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Weather Modification

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Dry Texas summers are painful reminders of man's dependence upon rainfall--and his inability to produce it. Devastating hailstorms are another common occurrence emphasizing man's helplessness in controlling the weather.

What can man do when rain is needed for his crops, his household, his very existence? When a 60-second hailstorm can ruin years of work and investment?

- He can watch clouds and study weather reports.
- He can store, conserve, and "wait until next year."
- He can kill a black snake and hang it upside down in a tree.
- He can pray.
- He can hire a weather modifier.

With present information available, it is a matter of opinion as to which action would be most effective. However this could change with future advances in knowledge and technology. Weather modification--developing the water resource in the atmosphere, controlling devastating hailstorms and winds--is a real possibility for Texas in the future. Already state and federal publications are available on developing "rivers in the sky," and there are currently seven operations in the state funded privately through voluntary contributions.

In general, the term "weather modifier" brings visions of the rainmakers of old: Indian medicine men with their elaborate rain dances or silver-tongued operators who depended more on their oratory than proven ability to woo customers for their services.

Early weather modification activities in Texas were for the most part undocumented and unregulated. Only a few reasonably well documented "rainmaking" attempts can be found in historical literature. The earliest of these apparently took place at Midland in 1891. This project was an attempt to increase rainfall by heavy artillery bombardment.

Regulation and proper documentation of all weather modification projects taking place within the state has been the responsibility of the Texas Water Development Board (TWDB) since the enactment of the Texas Weather Modification Act in 1967. The TWDB has the authority to license operators and issue permits for specific weather modification operations as well as the responsibility to maintain records of all weather modification activities within the state.

This system protects Texans from fast-talking con men such as Starbuck in The Rainmaker, a play by Richard Nash. His description of operations would certainly not meet TWDB requirements for license and permit:

Starbuck.

> Sister, the last place I brought rain is now called Starbuck - they named it after me! Dry? I tell you, those people didn't have enough damp to blink their eyes. So I get out my big wheel and my rolling drum and my yella hat with three riffle feathers in it. I look up at the sky and I say: "Cumulus!" I say: "Cumulo-nimbus! Nimbulo-cumulus!" And pretty soon - way up there - there's a teeny little cloud lookin' like a white-washed chicken house. And then I look up and there's a herd of white buffalo stampedin' across the sky. And then sister-of-all-good-people, down comes the rain! Rain in buckets, rain in barrels, fillip' the lowlands, floodin' the gullies. And the land is as green as the valley of Adam. And when I rode out of there I looked behind me and I see the prettiest colors in the sky - green, blue, purple, gold -colors to make you cry. And me? I'm ridin' right through that rainbow - Well, how about it? Is it a deal?

Rainmaker, 1977

The modern rainmaker is a highly-trained scientist who has at his disposal an array of scientific instruments such as computers and radar.

Theory behind modern methods of weather modification is that if foreign substances are introduced into super-cooled clouds, they could produce ice crystals. Dry ice was tried and found effective in 1946. Since that time it has been found that other substances with crystal patterns similar to ice have the same effect on clouds.

The introduction of silver iodide into clouds is by far the most widely used technique of precipitation management--and the only method now used in Texas. This is referred to as "cloud seeding." It can be carried out from ground generators in which a solution of acetone and silver iodide is burned or with silver iodide electric arc generators. Air currents carry the smoke or plume from the generator into the atmosphere. It is hoped that the plume will be drawn into the clouds by updraft. Smoke containing silver iodide is dispensed beneath appropriate clouds from rockets or planes equipped with flares or wingtip burners.

Cloud seeding efforts are divided into two groups: (1) experimental--designed with control features to permit an evaluation of what happened and provide some insight into why it happened; and (2) operational --based on the concept of using existing technology to produce as much additional rain or to reduce hail as much as possible.

Just as Starbuck had to have believers to finance him, his modern counterparts must seek sponsors to finance their operations. Three commercial operators currently have permits to operate in Texas. All are privately funded.

Better Weather, Inc., in Littlefield and Plains Weather Improvement Association in Plainview are primarily in business to suppress hail. They are hired by groups of area farmers and businessmen to reduce hail in their specific geographic area.

Both operations locate potential hail-producing clouds with ground-based radar, then direct aircraft to dispense silver iodide particles from flares or wingtip generators while flying through the base of the clouds. Strong updrafts carry the silver iodide particles to and above the freezing level in the clouds. The silver iodide particles act as ice crystals and accumulate available water on a great number of snowflakes within the clouds instead of allowing the water to form large hail kernels.

Another commercial operation is designed to stimulate rainfall in areas of New Mexico, Oklahoma, and Texas. Ground-based silver iodide generators are placed in a number of locations in Texas to burn silver iodide so that the smoke will be carried by updraft into the clouds. This silver iodide vapor reacts with existing moisture in the clouds and is designed to make the cloud more likely to rain or to rain earlier or for a longer time in designated areas. Irving P. Krick, Inc., of Palm Springs, California, has been conducting these ground-based operations in Texas since 1972. He presently has permits to operate in five separate areas. Generators are operated by local residents under Krick's direction.

Can You Bring Rain?

Even with sophisticated equipment, decades of research and development, and millions of dollars for evaluation, the unanswered question remains--can man effectively modify precipitation? This question was asked in another scene from The Rainmaker:

Jim: I asked him. Can you bring rain?

Starbuck: It's been done, brother - it's been done! **Jim**: Where? How?

Starbuck: How? Sodium chloride! Pitch it up high - right up to the clouds. Electrify the cold front. Neutralize the warm front. Barometricize the tropopause. Magnetize occlusions in the sky.

Lizzie: In other words - bunk!

Understanding of cloud and precipitation processes, seeding material, and delivery techniques has made tremendous strides the last 30 years, but much remains to be learned. Farmers, hydrologists, and politicians are anxious to use cloud seeding to increase water supplies. There are many who strongly believe man is now capable of modifying clouds and the precipitation from them. Scientists and government officials as well as private businessmen and farmers are dedicated to developing the water resources in the sky.

Still there are many others who would vote with Lizzie.

Attempts to evaluate the effects of cloud seeding have led to much confusion. One logical reason for the confusion is the great variability of the weather. Because it "rains on one side of the road and not on the other" without seeding, it is not possible to learn much about seeding effects by short-term comparisons of rain-gauge data.

During a period of two to five years, departures from normal precipitation are much larger than increases that could be expected from seeding. Simply comparing precipitation from a rain gauge in the target area and one outside the area might take many years to determine whether or not cloud seeding is effective.

According to John Carr, Chief Meteorologist, TWDB, insufficient data have been collected in and around weather modification project areas to conclusively say past attempts to increase rainfall or decrease hail have been successful or have not had an effect on weather. The effectiveness of present methods to stimulate rainfall is the research topic for a cooperative federal-state-local experimental project in the Big Spring area under Carr's supervision.

Evaluation Program

The Colorado River Municipal Water District Weather Modification Program is an operational rain enhancement program designed to increase surface water runoff over the Colorado River drainage area. The cost and operation of the rain enhancement activities have been funded by the water district since 1971.

An evaluation of the program was funded by a special appropriation from the Texas Legislature in 1973. The TWDB conducted the evaluation of the district's weather modification in Texas.

In addition to the activities sponsored by TWDB, the Bureau of Reclamation, U.S. Department of Interior, selected the project as one of three sites to study cloud seeding on the High Plains. Other locations of the High Plains Cooperative Program (HIPLEX) are in Kansas and Montana. This research effort is to develop an effective technology for precipitation management.

In the past two years the Bureau of Reclamation has allocated more than half a million dollars into the evaluation program. Part of this money and $125,000 state money has

been funded through the TWDB to support research at Texas A&M University and Texas Tech, according to Carr.

National Interest

The federal government has played a large role in guiding and nurturing weather modification. Work has been done in the Department of the Interior, Commerce Department, National Science Foundation and the Department of Defense. More than $20 million was allocated by Congress in 1976 for experiments in altering the weather.

The National Weather Modification Policy Act of 1976 directs the Secretary of Commerce to develop a comprehensive and coordinated national policy on weather modification research and experimentation to determine the means by which deliberate weather modification can be used at the present time. In addition, the program is to assess the economic, social, environmental, and legal impacts of an operational weather modification program. It is administered by the National Oceanic and Atmospheric Administration.

Project Skywater, the Department of the Interior's atmospheric water resources program is now in its 16th year. It has as its goal the development of "techniques for putting more of the atmosphere's water on the ground and in storage facilities where it is available for man's use." The Department's planning document states that "By 1985 a national capability should exist to provide most areas of the Nation the benefits of enhanced water resources from the atmosphere."

Legal and Moral Issues

Bitter arguments rage on over the legal and moral right to change clouds. One question yet to be answered is what effect artificially increasing the rainfall or suppressing hail in one area will have on the rainfall in other areas.

Opponents of hail suppression in the Texas Panhandle testified in a standing-room-only courtroom in Lubbock this spring that cloud seeding was diminishing rainfall in their areas. This same group won part of their long battle in June when Governor Dolph Briscoe signed a law providing for elections before a weather modification permit can be issued in Texas.

Since there are inadequate data to support claims of either side, it will be many years before the issue can be answered satisfactorily. Carr hopes that the TWDB can initiate a three-year study on the downwind effects of hail suppression this year.

Results from hail suppression seeding projects vary more than those from precipitation experiments. The National Hail Research Experiment in northeastern Colorado has provided important physical descriptions of hailstorms there. Results indicate that there are important differences in storms that produce hail. The same method of seeding that suppresses one type of storm would not necessarily work on another type, and it is

possible that current seeding methods and materials might even increase hail in some storms.

Twenty to forty percent reductions in hail appear to be about the most that can be expected. Massive seeding well before the first hailstones are formed must be done to be successful. Once hailstones become large, it is generally too late to start seeding; however, additional damage may be prevented by seeding new growth on the side of the parent storm.

Necessary Ingredient

One essential ingredient for all weather modification today is the right cloud in the right place at the right time.

A farmer near Littlefield summed up his-own, as well as mankind's, relationship with clouds: "We watch clouds in West Texas. We depend on them, we pray for them, and sometimes we run from them."

Perhaps in his lifetime he will be able to knowledgeably add ". . . and some of them we change."

**N. Richard Nash, The Rainmaker (New York: Random House, Inc., 1955), pp. 60-64.