

AN UPDATE

By

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Water resources are of crucial concern to the nation and particularly, I am sure, to the Western Snow Conference that so carefully monitors the condition of our great western reservoir, the accumulated snowpack. The program for this meeting attests to your diligence in applying high technology to this end, and to your concern for the user of this resource to whom you supply vital seasonal forecasts of water supplies.

The importance of water, and of any possible technical means for enhancing its supply, has been underscored to me by my recent tenure as Chairman of the Department of Commerce's Weather Modification Advisory Board. It gives me pleasure to discuss our report, the national program it proposes, and the chances for keeping it off the shelf and where the action is.

The Board was appointed in April 1977 in response to Public Law #94-490, called the National Weather Modification Policy Act of 1976. The function of this Board was to aid the Secretary of Commerce in conducting a comprehensive investigation and study of the state of scientific knowledge concerning weather modification, the present state of development of weather modification technology, the problems impeding effective implementation of weather modification technology, and other related matters. Congress also declared that this study should develop a comprehensive and coordinated national weather modification policy and a national program of weather modification research and development. The Board had 17 members drawn from the physical sciences, social sciences, and from agriculture and environment. The Executive Secretary, Dr. Edward Epstein, was the sole Department of Commerce (NOAA) member of the Board.

The Board met in North Dakota, Colorado, Illinois, California, Virginia, Oklahoma, and Georgia. At these meetings testimony was heard from 96 persons and, in addition, many written reports and informal reactions were conveyed to the Board. Several Board members met in Europe and in Canada. In addition, knowledgeable experts from Europe, the Middle East, Canada, Mexico, and Australia were interviewed. The Board completed its task in a little over a year and submitted its report to the Secretary of Commerce, Juanita Kreps, in July 1978.

The main conclusion of this report was that a usable technology for significantly enhancing rain and snow and ameliorating some weather damage is scientifically possible and within sight. It was recognized that people with an interest at stake have been investing in operational cloud seeding prior to full scientific demonstration. The total industry in the United States amounts to 4 to 6 million dollars a year with a dozen companies working for private groups, local authorities, and overseas clients. In 1977 clouds were seeded in 88 projects in 23 states. Cloud seeding projects have been carried out in 24 countries of the world. The use of the existing technology appears to be growing.

The guesses of 20 years ago that certain kinds of precipitation could be increased have been generally supported by experience. Striking advances in the technologies of measurement, computer simulation, and data handling make much better field experiments possible. Enough first-rate scientists and other specialists are available in this and related fields to start a considerably more vigorous program of research and development.

After review of the scientific attainments to date, the Board concluded that a much intensified and steady program of scientific inquiry over the next two decades would yield regionally important increases in mountain snowpack, increased rainfall in areas like our High Plains and Midwest, and reduce hurricane winds and hail damage. The margins of man-produced seasonal weather change would be 10 to 30% increases for snow and rain. Some hurricane winds would be reduced by 10-20%. Hail might eventually be reduced by up to 60% in some kinds of storms.

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The Board examined the economic and social consequences of such an enhanced capability and concluded that the case for hastening progress along these lines is very strong. The economic benefits of delivering more water in the right places for farming, for irrigated crops, for hydroelectric power, and municipal and industrial water use seem very likely to outweigh the cost by impressive amounts.

The public interest requires that deliberate changes in the atmosphere be designed and carried out with environmental prudence, and after consultation with the people most likely to be affected.

All of these considerations argued for 1) a national weather modification policy and 2) for a substantial federally-supported research and development program. In response to the first requirement, the Board has recommended a policy statement by Congress: that it may soon be possible to manage weather modification resources, that very great benefits may accrue from a vigorous and prudent use of the emerging technologies for weather resources management, and that an intensified and steady program of scientific inquiry gives promise of realizing this potential over the next two decades. Deliberate changes in the atmosphere should be designed and carried out with environmental prudence and after consultation with people likely to be affected. Weather resources management can best be developed in close cooperation with other people with whom we share the earth's atmosphere. Within the United States, the Federal Government has supervening responsibility for its management. This responsibility, to be exercised in partnership with the States, should use to the maximum the talent and initiative and local public authorities, university scientists, user groups and private weather management operators.

With regard to the second requirement, the Board made a careful study of research requirements and developed a twenty-year plan of action. The aim of this national program would be to achieve a comprehensive understanding of those combinations of cloud-environment conditions and seeding methods that lead to useful weather changes in a reliable and predictable manner. This requires a balanced and coordinated mix of quantitative theory, laboratory studies, and field studies controlled primarily with a view to what can be learned from them.

The following elements, taken directly from the report, would constitute this 20-year program of action:

- 1) Basic research in all relevant sciences to provide the scientific and engineering foundation for all forms of enhancement of the atmospheric environment -- including the creation of several dedicated laboratories at universities across the country.
- 2) A focused effort to refine existing techniques and develop new ones for increasing precipitation through cloud seeding. The two areas of highest priority are snowpack augmentation from winter mountain clouds and rain enhancement from convective clouds in agricultural regions during growing seasons. An effort to increase our knowledge of hail processes, and of how to moderate severe thunderstorm, should be associated with the projects primarily designed to make more rain.
- 3) Increased efforts to dissipate stratus and learn more about warm fog.
- 4) Studies of "unintended weather modification" -- that is, research on atmospheric responses to urbanization, industrialization, agricultural and land-use practices, and other human activities, with emphasis upon responses in time scales of hours and days, as opposed to years and decades. (The latter, which are also important, will be part of current plans for the National Climate Program.)
- 5) An effort to develop techniques for reducing peak winds in hurricanes, and possibly other damaging characteristics of hurricanes, through cloud seeding.
- 6) Create a growing pattern of international research cooperation and play our part in the first international cloud seeding program.
- 7) Research on methods other than cloud seeding to modify the weather.

- 8) Research on impacts -- environmental, economic, and social -- of weather resources management.
- 9) A cooperative Federal/State/local effort to garner the maximum scientific knowledge from selected operational cloud seeding projects.

The recommended R and D effort calls for Federal appropriations of \$37,000,000 (twice the current rate) in the first program year, and increases to \$90,000,000 in the fifth year. Weather modification has never attained a critical mass or momentum in federal organizations. The small pockets of interested activity are vulnerable to on-again-off-again budgets, bureaucratic rivalries, and the pluralism of Congressional jurisdictions.

Having found the requirements and produced plans to meet them, the Board thought hard about how to carry them out. The need for a better focused Federal leadership was clear enough. The problem was how to build into the structure of the Federal Government effective leadership for so comparatively small a spending program. A proposal, somewhat unusual but having a few precedents, was hammered out: that the Congress create and the President appoint a small commission, the National Weather Resources Management Board (NWRMB), with the executive authority and funding "to nurse through adolescence the science and practice of weather modification."

We considered and rejected the often suggested formula of designating of a "lead agency." That would leave things more or less the way they are. In practice, setting up a "lead agency" usually means telling one part of the executive establishment to take charge without placing in its hands the tools required for leadership.

In our proposal the key management concepts are the consolidation of all the Federal Government's weather modification work in one organization, and sufficient autonomy for that organization to produce, defend, and carry out a serious and consistent long-term program of research and development. The same organization could readily handle the licensing of weather modification operators and the formulation of guidelines for operational weather modification.

The new Board would appoint its own Executive Director with the concurrence of the head of the host agency. It would construct, and defend through the chain of executive and congressional review, a national budget covering all civilian federal weather modification activities; the only exception would be the basic research funded by the National Science Foundation as part of its general mandate to strengthen the nation's scientific underpinnings.

The National Weather Resources Management Board would bring into its purview, as its own staff or through contractual or relationships, all the federal government's existing weather modification activities. The new Board would carry on existing projects that fit the proposed R and D strategy; new major field experiments would be planned by the Board. It should be mandated by Congress to use in its work the services of universities, expert panels, state and local authorities, and private enterprises.

The Board studied at some length the issue of where in the government the new weather resources management function should be placed. Our strong consensus was that it should be in a new Department of Natural Resources if one were formed; a DNR now seems a likely finisher in the Washington reorganization derby. Meanwhile a case could be made, and indeed was made, for entrusting a consolidated weather modification effort to NASA, to the Bureau of Reclamation, or to the National Oceanic and Atmospheric Administration (NOAA). Our judgment was that since the main task for a number of years to come would be to promote solid research about the atmosphere, NOAA would be the logical "host" for a National Weather Resources Management Board.

In the eight months since the Weather Modification Advisory Board reported to the Secretary of Commerce, no official action has been taken in the Executive Branch, or even in the Department of Commerce, on the Board's recommendations. Drafts of legislation to carry the Board's proposals into action have been circulating on Capitol Hill, but prospective sponsors naturally want to know what the Secretary of Commerce will recommend in response to the mandate in P.L. 94-490, now two and a half years old, "to develop a com-

and coordinated national weather modification policy and a national program of weather modification research and development." One can hope that it won't require another drought or devastating windstorm somewhere in the United States to jar the government machinery out of neutral.