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.

ATOMIC INDUSTRY PROSPECTS LOOKING UP

Twenty years after the first controlled release of nuclear energy at the University of Chicago's Stagg Field on Dec. 2, 1942, optimism is rising as to the prospects of putting such power to economic use. This new prevailing optimism has been reflected by several sources during the past few weeks. For one, the Atomic Energy Commission released to the public a report on the future of atomic energy which had been requested last March by the President. According to the report, atomic power is on the threshold of producing economical electricity and by the turn of the century will be generating about half of all the electricity in the United States. By the middle of the next century, most electricity will be generated by a nuclear power industry built around "breeder" reactors producing a virtually inexhaustible supply of nuclear fuel, the AEC reported. (Breeder reactors not only produce power but also convert natural uranium as well as thorium ore into fissionable materials and thus produce more fuel than they consume.) As the AEC report pointed out, however, breeder reactor technology is still in its infancy and many difficult problems remain to be solved before economical power can be produced by such reactors. The report proposed a greater emphasis on research in this advanced type of nuclear power plant. The significance of the recent report is likely to be more political than technical in giving new endorsement

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JANUARY COUNCIL MEETING

The FAS Council will meet in New York City at the Statler-Hilton Hotel, 7th Ave. & 33d St., on Fri., Jan. 25, at 7:00 p.m. and again on Sat., Jan. 26, at 2:00 p.m. to continue through and after dinner. Meeting room to be announced at American Physical Society message center at Statler-Hilton.

MONEY PROBLEM IN NASA

The National Aeronautics and Space Administration appears to be running into monetary growing pains. Cost increases in the manned space flight programs (Apollo and Gemini) have eaten into two-thirds of the space budget and present estimates indicate that the projected program costs for the fiscal year ending next June will be $300,000,000 to $400,000,000 higher than estimated. As announced in late November (N. Y. Times 11/28), budgetary and technical problems were causing a delay or stretch-out in the two-man Gemini orbital flight—the prelude to the Project Apollo manned lunar flights. Consideration is also being given to the altering of present plans for a Gemini rendezvous with an Agena rocket—again a prelude to the rendezvous and docking techniques to be used in Apollo for the lunar vehicle retrieval.

Also conflicting with the hungry Apollo program and facing possible budget cutting is the nuclear rocket project Rover (N. Y. Times 11/30). This program is also fast becoming a heavyweight contender for funds with a present budget of $200,000,000 and a proposed doubling in the next fiscal year.

For the present, policy has been set apparently to make no cuts in the Apollo program. This, coupled with the decision not to seek supplemental funds from Congress early next year is forcing NASA to cut back other programs. The Apollo

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REPORT OF THE UNITED NATIONS SCIENTIFIC COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION

The following article, by Arthur C. Upton, Oak Ridge National Laboratory, is reprinted from the Nov. 1962 issue of Cancer Research, the journal of the American Association for Cancer Research, a society whose membership consists of scientists engaged in cancer research:

INTRODUCTION

The subject of radiation hazards has been of increasing interest and concern because of the amount of artificial radiation released into the atmosphere in recent years. Up-to-date, accurate information is, therefore, of vital importance to everyone and has special significance to those working in the field of neoplastic diseases.

The first report on the effects of atomic radiation, prepared by the United Nations Scientific Committee, appeared in 1958. A new report on this subject has just been issued, and the Board of Directors of the American Association for Cancer Research asked Dr. Upton to prepare a summary of this report for publication in Cancer Research. In this way it is hoped that interested readers will have access to an objective and authoritative survey of this timely and complicated question.

Harold P. Rusch, Editor

Those concerned about the hazards of environmental radiation will be interested in the second "Report of the United Nations Scientific Committee on the Effects of Atomic Radiation" (UNSCEAR) (1). This document, just released, reviews the sources and levels of ionizing radiation to which members of the world's population are exposed and the effects of radiation on man and his environment. The main text, which is written for nontechnical readers, briefly summarizes the salient findings and conclusions of the Committee, with particular reference to developments occurring since its first report in 1958. A more detailed treatment of the subject is provided in comprehensive appendices to the Report, which are extensively documented with tables, charts, and bibliographic references.

The Committee (UNSCEAR) was established by the U.N. General Assembly in 1955, chiefly to evaluate the hazards of ionizing radiation. Its membership includes representatives from Argentina, Australia, Belgium, Brazil, Canada, Czechoslovakia, France, India, Japan, Mexico, Sweden, U.S.S.R., United Arab Republic, United Kingdom of Great Britain and Northern Ireland, and the U.S. Other committees created at about the same time in the U.S., under the auspices of the National Academy of Sciences, and in England, under the auspices of the Medical Research Council, have also recently issued second reports, the conclusions of which are in general agreement with those of the U.N. document.

To afford the reader a basis for understanding radiation effects in human populations, the UNSCEAR report first reviews the fundamental physical and biological reactions resulting from the interaction of radiation with matter. Effects on the chemistry of the cell are summarized, including remarks on the role of water, free radicals, oxygen, peroxides, and other chemical and physical factors influencing the biological response. Effects on cellular growth, metabolism, and function are surveyed, including changes in nucleic acid and protein synthesis, mitotic rate, and survival. The effects of radiation on the genetic material are described, with reference to the nature and types of mutagenic changes, their relation to radiation dose, their induction by other mutagenic agents, and the role of isotope transmutation in mutagenesis. Biological factors influencing the effectiveness of radiation and

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measures that prevent or repair cellular radiation injury are considered in the last part of this section.

The next portion of the report deals with effects of irradiation on exposed individuals (somatic effects). Discussed are radiation injury of the embryo; effects of localized irradiation on different organs and systems of the body, of whole-body exposure, of internally deposited radionuclides, of radiation on the incidence of neoplasia, and on longevity. Also given are dose-effect relations and factors modifying the radiation response. Of particular interest to cancer workers will be the sections on radiogenic neoplasia. These review clinical and experimental data from a wide variety of sources and discuss them in relation to the carcinogenic risks of environmental contamination. In this evaluation, it is noted that neither empirical information on cancer rates in irradiated populations nor knowledge of mechanisms of carcinogenesis is adequate to enable confident prediction of the carcinogenic effects of low-level irradiation. At the same time, however, epidemiologic studies are cited which suggest that x-ray exposure of the fetus during diagnostic examination of the mother may increase the risk of leukemia in the child. This evidence, although inconclusive, is consistent with the high radiosensitivity of the embryo and fetus to other types of radiation effects, and compels caution in considering the hazards of radiation carcinogenesis at all ages.

Hereditary effects of radiation are considered in broad perspective in a later section. The role of mutations in the pathogenesis of naturally occurring defects and diseases is evaluated. Also discussed are the types and mechanisms of radiogenic mutations in relation to the prevalence of natural mutations and those caused by other agents. It is noted that since the previous UNSCEAR Report, a growing number of human diseases have been found to be associated with specific chromosomal abnormalities. It is also observed that cytogenetic studies on human cells irradiated in vivo and in vitro have demonstrated similarity in radiobiologic behavior between human chromosomes and those of lower animals and plants. The relation between mutation frequency and radiation dose is reappraised in the light of the newly discovered influence of dose rate on this relation in germ cells. Data are given on the occurrence of radiation-induced mutations in the offspring of irradiated individuals (humans, mice, fruit flies); their implications for human health are discussed. It is noted that, although a change has been reported in the ratio between boys and girls born to irradiated parents in Hiroshima and Nagasaki, induction of other hereditary effects, such as neonatal deaths and malformations, has not been demonstrated. It is also cautioned that the observed change in sex ratio, as in other recent mammalian studies, appears more complex than that predicted on the basis of unsophisticated genetic theory; hence its interpretation and its value in estimating human radiation hazards will require further study.

Observations on the sources and levels of environmental radiation are next summarized. The naturally occurring radiations are discussed—e.g., cosmic rays and radiocativity in the earth's crust and in water, foodstuffs, the lower atmosphere, and the human body. The contribution of nuclear weapons debris is examined for the period through 1961, and estimates are given for future levels in the event of continued bomb testing. Data on radiation dosage from medical, occupational, and other types of exposure are reviewed. Radiation sources are analyzed in detail with reference to kinds and amounts of radiations and to the individual isotopes involved, their transport in the environment, and their metabolic pathways in man and his food chain.

The conclusions of the Report are not fundamentally different from those published by the committee in 1958. In regard to radiation exposure levels, it is concluded that new data have improved estimates of the radiation dosage to the world's population. Inclusion of a neutron component in the dose attributed to cosmic rays increased by nearly 20 per cent the estimated average natural background as compared with earlier estimates. The background is estimated as 128 mrem/year to the gonads and 122 mrem/year to the bone marrow. In comparison with these values, the population dosage ascribed to medical exposure is estimated to range from 6 to 60 mrem/year in countries for which data are available. Estimates of the dosage from nuclear weapons fallout have also been refined, owing to new information on the residence time of atomic debris in the stratosphere and on the radioactive contamination of foodstuffs and of the human body. Although large uncertainties still exist, the current estimates are consistent with the continued weapons testing at a rate releasing 1 megacurie Sr^{90} per year, a level approximating the average rate of release for the period 1954-1961. Radiation from other man-made sources (watch dials, television tubes, industrial uses of radiation, and nuclear energy, etc.) is estimated to constitute only a fraction of a per cent of the total dose to the population.

Concerning the biological effects of radiation at the dose levels to which the population is currently exposed, the Committee stressed the uncertainties in estimating such effects—emphasizing, however, that mankind has always lived in the presence of radiation from natural sources and that the additional dosage from all artificial contributions still averages less than one-third of the natural background. At the same time, it noted (a) the growing evidence that genetic and somatic effects may result from small amounts of radiation and (b) that the effects of successive exposures may be cumulative, although new observations on experimental animals and man indicate a greater complexity in the relation between dose and effect than was heretofore recognized, for both genetic and somatic effects. Hence, especially since certain genetic effects may not become manifest until after several generations, the Committee urged that all unnecessary radiation exposure be minimized or prevented, particularly when large populations are involved, pending further information on dose-response relations at low dose levels. In the absence of more adequate data on absolute risks, the hazards of radiation from various sources are compared in relation to those from natural background, on the basis of comparative radiation doses. For example, the cumulative, genetically significant radiation dose to all generations from fallout of weapons tested up to the end of 1961 was estimated to correspond to less than 2 years' exposure to natural background.

It is too early to assess the influence this report will have on the scientific and political community. It may be expected, however, that the document will be widely used as a reference work. Despite deficiencies in style and continuity of a sort which are common to committee reports, it should be intelligible and informative to readers in all parts of the world and thus may help in shaping a sound and constructive policy on ionizing radiation and nuclear energy.

REFERENCES

1. Report of the United Nations Scientific Committee on the Effects of Atomic Radiation. Official Records of the General Assembly: Seventeenth Session. Supplement No. 16 (A/5216), 1962.

MONEY PROBLEM IN NASA

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top-priority status is reflected in Pres. Kennedy's request to the Budget Bureau to look into ways and means of obtaining additional funds to keep Apollo on schedule and minimize the delays in Gemini.

The funding problems for the massive lunar landing program has brought out a basic dichotomy of policy within the Space Agency administration manifested in the philosophies of James E. Webb, head of NASA and D. Brainerd Holmes, head of the manned space flight programs (*N. Y. Times* 1/12).

Mr. Webb, while acknowledging the top-priority status of the Moon project, feels that there are other projects in this category and that they should not be cut back to maintain the Apollo timetable. He apparently wishes to keep a well diversified over all program going even if it means the loss of time in the race to the moon.

On the other hand, Mr. Holmes, called in from industry (RCA) to manage the 20 billion dollar program (minimum estimate!), feels that it is of over-riding importance and that the agency, in a sense, has a public and presidential mandate to succeed.

The situation undoubtedly was discussed recently with President Kennedy at a White House meeting attended by both Webb and Holmes. The President subsequently asked the Budget Bureau to seek additional funds.

THE AMERICAN FACULTY COUNCIL FOR THE GRADUALIST WAY TO PEACE

The American Faculty Council for the Gradualist Way to Peace has been set up to promote position papers in the search for alternatives to war and surrender. It will review and give the widest public attention to position papers submitted to it, provided that the papers are in line with its Principles:

Peace can be gained and maintained without sacrificing the security and ultimate values of any society.

1. The continuous buildup of arms is an inadequate and unacceptable treatment of international problems in an age of large nuclear arms on what proves to be a small planet.

2. Any strategy that advocates or leads to surrender or appeasement is utterly rejected.

3. An adequate peace strategy must be comprehensive. It must be concerned with all aspects of the international situation—the atmosphere of hostility and tension which hinders fruitful negotiations, the continuation of the arms buildup, and the underlying ideological and power conflicts.

4. A workable peace strategy must take a realistic view of human nature. It cannot as a prerequisite demand fundamental changes in the nature of man or the structure of society. It must work toward the development of an international system in which conflicts are limited to non-violent means and must encourage an atmosphere in which freedom and justice are within the reach of all.

5. A successful peace strategy must provide for effective international institutions to guarantee the peace once it has been achieved.

6. Peace is the concern of all and it is clearly in the interest of everyone to work for it.

The position papers are circulated and approved according to the following Procedure:

B. Procedures

In order to advance the principles stated above, the National Council agrees that:

(1) Members of the National Council, Local Councils, and subscribing organizations will be entitled to bring before the National Council suggestions for the advancement of peace in the framework of the principles stated above. Each suggestion will be in the form of a resolution and a brief of the arguments in support of the resolution.

(2) A Steering Committee of five members will decide whether the suggestions made fall within the limits of the principles stated above. It will also supervise the administrative office of the National Council. The Steering Committee will be elected annually.

(3) Suggestions that fall within the limits of the policy will be circulated among the members of the National Council **in the name of those who initiated the suggestions.**

(4) Members of the National Council will be free to veto, approve, or disapprove a suggestion. Suggestions vetoed by more than fifteen percent of the members of the National Council will not be made public by the National Council. Suggestions vetoed by less than fifteen per cent of the members will be made public by the National Council **in the name of those who approved them.** The number of members dis-

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FAS NEWSLETTER

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Chairman.....Freeman J. Dyson

The FAS Newsletter is prepared in Washington by FAS members. The staff for this issue were: Editor—Gary Felsenfeld; Writers: L. Gellert, F. K. Millar, N. Seeman

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

A BRIEF HISTORY OF THE F.A.S.

(This is the conclusion of an article begun in the last issue.)

In 1952 we testified in favor of revision of the McCarran Act. In 1955 we supported Martin Kamen's appeal for a passport which was resolved as a result of a Supreme Court ruling. In 1957 we supported the appeal of Dayton which was also upheld by the Supreme Court. We have subsequently opposed bills designed to overrule these Court rulings. FAS committees have collected much information about delays and denials in issuance of visas to foreign scientists.

In this areas FAS has worked long and hard and often with great effectiveness. I remember how pathetically pleased some scientists have been to find a friend when their world has just collapsed on them. The procedures have improved considerably but there still are serious problems.

Cooperation With Foreign Scientists

Early in 1946 John Simpson attended a meeting of the British Association of Scientific Workers in England. In June, the Committee on Foreign Correspondence was formed, Amassa Bishop, Chairman. It distributed literature all over the world and helped encourage scientific participation in the solution of world problems. In Feb. 1947 FAS recommended international distribution of isotopes and kept at it until the AEC agreed. In 1948 a Committee to Aid Foreign Science was formed in the Rochester Chapter which did much to stimulate exchange of scientists and to resolve many individual visa problems. FAS hailed the Atom Pool proposals of Dec. 1943 and has tried to encourage the IAEA, established in March 1956. In Jan. 1956 the FAS called for declassification of nuclear fussion. In 1946 we proposed scientific attaches for the State Dept. Later this was proposed in the Berkner Report and came into being under Truman.

FAS sent observers to several meetings of the World Federation of Scientific Workers and to other international meetings. FAS members have been active in the Pugwash program. We have been little concerned with UNESCO, which is unfortunate. The Mohawk chapter became interested in foreign technical aid and set up an activity which is now independent (VITA).

Military Policy And Civil Defense

The FAS has paid little attention to development of military policies. Since these policies have had a profound effect on the arms race and on science, this seems unfortunate. In 1946 we were worried about military treatment of Nazi scientists and objected to the timing of the Bikini tests. In 1948 we were concerned about the effect of UMT on young scientists and on world opinion.

The Mohawk Chapter became interested in civil defense in 1954 and at their suggestion the Council urged further study and suggested that the government encourage dispersal. In 1957 a Chicago committee made an earnest study but the Council could not agree on a policy. The Council could not agree again in 1961 when civil defense suddenly became a major national issue but it did authorize a cautious statement of the issues. While this was not newsworthy it was constructive and useful.

Conclusion

During the first couple of years the FAS carried on an extensive educational compaign. We brought out a book in 1946 and a movie short in 1947. Individuals sought out newsmen and public figures. Chapters organized regional conferences and countless talks were presented across the country. The call for speakers and our enthusiasm dwindled as the UN talks bogged down. For long, the primary educational organ has been the Bulletin of the Atomic Scientists, founded by Hi Goldsmith and Eugene Rabinowitz in Nov. 1946.

From time to time the Federation has faced bankruptcy or wondered whether it should make the effort to continue. With more FAS types close to the government and with an Arms Control and Disarmament Agency to carry the ball, the question of continuing was raised again this spring. As will be reported in the future, the overwhelming response was that we have plenty more to do.

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to the atomic power program. Thus, as seen by commission officials, the report will have a beneficial effect in "educating" the Administration, which thus far has tended to take a sceptical budgetary outlook toward nuclear power. One question which has been raised is whether it is necessary to push the development of atomic power at an annual cost of $200,000,000 in view of the large reserves of conventional oil and coal fuels. The answer of the report was that fossil fuel supplies are not unlimited and presently visualized total supplies would be exhausted within two centuries in the absence of additional forms of energy. Development of nuclear power in this century offers a way of conserving reasonable amounts of these fossil fuel supplies for other valuable purposes such as transportation and industrial chemicals. To "bridge the gap between the infancy and maturity" of nuclear power, the commission proposed that the Government should (1) provide economic incentives, e.g., Government research assistance, to bring the already developed water-cooled types of reactors into use on a rapidly increasing scale, (2) develop improved "converter" reactors that would be more efficient power generators and would provide fuel for the breeder reactors until they could build up their own inventory of fissionable materials, and (3) expand developmental work on the breeder reactors with the objective of making them "economically attractive" as a power plant by the Nineteen Eighties (N. Y. Times, 11/23).

Optimism among officials of the atomic energy industry was apparent at the recent annual conference of the Atomic Industrial Forum, the trade association of the industry. Mr. Charles H. Weaver, president of the forum and vice president of the Westinghouse Electric Corporation, said in his opening speech that atomic plants had "firmly established themselves as being practical, reliable and safe." From a cost standpoint, he said, the plants stand "on the threshold of economic atomic power" and the further lowering of costs must be accomplished through the cooperative efforts of Government and industry toward the development of more advanced, efficient reactors. Behind the optimism expressed at the Forum Conference is the successful operating experience with the first atomic power stations. These are Shippingport, built under the direction of Vice Admiral Hyman G. Rickover near Pittsburgh; Dresden, built by Commonwealth Edison in southern Illinois; and Yankee, built by twelve New England utilities in western Massachusetts. Starting with Shippingport in 1957, the three plants have produced a total of 5.5 billion kilowatts of electricity and have provided the industry with valuable experience. Dr. Frank Pitman, director of the AEC's division of reactor development, predicted at the Forum conference that by 1980 it would be possible to build 500,000-kilowatt nuclear plants that would generate electricity at a cost of 3.8 mills per kilowatt-hour or less. At that rate the electricity would be as cheap as conventional-powered electricity throughout the country (N. Y. Times, 11/27).

AMERICAN FACULTY COUNCIL

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approving and vetoing, as well as a brief resume of their arguments, will also be made public. (The distinction between "disapprove" and "veto" is made to allow members to dissociate themselves from a particular resolution, but who do not wish to prevent its promotion by other members, to do so.)

(5) Only suggestions approved by all members will be made public in the name of the National Council.

(6) New members are to be invited by the National Council once a year, and are to be approved in the same way suggestions are approved; that is, no member will be invited if fifteen or more of the members veto his invitation. The general policy of the National Council is to keep the membership small, limited to responsible and outstanding members of the various professions and fields of learning, and to ensure that the non-partisan nature of the National Council will be maintained.

(7) Members of the National Council are urged to seek the advice of the local Councils for the Gradualist Way to Peace before casting their votes. It is hoped that local Councils will endorse the same resolutions passed by the National Council but the National Council does not bind the local ones, nor does it represent them.

(8) Resolutions published by the National Council will be sent to religious, professional, civic and other organizations that have declared themselves as supporting the principles stated above. The subscribing organizations are expected to examine the peace proposals published by the National Council, and, to the degree that these meet with their approval, work for their acceptance by their members as well as by members of Congress and the President. The National Council will examine peace suggestions made by subscribing organizations, but it does not represent them and will not make statements in their names.

The American Faculty Council for the Gradualist Way to Peace includes the following members: Charles A. Barker, Gregory Bateson, John Bennett, Hans Bethe, David F. Cavers, Owen Chamberlain, Theodosius Dobzhansky, Erwin N. Griswold, Moses Hadas, Oscar Handlin, Heinz Hartman, Alex Inkeles, Roman Jakobson, Alfred Kazin, Harold Kelley, Lawrence Kubie, Alexander H. Leighton, Aba Lerner, I. Michael Lerner, Seymour M. Lipset, Donald G. Marquis, Margaret Mead, Hans J. Morgenthau, Charles E. Osgood, Talcott Parsons, Mark Schorer, Henry Taube, Sol Tax, Paul J. Tillich, Robert Tucker, Paul Weiss, C. Vann Woodward.

The members of the Initiating Committee are: Emile Benoit, Walter Gellhorn, Polykarp Kusch, Paul F. Lazarsfeld, David Truman, Amitai Etzioni.

The National Office of the American Faculty Council calls upon FAS members to prepare either individually or in teams papers for submission to the Council. The address of the National Office is: 324-M Fayerweather Hall, Amsterdam Avenue and 118th Street, New York 27, New York.

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