somewhat different approach, although the differences would seem to be easily reconcilable. Pell, who last year sought to establish a National Arts Foundation, has again introduced a bill to accomplish that goal, S. 315. But he has also introduced a bill, S. 316, to establish a National Humanities Foundation that would wholly encompass the functions prescribed for the Arts Foundation. The humanities parts of the combined bill are essentially the same as corresponding provisions in the Moorhead and Gruening versions, but the Pell bill spells out the arts activities in greater detail, specifying, for example, that the arts are to be defined as including "music (instrumental and vocal), drama, dance, folk art, creative writing, architecture and allied fields, painting, sculpture, photography, graphic and craft arts, industrial design, costume and fashion design, motion pictures, television, radio, tape and sound recordings . . . plays (with or without music), ballet, dance and choral performances, concerts, recitals, operas, exhibitions, readings. . . ."

Under the Pell bill, the foundation would provide no more than 50 percent of the cost of any production, and groups would be ineligible for assistance if any of their net earnings went to private parties. Pell would start the foundation off with $10 million and raise the appropriation to $20 million in the second fiscal year.

As far as the internal workings of Congress are concerned, the proposals have good fortune on their side. In the House, the Moorhead proposal will go before an Education and Labor select subcommittee headed by Frank Thompson (D–N.J.), who is known to be sympathetic. In the Senate, it will be handled by the Labor and Public Welfare Committee's special subcommittee on the arts. Pell was chairman of this subcommittee in the last congress and will probably continue in that post, although there is a slight possibility that this may be affected by his appointment last week to the Appropriations Committee.

In any case, the prospects are bright, but the proposal is not yet in the category of a sure thing. It has a clear endorsement from President Johnson, who said at Brown University last September, "I look with the greatest favor upon the proposal . . . for a National Foundation for the Humanities." But out of caution, rather than hostility, the Congress may decide to take a long and careful look at what is in many respects a revolutionary proposal. Support for the sciences evolved initially from science's utility in exploration and later in military, agricultural, and medical matters. The needs were clear, and so were the dividends. The needs are also clear in the areas that come under the headings of arts and the humanities, but the early and easy outpouring of congressional support should not obscure the fact that some members, fully sympathetic to the arts and the humanities, harbor real concerns about the wisdom of meeting these needs through setting up a new federal agency. One of these members, with close ties to a major university in his district, commented that he endorsed Moorhead's bill but, before the matter comes to a vote, is going to have to be persuaded that the proposed NHF is the right way to meet what he readily agrees is an important need. Furthermore, while the scientists have had long experience in dealing with Congress and have formed useful alliances there, some of the humanists who have been lobbying through the corridors strike the members and their staffs as annoyingly amateurish. One staff member, who is heavily relied upon by one of the House's leading supporters of federal aid to education, remarked, after a long talk with one of the backers of the NHF, "I didn't have any idea of what he was talking about and I don't think he did either." The comment may be unfair, but it was made.

—D. S. GREENBERG

Weather Modification: NAS Panel Report and New Program Approved by Congress Reveal Split on Policy

After World War II it was widely assumed that a great time of beating scientific swords into technological plowshares was beginning. Perhaps the most dramatic prospects of all were proclaimed for the peaceful atom and weather modification. But while men have taken giant steps toward mastering their environment, the two prodigies have hardly fulfilled the great expectations.

Now nuclear plants producing electric power have begun to operate in the black, the uses of nuclear materials in industry and medicine are increasingly impressive, and the civilian atom seems to be coming of age. Weather modification, however, remains in the research and development stage.

High hopes, nevertheless, continue to be held for doing something about the weather. Last year Congress, by special resolution, appropriated $1 million intended for use in the most ambitious "operational" weather modification program so far. But, at the same time, a National Academy of Sciences panel was completing a survey of research activities in the field and an estimate of the potential and the limitations of future research, and late last fall it issued a report* which put a damper on expectations of major triumphs in modifying the weather very soon.

The resolution and the report present a contrast which reflects a controversy over the pace and direction of the national weather modification program. This controversy could become increasingly significant, since it ranges a group of influential legislators on one side, some distinguished atmospheric scientists on the other, and several science-oriented federal agencies in the middle.

The differences grow directly out of the modern history of weather modification, which began in the later 1940's with the well-known work of Langmuir and Schaefer on cloud modification. The Department of Defense financed sizeable projects in 1947, and since then the federal government has been involved as a patron of research in this field.

From the outset, public interest in weather modification centered on rainmaking. By the early 1950's some of the early enthusiasm had waned, because claims of success and refutations were about equally vociferous. But the armed services and the departments of Agriculture, Interior, and Health, Education, and Welfare continued to sponsor or conduct research in atmospheric sciences related to weather modification. Conspicuously absent from the field was the Weather Bureau in the Department of Commerce, which under its former chief, Francis W. Reichelderfer, displayed a studied lack of interest in weather modification research.

In 1958 the National Science Foundation was designated by Congress to promote and coordinate projects in the necessary fields to insure an effective national weather modification program. Other agencies continued to support applied and basic research; NSF primarily

* *Scientific Problems of Weather Modification*, available from the Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, NW, Washington, D.C. 20418

supported studies designed to provide basic data.

(In fiscal 1963, total federal expenditures for weather modification projects were $2.75 million, with some $1.3 million of that accounted for by NSF. For fiscal 1964, the total figure was $3.35 million, and the NSF figure, $1.57 million. NSF in fiscal 1963 spent slightly more than $16 million on its overall atmospheric sciences program, of which weather modification is a part.)

During recent years impatience has been growing in Congress, and particularly among a group of Western senators who have felt that a sizeable and long-term research program was not producing an adequate practical payoff.

Bills have been repeatedly introduced to launch "operational" programs in weather modification, ususally aimed directly at cloud seeding. Last year Senator Clinton Anderson (D–N.M.) introduced a bill authorizing the Secretary of the Interior to "conduct a program in five areas of the United States to increase usable precipitation and for other purposes." Cosponsors were senators Bennett and Moss (Utah), Bible and Cannon (Nev.), Engle and Kuchel (Calif.), McGee (Wyo.), and McGovern (S.D.).

Under the criteria governing the assignment of bills in the Senate, the bill was sent to the Commerce Committee, where it languished.

An effort to shift the initiative to the Interior Committee, which is dominated by Westerners from dry states, was successful when the sponsors backed a resolution providing for an increase of $1 million in appropriations for the Interior Department for "exploration, research, and application of weather modification methods for the purpose of increasing precipitation in the Colorado River Basin."

Hearings were held last May before the Interior Committee's irrigation and reclamation subcommittee, headed by Senator Moss, and the resolution was passed and then shepherded through the Senate Appropriations Committee by senators Bible of Nevada and Mundt of South Dakota. The measure was added to the Interior Appropriations bill and accepted by the House.

The Colorado Basin was probably picked first for the scaled-down program for the reason that two very dry years had made the always difficult water problem there potentially desperate. But also the senators and their advisers were convinced that the Colorado Basin provided promising conditions for a major test program aimed at increasing precipitation.

Encouraging reports have been coming in about results from seeding supercooled clouds, and the idea took hold that the so-called orographic storms over the Colorado Basin could be exploited. (Orographic cloud systems are found in areas where mountains in the path of moisture-laden air force the air to rise and cool.)

The hope was that precipitation from winter storms over the basin could be increased. If the program succeeded, the effect on the supply of usable water would be particularly favorable because of the extraordinary storage facilities in the basin. According to testimony at the hearings, an estimated 56 million acre feet can be stored, about four times the average annual runoff.

While the National Academy's panel* on weather and climate modification did not deal directly in any way with the new Colorado Basin program, its report amounts to a big wet blanket.

Operational Objectives

The panel accepted the objective of promoting effective weather modification at the earliest possible date, but in the introduction to the report it summed up its outlook on weather modification this way:

"The striking development during the past ten years of a number of new tools that produce intensely interesting effects, often involving the triggering of large releases of energy in clouds, in the atmosphere near the surface, and in the upper atmosphere, provides a basis for future efforts in weather modification. In the activities that have possible economic importance, our findings are as follows: it is possible to disperse stable clouds, such as super-cooled fog and stratus, by seeding; it has not been demonstrated that precipitation from winter orographic storms can be increased significantly by seeding; it has not been demonstrated that hurricanes can be "steered" or diminished by seeding; it has not been demonstrated that asphalt coverings, black dust, or any other surface modifications increase precipitation. On the basis of these findings, we conclude that the initiation of large-scale operational weather-modification programs would be premature. Many fundamental problems must be answered first. It is unlikely that these problems will be solved by the expansion of present efforts which emphasize the *a posteriori* evaluation of largely uncontrolled experiments. We believe that the patient investigation of atmospheric processes coupled with an exploration of the technological applications will eventually lead to useful weather modification, but we must emphasize that the time-scale required for success may be measured in decades."

The panelists make the general observation that despite advances made in the last two decades, scientists at present do not have "an adequate physical description of the precipitation process."

The body of the report is divided into four main sections, headed "Problems of Cloud Modification," "Surface Modification as a Means of Stimulating Convection," "The General Circulation of the Atmosphere," and "Contamination or Modification of the Upper Atmosphere." The discussions in these sections touch on such potentially practical aspects of weather modification as mitigation of hail by seeding, lightning suppression, hurricane suppression, and fog dissipation, as well as rainmaking. Only in the case of supercooled stratocumulus and fog, where cloud modification processes are reasonably well understood, are operational studies recommended. The report is a preliminary one, and the panel, which was appointed by the Atmospheric Sciences Committee of the Academy, plans to issue a final report by summer. This final report is expected to include recommendations on long-range policies and objectives for the national weather modification program.

Meanwhile, the Colorado Basin program is obviously making some scientists who are concerned with weather modification apprehensive.

The program is being administered by the Department of Interior's Bureau of Reclamation, which deals with conservation, development, and utilization of water and related land resources in the West. Its scientific program in the past has focused mainly on various phases of reclamation engineering, and in the early 1960's it was estimated that about 7 percent of the scientific work supported by the agency was in basic research.

The Colorado Basin program is still

* Chairman of the panel is Gordon J. F. MacDonald of U.C.L.A. Members are Julian H. Bigelow, Jule G. Charney, Francis S. Johnson, Edward N. Lorenz, Joanne S. Malkus, Joseph Smagorinsky, Verner E. Suomi, Edward Teller, Helmut K. Weickmann, and E. J. Workman.

in the planning phase, and it is not yet clear whether the bureau will mount a test program designed to improve evaluative techniques or will go directly to a larger operational program, which presumably would involve extensive seeding of clouds.

The bureau has set up a committee on atmospheric water resources, which draws members from the National Science Foundation, the Weather Bureau, and other federal agencies, to consult on the program. Relations between the bureau and other agencies at the moment are said not to be at their best. It is thought likely that the bureau will look to outside institutions with which it has already developed ties, such as the University of Nevada, the University of Wyoming, and the South Dakota School of Mines and Technology.

On the other hand, the bureau has a record of very substantial achievement in applying science and technology to the chief problem of the "reclamation states" of the West, and it is this record which has won the agency the senators' confidence.

Advocates of an operational program also point to scientific backing from inside and outside the government. In the hearing before the Moss subcommittee, for example, John C. Calhoun, science adviser to the Secretary of Interior, said in his statement on behalf of the department, "in summary at this point, our evaluation shows that the time has arrived for larger scale, well planned field experiments."

Calhoun went on to say that part of the department's role in weather modification should be sponsorship of a "continuing program primarily directed toward improving precipitation from winter storms." He added, however, that this program should be conducted in a "research atmosphere," and he later made the following cautionary observation. "To proceed into operational phases now without completely understanding the processes involved could lead to undesirable effects. These might range from decreases rather than increases in precipitation, to gross atmospheric contaminations leading to adverse weather and to possible handicaps to future research. So we believe it is essential that any new effort in weather modification be approached as carefully planned development research, which will take into account probable environmental consequences of experimental actions each step of the way."

A reading of the hearings produces the clear impression that the senators believe the "well planned experiments" (in Calhoun's phrase) are likely to produce results that can be counted in acre-feet in Colorado Basin reservoirs and ponds. The legislators candidly state that a gamble is involved, but they appear convinced by the evidence that the gamble is worth taking.

The Moss hearings were short and to the point. Only representatives from the Interior Department and its Bureau of Reclamation testified. No nongovernmental authorities were brought in, and nobody from other federal agencies engaged in weather modification research —including NSF—appeared.

Senatorial Displeasure

Among those most closely concerned with weather modification on Capitol Hill, the attitude toward NSF in this context seems to be expressed by one observer who said the legislators and their staff men feel that NSF has been "wishy-washy" on the subject of weather modification, because the agency kept recommending more research and the training of more weather modification researchers when the senators wanted action.

While there has been no showdown, it is fair to say that a significant split on weather modification policy has developed. On one side are scientists who are sanguine about the eventual development of effective techniques to modify the weather but are opposed to large-scale "engineering" programs now, since they feel that there is no sound way to design such programs at this time. They oppose proceeding on a trial-and-error basis because of possible unfavorable effects such as those mentioned by Calhoun, and because it would disrupt an orderly program of research in atmospheric sciences. Some feel that this, ironically, could turn out to be a year of unusual high precipitation in the Colorado Basin and that the apparent success of a seeding program could lead to misleading conclusions.

On the other hand, the legislators and their advisers feel that a lot of time and money has been spent on weather modification research without important practical results or signs of an approaching breakthrough. The states in the Colorado Basin area have exploited the last water sources available to them now, and the advocates of the new program believe that there are sound scientific reasons for gambling on finding a shortcut.

Among at least some of these advocates, it should be noted, there is also a feeling that research scientists—one salty veteran staff member called them "the Cosmos Club crowd"—are more interested in producing more scientific papers, while the senators are interested in producing more water.

Unfair as this may be, it nonetheless reflects an attitude which lies beneath the surface of relations between Congress and the research establishment but may come into play when friction develops, as it has over weather modification.

Aware of the storm signals, NSF has a commisison on weather modification, composed half of scientists and half of members distinguished in other fields, to survey the broad aspects of weather modification—legal, economic, biological, and sociological as well as scientific. The commission will make recommendations on long-range policy to the agency. The Weather Bureau is seriously reappraising its stand on weather modification. And the NAS panel hopes, next summer, to follow up its final report with an educational effort designed to make the status and prospects of weather modification research more widely understood.

While it should not be exaggerated, the current split on weather modification falls into the area of the problem of science advice for Congress. It represents, not a breakdown, but, rather, evidence that no adequate conduit between Congress and the community represented by the Academy and NSF has ever been soundly established.

—JOHN WALSH

Environmental Health Center: North Carolina Victorious in 4-Year Battle for PHS Facility

A 4-year political battle over the location of the proposed environmental health center ended last week, with an announcement that the functions of the long-sought Public Health Service facility are to be divided among three of the contending states, North Carolina, Ohio, and West Virginia.

The compromise solution grows out of congressional interference with the original PHS plan for a massive single center located in the Washington area. The center was to have taken the shadow environmental health units already