

F.A.S. PUBLIC INTEREST REPORT

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U.S.—SOVIET FORUM ON NUCLEAR WINTER

In response to an invitation from Senator Edward M. Kennedy, a Soviet delegation led by E.P. Velikhov came to the United States to testify before a Kennedy-Hatfield forum on the climatic effects of nuclear war and the possibility that these might destroy the human species.

Velikhov, Vice President of the Soviet Academy of Sciences of the USSR for mathematics and physics, was accompanied by Professor Sergei Kapitsa (see December FAS PIR for background on both), Academician A.S. Pavlov, a medical doctor, and Vladimir V. Alexandrov, a mathematical meteorologist.

Their testimony on December 8 was widely reported and both Velikhov and Kapitsa were on the NBC Today show.

In the course of the hearings, Academician Velikhov called for the freeze as a "first step" and said, in answer to a question of Senator Kennedy that "I have not studied build-down but I agree that the freeze is very important because it is a freeze on quality and quantity."

Alluding to the "nuclear winter" notion, Kapitsa said that "the choice is one freeze or another". Paul Ehrlich observed that reductions were given new meaning by the report and that "getting down to 5,000 weapons is not enough" since this was "far above threshold" even though we "don't know exactly where the threshold is" that might produce the nuclear winter.

Senator Kennedy, in summary, said: "And so the debate changes...The message of this panel is that the stakes are higher than we ever thought possible—what has been created is a doomsday machine. And what we have to do now is to dismantle it."

Before and after the panel, on December 6 and 9-12, FAS served as host for the Velikhov Delegation in Washington, Princeton and Boston during which the Delegation had discussions on arms control, fusion, meteorology, medicine, physics in general, and scientific exchange.



Participants from Left to Right
Carl Sagan, Alexandrov, Paul Ehrlich, Pavlov, Jack Geiger,
Kapitsa, Lewis Thomas, Velikhov.



Senators Kennedy, Hatfield and Pell
preside over Nuclear Winter Hearings

THE COMMITTEE OF SOVIET SCIENTISTS AGAINST THE NUCLEAR THREAT

by

Frank von Hippel, FAS Chairman

The precipitate decline in the relationship between the superpowers has led to a renewed interest in nuclear weapons issues among civilian scientists in the Soviet Union as well as in the West. Although the permitted manifestations of this interest are much more limited in the Soviet Union, they are nevertheless significant. One of the most important of these is a new high-level "Committee of Soviet Scientists for the Defense of Peace and Opposition to the Nuclear Threat" which was organized at a conference held in May 1983 in Moscow under the auspices of the Soviet Academy of Sciences. This Committee hosted the recent FAS visit to the Soviet Union reported in the December 1983 newsletter and two weeks later sent its own delegation to the US in response to an invitation to testify at a hearing organized by Senator Kennedy.

The leadership of the Committee of Soviet Scientists includes scientists of genuine stature in the Soviet civilian scientific establishment (see p. 8). Thus far, the Committee appears to have concentrated on making itself and its objectives known to the larger Soviet scientific community and in establishing relationships with Western scientific organizations interested in arms control.

Two pieces of technical work which have been completed under the Committee's auspices thus far are a paper on the climatic consequences of nuclear war and a critique of some of the proposals which have been put forward in the US for space-based antiballistic missile systems.

The first paper, co-authored by V.V. Alexandrov and G.L. Stenchikov of the Soviet Academy of Sciences' Computing Center, presents calculations made using a 3-dimensional computerized climate model of the temperature changes which would result from a heavy loading of the earth's atmosphere with light-absorbing dust and soot from ground-level nuclear explosions and nuclear-explosion-induced fires respectively. The assumptions concerning the magnitude and duration of the blockage of sunlight were drawn from the same 1982 *Ambio* paper by Crutzen and Birks which inspired the one-dimensional calculations by Turco *et al* which Carl Sagan recently used to popularize the idea of a "nuclear winter." Both the US and Soviet groups obtained similar results which were presented at a conference held in Washington, DC at the end of October 1983 and subsequently at the hearing held on December 8th by Senator Kennedy.

The critique of proposals to deploy space-based laser and particle-beam anti-ballistic missile systems was prepared by a group of technical experts from the Soviet Academy of Sciences' Institute of Space Research led by the Institute's director, Roald Sagdeev, in collaboration with a group of arms controllers led by Andrei Kokoshin, head of the Division of Military-Political Affairs of the Institute of USA and Canadian Studies. Thus far we have in English only a summary of this report [see p. 4] but, based on this summary and what we have been told, the report appears to arrive at conclusions similar to those of US critics such as Richard Garwin. Among these conclusions on the technical side are the following:

- The cost of a system with even marginal effectiveness against current missiles would be huge;
- It would be possible to deploy relatively inexpensive passive countermeasures which would increase the difficulty of the problem by more than an order of magnitude;
- There exist a variety of obvious *active* countermeasures to directed energy beam weapons—including pre-emptive attacks by the corresponding weapons of the other side.



V.V. Alexandrov

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The report also makes more general arguments against missile defenses similar to those made by US arms controllers:

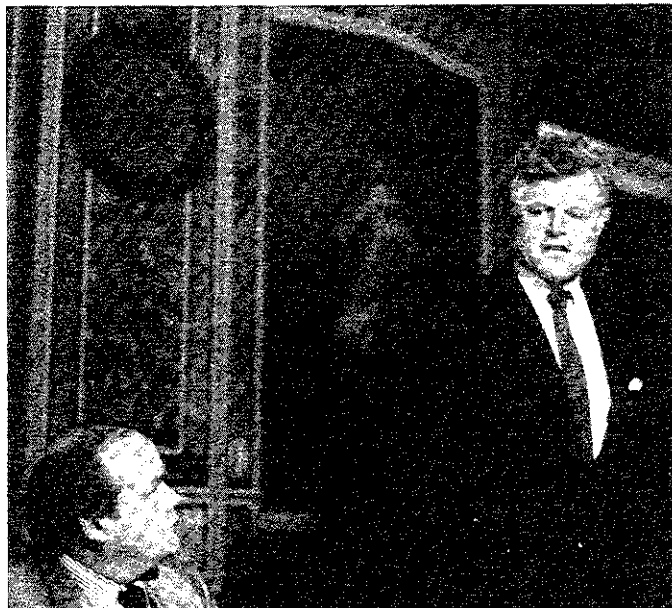
- Although the systems would probably be relatively ineffective against a first strike, they would be more capable against a weak, uncoordinated second strike;
- By raising doubts about the adequacy of offensive forces, they would stimulate increases rather than facilitating negotiated reductions in these forces;
- An arms race between offensive and defensive strategic systems would represent an enormous waste of talent and resources.

Although some, at least, of the leadership of the Committee of Soviet Scientists may have access to information on Soviet military research and development programs, there is no indication in the report on space-based anti-ballistic missile defense that the authors took advantage of such access. The calculations are made from fundamental physical principles, and when specific devices or systems are discussed, reference is made to Western journals such as *Aviation Week and Space Technology*. This is similar to the approach used by US critics who have access to but cannot quote the classified technical literature.

The asymmetry arises from the fact that the Soviet Union does not have any counterpart to *Aviation Week*. This does not seem to pose an insuperable problem to US intelligence agencies who have other ways in which to obtain information about Soviet weapons systems. It has the unfortunate effect, however, that when US and Soviet scientists discuss the technical details of arms control measures, they do so with a much more fully shared knowledge of US than of Soviet weapons systems and production arrangements. While this may not affect the validity of conclusions arrived at in these discussions, the resulting greater focus on the US side of the arms race tends to lend tacit support to the frequently reiterated Soviet contention that their weapons deployments are made only as necessary "countermeasures" to US deployments.

It would be wrong, however, to dismiss the Committee of Soviet Scientists as simply another Soviet propaganda vehicle. The leadership of the Committee is very serious both about facilitating arms control agreements with the US and about publicizing to the Soviet public the horrors of nuclear war.

Evgeny' (Eugene) Velikhov, Chairman of the Committee, has made clear that one of his major objectives is to educate a "new generation" of Soviet scientific leaders about arms control matters. Certain members of the previous generation played an important role in facilitating the development of the common US-Soviet understanding which made possible the 1972 Treaty on the Limitation of Anti-Ballistic Missile Systems. Velikhov obviously thinks that members of the new generation should be prepared to play a similar role and he apparently sees discussions with western arms controllers as providing an important part of their education. Velikhov, himself, is obviously a prime example of the new generation, being at only 48 the senior Vice President of the Soviet Academy of Sciences.



*Vice Pres. Evgeny Velikhov and Senator Kennedy
at a luncheon for the visitors*

As a result of Velikhov's tireless efforts to organize joint studies involving both Soviet and US scientists and arms controllers, it appears that many more scientists on both sides will be able to become involved in such studies than ever before. A partial list of the new studies which have recently been initiated and their US sponsors is the following:

Militarization of Space; American Academy of Arts and Sciences

Strengthening the ABM Treaty; Federation of American Scientists

Technical Basis for a Phased Nuclear Weapons Freeze Agreement; International Pugwash Group

Characteristics of a Minimal Deterrence Regime; Princeton Program on Nuclear Policy Alternatives

The Committee also seems genuinely interested in following the lead of the Soviet Committee of Physicians for the Prevention of Nuclear War, who have joined with American colleagues in live discussions on Soviet national television of the horrors of nuclear war. According to an article by John Burns in the December 11, 1983 issue of the *New York Times*, such efforts appear already to have had a major impact in solidifying the view among the Soviet public that nuclear war is not survivable. Although the Soviet Union is not a democracy, it seems unlikely that the Soviet leadership would spend as much effort as it does on internal public relations if it did not consider public support for its policies important. Furthermore, it appears likely that the leadership is to no small extent affected by its own propaganda.

The most obvious resource of the Committee for reaching the public is Sergei Kapitza, the physicist-son of the famous physicist, Pyotr Kapitza. Sergei Kapitza has become well-known to the Soviet public as a result of his hour-long science program, which appears every other week on Soviet national TV. In July 1983 Kapitza hosted

on this program a discussion of the psychological effects of the nuclear threat featuring Bernard Lown, the head of the US chapter of the International Physicians for the Prevention of Nuclear War, and Natalya Bekhtereva, a neuro-physiologist member of the Committee of Soviet Scientists.

The American television audience has recently twice been briefly exposed to Kapitza: on November 1, 1983 when he appeared via satellite link on Ted Koppel's ABC program, "Nightline", to discuss "nuclear winter" and subsequently when he appeared with Velikhov on NBC's Today show after Senator Kennedy's hearing. Kapitza's excellent English (he spent his first seven years in Cambridge, England) and his ability to explain scientific results clearly and simply make him an obvious choice for such appearances.

Overall, this is a rather substantial performance for a group which has been in existence for only a little more than six months. The Committee of Soviet Scientists seems to be one of the few rays of sunshine in the currently rather gloomy landscape of US-Soviet relationships.



Andrei Sakharov

TWISTS IN SAKHAROV CASE

On December 10, on UN Human Rights Day, Vitaly P. Ruben, Chairman of the Chamber of Nationalities of the Supreme Soviet of the USSR, defended Soviet treatment of Sakharov by calling him a mentally sick man needing "moral calm" in Gorky.

In the midst of these absurdities, there were two potentially valuable references. He said that "Madame Sakharov, of course, has the right to travel abroad". This will be helpful to her (if true) in connection with her medical problems since, as FAS members saw in the last issue, she does not trust Soviet doctors.

Second, in conjunction with calling Sakharov crazy, Ruben may conceivably have been laying the groundwork for releasing him to the West. He said:

"You know, many people have left this country. We have released them. They were cuckoo, as our psychiatrists believe."

There continues to be reason to believe that Andropov did want Sakharov released to Austria but that last-minute resistance from the bureaucracy (the Army?) prevented it. If so, it may still be possible that the Sakharov case will someday be resolved in a satisfactory way and FAS is continuing to work on it.

What follows is the Soviet summary (with Soviet title) of an unusual Soviet unclassified paper on the issue of space-based ABM, by the Soviet Commission just discussed.

POLITICAL-MILITARY IMPLICATIONS OF PERSPECTIVE (sic) AMERICAN SPACE-BASED ANTIMISSILE SYSTEM (SBAMS)

The special research project on this problem* has been recently completed by the Committee of Soviet Scientists Working Group headed by Academician R. Sagdeev and Dr. A. Kokoshin.**

Particular attention in the research project has been paid to the potential weapon systems that could be built on the principle of directed energy transfer—weapon systems which are the subject of active debate in the USA today.

Several types of energy sources, undergoing different stages of technical development, were considered as possible components for the direct energy transfer weapon system. It was noted that a prototype system with 5 MW laser and 4-meter diameter mirror could presumably be developed within 8-10 years. According to the estimates done by the Working Group, the space BMD system having approximately 18 orbital stations would be capable of destroying about 15 ICBMs only in 1000 sec. (assuming massive launch) or up to 100 ICBMs in 15 minutes (assuming time-scattered launch). It was presumed that the launch sites should be within the range of two orbital stations simultaneously. According to the Group technically feasible improvement of ICBM resistance to laser beam up to 10-20 KJoules/sm, would make such a system incapable to destroy ICBMs.

The estimates of the Working Group show that the development of SBAMs effective enough to destroy 1000 ICBMs in 100 sec. would require the increase from 4 to 15—in the mirror diameter, from 5 to 60 MW laser power capacity and from 45 to 700-800 tonnes—in fuel capacity.

It was also pointed out that the development of a new space launcher, considerably heavier than the current Space Shuttle, would be needed to build such a SBAM system. Some additional requirements would be obviously imposed on the system if ICBM protective measures were taken.

According to the Group study, construction of SBAM system using neutral particle beam accelerators and UHF generators (which are currently in early stages of development) would take much greater technical and budgetary efforts. Members of the Group were quite critical regarding the possible SBAMS uses of X-ray laser.

The estimates mentioned above are related to the hypothetical "ideal" full-scale SBAMS supposed to be 100% reliable both technically and operationally. Obviously the real SBAMS would not be so reliable and would require back-up duplicating components. It could mean the need to have even such duplicating elements as orbital stations themselves to compensate for technical unreliability. Operational unreliability would require the development of multilayer SBAMS (having in particular traditional missile land and/or SBAMS as an additional

component) which is being actively considered in the USA in recent years. It should be noted that even high operational reliability could not guarantee absolute protection. For instance three layer anti-missile system, with 90% operational reliability for every layer if used against 1000 ICBMs (each having, say, 10 warheads) would be penetrated at least by 10 warheads, that could inflict tremendous damage.

The construction of effective SBAMS might take placing into orbit at least 50 such platforms. According to the study group, a total cost of one layer only for such a system would roughly amount to \$400 billion.

There are sound reasons to believe that effective countermeasures could be taken much faster and easier at the cost amounting only to 1-2% of total investments required for building a consequent SBAMS. This cost-ratio would be kept with the capacity of SBAMS increasing.

The SBAMS vulnerability to countermeasures is the main factor that makes it possible to consider such a system as intended for assuring successful first strike. Such a strike could be launched both against offensive forces and anti-SBAMS systems of another side with a hope to reduce its ability for retaliation and further protecting itself with the from such a retaliation.

According to the Group all this allows to conclude that the deployment of SBAMS would not assure (as it is claimed by its proponents) a shift from the "MAD" posture—from the "strategy of deterrence based upon the threat of retaliation" to the defensively-oriented strategy based on the ability to assure protection against a full-scale ICBM attack. On the opposite, the deployment of such a system would complicate the dilemma of deterrence, make the strategic situation highly unstable, for it would stimulate the dangerous illusions regarding the advantages (damage limitation and even chances for survival in nuclear war) associated with the first strike.

As it was noted by the Working Group, American refusal to undertake no-first-use of nuclear weapons commitment, US strategic programs aimed at accumulating the first strike potential could serve as an additional stimulus for considering potential US SBAMS within the framework of the first strike strategy. On the contrary the Soviet side, bearing in mind tremendous importance of strengthening the strategic stability in the atmosphere of growing political-military tensions, already in June 1982 undertook unilateral obligation not to use first nuclear weapons. This obligation became an integral part of Soviet military doctrine, an important guideline in training Soviet military forces.

It was also stressed by the Group, that the presence of tested and deployed elements of SBAMS system, even if its scope is limited, could considerably hinder the progress at the talks on strategic arms limitations and limitations of nuclear weapons in general. Such an unfortunate development is inevitable, for the appearance of that qualitatively new component in the strategic arsenal of one or both sides would confuse the existing assessment system of strategic balances and bring up additional complications in the comparison of forces.

Vast resources which should be devoted to the construction of SBAMS scientific and technological capital already accumulated in the field could be effectively diverted to a full-scale international bilateral and national programs of peaceful orientation. In such a case those industrial branches which were supposed to be employed to develop SBAMS could effectively be engaged in such peaceful projects.

It was unanimously believed by the members of the Group that consequent programs of co-operation in this field could substantially contribute to expedite the solution of such ever more acute global problems as economic development, energy, resources, ecology, and also create a basis for successful space exploration by the future of the Earth inhabitants.

* See the report "Political-military implications of perspective American space-based ABM system" issued by the Committee of Soviet scientists for peace against the threat of nuclear war, Moscow, November, 1983.

** Academician R. Sagdeev heads the Institute of Space Research of the USSR Academy of Sciences. He serves as Vice-chairman of the Committee of Soviet Scientists. Doctor A. Kokoshin is the head of the political-military department in the Institute of USA and Canadian Studies of the Soviet Academy of Sciences. He is also Vice-chairman of the Committee of Soviet Scientists.

The Working Group included scholars from the Institute of Space Research, Institute of World Economy and International Relations, Institute of USA and Canadian Studies, as well as physicists and experts on missile and space technology. They were: A. Arbatov, A. Vasiliev, R. R. Nazirov, O. Prilutsky, R. Rodin, S. Rodionov.



Andrey Kokoshin (with FAS Chairman von Hippel)

FRINGE GROUPS RALLY ROUND STAR WARS

Six months after President Reagan's March 23 call on scientists to "give us the means of rendering...nuclear weapons impotent and obsolete", a number of interests have rallied round for various ideological or technological reasons.

The Congressional flag under which they are flying describes itself as the "People Protection Act" (H.R. 3073).

Its goal is to create executive branch centers of advocacy for the star wars approach.

It wants, for example: a new agency to consolidate the directed-energy activities of the armed forces; a new unified space command to take over space "theater" operations; a major Army command for ground based ABM; and immediate development of a manned space station.

Reasoning that President Reagan's administration will not extend to the deployment of such defenses, they seek to ensure that the policy is not changed by future administrations.

In hearings in which FAS participated on November 10 before the House Armed Services Committee, the Administration's chief engineer, Richard DeLauer, tried to distance the Administration from these goals. Re the organizational changes, DeLauer suggested, "Let's figure out what we are going to do and then figure out how to do it rather than the reverse." He pointed out that when deployment was at issue, "You will be staggered by the cost", and his charts showed 12 boxes, each of which he alleged posed problems every bit as difficult as the Manhattan Project or the Apollo project to put a man on the moon.

Later, in testimony just after that of Edward Teller, FAS Director Stone pointed out that both of those projects were contests against "nature", not against the Soviet scientists.

There was no reason, he argued, for believing that our scientists could prevail against Soviet scientists if we gave them the easier job of destroying life while our scientists were assigned the more difficult task of protecting it.

While it was, of course, no surprise to see Edward Teller supporting Star Wars or General Daniel Graham urging this "technological end-run" on the Russians using high technology, it was interesting to see the second man on the moon, Buzz Aldrin, explaining why a military interest in space was healthy.

"Some," Aldrin announced, "may say that we can exploit space without the military; this is simply a pious hope." Indeed, he felt we should be "grateful" for a race in space, not apprehensive, because it would draw mankind into space. Since this is precisely what had, in fact, drawn Aldrin to the moon, it was understandable. But when he pointed out that Grenada showed the importance of "choke" points or that lunar dust could be used to protect against earth attack, one felt that, on earth, he was out of



Richard DeLauer

his depth. He explained carefully that a statement he submitted had been signed by "sixteen Ph.D.s".

Richard Perle, who was widely reported to have been the center of last-minute internal opposition to the star wars speech—and to have been chastized for it—, has seen the light. Now he explains that these defenses "have the potential to increase stability" by reducing the "utility of preemptive attack." The approach, he explained, was fully complementary to our effort to "reduce offensive weapons through arms control".

In fact, even the bill's originator responded to Stone's testimony by admitting that the Soviets would not like our efforts and would resist them. He allowed as how he would "welcome that." (Decoded, this means that the backers know that the Soviets will try to maintain their deterrent with offensive weapons but, this being hard to admit to the public, they adopt, in the very next breath, the pretense that the contest will somehow switch away from offensive weapons to defensive weapons rather than switch simply to both.)

Edward Teller's idea of candor is to explain that we should keep our retaliatory weapons "until our defenses are perfect"; to see a scientist suggesting to the Committee that defenses might someday be "perfect" was enough to turn one's stomach. He richly deserves the view which so many scientists have of him.

What the Administration is really trying to do, it appears, is to undermine the Soviet ballistic missile force in a 20-year program. By the end of 20 years, ballistic missiles are likely to be obsolete anyway, in favor of cruise missiles and still newer devices. Obviously, any defensive system that takes that long to build will not succeed in defending the country, just in changing the threat. But coupled with the receding mirage of defense later, we are getting accelerated arms race now. It reminded one observer of "Lord of the Flies"—the adults have vanished and the children are playing with the ultimate set of matches.

SCIENTIFIC EXCHANGE ON AN INSTITUTIONAL BASIS

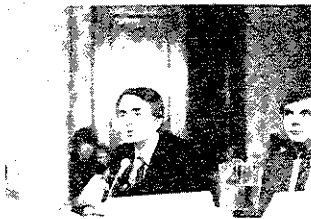
Scientific exchange with the Soviet Union has been cut from 100 man months to 50 man months as a result of a general cut in funding of international programs by the National Science Foundation.

Members interested in expanding scientific exchange with the Soviet Union should know that the exchange agreements have always contemplated additional exchanges arranged on an institutional basis. Thus the agreement operational in 1983 contains this paragraph:

"In addition to the visits otherwise provided for in this Agreement, each Academy may extend through the other Academy, or express its endorsement of invitations from universities, institutes, laboratories and other scientific institutions in its country to individual scientists of the other country for special visits. The financial arrangements for such visits shall be determined separately in each case; in general, the receiving scientific institution will bear necessary domestic expenses and the invited scientist will be responsible for international transportation."

In sum, if separate institutions had the funds to support Soviet scientists at that institution, direct scientific exchange could be arranged and American scientists could be sent from the host institution to the comparable Soviet Institute at the latter's expense (for internal costs).

Some Participants in the Nuclear Winter Symposium



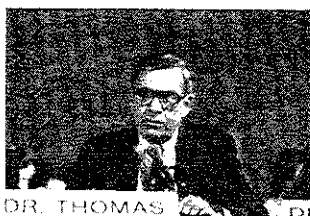
Carl Sagan & Alexandrov



Professor Paul Ehrlich



Academician A.S. Pavlov



Dr. Lewis Thomas



Dr. Jack Geiger



Dr. S. Kapitza

PUBLIC SERVICE AWARD TO KENNEDY

The FAS Public Service Award has, since its inception in 1970, gone to scientists. This year, struck by the significance of Senator Kennedy's work on arms control, the Federation decided to give it to that non-scientist.

The citation, given in full below, explains why: arms control treaties have, in the past, followed public uprisings against the arms race. And of the three uprisings FAS has witnessed in 38 years, Kennedy has played an absolutely critical role in two.

CITATION

In the thirty-eight years since Hiroshima, there have been, in this country, only three public uprisings against the arms race.

Coming at twelve-year intervals, the public pressures these uprisings produce appear to be necessary conditions for the negotiation and ratification of arms control treaties by the U.S. Government. Indeed, on the record, the public is batting 1,000 thus far with each public uprising producing, within a few years, the treaty it demanded.

The first uprising, against radioactive pollution of the atmosphere, made it politically possible for President John F. Kennedy to conclude the atmospheric Test Ban Treaty.

The second public uprising, in 1969, against anti-ballistic missile sites near cities, made possible the Anti-ballistic Missile Treaty. Here it was Senator Edward M. Kennedy who moved that uprising onto Capitol Hill, who mobilized the scientific opposition, and whose political strength, and readiness to use it, moved the ABM opposition from 10 to 34 Senators in a year and provided the momentum that produced the Treaty.

By a coincidence that appears to be no accident, it was again Senator Edward M. Kennedy, a dozen years later, who performed that same service for the Freeze movement. Galvanizing a popular movement whose own timetable saw Capitol Hill as years away, Senator Kennedy entered the fray with such force and skill as to bring 20 Senators with him and 150 Congressmen. No other office on Capitol Hill could have done a quarter as much to make this a national issue.

In between these issues, it is the Kennedy office again that has led the effort to make comprehensive the existing Test Ban Treaty.

In playing this unique and indispensable role in linking popular pressures to the political establishment, Senator Kennedy has had to champion complicated ideas before their time has come in front of skeptical audiences.

The world knows the physical courage of this and other Kennedys. But as intellectuals, and arms control entrepreneurs, we have a special awareness of the intellectual courage this leadership entails. With all this in mind, we are giving the FAS annual public service award, for the first time in our history, to one who is not a scientist: Edward M. Kennedy.

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