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ANALYSIS OF RESULTS OF RAIN MAKING PROJECTS
IN THE WESTERN STATES

by

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ENGINEERING RESEARCH

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The biggest question in the West these days is, "Can we get more moisture by artificial means?" It is a vital question in all the portions of the United States in which more precipitation is needed to give satisfactory moisture for field crops and to get the best production out of thousands of acres of grasslands. In fact, the entire public has a stake in knowing the answers since an economically successful increase of precipitation artificially will affect all water supplies - agricultural, domestic, and industrial. Its impact will be felt in engineering, law, economics, transportation, hydroelectric power production, agricultural practices and almost every human activity.

Hence the possibility of increasing precipitation by artificial means has literally taken the West by storm and as a result hundreds of thousands of dollars have been spent by farmers, ranchers, and other groups in this region in an effort to increase precipitation by cloud seeding.

Independent evaluations of these rain making projects have been made by impartial interested groups such as state colleges and governmental agencies.

One of the first independent studies was made by G. E. Stout, Meteorologist, Illinois State Water Survey Division, who stated:

"This organization attempted an evaluation project back in 1947 when cloud-seeding work boomed forward with great vigor. We were given logs from eight rain-making flights in Central Illinois and after careful review of the Weather Bureau data, I found that no rain fell in the area where they were doing their seeding. However, due to the scarcity of gages in that area it was impossible to make a fair statement. Since that year there has been no rain-making work in Illinois."



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In the Bishop Creek artificial nucleation experiment, planes were used for distributing silver iodide in cloud seeding tests during 1948, 1949, and 1950. The basic procedure of testing by the U. S. Weather Bureau consisted of establishing a relationship of regression between flow in the experimental basin and flow in the comparative basins. The conclusions drawn were:

"The results of the tests do not show conclusively that there was an effect from artificial nucleation. It is believed, however, that they indicate the desirability of reexamining the individual seedings in an attempt to explain the unusual increase in 1949 in contrast to the other two years. The significant increase in flow shown in the tables may also justify continuance of the experiment if the expected gains in flow are of economic importance."

Joint U. S. Air Force - Weather Bureau cloud seeding trials conducted during winter and spring, 1949, consisted of nine seeding missions using dry ice flown over the western slopes of the Sierra Nevada mountain range and thirteen seeding missions in the Gulf of Mexico region. The evaluation of results published in May 1950 of the above trials was summarized as follows:

"The nature of the trials conducted to date were not of the type to permit extensive deduction of possible or probable cloud physics reactions resulting from seeding; in addition, acceptable theories are still in an undeveloped state. These are the difficulties that exist at the present time.

"It would be a serious mistake to discard completely the concept of cloud modification by artificial means because of the failure to achieve more spectacular results to date. The demonstrated modifications are highly significant in the sense that they prove that cloud control is not an impossibility; and, in fact, it may possibly develop into an extremely valuable technique.

"The feeling here, however, is that the greatest need at present is to understand thoroughly the cloud physics processes which are significant in weather control.

A sound knowledge of these fundamentals certainly will enable one to make definite predictions as to the extent of possible control, and at the same time point out the direction to which the maximum effort should be made to achieve this control."

Another independent study was made of a project in north central Oregon by the Oregon State College Agricultural Experiment Station in collaboration with the U. S. Soil Conservation Service. Cloud seeding was conducted in the area of Sherman, Gilliam, and Morrow counties from September 1, 1950 to June 30, 1951, using ground generators, which burned charcoal impregnated with a solution of silver iodide and acetone. The analysis consisted of a statistical study showing the relationship of precipitation during the cloud seeding period to the probable amount which would have occurred normally and a geographical distribution study of all rain fall occurring in the Northwest. The following conclusions were reached:

"1. There is no evidence that cloud seeding established or resulted in establishment of any systematic precipitation pattern in the Northwest month after month during these operations.

2. Favorable departures did occur between tri-county precipitation stations and control stations of Washington and Oregon as based on statistical estimates. These were not statistically significant, however, and therefore may have been due entirely to chance.

3. Evidence indicates that cloud seeding did not substantially increase precipitation when performed on marginal days when only small amounts of precipitation were likely to occur.

4. In view of the departures which did occur this past year, it is felt that one year of operation is not sufficient to draw definite conclusions as to the real economic possibilities of cloud seeding. The station recommends, therefore, that this project be continued, if possible, to provide additional information."

The above group also analyzed an attempt to increase precipitation by cloud seeding in the Medford, Oregon area. Preliminary conclusions drawn were:

- "1. There is no evidence that cloud-seeding increased the amount of precipitation stored as water in snow over the deposition area in 1950-51.
2. So far there is no conclusive evidence that cloudseeding affected one way or another total amount of precipitation falling over the deposition area in 1950-51.
3. In view of the short length of the experiment (2 years) it is not believed that the complete economic possibilities of cloud-seeding in this area have been fully explored or demonstrated."

Dr. E.J. Workman of the New Mexico Institute of Mining and Technology in reporting to the American Meteorological Society stated:

"The enthusiasm with which we started four years ago has not been sustained. Our simple field experiments have been inconclusive for the most part."

An analysis of the climatological data for the cloud seeding period, March 1, 1951 to June 1, 1951, over north central Colorado was made by the author for the Colorado A & M College Agricultural Experiment Station. The attempts to increase the total precipitation by spreading silver iodide from ground generators were analyzed by statistically studying precipitation on the target area and a control area, comparing snow pack on the target area and a control area, and by studying the rain fall patterns over the entire western United States. The results indicated that there was no apparent increase in precipitation resulting from cloud seeding during the period March 1, 1951 to June 1, 1951, over north central Colorado. There is also no proof that possibly good results cannot be brought about by artificial cloud seeding. Extensive field experimentation over a period of years, under conditions that permit scientifically adequate observation, may be required to establish the degree of success which cloud seeding operations may be expected to achieve.

In view of the above findings of impartial agencies evaluating cloud seeding experiments and in view of the lack of understanding of cloud physics processes which are significant in weather control, for example, the contrary theories as to rain drop formation or as to whether there is a lack of ice crystals or an over-abundance of ice crystals in many cloud formations, a justifiable conclusion is that although cloud seeding probably has had some effect on precipitation, the effect has been on too small a scale to detect and the hopes of the public, fanned on by over-optimistic statements in the public press, have not been realized.

However the results to date warrant full scale applied and theoretical experimentation both in the laboratory and in the field on cloud physics and the artificial stimulation of precipitation to determine the most favorable procedures and conditions for cloud seeding and to determine with any assurance the economical value of cloud seeding.

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ABSTRACT

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