F. A. S. *NEWSLETTER*

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– – – – – – – – to provide information and to stimulate discussion. Not to be attributed as official FAS policy unless specifically so indicated.

CB WARFARE: TWO ARTICLES IN *SCIENCE* AND AAAS RESOLUTION

Science, in its issues of 13 and 20 January, contains two articles by Elinor Langer reviewing U.S. activities and policies in the area of chemical and biological warfare. The first article focuses on the nature and extent of research now supported by the U. S. Government, and includes a page on the highly publicized controversy at the University of Pennsylvania. The second article reviews what is known about some of the weapons themselves and notes a few official statements that have been made about their use. The two *Science* articles are probably the most comprehensive brief reports on CB weapons that have appeared anywhere recently, and FAS members and others interested in this topic are directed to them.

The AAAS Council, at its recent Washington meeting, adopted a resolution expressing its concern over the danger of CB warfare. It is reported that the originators of the resolution were primarily concerned with Vietnam, although the resolution was broadened to cover all chemical or biological agents that modify the environment, whether for peaceful or military purposes. The text of the resolution follows:

Whereas modern science and technology now give man unprecedented power to alter his environment and affect the ecological balance of this planet; and

Whereas the full impact of the uses of biological and chemical agents to modify the environment, whether for peaceful or military purposes, is not fully known:

Be it resolved that the American Association for the Advancement of Science:

1. Expresses its concern regarding the long-range consequences of the use of biological and chemical agents which modify the environment; and

2. Establishes a committee to study such use, including the effects of chemical and biological warfare agents, and periodically to report its findings through appropriate channels of the association; and

3. Volunteers its cooperation with public agencies and offices of government for the task of ascertaining scientifically and objectively the full implications of major programs and activities which modify the environment and affect the ecological balance on a large scale. (New York Times, 31 December 1966)

NUCLEAR TEST DETECTION: MORE DECOUPLING EXPLOSIONS PLANNED

Following is the complete text of an article by John W. Finney which appeared in the New York Times on 7 January 1967 datelined Washington, Jan. 6.).

The Defense Department announced today that it was planning larger atomic explosions in underground caverns to determine the feasibility of concealing nuclear tests.

The decision to extend the research is a result of a small-scale underground nuclear explosion conducted last month in a Mississippi salt dome by the Defense Department's Advance Research Projects Agency.

The 350-ton explosion, the Pentagon announced, provided "experimental verification" of the theory that it is possible to muffle the seismic force of a nuclear explosion by firing it in an underground cavity. The small nuclear device was fired in a cavern, 110 feet in diameter, that had been carved out of the salt dome by an earlier atomic explosion.

A preliminary analysis of the Project Sterling experiments shows, the Pentagon said, that the force of the seismic signals was reduced 100 to 200 times by the "decoupling" effect that was provided by conducting an explosion in a cavern.

Significantly, the decoupling effects were highest in the low-frequency seismic signals that are used primarily for detection and identification of underground explosions.

Maximum Distance Reduced

Thus, the 350-ton Sterling explosion created seismic signals comparable to those that would be generated by 2.25 ton explosion tightly surrounded by materials. The maximum distance at which seismic signals were detected from the Sterling explosion was 68 miles.

The Defense Department said that the results of the experiment were "of sufficient importance to warrant further research in decoupling."

As a result, the Atomic Energy Commission has been requested to conduct a study on the feasibility of mining or leaching an underground salt cavity sufficiently large to decouple a five-kiloton nuclear explosion.

The Defense Department's announcement did not touch on the technical and political impact of the Project Sterling results upon diplomatic efforts to extend the limited test ban to include underground explosions.

Officials of the Arms Control and Disarmament Agency said, however, that the results did not "fundamentally change" the United States position on the detection system and on-site inspections needed to monitor a ban on underground tests.

RECENT TRENDS IN FEDERAL SUPPORT OF BASIC RESEARCH

The next two Newsletters will probably contain various reports from the FAS Council meetings in New York at the end of January. Following is the text of a memorandum submitted by the Washington Association of Scientists to the Council before the January meetings.

The Federation of American Scientists has in the past concerned itself primarily with the impact of scientific developments on public affairs and has not dealt with the state of scientific research itself. However, F.A.S. should be concerned with the health of the scientific enterprise in this country, since this will affect the benefits which science can bestow on the U.S. The F.A.S. has always dealt with the federal role in utilizing the products of scientific research, and it may well be concerned with federal programs which influence the course that science takes in this country.

The Washington Association of Scientists has been discussing for the past four months some recent trends in federal support of basic research. While it has not as yet formulated specific proposals, it would like to suggest that the F.A.S. as a whole begin to consider what it might do in this area.

From the mid-50s until 1963 federal funds for the support of basic research were increasing at the rate of about 25% per year. This rate of growth was such that essentially all worthwhile research projects could be funded, and this favorable outlook encouraged many new students to enter scientific fields. Since 1963, as a result of altered Congressional and Presidential attitudes and the budgetary competition of the war in Vietnam, the growth rate of federal support has fallen off sharply, so that the funds for fiscal year 1967 are only about 10% above those of the previous fiscal year. (This overall growth figure includes both the biological and physical sciences, and the growth in the physical sciences has been cut back even more to an estimated 7.6%.) Furthermore, it appears that the growth, if any, for the next fiscal year will be even less. While other organizations of scientists can consider the implications of this trend on their own specializations, F.A.S. may make a contribution to this national discussion by examining the overall implications of this for the scientific and educational welfare of the country.

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The FAS, founded in 1946, is a national organization of scientists and engineers concerned with the impact of science on national and world affairs.

Sources of information (given in the articles in parentheses) are for further reference. Items reprinted directly from other publications are designated as such in an introductory paragraph.

A primary factor which must be considered in analyzing the growth rate of research funds is the balance between funds for research and those for education and training, including not only federal funds but also funds from state and other sources. During the same period that federal research funds have been severely limited, support for higher education, including graduate education, has been increasing sharply. If the nature and objectives of graduate study are not altered, this combination will lead, within a short time, to a situation in which there will be a large number of new Ph.D's who have trained for a career in research but who find no basic research jobs available, as well as Ph.D. students whose research during their graduate education cannot be supported. In this context the goals of graduate education, and especially of Ph.D. programs, may deserve re-examination.

Federal decisions on funds for basic research and for various forms of higher education do not appear to be made in a coordinated way, and these inter-relations certainly do not enter into the Congressional deliberations on these funds, where quite diverse committees handle the individual appropriations. If the health of the scientific establishment in this country is to be maintained, it appears essential that more thought be given to the types of federal support programs which can most effectively meet the needs for scientific manpower of this country. Basic research as it is currently conducted in many fields requires a substantial number of graduate students to perform the detailed experimental and theoretical work. One possible way of reacting to a limitation in research funds would be to reduce the number of graduate students in the sciences. This would require a substantial shift in the present mode of conducting research and would lead inevitably to a slowdown in the pace of scientific development in this country. However, if the country is to maintain an active research effort in the universities, there must be a continuing supply of new blood entering the field. This will be very difficult, if not impossible, without a substantial continuing growth in research funds, at least until presently-active scientists begin to retire. According to some estimates, basic research funds should grow at a rate of 15-20% per year to maintain an influx of younger people. If the growth rate is in fact reduced below this, then the scientific community must consider how it can best maintain its present vitality in this new environment.

If funds for the support of research by academic scientists are not going to be readily available, the federal government may well consider providing much more support for summer research by college teachers. Experience has shown that the best undergraduate education is obtained when the teachers maintain an active association with current research; the nation's scientific potential could be severely damaged if the cutback in the growth of research funds should prevent a close association between science faculties and current scientific research.

The Washington Association of Scientists urges the national F.A.S. to consider these problems and, in particular, to explore ways of encouraging the federal government to adopt a longer-range perspective than has been customary until now, so that the impact of annual budget decisions on the future of science in America can be correctly judged.

NEWS ITEMS

A milestone may have been reached last year in the development of **U.S. nuclear power generating capacity.** For the first nine months of 1966, 51% of the new electric generating capacity ordered by U.S. utilities, both public and private, was nuclear. Although this statistic may reflect a temporary surge in orders for nuclear plants, it does illustrate the continuing trend toward nuclear power in preference to fossil fuels.

The twenty nuclear power plants ordered in the first nine months of 1966 will have a total capacity of nearly 16 million kilowatts. This is 38% more than the capacity of all U.S. nuclear power plants built or announced before 1966. On 1 October 1966, the total installed capacity of all U.S. utility plants, nuclear and fossil fuel combined, was 244 million kilowatts—about 15 times the capacity of the nuclear plants ordered in the first nine months of 1966. The investment in the new nuclear plants will come to $1.7 billion. (*Scientific American*, January 1967)

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The Federal Government will not be taking any further action on the **project to publish a daily science newspaper,** although a government task force looking into the matter seems to have concluded that such a paper could be published and appreciated by many in the scientific community. In spite of enthusiasm on the part of many scientists who were exposed to a prototype issue of *Science Daily*, many private publishers protested about possible federal encroachment on private commercial interest. Other publishers saw a possible opportunity for a successful commercial venture. It is reported that several private publishers are still studying the matter. (*Physics Today*, January 1967)

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Government support of science and higher scientific education in the U.S. is sometimes criticized on the ground that too many grants are awarded to an individual and his project and not enough are given directly to the educational institution for which he works. The NSF **has now begun two new programs of direct aid to colleges and universities** and has changed an existing program to help improve science instruction and research institutions "that are not now at the forefront but that have potential and aspirations to rise."

Grants of up to $100,000 a year will be available in the new College Science Improvement Program, with the amounts related to the number of science baccalaureate degrees awarded. A new Departmental Science Development Program is intended for institutions that have graduate programs in science but are not recognized as having "outstanding strength" in the field. Grants of up to $600,000 for three years will be made for the support of specific areas in which the institution seems to be capable of reaching a high level. (*Scientific American*, January, 1967)

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Dale Wolfle comments editorially in the 6 January 1967 issue of *Science* on the difficulty of justifying basic research —at least in comparison with applied research—in the kind of cost-benefit terms upon which the federal budget increasingly depends. Wolfle suggests that the real benefits of basic research — not just those that can be easily translated into dollars and cents — should be more effectively presented. He comments that the Office of Science and Technology and the National Science Foundation should take the lead in dealing with the Bureau of the Budget and the Congress, but that individual scientists can help by writing to and talking to their Congressmen, and by acknowledging the federal source of support for their work when new findings are announced. "Agencies and individuals alike must recognize that there will be only as much federal money for basic research as the majority of individual congressmen are willing to appropriate."

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The American Chemical Society has begun publication of a **new monthly journal,** *Environmental Science and Technology*. The first issue, which appeared on January 24th, reports on a new method of detecting air pollutants from a distance. The method, which is based on an analysis of infrared radiation from smoke, can be used to record the presence of sulphur dioxide and other agents and, significantly, works at night when surveillance by other methods may be impossible. (American Chemical Society Release, 24 January 1967)

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Eleven scientists received the **1966 National Medal of Science.** The Medal was established in 1959 by Congress to be awarded by the President to individuals for outstanding contributions to knowledge in the physical, biological, mathematical, or engineering sciences. The 1966 recipients are, in the biological sciences: Edward F. Knipling, U.S. Department of Agriculture; Fritz A. Lipmann, Rockefeller University; William C. Rose, University of Illinois; Sewall Wright, University of Wisconsin. In the engineering sciences: Claude Shannon, M.I.T.; Vladimar Zworykin, Radio Corporation of America. In the mathematical sciences: John W. Milnor, Princeton. In the physical sciences: Jacob A. Bonnevie Bjerknes, UCLA; Subrahmanyam Chandraeskhar, University of Chicago; Henry Eyring, University of Utah; John H. Van Vleck, Harvard. (New York Times, 25 December 1966)

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Communist China, in its latest nuclear test, apparently was experimenting with a triple stage bomb—the "dirtiest", most powerful type of nuclear weapon. The AEC announced, on the basis of a preliminary analysis of the radioactive debris from China's fifth test, that the yield was estimated to have been about 300 kilotons and involved thermonuclear material. Most significant, perhaps, was the fact that, according to the AEC announcement, some uranium-238 was involved. This may mean that China was attempting to develop a triple-stage "fission-fusion-fission" weapon. The "dirtiness" of such a device comes from the fact that it is the fission process that is primarily responsible for producing the radioactive byproduct found in fallout. An alternative — and presumably more hopeful theory, at least at this stage — is that the uranium 238 may have been incompletely separated from the uranium 235 in the fission trigger. (New York Times, 31 December 1966)

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The Public Health Service reported that the **highest levels of radioactivity** recorded from any Communist Chinese nuclear weapons test have been recorded in the United States since the fifth test on December 27th. The readings were on the order of four times greater than the highest values measured from earlier Chinese tests. (Washington Post, 12 January 1967)

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A **nuclear powered airplane** which could stay aloft for months at a time may be receiving serious study again. NASA is reported to have specialists working full time on the feasibility of nuclear engines which could be adapted to the Air Force's big C-5A transport. Although the AEC and the Defense Department sank altogether about $1 billion into nuclear plane technology before abandoning the 15-year effort as impractical in 1961, the sheer size of the C-5A — the first of which is to be finished in February, 1968 — with a wing span of 223 feet and a length of 246 feet, may make the nuclear propulsion idea look somewhat more practical. (Washington Post, 18 January 1967)

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India's Atomic Energy Establishment at Trombay has been named for Homi J. Bhabha, India's leading nuclear scientist who died last year in a plane crash in Europe. At the dedication ceremonies, attended by U.S. AEC Chairman Seaborg, Prime Minister Indira Gandhi, reaffirmed India's determination to use atomic energy only for peaceful purposes.

The Bhabha Center is essentially a research facility with two nuclear reactors. It is more than half completed, with American and Canadian assistance. India expects soon to build more nuclear plants on its own. In an apparent effort to reduce Indian concern at taking a back seat in the world

NEWS ITEMS

(Continued from Page 3)

nuclear community because she has not developed nuclear weapons, Seaborg commented that India's achievement "equals that of China in the broad field of nuclear technology." (Washington Post, 13 January 1967)

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The Center for the Study of Democratic Institution will sponsor an **unofficial world "Peace Conference"** to explore avenues toward East-West coexistence in Geneva, May 28 to 31. The meeting will be held in the Palais des Nations, the former headquarters of the League of Nations and now the site of various international disarmament and other discussions. The Geneva meeting, entitled "Pacem in Terris—II" will be a sequel to the Center's similarly named convocation in New York in February 1965. It is hoped that prominent individuals from the Soviet Union, North Vietnam, and other Communist nations will be among the 300 participants. (New York Times, 19 January 1967)

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The AEC will shut down another of its plutonium producing reactors at Richland, Washington, about 1 July 1967. The decision follows a review of projected requirements for reactor products in defense and civilian programs and will reduce the number of operating AEC production reactors to nine. (AEC Release, 24 January 1966)

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The AEC has established an Advisory Panel on High Energy Physics. The first chairman of the Panel will be Professor Victor F. Weisskopf, head of the physics department at MIT, and director of CERN from 1961 to 1966 (and a long-time FAS member). Other members of the panel are: Rodney L. Cool, Brookhaven National Laboratory; Earle C. Fowler, Duke University; Leon W. Lederman, Columbia University; Edward J. Lofgren, Lawrence Radiation Laboratory; George E. Pake, Washington University; W.K.H. Panofsky, Stanford University; Robert G. Sachs, Argonne National Laboratory; Keith R. Symon, University of Wisconsin; Robert L. Walker, Cal Tech; Robert R. Wilson, Cornell; C. N. Yang, State University of New York, Stony Brook. (AEC release, 19 January 1967)

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The AEC announced that it is studying the possibility of selling or leasing its three uranium producing plants to private industry. Built at a cost of $2.3 billion to produce enriched uranium for weapons, the plants are in Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio. (Washington Post, 31 December 1966).

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Communist China could probably launch a satellite in the near future if it decided to do so, according to "top government officials." According to the prevalent view, Chinese missiles are powerful enough to put a small satellite into orbit if a simple upper stage is added to the basic missile design. It is not clear that the Chinese are hurrying to orbit a satellite, but China has placed great political emphasis on becoming the first Asian nation with nuclear weapons and the first Asian nation with military missiles. Probably, at very small extra cost, she could now become the first Asian nation and the fourth in the world (after the United States, the Soviet Union, and France) to launch satellites into space. (New York Times, 18 January 1967)

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