

PHYSICS and SOCIETY

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PHYSICS AND SOCIETY is a quarterly newsletter of the Forum on Physics and Society, a division of the American Physical Society. The newsletter is distributed free to members of the Forum and also to physics libraries upon request. It presents news of the Forum and of the American Physical Society and provides a medium for Forum members to exchange ideas. PHYSICS AND SOCIETY also presents articles and letters on the scientific and economic health of the physics community; on the relations of physics and the physics community to government and to society, and the social responsibilities of scientists. Contributions should be sent to the Editor: John Dowling, Physics Department, Mansfield State College, Mansfield, PA 16933, 717-662-4275.

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THE SECOND SHORT COURSE ON THE ARMS RACE

A Topical Meeting sponsored by
The APS Forum on Physics and Society and the
American Association of Physics Teachers

Sunday, April 17, 1983

(The day before the Spring APS Meeting)
Hyatt or Hilton Hotel, Baltimore, Maryland

This course is intended to supply information to physicists who either plan to teach about the arms race, or who want to study the issues of the arms race more deeply. The **PROCEEDINGS** of this course will be published by the AIP in its series of conference proceedings.

Morning Session

"The Effects of Nuclear War":	Frank von Hippel (Princeton University)
"Physics & Technology of the Arms Race":	Richard Garwin (IBM Research Center)
"New Technologies of the Arms Race":	Kosta Tsipis (M.I.T.)

Afternoon Session

"Seismic Verification of Nuclear Weapons Testing":	Lynn Sykes (Columbia U.)
"Technical Aspect of Verification":	

"Teaching about Physics and the Arms Race"	
"Courses on the Arms Race":	Dietrich Schroeer (Univ. of No. Carolina)
"Films on the Arms Race":	John Dowling (Mansfield State College)
"The FAS Nuclear War Education Project":	Barry M. Casper (Carleton College)
"Interactive Computer Graphics":	David Hafemeister (Cal. Polytech St. U.)

Evening Session

"Should Technology be Limited by Agreement":	Albert Carnesale (Harvard Univ.)
"Congress and National Security":	Peter Sharfman (OTA)

Films, Videotapes, and Slide Shows

The latest films on the arms race and nuclear war will be shown between sessions.

Registration

1983 Spring APS Meeting
Second Short Course on the Arms Race
17 April 1983

- I shall attend the Second Arms Race Short Course
- I hope to attend the Second Arms Race Short Course

(Name)

(Mailing Address)

City) (State) (Zip)

- Enclosed is \$40 to cover course costs (including PROCEEDINGS)
- Enclosed is \$25 for registration, sorry I can't afford the PROCEEDINGS
- Enclosed is \$10 for registration, I am a graduate student.

Return this form to: Dietrich Schroeer
Department of Physics and Astronomy 039A
University of North Carolina
Chapel Hill, NC 27514

Call for a FORUM contributed paper session at the April Baltimore meeting. The FORUM urges its members to submit abstracts for a special FORUM session devoted to papers dealing with "Physics and Society." Deadline for abstracts to the APS is 28 January 1983.

FORUM AWARDS

The Forum is pleased to announce that Andrei Sakharov is the 1983 Szilard Award recipient and *The Bulletin of the Atomic Scientists* - Ruth Adams, Editor, is the 1983 Forum Award recipient. Sakharov was cited for his role in the 1963 Limited Test Ban Treaty, the continuing arguments for mutual arms reductions and for peace, and for a voice and an example in furthering the cause of human rights. The Forum Award went to *The Bulletin of the Atomic Scientists* for providing a forum for discussion of critical Science-Societal issues in the global arms race and to Ruth Adams, Editor, for providing *The Bulletin's* driving force. The formal presentation of the awards will be at the April 1983 Baltimore meeting. In the event that Andrei Sakharov can not be present his daughter, Tanya Yankelevich, has agreed to accept the award. The Awards Committee consisted of John Dowling (Chairperson), Leo Sartori, and Joe Lach.

Horizontal Proliferation: The Spread of Nuclear Weapons to Other Countries - Gene I. Rochlin.

"From the earliest days of the Atoms for Peace program, it has been recognized that development of even the most peacefully intentioned program in nuclear power technology begins to confer upon a country the potential for developing nuclear weapons. The larger, the more sophisticated, and the more diverse that program becomes, the greater the capacity to exploit that potential for weapons purposes."

Vertical Proliferation: The Nuclear Arms Race of the Superpowers - Herbert F. York.

"Although the history of the U.S. - U.S.S.R. arms race has typically been characterized by extreme changes and fluctuations, three remarkably constant features also emerge. In the following, we describe these constants of the arms race, conjecture about the reasons for them, and try to draw some conclusions from them. The three constants are:

1. The rhetoric of the Soviet-American relationship, which has scarcely changed in 35 years;
2. The number of strategic nuclear delivery vehicles in the United States arsenal, which has remained essentially constant since the Korean War;
3. The expenditure level of the Soviet Union on strategic armaments, which has been about the same fraction of their GNP since 1964."

FORUM PUBLICATIONS:

Nuclear Energy, Nuclear Weapons Proliferation, and the Arms Race. This 48 page booklet of the proceedings of the Forum on Physics and Society Symposium at the 1982 APS/AAPT San Francisco meeting is now available for \$2.50 (in U.S.) or \$3.00 (foreign). Copies are available from AAPT, Publications, Graduate Physics Building, SUNY, Stony Brook, NY 11794. The publication was edited by Jack Hollander. Titles and short excerpts of the articles follow.

Nuclear Power and Nuclear Weapons: The Connection is Tenuous - Bernard I. Spinrad.

"Four main arguments will be presented to support the position that there is, at best, a tenuous connection between nuclear power and nuclear weapons.

"First, there is essentially no technical barrier to making nuclear weapons.

"Second, nuclear power presents more discouraging factors than encouraging ones as a route to proliferation.

"Third, the only effective barriers to non-proliferation are institutional, and depend on national and world consensus that proliferation is unsafe and not useful, and on actions to build and maintain such a consensus.

"Fourth, for over twenty-five years, nuclear power has been instituted in many countries as a trade-off against nuclear weapons."

Nuclear Power and Nuclear Weapons: The Connection is Dangerous - John P. Holdren.

"In the past few years, blue-ribbon reviews in several countries have viewed with alarm the link between nuclear power and the spread of nuclear weapon's capability among nations.

"I do not claim that nuclear power's 'weapon's connection' manifestly renders intolerable the use of this energy source in all circumstances and for all time. I simply contend that a realistic appraisal of the weapons liability must be included, along with the best information about the other costs and benefits of nuclear power and of the alternatives to it, in any sensible evaluation of energy strategies."

Nuclear Weapons and Nuclear War. This booklet is from the Forum Awards session at the 1982 Washington APS meeting and is also available for \$2.50 (in U.S.) or \$3.00 (foreign) from the AAPT at the same address given above. The publication was edited by Ken Ford. Titles and short excerpts follow.

Caught Between the Asymptotes - Philip Morrison.

"My title is inspired by remarks of John von Neumann...a brilliant mathematician and father of the digital computer, who was also a systematic promoter of large scale, modern weaponry. He was, at the same time, a man of clear-sighted vision who recognized the terrible hazard posed by escalating weaponry. Our problem in the second half of the twentieth century, he said (I am paraphrasing), is that our weapons grow - in numbers, in accuracy, in destructive capacity - more or less monotone. They don't stand still. They don't go backwards. But the area of the surface of the earth and the volume of its atmosphere remain fixed, gaining not an acre nor a cubic kilometer as time goes on. An extrapolation is painfully clear. We are caught between asymptotes, with ever diminishing room to maneuver. The distance between von Neumann's asymptotes has been halved, and halved again, since he offered the metaphor in the early 1950s."

We Are Not Inferior to the Soviets - Hans Bethe.

"Hawks and doves agree on at least one thing: that nuclear armaments are excessive and must be reduced.

The arms race has to be stopped.

The claim that the United States is inferior to the Soviet Union in strategic nuclear armaments is wrong. The claim that the conventional forces of NATO are hopelessly inferior to those of the Warsaw Pact nations is also wrong. These claims needlessly fuel the arms race.

Only by ending the arms race and then decreasing nuclear armaments can the United States and the world find real security."

MAD versus NUTS - W. K. H. Panofsky.

"The last years have seen a dramatic upsurge in public awareness of the threat of nuclear war. It is not totally clear why this has occurred; it may be this Administration's oratory; it may be the raised public exposure of nuclear issues brought on through the debate about ratification of SALT II; it may be the initiatives started in Europe of not wishing to become a nuclear battlefield.

"I conclude that, should nuclear weapons of any type be detonated in a conflict by any power, in any theatre of war, under any doctrine, then vast segments of the populations and resources of the belligerent countries and their neighbors will be in gravest danger. Only drastic limitations and reductions of the nuclear stockpiles accomplished through restraint and successful measures of arms control can remedy this situation. We must alter our national priorities toward this end, or the future indeed looks grim."

EXECUTIVE COMMITTEE MEETING OF THE FORUM.

The Executive Committee will meet at 3:30 PM on Tuesday, 25 January 1983 in Suite 540 of the Hilton. All Executive Committee members are urged to attend, all Forum members are invited to attend. Agenda items include (in no particular order): Baltimore contributed paper session, Arms Control Studies (Leo Sartori), the unresolved link between POPA and the Forum, a proposed topical conference on arms control studies, educational activities (Mike Casper), operations of the nominations and awards committees, the publication of invited papers (K. Ford), the Second Short Course on the Arms Race (D. Hafemeister/D. Schroerer), Treasurer's and newsletter editor's reports, APS Fellow nominations, general discussion of APS meeting symposia and other activities of the Forum - to which creative contributions are invited.

FORUM SESSIONS AT THE JOINT APS/AAPT MEETING JAN. 1983

SESSION BA - SYMPOSIUM OF THE APS PANEL ON PUBLIC AFFAIRS, THE FORUM ON PHYSICS AND SOCIETY, AND THE AAPT: THE CRISIS IN SCIENCE EDUCATION, Monday afternoon, 24 January 1983; West Ballroom at 2:00 PM; Robert Marshak, presiding.

- 2:35 BA2** Science and Mathematics Education - a National Dilemma. DON FUQUA, United States House of Representatives
- 3:10 BA3** Strategies for Obtaining Qualified Mathematics and Science Teachers. FRANK MACHIAROLLA, New York City Board of Education.
- 3:45 BA4** ALBERT SHANKER, United Federation of Teachers
- 4:20 BA5** Sputnik Times Two Equals One. F. JAMES RUTHERFORD, American Association for the Advancement of Science.

SESSION GD: JOINT SYMPOSIUM OF THE APS PANEL ON PUBLIC AFFAIRS, THE FORUM ON PHYSICS AND SOCIETY, AND THE AAPT: THE CRISIS IN SCIENCE EDUCATION, PART II, Wednesday morning, 26 January 1983; West Ballroom Room at 9:00 AM; John W. Layman, presiding.

9:10 GD1 Review of Data on High School Physics Teachers
BILL ALDRIDGE, Executive Director, National Science Teachers Association, Washington, DC 20007, 202/328-5810.

9:30 GD2 A Metropolitan University's Response
HARRY LUSTIG, Provost, City College of the C.U.N.Y., New York 10031 212/690-6638.

9:50 GD3 Industry - Classroom Teacher Initiatives
GERTRUDE CLARKE, Chatham High School, Chatham, NJ 07928, 201/635-7200.

10:10 GD4 Leaving Teaching: A Difficult Choice
J. R. MOWBRAY, EMC Contrls, Box 242, Cockeysville, MD 21030, 301/848-0236.

10:20 GD5 One State's Efforts at Addressing the Issues
J. R. FRANZ, Indiana University, Bloomington, IN 47405, 812/337-4359.

10:50 GD6 What Has Gone Wrong With Physics Teaching in Schools, and Where Can We Go From Here?
CHARLES A. COMPTON, Science Department, Phillips Exeter Academy, Exeter, NH 03833, 603/778-8264.

Panel Discussion on Arms Control Negotiations: Issues, Positions, and Prospects. 7:30 PM Monday, 24 January 1983. Sutton Ballroom North, Hilton Hotel. Presiding: Joe Lach, Fermilab.

Perspectives of the present and previous U.S. Administrations, of the U.S.S.R., and of outside critics will be presented. Participants to be announced.

Science, Technology, and War: New Technologies, New Weapons, New Problems. 7:30 PM, Tuesday, 25 January 1983, Sutton Ballroom North, Hilton Hotel. Presiding: P. Zimmerman, Louisiana State University.

New Technologies: A Survey. W. Kincade, Executive Director, Arms Control Association.

New Developments in ABM Technology. A. Carter, M.I.T.

New Aspects of Proliferation. A. Kramish, R&D Associates, Marina Del Rey, CA.

Technologies Which Make an Order-of-Magnitude Difference. G. Heilmeier, Texas Instruments, Inc., Central Research Labs, Dallas, TX.

Assessing the Environmental Risks of Energy Technologies. Joint Sponsorship of the Forum and POPA. 9 AM, Wednesday, 26 January 1983, Sutton Ballroom North, Hilton Hotel. Presiding: A.V. Nero, LBL, Univ. of California, Berkeley, CA.

Comparison and Interpretation of Energy Risk Estimates. C.G. Whipple, Electric Power Research Institute, Palo Alto, CA.

Nuclear Reactor Accidents. H. W. Lewis, University of California, Santa Barbara, CA.

Potential Climate Effects from Fossil-fuel Use. J. E. Hansen, Goddard Institute for Space Studies, New York, NY.

Indoor Radiation Exposure: Potential Increases Due to Energy Conservation Measures. A.V. Nero. LBL.

The Forum at Los Angeles (21 - 25 March 1983) there will be two Forum Sessions at times and places not yet specified.

Physics Education: The Crisis and Beyond. Jointly sponsored by the Forum and the APS Education Committee. Presiding: A. M. Portis, University of California, Berkeley, CA. Talks will be given by G. Holton, Harvard, member of the National Committee on Excellence in Education; D. S. Saxon, President of the University of California; and J. Franz, University of Indiana, Chair of the Education Committee.

The Problem of Nuclear War. Presiding: Nina Byers, University of California, Los Angeles. Speakers include R. Scheer, Los Angeles Times Reporter and author of *With Enough Shovels*; J. Cohen, M.I.T.; and one or two weapons experts from the Lawrence Livermore Laboratory.

ANNOUNCEMENTS

Bibliography on Women in Science. This bibliography was prepared for the Committee on the Education of Women of the AAPT. It consists of seven sections: 1) career material, 2) job statistics, 3) general material, 4) minority, 5) sex stereotyping in education, 6) slide presentations, and 7) books. The list was prepared and is available free from Dr. Eugenie Mielczarek, Physics Dept., George Mason University, 4400 University Drive, Fairfax, VA 22030.

Women Physicists and Their Research - A Video Course. This is a series of five 30 minute videotapes in which five women physicists discuss their research, the stages in their careers, combining family and career, their education and background, supportive people in their lives, and some advice to students. The five physicists (all Ph.D.s) are Sandra Zink - Los Alamos Meson Physics Facility on medical physics, Barbara Jones - Mt. Lemmon Observatory on infrared astronomy, Mary Young - Hughes Research Lab on solid state physics, Elsa Garmire - USC on integrated optics, and Mary Hudson - UC Berkeley - on plasma physics. These tapes are available on either VHS or

3/4" formats, \$100 purchase, \$15 rental. Contact K. Allison Nies, California Video Institute, 18216 Donmetz St., Northridge, CA 91324.

Editor's note: while most of these tapes are in rough form (however, some - particularly the plasma physics tape, are excellent for classroom use), they are an important first step in developing programs that show women as physicists. Allison Nies is to be commended for initiating and carrying out this project, she and some volunteers did it all alone. She deserves more support. You can help by showing them on your campus.

NEH SUMMER SEMINARS FOR COLLEGE TEACHERS

The NEH Summer Seminars for College Teachers program will offer 84 eight-week seminars during the summer of 1983. Those teachers selected to attend will receive a stipend of \$2,700 to cover travel expenses to and from the seminar location, books and other research expenses, and living expenses. The purpose of the program is to provide opportunities for faculty at undergraduate and two-year colleges to work with distinguished scholars in their fields at institutions with library collections suitable for advanced research. The 1983 Summer Seminars for College Teachers brochure, which lists seminar topics, directors, dates, and locations will be available locally from department chairpersons or from the Division of Fellowships & Seminars, MS 101, NEH, 806 15th St., N.W., Washington, DC 20506 in January 1983. College teachers interested in applying to a seminar should write directly to the seminar director (addresses below) for detailed information and for application materials. The deadline for submitting applications to directors will be April 1, 1983. Of particular interest are:

History of Modern Physical Science (S.G. Brush, Inst. for Physical Science & Technology, U. of Maryland, College Park, MD 20742).

Reappraisals of the Scientific Revolution (R.S. Westman, Dept. of History, U. of California, Los Angeles, CA 90024).

SYMPOSIUM ON INSTITUTING EDUCATION ON NUCLEAR WAR

To promote communication and cooperation between individuals and organizations active in nuclear age education, International Student Pugwash will sponsor the first national gathering of leading educators and administrators in the nuclear field. The weekend symposium, "Instituting Education on Nuclear War," will convene at Emory University, Atlanta, January 21-23, 1983. Conference proceedings and extensive resource materials will be published in *The Nuclear Age Education Sourcebook*. The symposium and sourcebook are part of an ongoing Nuclear Age Education Project at ISP intended to stimulate dialogue between innovators and help them chart a cooperative future path for nuclear war education. For more information contact: Fred Rose, Nuclear Age Education Project Coordinator, International Student Pugwash, 305 Massachusetts Ave., N.E., Washington, DC 20002, (202) 544-1784.

FILM REVIEWS

Nuclear Waste Isolation. Produced by Media Group Inc. for U.S. Department of Energy, Office of Nuclear Waste Management, Project: Management Division Nuclear Waste Isolate. Distributed by Modern Talking Service, 500 Park St., St. Petersburg, FL 33709. 16 mm, color, 28 min., 1982. Free Loan. (Reviewed by William F. Schmid, Chemistry Department, Mansfield State College, Mansfield, PA 16933).

Nuclear Waste Isolation reviews the problems and proposed solution for the permanent isolation of radioactive waste, and seeks to inform the public on these issues. First, it considers the stop-gap temporary storage of waste which requires caretaking of stored radioactive waste at power plants and government facilities. While satisfactory for the immediate future, it does not offer a solution for long term. The film then discusses the two types of radioactive waste: fission products with relatively short half lives but high levels of radioactivity and spent fuel with long half lives but lower levels of radioactivity.

In the storage of radioactive waste both types of waste must be considered, but the safe disposal of long life spent fuels is particularly important. The approach to permanent storage is to place it in mines at least 2500 feet deep. Various research projects which are evaluating the methods of storage and containment, and their possible deleterious effects on the environment are discussed. Different types of geological formations such as salt, granite, volcanic rock and basalt are considered in some detail, and the narrator visited several of these test facilities in Nevada, Washington State and the Gulf coast. Research on the effects of heat and radiation are mentioned. The film shows research on the absorption properties of rock being conducted at Argonne National Lab, the evaluation of possible interactions of radioactivity and underground water aquifers at the Batelle Office of Nuclear Waste, and reviews the best methods of inert solid entrapment as in glass or ceramics.

In summary, **Nuclear Waste Isolation** is a non-technical, but thorough review of the research projects being conducted by the U.S. Department of Energy for the permanent storage of radioactive waste. The main theme of the film is that well-planned procedures for the permanent safe storage of high level radioactive waste do exist. However, continued engineering work and research evaluation is still required before the U.S. proceeds to move radioactive waste from its present temporary storage to permanent storage sites.

NUCLEAR WAR GRAPHICS PROJECT

Stop vs. Start and **Under the Mushroom Cloud** are two new sound and 35 mm slide shows available from Nuclear War Graphics Project, 100 Nevada St., Northfield, MN 55057 for \$15 each. (Reviewed by John Dowling, Physics Dept., Mansfield State College, Mansfield, PA 16933.)

Stop vs. Start contrasts the nuclear freeze proposal with the Reagan administration's proposal at the Strategic Arms Reduction Talks (START). The com-

prehensive discussion of the destructive capabilities of the U.S. and the Soviet Union strategic arsenals leads to the conclusion that START not only means to build up new weapon's systems but is also an attempt to counter the nuclear freeze movement.

Under the Mushroom Cloud reviews civil defense of the 1950's and 60's; discusses why nuclear war civil defense is back again; explains the crisis relocation concept; critically examines its fundamental assumptions and their invalidity; vividly describes what nuclear war would really be like; and contrasts the options of preparation and prevention of war.

Both slide shows combine creative graphics with a good narrative. The results are two excellent productions on the arms race talks and current civil defense plans. These both would serve well as the main item on a program to inform people and to motivate them to work toward solutions of the arms race. Both are well worth the \$15 price.

APS Council Report from the 5-6 November 1982 Meeting at Philadelphia by Mike Casper, Carleton College, Northfield, MN 55057.

Items of special interest to **Forum** members include the following:

A. Washington Office: The APS is opening a one person Washington Office on a one year trial basis. Robert Park, of the University of Maryland, who is named APS Executive Director for Public Affairs will represent us in Washington. The precise nature of his duties is still under discussion.

B. The APS and Nuclear War (continued): the Council Executive Committee had endorsed the rather general, rather cautious National Academy of Sciences (NAS) Resolution on Nuclear War and Arms Control at its June meeting. In Philadelphia the Council went a little bit further:

1. It welcomed the efforts of the **Forum Arms Control Study Group** chaired by Leo Sartori (Behlen Lab., U. of Nebraska-Lincoln, Lincoln, NE 68588), which has identified several likely topics for APS mini-studies and has elicited more than 70 responses to its call for volunteers. The topics include laser and beam weapons, EMP, proliferation, verification, and "vulnerability and bias errors, etc." Civil Defense was another topic that received much interest but needs someone to volunteer to head the study. The Council voted \$2000 for this committee to continue its work. Contact Leo Sartori if you would like to volunteer to work on any of these arms control proposals.

2. It welcomed any further arms control proposals generated by the **Forum**. We might pursue proposals for APS efforts in nuclear war education (a permanent **Forum** or APS committee on nuclear war educa-

3. It approved the creation of an *ad hoc* Council committee to formulate "a draft statement in the area of arms control, potentially more comprehensive than the NAS statement." Contact incoming APS President Robert Marshak (VPISU, Blacksburg, VA 24061) if you have suggestions for ingredients of this statement.

A personal note: I personally believe that we as physicists and the APS as our professional organization, could be exercising a much stronger leadership at a time when public concern about nuclear war has opened a window of opportunity. Given the historical role of the physics fraternity in the creation and development of nuclear weapons, why are we temporizing while physicians and church leaders push for solutions? As I suggested in my last contribution to this column, physicists could have great political impact at this historic moment if many of us, around the world, stated stongly that enough is enough, pledged together not to work on nuclear arms, and dedicated ourselves instead to reversing the world's rush toward nuclear war. Please contact Forum Councillor Mike Casper with reactions and suggestions.

STATEMENT OF NATIONAL-SECURITY IMPACT OF INCREASED NUCLEAR-WEAPONS TESTING by Concerned Argonne Scientists.

Nuclear-explosive testing is now being accelerated in the United States, and a new generation of nuclear weapons that would require even more extensive testing is being proposed. These activities are contradictory to expressed national and Presidential goals of achieving reductions in strategic nuclear arms and discouraging proliferation of nuclear weapons.

We have reached this conclusion after evaluating the information below. The present and proposed nuclear-weapons testing programs have such profound impact that we call for federal action to reaffirm our treaty commitments and avoid policies that would tend to promote proliferation.

The current testing program. While the Soviet Union has been decelerating, the United States has been accelerating the testing of nuclear-explosive devices (1). Through 1978, the US had tested almost twice as many nuclear warheads as the USSR. The U.S. exploded 14 nuclear devices in 1980, 16 in 1981, and 16 in the first three quarters of 1982. In the meantime, from 20 in 1978, the USSR reduced the number of its detonations to 15 in 1979, 10 in 1980, 9 in 1981, and 4 through the third quarter of 1982.

Some American testing is presumably for enhanced-radiation (neutron) warheads, some for other new warhead configurations such as MX and Trident, some for radiation effects on warheads and missiles, some for weapons safety, and perhaps a few for reliability checking. Nuclear warheads for the United Kingdom are also tested in Nevada. While these warhead developments have been taking place, major advances have been made in the accuracy of targeting ballistic missiles.

Proposed testing program. Public information (2, 3), and statements by Edward Teller, indicate that a new, third generation of nuclear weapons is being funded at U.S. weapons laboratories. (The first generation consisted of fission explosives of the type used to destroy Hiroshima and Nagasaki; the second generation is the multistage thermonuclear weapon that gave a thousand-fold increase in explosive yield. There has also been a significant ongoing miniaturization of nuclear weapons which could be considered a generation of its own.)

One of the new-generation weapons that has received wide publicity is the directed-energy x-ray laser pumped by a small nuclear explosive. The device, if it worked, would be used in anti-missile defense, situated in orbiting satellites or placed in orbit at the outset of a crisis. (4)

Another Teller proposal is for the direct use of small-yield nuclear explosives that would be launched and exploded in the proximity of in-flight ballistic missiles. This missile defense, reminiscent of the discredited Safeguard ABM system, would also require nuclear weapons orbited in space or shot into the outer atmosphere by rockets. The nuclear warhead would be radar-guided into the path of incoming missiles.

A third element in the proposed new generation consists of nuclear weapons exploded in the upper atmosphere so as to create electromagnetic radiation that selectively damages and jams at Russian command, control and communications frequencies, while leaving American frequencies relatively free of such effects.

A fourth concept uses space-borne warheads in which the reaction fuel elements are configured to concentrate the nuclear blast in a particular direction. This too would serve in anti-missile warfare.

Each of these devices in the new generation is being promoted as a defensive weapon, although all have the potential to support first-strike, offensive action.

Just to determine feasibility, these proposed developments clearly require an extensive program of nuclear detonations that would have to continue far into the future. Moreover, in order to proof-test any of the four new-generation systems, nuclear explosions in the upper atmosphere or outer space would be needed.

Nuclear Testing Treaties. There are several treaties (5) that govern the testing and deployment of nuclear weapons. The Limited Test Ban Treaty prohibits nuclear-weapon tests "or any other nuclear explosion" in the atmosphere, outer space or under water.

The Threshold Test Ban Treaty restricts underground detonations to a maximum yield of 150 KT. The treaty also obligates the super-powers to continue negotiations towards the "cessation of all underground nuclear weapons tests." The Peaceful Nuclear Explosives Treaty limits tests that have non-military objectives; no such explosions have been conducted in recent years by the USA and few by the USSR. Although signed, respectively, by Presidents Nixon and Ford, these latter two treaties are yet to be ratified by the U.S. Senate. Both the United States and the Soviet Union are observing the explosion limits.

The Outer Space Treaty forbids placing in orbit or otherwise in outer space "any objects carrying nuclear weapons or any other kinds of weapons of mass destruction."

In the Anti-Ballistic Missile (ABM) treaty, the USA and USSR agreed to limit their ABM systems (which have since become obsolete). The treaty also prohibits the development, testing, or deployment of space-based ABM systems or components. Any fixed, land-based defense of the MX "dense-pack" system would be restricted by the 1974 Protocol to a single site, currently Grand Forks, ND.

Negotiations had been underway during previous Administrations on a Comprehensive Test Ban Treaty. This would have led to a ban on all nuclear-weapons testing. Because the threshold test ban requires that testing be underground, which is expensive and self-limiting, it reduces the rate at which the new small, third-generation weapons can be developed; the comprehensive ban would prohibit testing and therefore effectively deter their development altogether.

Opponents of a comprehensive test ban claim that further study of radiation effects from nuclear explosions is needed to keep our deterrent invulnerable. But nuclear-explosion radiation can be simulated by other means. Despite the need to prepare for the advent of complete test ban, funding for non-nuclear simulation has been reduced, while the program for nuclear test explosions has been expanded.

Under the Limited Test Ban and ABM Treaties, verification is largely accomplished by national means, namely satellite reconnaissance, seismic sensing, air-, ground-, and underwater-based monitoring, and intelligence data. In addition, if the Threshold Test Ban Treaty were ratified by the Senate, geophysical and test-site data would be exchanged in order to improve the precision associated with the determination of aggregate yields; also, testing would be limited to specific sites, and calibration data would be exchanged.

In the Treaty on Peaceful Nuclear Explosives, on-site inspection is permitted, including drilling holes, taking photographs, and establishing a remote seismic network. If the comprehensive ban were negotiated, confirmatory on-site data might become available, including the stationing of remote seismic monitors near test sites.

Those treaty provisions that require continued negotiations towards a comprehensive test ban, prohibit development of ABM systems, and introduce on-site inspections are not well known publicly.

Implications. In view of military interest in more testing of the present generation of nuclear weapons and in proceeding with development of a new generation, there are pressures against Senate ratification of the Threshold Test Ban and Peaceful Nuclear Explosives Treaties (6); in fact, there are suggestions that some existing treaties should be renounced by the United States so that the larger weapons and the new generation can be tested.

The current US program has the potential for undermining the Threshold Test Ban because the explosive yields of the MX and Trident missiles which might be tested are two to six times greater than the 150 kT limit embodied in the Treaty. Recent testimony before the House Armed Services Committee by Maj. Gen. William W. Hoover, Director, USDOE Office of Military Applications, states "...we think we need to increase the underground testing level. This has been verified by a special committee set up by the President."

ACDA Director Eugene Rostow has informed the Senate Foreign Relations Committee that "...we are going to need testing, and perhaps even testing above the 150-kiloton limit." (6).

Even the undertaking of development of a space-based ABM would seem to violate the ABM Treaty; and the deployment of any proposed defense systems that place fission-explosive triggers above the atmosphere would appear to violate the Outer Space Treaty. Moreover, suspension or withdrawal of the United States from Comprehensive Test Ban negotiations might already be a violation of the Threshold Test Ban Treaty.

By backing away from its program of explosive simulation and by funding research on defensive systems that require nuclear-explosive tests, the Administration is, in effect, declaring that it has no interest in meaningful Comprehensive Test Ban negotiations.

More and more people are realizing that positive steps are needed to bring a halt to the nuclear-arms race and the drift towards nuclear war. Because of its strong linkage to the proliferation of nuclear weapons, the continued testing of fission and fusion explosives undermines any efforts towards arms control.

In a "Declaration on the Prevention of Nuclear War," a prominent worldwide panel of scientists and educators (7) called upon all nations "To find more effective ways and means to prevent the further proliferation of nuclear weapons. The nuclear powers, and in particular the superpowers, have a special obligation to set an example in reducing armaments and to create a climate conducive to nonproliferation...."

The National Academy of Sciences and the American Physical Society (8) recently approved resolutions calling for significant reductions in the number of nuclear weapons, for practical measures to inhibit proliferation, and for continued observation of all existing arms-control agreements. The Institute of Medicine (9) has issued a proclamation calling for a halt to the continued build-up of nuclear arms and urged a mutually verifiable agreement between the superpowers to stop the arms race.

The new generation of nuclear explosives that has been proposed by the weapons laboratories has "intrigued" the Senate Armed Services Committee and elevated the enthusiasm of the Administration (6). Evidently the new "defensive" concepts were endorsed without sufficient regard for their contradictions to American arms-control objectives.

By embarking on programs that threaten to violate or terminate existing treaties, by foreclosing options for a comprehensive test ban, and by generating its own arms-race momentum, we find that nuclear-weapons testing -- especially an expanding program -- is a menace to national and international goals of nuclear-arms reductions and non-proliferation.

We call upon -- the Administration to continue to honor our treaty obligations, -- the Senate to ratify treaties signed by American presidents, and -- the federal government to avoid nuclear-weapons testing policies that proliferate nuclear weapons.

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(Signers are members of the Concerned Argonne Scientists, an organization of employees at Argonne National Laboratory who desire the rational use of technology for peaceful purposes. The CAS is not officially connected with the Laboratory.)

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