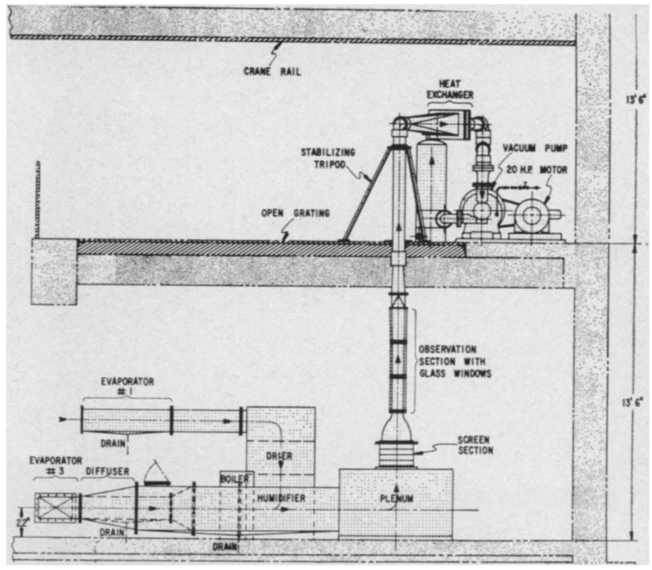
Doing something about weather

Meteorologists and their allies are no longer just talking about it

by Ann Ewing



University of California

Cloud tunnel at UCLA brings the weather inside.

There is general agreement among meteorologists that on a small, local scale, man can and does modify the weather. Dispersing cold fogs over airports is an example: dispersing pollutants into the air is another.

But as the scale grows larger, there is not only no general agreement about whether it is possible; there is also no agreement as to the scale for which the possibility — and the feasibility — of changing becomes too large.

Nevertheless, the tools for learning what goes on in clouds, weather-producing factories around the world, are being honed. Both methods and theories have improved considerably in the last four years.

Probably the most important recent advance, as far as the future is concerned, is the tentative merger of cloud dynamics and cloud physics; the former involves air circulations on a cloud-size scale, the latter what happens in and around the droplets and rain-forming particles in the clouds.

Both are intimately related—convection in clouds play a major role in driving the large-scale circulation, and these larger circulations control the extent and character of the convective clouds embedded in them.

Typical of the promising union was a report by Drs. Geirmundur Arnason, Richard S. Greenfield and Edward A. Newburg of Travelers Research Center, Inc., at the recent International Conference on Cloud Physics in Toronto. The researchers performed a numerical experiment on dry and moist convection, including the rain stage.

Although their numerical model is not sophisticated, it is the most elaborate to date. It achieves a realistic simulation of many of the major phases of a convective cloud from its initial stage as a small buoyant bubble to the stage of precipitation and later dissipation.

Included in their numerical model are equations of motion, thermodynamics and continuity. The computer program also includes the effects of cloud physics, thus allowing rain to develop through accretion, as well as the evaporation of rain falling through unsaturated air.

This numerical research is also typical of the essential and growing role of computers, not only in cloud dynamics but in all meteorology, both in research and in weather prediction. Other computers are being used to calculate the way individual drops form (Sn: 9/14 p. 268).

On the experimental side, the successfully operated cloud tunnel at the University of California at Los Angeles is being hailed as a facility that will be very helpful and important in the next several years.

Experiments in the cloud tunnel are yielding quantitative information on the rates at which cloud droplets grow to precipitation by collision and coalescence. Drs. Morris Neiburger and H. R. Puppacher note that the processes by which rain is formed can now be studied in the laboratory under conditions that simulate as closely as possible those in natural clouds.

Experiments planned for the tunnel include determination of the freezing temperatures and the evaporation rates of cloud and rain drops falling freely relative to the tunnel's updraft, of the growth rate of a freely suspended cloud drop by coalescence with smaller drops, and of the growth rate of an ice crystal held rigidly in tunnel air containing supercooled cloud drops or ice crystals.

Evaluation of these rates will provide tests of existing theories of the growth of cloud particles to precipitation size.

Alex Gray

Cloud physics patriarch Tor Bergeron.

Getting out of the laboratory and into the atmosphere, cloud physicists are trying out their experimental and theoretical ideas in actual weather. Typical of this approach is the use of surface-active materials to change the surface tension of water drops within clouds, as reported by Dr. V. G. Morachevski of the Hydrometeorological Institute in Leningrad.

He finds that a spray of small droplets of tetraisoamyl ammonium at a layer immediately above the maximum updraft level of a convective cloud enhances the growth of raindrops in the

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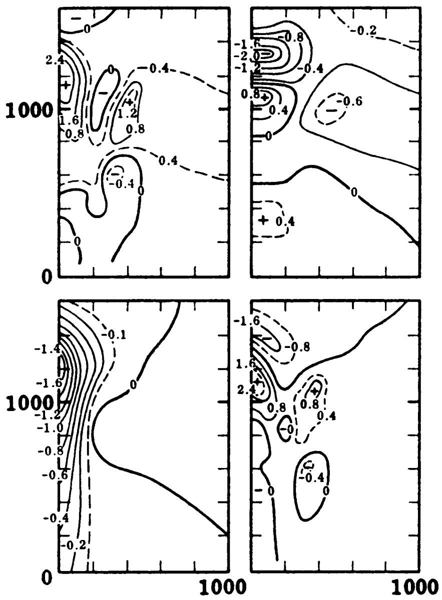

Travelers Research

Computer simulation of convection.

lower part of the updraft and leads to increased rainfall. A moderate amount of surface-active material reduces tension, making coalescence and the breakup of droplets easier.

Most of those attending the conference were impressed with the results of the evidently successful hail suppression program in the U.S.S.R. (SN: 9/14, p. 261), even though they had difficulty understanding, and the Russians had difficulty explaining, why it works. The general agreement: since it is effective, we should like to find out why.

Understanding the Soviet techniques was made difficult for U.S. physicists because their ways of thinking about weather modification—including even the amount of liquid water present and the location of updrafts—differ widely from those of their Soviet colleagues.

All these approaches have led to a burgeoning growth of cloud physics research. Dr. Basil J. Mason, director of the British Meteorological Service, who has invited the Toronto conferees to the next session in London in 1972, pointed to the growth and a slight problem it presents. At the first meeting in 1960, he said, 50 papers were presented in 15 days; in 1964, there were 100 papers in 10 days, and 1968 found 150 papers given in 5 days.

"Continuing this progression," he warned, "would mean 200 papers in zero days in 1972," a problem that "must be solved by the next meeting."

That is a pleasant kind of problem to have. Said Dr. Tor Bergeron of the University of Uppsala, Sweden: "Such a conference would have been a monologue in 1933," when he first put forward the suggestion of seeding clouds.