefit from improved communications. One way to bring that about is to look far into the future at the blue-green laser satellite talking to submarines. Another is to provide now a small "fish" that swims above the submarine and listens to the radio right near the surface while the submarine is patrolling at depth. It would communicate to the submarine below by megahertz acoustic link, which is not detectable by the other side.

All these things were proposed long ago. All of them are on hold. The Navy is not about to stop building Tridents just to get small submarines. And the Air Force feels that the MX has to be deployed before it will show any interest in the Midgetman.

Two or three nuclear weapons are often aimed at certain targets of high value but of no particular urgency. If we could make sure weapons went off in the right place, we wouldn't need so many, or we could cover more targets. It would be easy to arrange the weapons so that they emit a coded radio impulse just before they explode, so as to determine the location very accurately. This is something we ought to do, and which cannot be verifiably limited by arms control.

We really ought to know about mid-course correction for reentry vehicles. If the other side has such a system, along with the ability to watch signal-transmitting aircraft such as command-and-control aircraft in wartime, then those aircraft are vulnerable. You might not be able to rely on airborne command posts any more in nuclear war unless you have an awful lot of them.

Finally, we ought to have the future capability for automated remote-managed orbital rendezvous, resupply, and repair. One would like to be able to send up a few hundred pounds worth of cryogen, of fuel, a repair system, and so on, without paying to send a 200,000-pound payload into orbit. You saw in Mr. Culbertson's graphic depicting the Space Station a polar orbiter looking very lonely. It unfortunately has nothing to do with the Space Station. It is in an orbit where it can do useful things looking over the entire earth's surface, whereas the Space Station is going to be in a 28-degree orbit where not much interesting happens.

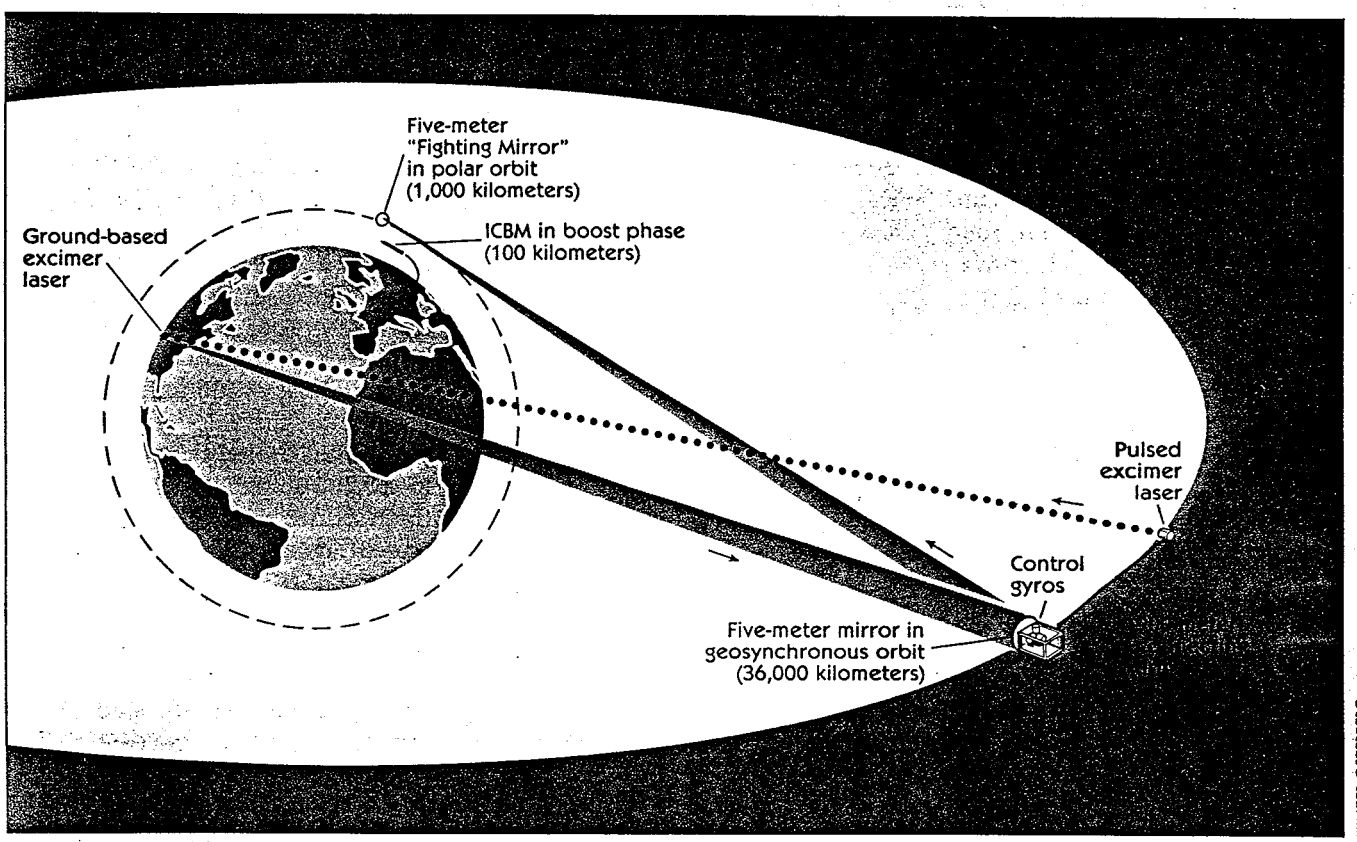
Those of you who would like to know more about ASAT than I am able to talk about here can read the article "Antisatellite Weapons" in the *Scientific American* of June 1984, which I published with Don Hafner and Kurt Gottfried.

ASAT weapons look very effective. They are primarily space mines, an old technology, little satellites that go around in orbit within lethal range of the satellites they are supposed to destroy. Other ASATs could be hydrogen-atom beam accelerators, very good for ASAT, but not so great for ballistic missile defense. Space lasers are a pretty hard way to destroy a satellite when there are many other ways to do it.

Ground-based lasers and direct-ascent little homing kill vehicles are perfectly good. We did that on June 10, 1984. We called it the Homing Overlay Experiment in the BMD program, but it showed very little capability for serious BMD. In nuclear war we would have to face decoys and nuclear bursts and attack on our sensors. But it's a good ASAT.

There are countermeasures to ASAT and these are also aided by the advance of technology. But there is no countermeasure to allow a satellite in low earth orbit and costing hundreds of millions of dollars to survive against a determined adversary.

As I published in a paper in the 1980 *International Security*, one can survive against ASAT — in the case of infrared early warning satellites — primarily by building a system that will survive because there are a lot of satellites. Most of them are decoys; some of them are dark; they are all identical because of antisimulation, so they are not



WALTER OSTERBERG

Shown is a potential ground-based laser weapon arrangement. Placing the massive, complex laser on the ground would prevent having to place it and its weighty fuel in orbit. In order to see around the curvature of the earth, relay mirrors in geosynchronous orbit would be required, sending the light to "fighting mirrors" in low-earth orbit. The distortions of the atmosphere, which would otherwise reduce the beam intensity by a factor of 1,000 or so, could be compensated by the pulsed excimer laser, as shown. This would require peacetime conditions, that is, a normal clear atmosphere.

station-keeping. Read that article.

Strategic communication can also survive. We can have one strategic communication satellite that is being used, a lot of decoys, and a lot of dark satellites, any of which can be used to replace it. That requires a system in which one prizes essential strategic communications more than one prizes a lot of communications in peacetime.

Ballistic missile defense is a much more difficult problem than ASAT. There are many more active ballistic missiles. Each ballistic missile once it gets into space can break up into 10 reentry vehicles or 30 or 40, plus thousands of decoys. There are nuclear weapons going off attacking the defensive system. It's a real problem.

General Abrahamson indicated that priority would be given to, and

that it is most valuable to intercept in, boost phase.

One shouldn't forget mid-course intercept, and in late mid-course one would not use five-kilogram or three-kilogram homing kill vehicles launched by electromagnetic guns. Rockets work perfectly well; they are cheaper and better. The frontier there is in *micro*-homing kill vehicles, things that weigh not six or seven pounds, but a quarter of a pound (100 grams, or even 1 gram). A little hornet, for instance, at eight kilometers per second relative velocity will destroy a reentry vehicle.

Countermeasures against ballistic missile defense are easier to develop than countermeasures against ASATs. Fast-burn boosters (well within the state of technology we have demonstrated since 1965 with Sprint, as have the Soviets with their high acceleration interceptor) can burn out *within* the earth's atmosphere. The X-ray lasers and neutral-particle beams (hydrogen atom beams) therefore cannot be used for boost phase.

But for mid-course there are many more countermeasures, such as decoys and closely-spaced objects. For instance, the little homing kill vehicle can eat its heart out getting close enough. When it gets there it finds that it's not a single point of light that keeps getting bigger — there are *three* points of light. Without special design and intelligence it won't strike *any* of them, and even with these features two will still be decoys. So it's tough.

Space mines are countermeasures against a ballistic missile defense deployed in space. They must have sensors in space and battle management in space. So other antisatellite capabilities are also very effective.

> The alternative to the SDI is not an unbridled offensive arms race. It is a limitation to what we need.

There is a lot of misunderstanding about ballistic missile defense — not all of it limited to the Strategic Defense Initiative Program Office. But when General Abrahamson says his neutral particle beams don't go at 300,000 kilometers per second — the speed of light — but at 60,000, those are mighty weak beams. Those are hydrogen atoms of 20 million electron volts energy. They will not penetrate one millimeter of lead. We can do better than General Abrahamson's 60,000 kilometer-per-second beams and we ought to do so — both in effectiveness of the beam and precision of statement. But it is an advance over the misrepresentation of neutral-particle beams as *neutrons*.

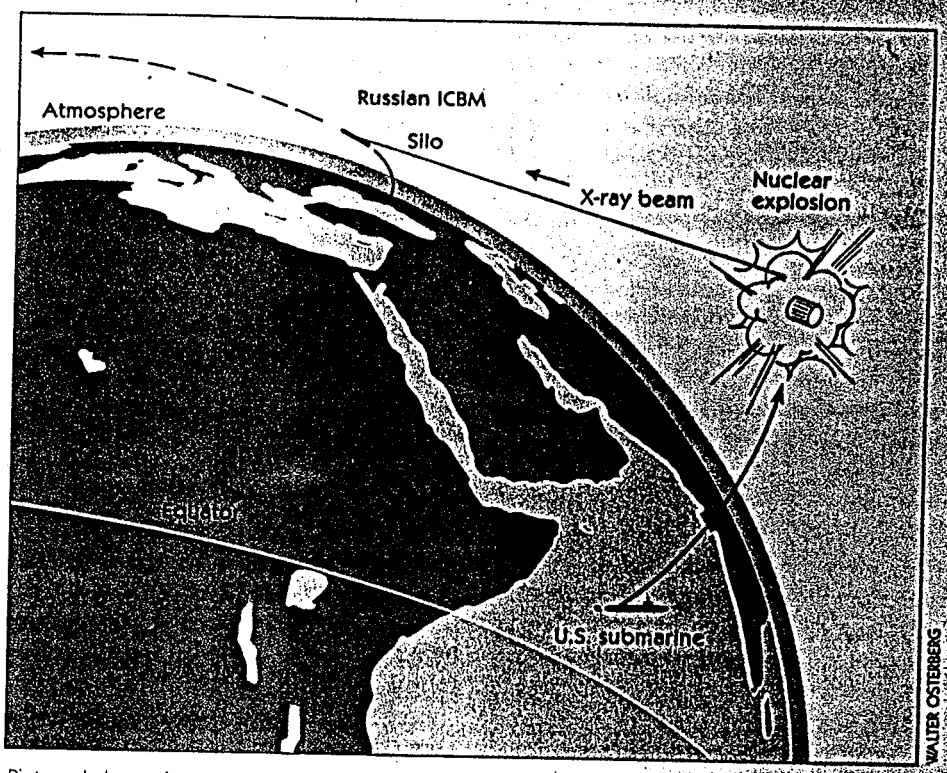
Our article, "Space-Based Ballistic Missile Defense," in the October 1984 *Scientific American* shows my contribution to the space-based chemical laser sweepstakes. This space-based laser combines hydrogen and fluorine and produces 25 megawatts of laser light. If the 10 meter square mirror is optically perfect, and perfectly pointed, the laser can produce at a distance of 3,000 kilometers a spot of about 1 meter in diameter. A booster hardened to 20 kilojoules per square centimeter could be destroyed in some 7 seconds at this distance. At least 5 tons of fuel would have to be burned in the 100 seconds during which the laser might be operating. At present, chemical lasers have been demonstrated in the megawatt range, but with much smaller mirrors. None has been demonstrated with the optical quality of laser light approaching that required for this job.

The illustration on page 105 shows a ground-based laser. I tried to take seriously George Keyworth's favorite scheme, according to his speeches, so we put some 25-megawatt lasers on the ground and five-meter optically perfect mirrors in orbit — some in geosynchronous orbit, some down in low earth orbit — and with these we can also destroy cooperative boosters. The problem is that you can't destroy *un*-cooperative boosters because they will not let you stay in space. And there are other little problems with this program.

The illustration at right shows an X-ray laser. If it's in space it has problems. It has problems in boost-phase intercept because its beam cannot get down deep into the atmosphere where a fast-burn booster will burn out at 80 or 90 kilometers. It can't destroy the bus because I'm not having a bus on my Midgetman — the decoys are liberated at the same time as the one warhead. This X-ray laser is launched from a U.S. submarine somewhere in the Persian Gulf and has to climb in the interceptor a long way in the boost phase (to such an extent that a 50-second burn time booster prevents *any* boost-phase intercept).

A very good paper for those who want to read further is the background paper by Ash Carter, provided in April 1984 to the Congress by the Office of Technology Assessment.

I admired Jim Schlesinger's banquet address both for the cogency of analysis and the eloquence of presentation. According to Schlesinger, the original goal of the Strategic Defense Initiative was city survival. Anybody who reads English can come to no other conclusion. That's nowhere in the program anymore. People who support the SDI most vehemently say the President was never talking about that, and that it's ridiculous to imagine he was.



Pictured above is a version of the so-called pop-up defensive system. To see around the curvature of the earth without having vulnerable satellites in orbit, a submarine-launched pop-up interceptor might be used to obtain line-of-sight to the booster while the booster is still burning. Very large initial rocket size is required to obtain the high velocity to reach the line-of-sight during the minute or so available.

Then we talk about denying military goals. In my Senate testimony of April 24, 1984, I quote Fred Hoffman, the principal author of the Hoffman study from 1983. Commenting on one of my talks in Los Angeles last January, Fred and I had a discussion where *he* chose the example. In that example, the United States is using four ports to resupply military ships to aid our allies in a conventional war in Europe. And the Soviet Union right now with reliable accurate reentry vehicles can confidently destroy those four ports with four nuclear warheads out of their strategic force of 8,000.

But Fred says if we have a 50 percent effective ballistic missile defense they cannot count on doing that, so they won't even try. You say "But wait a minute, how about eight weapons, how about shoot-look-shoot? You can't load a ship and get it out of port in ten minutes. How about eight weapons?" Fred said no, they would never do that because the President would retaliate. So they would be deterred by the threat of retaliation — never mind morality or immorality of such deterrence — which the defense was added to *avoid*! My question is why wouldn't the President retaliate if the Soviets destroyed those four ports with four nuclear weapons and four nuclear explosions, instead of eight nuclear weapons and four nuclear explosions?

I think some people believe that rather than define a goal that might be evaluated (or maybe, God forbid, criticized) it's better to keep quiet what those goals are. So one continues to ask, as Ash Carter did in his background paper, what the goals *might* be; and then you have to go through the whole analysis.

Another possible goal is to preserve the retaliatory force. The Scowcroft Commission was created in January 1983 to look at exactly this problem. They gave their answer. They said Minuteman vulnerability had seemed to be a big problem, but really when you look at it in the context of the overall strategic retaliatory force, it's not a problem — so little a problem we can put the MX missile in vulnerable Minuteman silos. If our job is to preserve the retaliatory force there are lots of other ways to do it. Potential measures range from greater dependence on submarines to greater deployment of Midgetman single-warhead missiles — especially if you're not limited by the arms control agreement, as you wouldn't be if you deployed or even proceeded very far with the SDI.

Another goal might be a bargaining chip. Dr. Schlesinger returned to this, although I thought that the recommendation that the SDI would be a good bargaining chip did not follow from the analysis.

So the goals of the SDI have progressed from *replacing* deterrence to *strengthening* deterrence, and that's very different. I agree with Jim Schlesinger that if the job is to strengthen deterrence we had better stop saying how immoral deterrence is and how we have to avoid it.

Some of the problems you have heard about in regard to the SDI and the problems with the antisatellite weapons program came out yesterday in discussions of the Homing Overlay Experiment and ASAT test. The Tsongas amendment said, roughly, that one could not test an ASAT against an object in space (not a space object — I don't want to go into details about what that means). But the rest of the ambiguity is typically alluded to by Dr. Keyworth. He says very frankly that if there's no ASAT test ban, we can test ASAT weapons to obtain a basis for ABM capability, the test of which would otherwise be banned by the ABM treaty. We have already tested an ABM as allowed by the ABM treaty to demonstrate an ASAT capability.

Well, what should we do faced with this? Bill Hyland suggests we ought to think about arms control that encompasses the SDI. I tried, but it's too hard for me. I really don't think that we ought to proceed with that SDI until we find that the research program is worth the money. It comes out of the same pot of engineers and scientists and R&D money (not just total defense money), as other things we need to do.

We can't count on any defense to protect our society against a large force of nuclear weapons. We shouldn't imperil deterrence by giving up the penetration advantages of the 1972 ABM treaty. The confrontation of mutual defense measures in space (even if we do — which I would not advocate — develop this thing and give it to the Soviet Union) is a good place for war to start, which would not be limited to space. Space is not a better place than earth to have a

war — it would surely spread to earth. It would be better to negotiate a ban on weapons in space and ASAT tests while we continued to expand our military-support use of space as well as civil applications.

In agreement with Dr. Schlesinger I think that defenses against nuclear weapons will *prevent* reductions in destructive power, not aid them. Al Carnesale related what happened in the 1960s when we saw a little bit of Soviet ABM. Did we say "My goodness, our strategic weapons are becoming less valuable, let's throw them away"? No. We built MIRVs. We would have built a lot more had there not been the ABM treaty. The reason for the power of strategic offensive weapons is their very low cost, in the million dollar range alluded to by Bob Cooper, I suppose. A warhead of $10 million delivered cost can destroy a city worth $100 billion, not to mention the half million people.

The alternative to the SDI is not an unbridled offensive arms race. It is a limitation on both sides — on our side, particularly, to what we need. As President Eisenhower said, "We need what *we* need." It doesn't matter what *they* have so long as we choose appropriately what *we* need.

We could do with as few as 1000 nuclear warheads. You don't have to have battlefield-deployed nuclear weapons. I don't renounce battlefield explosions; I don't renounce first use of nuclear weapons to deter conventional attack in Europe. I can do all those things with strategic nuclear weapons on submarines and air-launched cruise missiles and Midgetmen in silos.

Assured survival by threat of retaliation is all we have. Counterforce against strategic forces on the other side (damage limitation) just makes it harder to reduce the number of weapons on the other side. You might as well give up strategic counterforce; you'll never be able to use it anyhow. If it becomes effective, the other side will go to launch under attack. It would be better to preserve the ABM treaty and ban ASAT tests and space weapons.

> We shouldn't imperil deterrence by giving up the penetration advantages of the 1972 ABM treaty.

You often hear that the scientists on the Fletcher panel are all for this. The Fletcher panel hasn't met since its final report. Major General John C. Toomay, the panel's Deputy Chairman, has said that the panel tended to be "pessimistic whether these technical objectives could be realized but felt that on balance, the research and engineering was well worth doing." The difference between the panel's assessment and its recommendation is "like the difference between the horse you bet on and the sentimental favorite."*

Another leader of the Fletcher panel agrees we ought to have a ban on ASAT tests and space weapons because it's going to be a long time, 20 or 30 years, before we do the research and can make the decisions for or against deployment. So we might as well have the protection of an ASAT test ban and a ban on space weapons, especially since we are supposed to conduct this program within the limitations of the ABM treaty. (On a television program with Bill Moyers, Dr. Keyworth says we will not be able to protect society against nuclear-armed ballistic missiles until the passage of "generations.")

And finally, we really have to emphasize preventing the proliferation of nuclear weapons to additional countries. For that reason a total ban on nuclear explosions (including ours) is desirable.

Now, Jim Schlesinger suggested that although the SDI is spherically useless, it could be used as a bargaining chip. And that it was irreversible, we couldn't roll it back.

I think it *can* be rolled back, and that it must be rolled back. I even suggest what the President should say in order to do the best job for the national security and for his

*(National Journal, July 7, 1984, page 1316.)

place in history. We should roll back the SDI because it won't replace deterrence. It will not provide the United States with benefits as big as the problems that the loss of Soviet arms control will cause us, and it's a poor bargaining chip. The last thing in the world we want is to have to proceed with the SDI and deploy the thing; it will be more harmful to us than to the Soviets.

So how do you reverse it? If you're the President you say, "You know folks, I never said anything about anything up *there*. I just want a way to nullify these nuclear weapons. I'm waiting for somebody to think of that."

You don't get just thinking for $26 billion in five years, and $50 billion the next five, and a trillion dollars for deployment. People should think; but if there's a way to nullify nuclear weapons then we should be very careful the Soviets don't get it. If they do, we should have something else in mind for deterring them.

So the President should say, "You know, this program called the 'President's Strategic Defense Initiative' really has nothing to do with what I asked for. It's a good job; a lot of ingenious people went to work and proposed this program. But we will return to what I said in the fall of 1982 was the purpose of our research on ballistic missile defense — namely to maintain a hedge against things Soviets might do, to have a window on technology. These are the classical purposes of BMD."

Before you have arms control and verification, you have to have some idea in mind of what you want to accomplish. I want to have a regime in which the United States can live securely for a long time, while our children and students think of better ways for us to attack the long-term problems. That's a regime in which the Soviet Union can be secure, too. I don't think there is any one-sided security possible in this future.

So let's go back to the situation we had in the 1970s, when Jim Schlesinger was Secretary of Defense, and had no counterforce capability. We should have "limited options" so in case we need to deter or react to a "little" attack, we can use one or two nuclear weapons — not new force characteristics, not expanded forces, but a strategic force capable of causing a lot of damage or little damage as you wish.

While we should not proceed with the SDI, there is much we should do in the strategic area. Below is a set of goals I think we can achieve if we work hard and steadfastly, both on the defense management and the international negotiations side.

- Limit the number of nuclear warheads to 1000 each for the United States and the Soviet Union (400 Midgetmen in silos, 50 small subs with 8 warheads each, and 100 aircraft each with 2 air-launched cruise missiles).
- Assure survival of society by threat of retaliation — no counterforce against strategic forces.
- Preserve the ABM treaty.
- Ban ASAT and space weapons.
- Emphasize non-proliferation of nuclear weapons, using all available national sanctions. (The comprehensive test ban treaty is essential.)