decade, and official government policy, stemming from the National Marine Resources Council, is that the United States does not wish to start a race for ocean territory, or to antagonize any of the countries, including the Soviet Union, which have been asked to participate in the decade.

In a recent action which reflects the stated U.S. policy on this issue, UN representative Leonard C. Meeker presented a draft resolution to the UN Ad Hoc Committee to Study the Peaceful Uses of the Sea-Bed and the Ocean Floor Beyond the Limits of National Jurisdiction. It recommended: (i) that no state claim or exercise sovereignty over any part of the deep ocean floor; (ii) that an international agreement governing exploitation of resources be established as soon as possible; (iii) that the Continental Shelf be redefined to establish a more precise boundary and area of claims.

Meanwhile, though funds are still to be raised, scientific plans for Cobb Seamount under the title, "Project Sea Use" are proceeding, despite government and individual differences in opinion over jurisdiction. The four principal sponsors, directed by the Washington State Oceanographic Commission, plan a comprehensive exploration program which they hope to initiate for a 2-month period in the summer of 1969, whether they receive government support or not. This project would include an underwater manned habitat located directly on the summit of the mountain, two oceanographic research ships, and one or more underwater research vehicles. In addition, a scientific and environmental services mast would be erected and initially employed during the expeditionary phase in support of basic scientific research. An effort also is underway to seek the cooperation of private and state organizations. Oregon State University researchers have already moored a research buoy on Cobb's summit. Because the summit is close to the surface and the water is of very high clarity, extensive fish populations can be observed. Cobb Seamount also presents an opportunity for conducting ecological investigations and conservation studies because there are few known seamounts in the entire world that reach into the photic zone and therefore can be populated by algae. It is also thought that continuous, long-term observations of biological production in the open sea could be made from Cobb Seamount, perhaps leading to insights into deepwater food harvesting. Besides scientific research in environmental biology, programs in the atmospheric sciences, chemical oceanography; geological, geophysical, and physical oceanography are being considered as well.

A preliminary schedule has been prepared for the development of the seamount, but one of the big problems will be raising the $2 million which is needed for financing. The four sponsoring organizations have contacted numerous agencies for financial and program support, but with a tight squeeze on the federal budget, Project Sea Use representatives may have to settle for services and equipment, such as ships, navigation devices, weather facilities, research apparatus, and manpower rather than money. They may also have to look more closely at possibilities for private and regional funding, independent of government support.—MARTI MUELLER

On the Use of Herbicides in Vietnam

A statement by the Board of Directors of the American Association for the Advancement of Science

The serious concern of the scientific community about the consequences and implications of the use of herbicidal chemicals to destroy crops and forest vegetation in Vietnam was reflected in a resolution passed by the Council of the AAAS on 30 December 1966. This resolution stated, in part:

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;

Pursuant to this resolution, we, the Board of Directors of the AAAS, initiated discussions with representatives of the Department of Defense regarding the use of herbicides by U.S. military forces in Vietnam. In reply to our inquiry, the Department of Defense, in a a letter (29 September 1967) from John S. Foster, Jr., Director of Defense Research and Engineering, stated that:

As you know, we have considered the possibility that the use of herbicides and defoliants might cause short or long-term ecological impacts in the areas concerned. The questions of whether such impacts exist, and, if they do, whether they are detrimental or advantageous, have not yet been answered definitively, even though these chemicals have been used commercially in large quantities for many years. Qualified scientists, both inside and outside our government, and in the governments of other nations, have judged that seriously adverse consequences will not occur. Unless we had confidence in these judgments, we would not continue to employ these materials.

We note with satisfaction Dr. Foster's statement that our government would not sanction use of these agents in Vietnam were it not confident that they have no serious long-term adverse consequences for the environment.

We have reviewed the Midwest Research Institute report entitled "Assessment of Ecological Effects of Extensive or Repeated Use of Herbicides" sponsored by the Advanced Research Proj-

ects Agency of the Department of Defense through Contract No. DAHC 15-68-C-0119, and wish to thank the Department of Defense for providing this useful compilation of the literature. We have also reviewed the commentary on the Midwest Research Institute report by a committee appointed by the National Academy of Sciences (transmitted by letter of 31 January 1968 from the president of the National Academy of Sciences to the director of Defense Research and Engineering) and the comments of a number of individual scientists whose judgments concerning this report we requested.

Our review of these documents leaves us with the conviction that many questions concerning the long-range ecological influences of chemical herbicides remain unanswered. The extent of long-term deleterious effects of the forest defoliation in Vietnam is one of these unanswered questions (1, 2)*. We do agree that the use of arsenicals on crops may have serious hazards, and we are concerned with the ultimate route taken by arsenical compounds in plants, soil, and animals. Therefore, on the basis of the information available to us, we do not share the confidence expressed by the Department of Defense (in the letter of 29 September 1967 quoted above) that seriously adverse consequences will not occur as a result of the use of herbicidal chemicals in Vietnam, insofar as arsenical compounds are concerned.

In the course of our study, we became aware of the serious concern expressed by scientists in Vietnam over long-term environmental consequences of the military use of herbicides. Extensive claims of environmental poisoning through use of these agents have been made. Because of uncertainties in available evidence on the long-term effects of such materials, such charges cannot now be answered unequivocally.

Because large-scale employment of herbicides has taken place in Vietnam, and because questions of the long-term welfare of all the people of Vietnam are of great importance to the United States and other countries, we urge that steps be promptly undertaken to initiate detailed, long-term, on-the-spot studies of the regions of Vietnam affected by the use of herbicides. If rehabilitation of lands adversely affected by these agents is required, ecological studies initiated now will be of substantial value in defining the required programs. If defoliation has produced or can produce beneficial influences on the food-producing capacity of the affected regions, these possibilities should be evaluated fully so that they can be most effectively exploited for the benefit of the Vietnamese people.

Accordingly, we urge that a field study be undertaken under the auspices and direction of the United Nations (3), with the participation of Vietnamese scientists and scientists from other countries, and with cooperation, support, and protection provided by the contending forces in the area. This study, which could well be supplemented by experimental work elsewhere, should provide a detailed environmental analysis of the long-range effects of the agents used and of the steps necessary to assure optimum future productivity of the environment for the welfare of its inhabitants.

Further, we urge that the maximum possible amount of relevant data be released from military security, so that the scientists conducting the study may know the areas affected, the agents used, the dates applied, and the dosages employed.

We express especial concern about the use of arsenical herbicides in Vietnam, and urge that their use be suspended, if it has not already been stopped, until the ultimate fate of the degraded arsenical compounds can be more reliably determined.

We recognize the difficulties involved in the proposed field study; however, it is our hope that the feasibility of such a study may be increased as a result of the current peace talks in Paris.

Finally, we hope the recommended study can be initiated promptly and we proffer the good offices of the Association in helping to plan it and to publicize its findings.

DON K. PRICE, *Retiring President and Chairman, Board of Directors*
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Supplementary Statements by Some Members of the Board of Directors

1) The confidence of the Department of Defense that seriously adverse consequences will not occur as a result of the dissemination of herbicides by military operations in Vietnam is unwarranted, we believe, not only with respect to arsenical materials, but also with respect to 2,4-D and 2,4,5-T. According to the Midwest Research Institute report, the latter are being sprayed in Vietnam at dosage levels about ten times greater than the levels used in domestic applications. Therefore the estimates regarding possible long-term effects that are derived from domestic experience are not applicable in Vietnam. Since, to our knowledge, there are no relevant observations in Vietnam itself, it is not possible at this time to make a reasonably accurate prediction of the long-term effects of dissemination of 2,4-D and 2,4,5-T. However, there are specific reasons to anticipate certain important hazards from the use of these herbicides in Vietnam. According to the MRI report (pages 198–200), 2,4-D inhibits the formation of nitrogen-fixing nodules in leguminous plants; plants of this type are particularly important in tropical vegetation. In addition, according to the MRI report (pages 201–203), 2,4-D and related herbicides induce serious chromosomal abnormalities in various higher plants by interfering with the mitotic apparatus that governs the behavior of chromosomes during cell division. Evidence advanced by the MRI report that these herbicides do not cause mutations in bacteria is irrelevant since bacteria lack the chomosomal apparatus which is affected by the herbicides. Hence, intensive use of 2,4-D and 2,4,5-T in Vietnam may cause widespread chromosomal damage among plants, with effects —on the genetic characteristics of the affected plants and therefore on their ecological behavior—that cannot be foreseen at this time. For these reasons, we believe that the scientific grounds for the use of herbicidal chemical weapons in Vietnam—that is, Department of Defense confidence in the judgment that they will cause no long-term effects—are not valid. Accordingly, in keeping with the precept stated in the Department's letter of 29 September 1967, the herbicide program should be stopped. Apart from the morality of the war itself, which is not at issue here, continued used of a weapon with effects

* Supplementary statements, indicated by numbers, appear at the end of this statement.