REPORT ON RAIN MAKING

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Here's A Discussion by A Scientist Who Helped Analyze the 1951 Northern Colorado Project

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IF ONE of our modern "artificial precipitators" (rainmakers to you) said he could increase the normal annual rainfall to 500%, everyone would steer clear because they wouldn't want to be drowned out. However, if he said he could hold it to 200%, or double the annual normal, then many areas of the West would be extremely enthusiastic.

The latter is exactly one of the claims that has been implied and accepted by groups of people in some arid regions. Although commercial seeding operators still assert spectacular results as percents of normal for a certain month or short period, the claim of being able to produce definite large increases above normal for any extended period is not heard any more. And the reason is that such an assertion now appears greatly exaggerated and perhaps impossible.

This article is not intended as a condemnation of attempts at artificial precipitation or of the operators, but is more of an effort to present all sides of the rainmaking controversy. It is further an appeal to require more scientific proof of all the claims of the operators. How this can be done economically is presented later in the article.

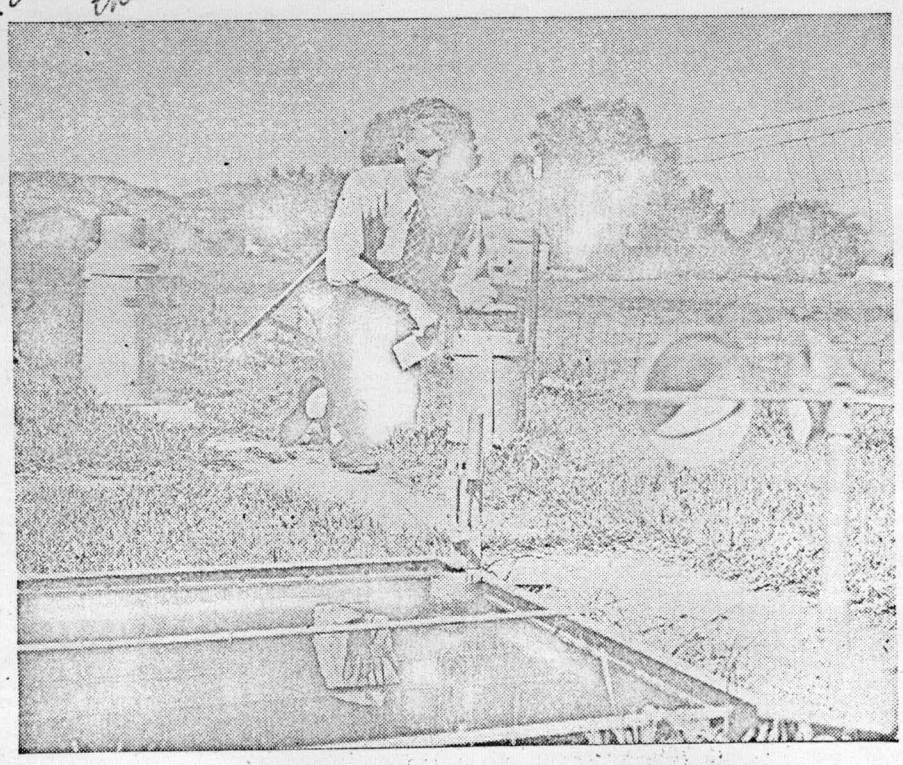
This year most of the drier regions of the West have been practically covered by contracts for artificial precipitation. Without any real proof whatever, farmers and ranchers in particular have spent millions of dollars in the hope that better weather control was possible. To conduct a proper scientific experiment to prove or disprove the value of artificial seeding, it would be much better to concentrate the effort on no more than two or three typical projects in different regions.

It is recognized that the agriculturalist has to be somewhat of a gambler by necessity because he must take a chance on one of the most variable of agents—the weather—in order to produce a crop, whether it be plant or animal. But the man who has to take calculated risks is not going to throw his money away if he knows he would have gotten what he wanted anyway without gambling.

Extremes in Rainfall

As only one example of the astounding natural extremes in precipitation, let us look at a few variations in the station at Fort Collins, Colo., with its continuous record since 1887. The average annual precipitation is 14.71 inches, but in 1923 the amount was 27.57 inches and in 1893 it was 7.11 inches. This may be hard to believe, but then look at the month of April. The average is 2.09 inches. In 1900 it was 10.56 inches and in 1908 it was 0.05 inch.

This year, after all artificial seeding had been over since June in the Fort Collins area, the station had a total of 6.18 inches for August 2 and 3. This is almost one-half the annual average and over four times the average for August. The final total for August this year has been over FIVE TIMES the average for August in the 64 years of record. Extremes of the same nature as those mentioned above occur all the time at all stations and show how unreliable nature is when it comes to weather.



T. H. Evans, dean of engineering at Colorado A & M and author of the accompanying article, inspecting a rain gauge at the College weather station. (Colorado A & M photo.)

The commercial operators have cited a number of examples of large increases above normal (400, 500, or 600%), which for short periods occurred in areas over which they were seeding, as proof that their operations have been successful. There is very little proof, however, that these were not just some of the natural extremes that are constantly occurring in the weather everywhere. For every claim made by the operators there has either been very little proof at all, or a statement by reliable scientific authority that the occurrence could have been natural.

Seeding Results

What have been the results of the vast seeding operations carried out in the West this year? Unfortunately only a very few of the projects are being evaluated by an impartial scientific agency of some sort. No official report seems to be available yet on any operation evaluated by an outside agency except that for the Northern Colorado Natural Resources Association made by the Engineering Division of the Colorado Agricultural Experiment Station at Fort Collins.

To be specific about some known results, let us look at the San Luis Valley operation of last winter. A minimum was to be paid the operator for trying, and a maximum if he produced a snow cover of a certain percent of normal by April first. The results fell far below the amount required for the maximum payment; so the operator got only the minimum for trying. The operator excused the poor showing by stating there had not been enough seeding opportunities—which may have been quite right. Yet in the area surrounding the Valley to the north there was above-normal snowfall. In this case the Valley group was protected against poor results by a performance contract.

In the Tri-County project of northeastern Oregon, it is reported unofficially by a reliable source that for a similar type of minimum-maximum contract the monthly payments of a 10-month period have been mostly at the minimum, or a little above. This would indicate no apparent marked improvement in the weather patterns that had been anticipated for cloud seeding. The payment formula is based on the amount of precipitation in the target area in relation to that in a large adjacent control area which is unseeded.

In the California Electric Power Company project in the high Sierras near Bishop, Calif., the project engineer, who is employed by the company, states after three years of operation and close attention to all seeding opportunities that he believes they have apparently increased the normal precipitation by from 9 to 12%. It is understood the U. S. Weather Bureau is now analyzing the data from this project. A figure of similar magnitude—about 14%—is reported for the vast New York City project where the annual precipitation is normally very high anyway and the seeding opportunities almost without end.

North Central Project

The other project for which an impartial analysis has been run is that in the north central Colorado over the watersheds and valleys of the Poudre, Big Thompson, and St. Vrain Rivers. The principal conclusion in the report was that there was no apparent increase in precipitation as a result of cloud seeding for the period of contract (March, April, and May). The writer has had close personal contact with this operation as administrative head of the group doing the evaluation. A preliminary report covering the analysis, conclusions, and observations is available upon request to the Engineering Division, Colorado A & M College, Fort Collins, Colo.

The above examples may leave the impression that artificial nucleation has been unsuccessful. The writer and his colleagues at Colorado A & M believe, on the contrary, that there has been no conclusive proof yet that the operations are unsuccessful. The only proof from the examples cited is that some claims of the commercial operators have been possibly overexaggerated and even misleading in certain cases. Many years of properly conducted, impartial evaluations are needed to determine what the real worth, if any, of artificial cloud seeding is. It will take considerable time to gain a measuring stick that will separate the natural from the artificial.

The appeal mentioned as the theme of this article is for a demand from all sponsors of seeding operations to require that certain key projects be evaluated by an impartial scientific agency. Any Engineering Division of a state Land Grant College, that is willing and qualified with suitable staff, is capable of doing the job. These colleges, which serve the people of their respective states, would probably—as it is definitely known Colorado A & M would—do the work at cost. The experience gained by Colorado A & M College in the northern Colorado operation has assured us that an evaluation properly carried out can lead to reliable answers. The analysis made this spring was a pioneer attempt to probe and learn what needed to be done in evaluating a project. It may take 10 years to have reliable answers but this short trial by the College served to bring out more clearly the problems involved, the data needed, the controls necessary, type of cooperation required between operator and evaluator, type of staff needed; and to provide a proving ground for methods of evaluation.

Groups Could Cooperate

The writer is convinced that by concentrating on a few key projects —say one in Colorado—a number of associations could band together to finance an evaluation that would be complete and economical. The results on this particular project would be just as valuable to the other associations, even though it was not theirs, because all the factors would be similar. Just to give a numerical example, suppose such an evaluation would cost $15,000 for one year, If only three associations get together to finance it and their costs for their own seeding operations totalled $150,000 it can be seen that the evaluation is relatively cheap. These figures are not real and it is possible that an actual example could be given where the proportion of cost to evaluate was much less.

There was created by the last Colorado legislature an agency known as the Colorado Weather Control Commission. Its primary duties are to protect the public interest in matters of artificial weather modification, to make regulations, and to issue licenses to operators. To date little has been heard from this Commission although we are in the midst of the greatest boom in artificial seeding the state has ever experienced. Most of the agricultural land in the state is under contract. A plan, similar to that outlined above for a thorough scientific evaluation, has been proposed by

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district; Charlie Rogers, Dolores district in the San Juan Basin; O. H. Woods, Joe Bruck and W. A. Weeks, Jr., Shavano district; Edward Voss, Orchard Mesa district, Mesa County; R. E. Jones, East Routt County district; and Mrs. Arthur Peterson, Jefferson district.

To be more explicit about a district, it is a group of farmers and ranchers organized under state law to conserve soil and water through the means which they deem most applicable to the conditions existing in that area. The direct responsibility for the administration of the business of the district rests with the district board of supervisors. This board has three of its five members elected by the people in the district and the remaining two are appointed by the elected members. It is completely democratic, answerable only (other than to the state government of which it is actually a subdivision) to the people of the district.

The district, through its board of ... conserve and improve his soil so that it may pass on to others in a better condition than he found it. They must endeavor to give all people, town and city dwellers as well as the rural folks, a full understanding of the necessity of the soil conservation program.

That the districts and their boards are becoming more keenly aware of the responsibilities which are theirs and the status which they can achieve was very evident as the districts throughout the state were visited during the aforementioned contest. Many judging trips into districts really became field days. Accompanying the judges, the supervisors and the farmers representing the district, were bankers, businessmen, chamber of commerce officials, local press and radio representatives, 4-H club and FFA members; all of whom knew what was going on and were extremely interested in the practices being used to conserve the soil and water and to stabilize the farm operation.

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the writer to this Commission, to act as sponsors. Since the Commission, as such, has no appropriations for evaluations the method of financing by associations was suggested.

The Colorado A & M analysis of the northern Colorado seeding operation of last spring was made by five methods of attack, most of which were statistical in nature. We were fortunate in having a sufficient number of weather stations with at least 40-year records on which to base our analyses in the target area.

One of the principal results of the analysis was that the total precipitation on the target area was less than normal and had been equaled or exceeded naturally every two years out of three for the past 40 years. When it was possible to use a nearby, unseeded area for comparison it appeared by this method that seeding in the target area gave no significant results. It appeared also that there were about as many seeding opportunities as would be expected normally.

A method of analysis is being used which, for the final report, should indicate if there has been any reduction in the degree of spotty precipitation on the target area. It is hoped to learn if there was any improvement in the pattern or distribution of rainfall to reduce the usual extremes such as violent downpours, not enough in some spots and too much in others, and excessive runoff causing physical damage.

A map of the entire United States west of the Mississippi shows some very interesting and unexpected facts during the seeding period studied for March, April, and May. Generally speaking, the areas which were unseeded—particularly in the semi-humid states east of Colorado —show higher percentages of precipitation with respect to normal than do the seeded areas.

The study referred to does not condemn nor disprove the possible value of artificial cloud seeding. And it certainly doesn't prove its worth. What the study shows to most of us is the need for many years of further adequate and scientific evaluation to explain the apparent lack of significant results on this project. Perhaps the results are so small that they will not appear significant because of the natural great extremes in weather until we have plenty of years of study for better analysis and comparison.

To do an evaluation job properly

it is believed there must be adequate control or comparison areas in the vicinity of the target area, close cooperation between operator and evaluator, and adequate staff for the work. Not only must the operator and evaluator be in constant touch with each other, but the operator must report the "where," "when," and "how long" on cloud seedings on the day they occur in order to strengthen the evaluation.

To give a fairer type of contract to the purchaser during these uncertain and unknown years in the development of cloud seeding, it is suggested that a performance requirement be included. By this is meant—as an over-simplified example—a requirement that precipitation or runoff be a certain percentage of normal. In addition it is suggested that a "cost plus" type of contract would also not be unreasonable. In this case the operator, like a building contractor, would be required to prove his costs and above these would receive a fair profit.

"This is a good club to keep you off my farm."

Shipping Fever

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WHEN cattle are moved any considerable distance, especially young animals, they are subject to shipping fever. This is true whether it be by rail, by truck or by driving. When shipped by rail they are always exposed to the disease in the public yards, and unless trucks are disinfected between hauls they could be the means of transmission.

The explanation of outbreaks following the movement of animals from the range to the meadows is not so easy. It may be that mere exposure to the causative agent is not the chief cause. The conditions that accompany movement may be the big factor. At least it is there that control can be applied.

Assuming that whenever cattle are moved from one place to another they may develop the disease, attention needs to be directed to the possibility of preventive measures. What can be done to carry the animals through with a minimum of loss?

Weather conditions no doubt play a large part. We can't control the weather but we may be able to alleviate some of its effects. Cattle should not be driven during a cold rain or snow. If shipped during bad weather they may become chilled either during transit or on unloading. In cars and trucks they may be overheated and then chilled on arrival at the destination. The change in feed can hardly be prevented, but at least feed can be given at regular intervals. Fatigue probably plays a part both in animals that are shipped and those that are driven. When brought into the feed lots they can be well bedded, allowed to rest and given a light diet.

The lots themselves may carry the infection. We do not know the actual cause of the disease. It has been called hemorrhagic septicemia on the assumption that it was due to the micro-organism of that disease, which is frequently found in the lungs of animals that die of pneumonia. Those organisms are also found in the upper breathing tract of normal animals. Other bacteria may also be found in badly diseased lungs. The reason that there is some doubt about the disease primarily being hemorrhagic septicemia is that in animals dying early, that organism may not be found. It seems to come later in the disease.

In a way the disease parallels influenza in man. Influenza is known to be a virus disease, yet the virus rarely produces death. It merely paves the way for secondary bacteria that are responsible for the high death rate. Many scientists have thought that shipping fever was also initially a virus disease. Some have isolated a virus but the positive proof is still lacking. If true it would be a very happy explanation. In that case we could still stress all the predisposing factors such as chilling, fatigue, change of feed, as tending to increase the mortality by favoring the secondary bacteria. In other words, if given a chance most animals would recover from the virus invasion in three or four days and there would be little loss from the secondary infections.

That brings us to a consideration of the value of hemorrhagic septicemia vaccine. The U. S. Bureau of Animal Industry showed some years ago that these vaccines only increased the mortality when given at the time the cattle moved through the yards. They also increased the death rate when administered during an outbreak. The advice of the Bureau was to give them at least 10 days before shipping. Many have felt that even this did not prevent the cattle from coming down with shipping fever. If effective at all it prevented the development of secondary pneumonia.

Similarly the serum would only be curative against the septicemic bacteria and not against the virus, but since the bacteria are the chief cause of death the use of serum in a sick animal could be justified. The greatest objection to its use is its expense. If used at all it should be given in generous quantities.

The sulpha drugs have also been found useful in sick animals but here again their value probably lies in their ability to check the growth of the secondary bacteria.

From the standpoint of the cattleman, good care, good nursing, warmth, rest, light diet and good ventilation are still his sheet anchor in treatment. The use of serum or drugs is best left to the veterinarian.