



Bureau of Reclamation

Cloud cap on Elk Mountain, Wyo., was intensively seeded in Bureau study.

Tailored Weather

A measure of control over weather now seems within our reach.

by John Ludwigson

Rainmaking, once reserved for medicine men and charlatans, has become a respectable field for scientists and engineers.

It is the first area of the vastly broader field of weather modification to have reached the point of imminent practical application on a wide scale.

Secretary of the Interior Stewart L. Udall recently virtually promised a Senate committee that the Bureau of Reclamation would wring an additional 1.5 million acre-feet of water from clouds over the Colorado River Basin by 1972.

And by 1985, he told the Senators, the Bureau hopes to achieve "... a general national capability to enhance or redistribute precipitation. . . ."

The Secretary apparently was under considerable political pressure to produce—an indication of social and legal problems to come as weather modification capabilities increase. The chronic shortage of water in the Colorado has been one of the major problems holding back Congressional approval of the Central Arizona Project, which would tap the river to slake the thirst of Phoenix and Tucson.

A study of the legal problems of weather modification is beginning at the University of Arizona's College of Law under an Interior Department grant. A report on what needs to be done may be ready by next January, Udall told the Senators.

With the field's new respectability and the sharp increase in weather modification research both in and out of Government, the legal study will come none too soon.

The Interior Department is only one

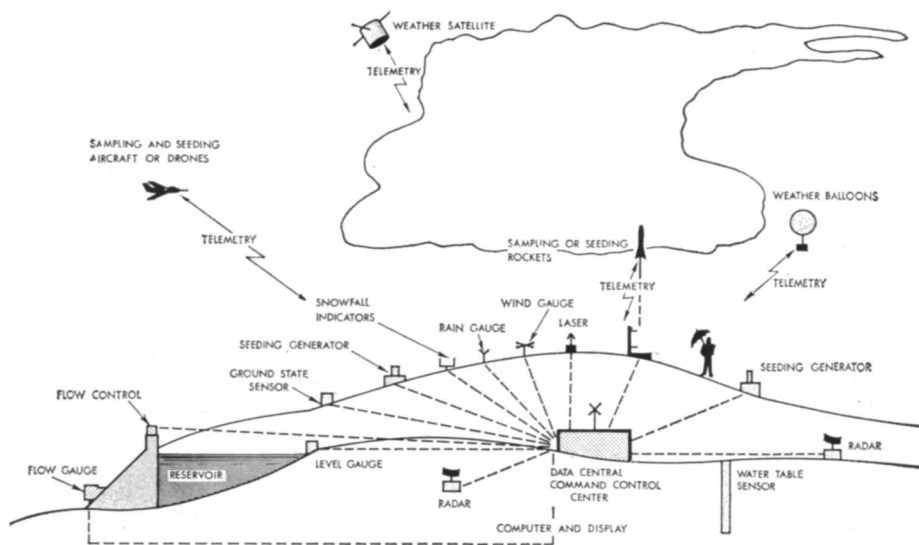
ministration, Federal Aviation Agency and Atomic Energy Commission.

Of those, probably the most active programs are in Interior which is largely concerned with increasing the nation's usable water supply, the DOD which is studying hurricane control among other matters, and the NSF which supports a broad range of research projects.

A lot of the basic research is being done by the Environmental Science Services Administration's Institute of Atmospheric Sciences. This includes mathematical simulation of the atmosphere, investigation of inadvertent weather modification by air pollution and some work on hail and lightning suppression.

ESSA also sponsors two major practical programs: Project Stormfury, a joint Navy-ESSA effort to find out if hurricanes can be controlled; and an attempt to get snowstorms over the Great Lakes—especially Lake Erie—to dump their snow in the water rather than on land. Another program is presently being designed for a look into ground-based cloud seeding in the Northeast. Most such work to date has been done in the far West.

NSF recently formed a Task Group on the Human Dimensions of the Atmosphere which will be looking into economic, social and legal problems related to the weather. While the basic techniques for modifying weather seem now to be attainable in the near future, questions such as who is to control the modification and how to decide who



Bureau of Reclamation

A proposed operational weather modification system.

of nine Federal agencies now actively supporting programs in weather modification. The others are the Departments of Agriculture, Defense, Commerce, and Health, Education and Welfare, the National Science Foundation, National Aeronautics and Space Ad-

gets rain and who doesn't may be far more difficult to resolve.

At present, although 22 states have adopted some form of regulation of weather modification activities, there are no nationwide standards. Maryland forbids any such activity, California has

a strict licensing arrangement, and six states have thought it necessary to assert their sovereignty over the moisture in the air over their lands.

Licensing fees for would-be rain-makers range from \$10 in North Dakota to \$200 in Nebraska. To get a permit, a weather modifier may not need to list any qualifications at all. In another state, he may have to prove that he is a professional engineer, or either be a member of the American Meteorological Society or prove that he could become one.

The legal hodge-podge reflects the horse-and-buggy state of previous research. While colleagues in more accepted fields have long since filled their labs with equipment purchased with Federal grants, weather modifiers have often had to make their own.

Thus, they seed clouds with silver iodide generators that look like stovepipes from grandma's kitchen, photograph the results with amateur movie equipment and, in an age of ever-larger electronic computers, reduce their data by hand or on desk calculators.

Things are improving, however. In 1962, Bureau of Reclamation researchers financed their entire modification program with \$100,000. This year they



Bureau of Reclamation

Dry ice seeding at Old Faithful.

have \$3.75 million and they are asking Congress for \$5 million for fiscal year 1968.

"Experience has shown," observes Bureau Commissioner Floyd E. Dominy, "that this latter amount is sufficient only to pay for a beginning on the work and facilities required to mount a national program. The importance of the problem . . . justifies a much higher funding level. . . ."

The money could well be used, since scientific understanding of exactly what goes on in a cloud—or clear air, for that matter—is still quite limited.

"When you get down to actual operations you find things don't work as simply as in your backyard experi-

ment," notes Peter H. Wyckoff, director of NSF's weather modification program. "There's no one way of getting rainfall. Each situation is different. The key to the whole thing is understanding the natural process . . ."

At the moment, he observed, most weather modification work is confined to areas where there is the least possible interference from other activities and where the scientific problems seem simple.

That has meant, largely, the mountains of the western United States, plus some work on hail suppression over the Great Plains, hurricane studies in the Caribbean and dispersion of fog at airports.

A system of radio-controlled silver iodide generators—devices that vaporize silver iodide in a large propane flame has already been installed in the Wasatch Mountains east of Salt Lake City. Weather radars there monitor the atmospheric conditions. When conditions seem right, the generators are switched on remotely in an operation that foreshadows the nature of permanent weather modification systems to come. Scientists from Utah State University are in charge of the project, a test of instrumentation as much as of weather modification methods.

Basic tools of the weather modifier are the well-known silver iodide generator, dry ice devices usually installed in airplanes and, more recently, systems to spray liquid propane into supercooled fogs.

A promising area of research is the use of high-voltage electrical fields to get water vapor to coalesce and form raindrops.

A spectacular experiment is scheduled for this summer by University of New Mexico scientists to test this method. They plan to inject charged dust particles into clouds passing over a mountain peak. The particles will be blown directly into the clouds through a 1,000-foot high plastic tube fastened, at its lower end, to a blower using an airplane propeller turned by an 1,100 horsepower engine.

Less spectacular experiments will explore redistribution of rain from the Pacific Northwest to inland areas; the role, if any, of automobile exhausts in inadvertent weather modification, and ways to wring rain from warm clouds and fogs which have defied attempts up to now.

The work promises tremendous benefits for a relatively small investment and those involved seem to feel a sense of impending great achievement.

As Secretary Udall told the Senate, "The time has come to determine the feasibility of moving water around by means of the rivers in the sky and of bringing it down out of the sky where and when we need it."



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