members appointed by the International Council of Scientific Unions to the Committee to Consider the Complications of Contamination of the Moon and Planets by Extraterrestrial Exploration (CETEX). Hughes participated in both the 1955 and the 1958 International Conferences on the Peaceful Uses of Atomic Energy as one of the representatives from the United States. Upon request of the secretary general of the conference, he presented papers reviewing the most recent worldwide nuclear data of technical importance.

In all of these international activities, Hughes established important contacts in many countries and was instrumental in developing a free flow of information between the United States and the rest of the international scientific community.

Hughes had been active as a teacher and a writer. He was a Fulbright professor at Oxford University in England from 1953 to 1954. He was the author of a number of books which have become standard works in the field of neutron physics. These include *Pile Neutron Research* (Addison-Wesley, 1953), *Neutron Optics* (Interscience, 1954), *Neutron Cross Sections* (Pergamon, 1957), and *On Nuclear Energy* (Harvard Univ. Press, 1957). An indication of the scientific value of these books is the fact that *Pile Neutron Research, Neutron Optics*, and *Neutron Cross Sections* have all been translated into Russian by the U.S.S.R. Hughes was also managing editor for a series of books entitled *Progress in Nuclear Energy*, which are published by Pergamon Press in London, and he was a highly valued member of the editorial board of *Science*. His latest book was *The Neutron Story*, which was intended for high school students and the interested general public. During his lifetime Hughes published some 115 papers in scientific journals concerning research with which he was associated.

HARRY PALEVSKY
Brookhaven National Laboratory, Upton, New York

Science in the News

Oceanographic Research: Organizing Support for a Fragmented Program

A bill was reported by the Senate Commerce Committee last week authorizing an extensive 10-year program in support of oceanographic research. Hearings on a similar bill are being held in the House. As it happens, many of the agencies interested in oceanography have come out against the form of this particular legislation. Even its sponsors concede that it has no chance of passing this year, although some of the specific proposals may be passed in separate bills. Yet the bills have been the center of considerable interest, if only as symbols of the extent to which this very important but rather obscure branch of science has been brought to the attention of policy-makers in Washington. As a result, even without any formal legislation, spending in this area has been roughly doubled in the past 2 years, and further increases are expected.

When the organized effort to increase federal support for oceanography began about 3 years ago the science faced two especially important obstacles: it was popularly regarded as a field about as far removed from practical affairs as astronomy, and it faced a peculiar organizational problem in that the various elements of oceanographic research were fragmented among a dozen or so different government bureaus and agencies. As a result, although a growing number of people began to recognize that it was in the national interest to develop much enlarged support for the science, the fragments of the program scattered through the Navy, Interior, Commerce, and other departments and agencies tended to be little noticed in the over-all functions of the agencies and in their budget making.

A committee was formed by the National Academy of Sciences–National Research Council to report on the state of the science and to develop a national oceanographic program. This report was issued in mid-1958 and led directly to the formation of a special committee on oceanography in the House, and the formation of an interagency council on oceanography in the executive office of the President. (This council functions under the Federal Council on Science and Technology, which is headed by George Kistiakowsky, the President's science adviser.)

Much use was made of the perhaps illogical but nevertheless quite effective argument these days that the Russians are spending about three times as much on oceanographic research as we are. Press support was sought and gained, such as the fairly recent major article in *Fortune* and the cover story in *Time*. Even the techniques of Madison Avenue came into play, and oceanography began to be described as the exploration of "inner space," a term which may not be quite analogous to what is meant by outer space but which nevertheless sticks in the mind.

Possibilities of Research

In general, a fairly successful effort was made to acquaint Congress and the budget-makers with the sort of results that an expanded program could be expected to achieve.

There are, of course, a great many interesting problems in basic research, rare forms of life that have gone virtually unchanged for hundreds of thousands of years, crevices the size of the Grand Canyon, and mountains nearly as high as Everest protected from the erosion which tends to obscure some of the information that might be gleaned from these formations on land. There are "rivers" deep under the sea several thousand miles long and carrying currents several times greater than the Mississippi, and scientists are far from clear on the mechanism that causes them to exist.

But interesting as these questions

are, the growing federal support for the science stems from more practical motives. Paramount is the importance to the national interest of obtaining detailed maps of the submerged areas of the globe. The Polaris missile-firing atomic submarine could become our most important weapon system, and detailed maps would enable these submarines to calculate their positions within a few feet without ever venturing near the surface. The information would also be extremely useful for antisubmarine warfare. Beyond such direct military applications the time is seen ripe for making enormous strides in "farming" the sea, in controlling food fish, and, to a surprising extent, in controlling the weather.

It is pointed out, for example, that the difference in density between deep and surface water is a matter of the fifth decimal in relative density. This makes practical the "plowing" of the sea at a trivial expense of energy compared with that which is required to turn over the earth. It is suggested that releasing compressed air from tubes laid under certain areas of the sea could raise vast quantities of nutrient-laden deep water to the surface, with the result of producing a great increase in the yield of fisheries. The same technique has been suggested as a method for keeping certain ports, now ice-locked much of the year, open through the winter; compressed air would be used to raise currents of warm subsurface water to the surface.

Weather Control

It has been suggested that at certain critical points it may be possible to apply sufficient pressure to shift major ocean currents enough to alter quite substantially the prevailing climate in huge land areas. And it has been noticed that arid coastal areas receive increased rainfall when the sea is foamy. This is because droplets thrown into the air evaporate, leaving minute salt particles which are carried aloft where they serve as the nuclei of raindrops. It has been suggested that compressed air, again, might be used to achieve this effect artificially, producing substantial increases in rainfall along these now arid coasts.

Organizational Problems

It is the publicity that all these things have received from the NAS–NRC report and the other forces at work that have led to the increases in support for the science. But assuming, and opinions vary on this, of course, that oceanography has now achieved a proper degree of support in relation to other scientific programs, the question is raised whether this rather makeshift, basically political, method of rallying support for oceanography is really satisfactory and efficient. It is tempting, in situations like this, to seek some organizational cure-all, and advocates of a cabinet-level Department of Science sometimes point to an area like oceanography as an outstanding example of where such a department could function to establish priorities in various fields of science and to organize support in a more straightforward and less time-consuming method than had to be used in this case.

Indeed, several of the scientists who appeared before the Jackson committee this month, while opposing a Department of Science, suggested that in the case of areas like oceanography, which are so fragmented that there is no one who really feels responsible for the area as a whole, the National Science Foundation might be used to present a unified program to Congress and then distribute the appropriations to the operating agencies, as it now distributes research funds to nongovernmental agencies.

This would alleviate the sort of problem that was run into when the House subcommittee handling Commerce Department appropriations cut out the $300,000 of the over-all program assigned to the Weather Bureau. To this subcommittee the Weather Bureau is only a minor function of the Commerce Department, and when they began looking for things that could be cut it is not surprising that they questioned the necessity of the Commerce Department supplying the Weather Bureau with funds to do research in the ocean.

A considerable amount of effort, both in the executive and in Congress, has been going into such organizational improvements. In fact, there is a good deal of experience that suggests that more organization, by removing authority one degree further from operating responsibility, often succeeds only in further complicating the problems it was intended to cure. So the desire to seek organizational solutions is tempered by the recognition that there is a limit to the degree to which neat organization charts can really solve administrative problems.

Test Ban Talks: They Are Continuing Despite Summit Collapse

The technical side of the test ban negotiations continued through the collapse of the summit last week. Arrangements were being made to resume the political negotiations this week as the U.N. began the debate of the U-2 incident.

Officials here are pessimistic over the possibility of reaching agreement, for the principal unsettled issue is the question of inspection, and the events of last week will tend to make it more difficult to reach a compromise on this issue. On the one hand, the Russian contention that the West will use the proposed inspection as a cover for espionage has been strengthened; on the other hand, Khrushchev's exceedingly erratic behavior has led to new demands here that a really elaborate inspection system is needed to make sure that the Russians will not cheat.

British Prime Minister Harold Macmillan has told Parliament that he had gone to Paris with the hope that the remaining details for a test ban treaty could be pretty well worked out during the summit meetings. He said that even after the blow-up both Khrushchev and Eisenhower had assured him that their governments' policy of working toward a formal ban had not been changed, but that "I should not conceal from this House that this process may be somewhat less rapid than I had hoped." It was generally felt here and abroad that Macmillan's remark was a fine example of the British art of understatement.

There is a consensus of opinion that Macmillan is correct in his belief that basic policy on a test ban, as well as on other matters, has not been changed because of the blow-up. It was felt that this was indicated by Khrushchev's comparatively conciliatory speech in East Berlin, when he said that he had no intention of precipitating another Berlin crisis, that he hoped to settle the issue amicably at another summit conference "in 6 or 8 months." More specifically in regard to Geneva, it was noted that the Russian agreement to include nuclear as well as conventional explosions in the underground test research program, which the Russians regarded as a concession, came several days after the U-2 was downed. After our announcement of plans to resume nuclear testing as part of the detection program, a New York *Times* report