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PROBLEMS IN RAIN MAKING

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ENGINEERING RESEARCH

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PROBLEMS IN RAIN MAKING

IN the far western states during the past two years there has developed almost a tidal wave of large scale operations to force nature either to give up or to withhold moisture in the atmosphere to suit the will of man. This work comes under the general heading of artificial nucleation, a scientific development that is only an infant but which gives promise of unbelievable results. It is claimed by one operator in the field that it is possible in many arid regions of the country to double the average annual precipitation or runoff. This means doubling either the average annual rainfall, or snowfall, or a combination of these, depending on the region. It is further claimed that hail can be prevented, and that undesirable rain can be prevented at will. It is even believed by some that fog can be dissipated where desired. These are merely some of the claims. Perhaps they will all be substantiated. Most of us who live in the arid and semi-arid west hope they can be.

It is easy to imagine the terrific impact of such an achievement on agricultural practices, engineering, law, economic level, transportation, domestic water supplies, hydroelectric power, and almost every human activity. If the claims prove correct this will be the biggest thing since the atomic bomb. The impact, of course, will not be limited to the drier sections of the country but will be felt nationally. The large scale experiments that are going on in the west were tried in the New York City watersheds to improve the critical situation that developed there in 1950.

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What Could Happen

The impact would radically alter certain agricultural practices because it would not be necessary to hope for rain in dry farming—it would be there about when wanted. Susceptible areas that now rely entirely on a little rain and elaborate irrigation systems could forget their worries about water shortages in the system, or about priorities under appropriation law. In fact priorities might even become unnecessary if there were always assurance of an abundant water supply. Towns that are now limited because of inadequate water supply might continue to expand. Regions that are short on industry because of inadequate water could begin to attract industries. Areas that have had their economic level held down because of all too frequent crop failures could begin to raise that level. Grazing lands would be lush with rich grasses. The threat of dust bowls would disappear. Streams would have new and higher averages that would be free of the extreme variations that exist now. Hydroelectric plants could operate on a larger firm power load. If fog could be dissipated at will, the transportation systems—particularly ship and air—could maintain better and safer schedules.

This all sounds too good to be true, and that may be just the case. So far there is no conclusive proof, on a sound scientific basis, that all this can be done. In the first place there has not been sufficient time for adequate proof and, secondly, even outstanding meteorologists, who are most closely allied to this scientific field, are in disagreement as to its possibilities. We, in the west, where additional water is needed badly in most areas, want the experimenters and operators to have every reasonable opportunity to prove their claims. We feel that these large operations on a county- or basin-wide, scale must be continued for enough years to acquire reliable scientific data for evaluation.

How Rain Making Started

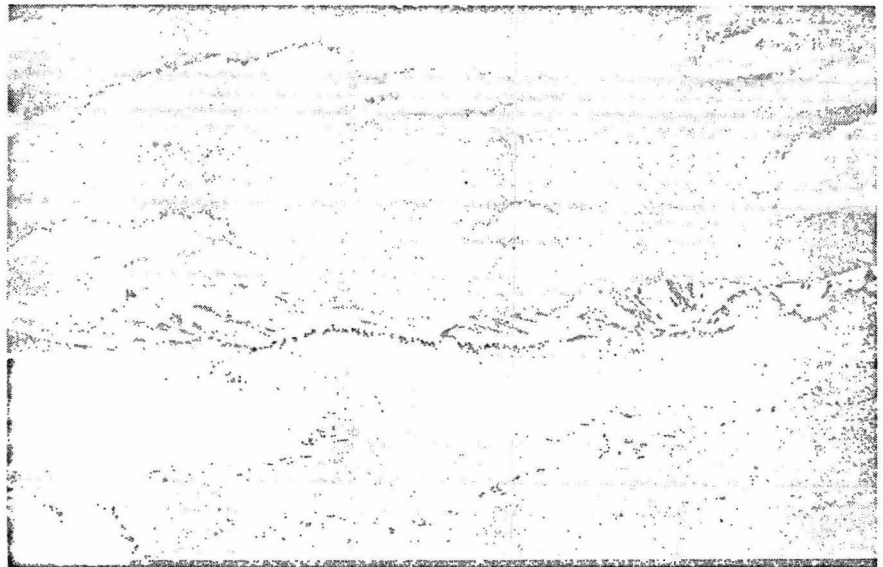
All of this really got started just a few years ago. Although many laboratory research men, here and abroad, had delved into the science of meteorology and cloud physics for decades, it was probably not until Schaeffer's experiments at General Electric in 1946 that the real possibilities of causing artificial precipitation from certain types of clouds was fully realized. Dr. Irving Langmuir made some large scale experiments in New Mexico in 1949 that received considerable publicity and seemed to start a chain reaction of other experimentation. There are now many commercial concerns operating in this field under various kinds of contracts with farmers, ranchers, municipalities, etc. At present practically anyone can try to milk clouds or knock off thunderheads but the fly-by-night operator

with no experience, unsuitable equipment, and poorly trained personnel will probably only last a short time.

The principal method used today is that which involves spraying vaporized silver iodide into the atmosphere from the ground in such a way as to disperse it by winds to the so-called "target" area. By the time the particles have travelled some distance downwind from the generator they have dispersed into a very large volume of air—both vertically and horizontally. The optimum conditions within the area must be such that precipitation is incipient and lacks only the necessary nuclei to trigger it off. It is possible also to "over-seed" and dissipate a potential rain, or even the entire cloud. Nuclei are quite often there naturally. If not, however, and all other required conditions exist, then the artificial nuclei will start things going. Another advantage of the artificial nuclei is that even though some natural rain would fall, the amount can be increased because such nuclei are effective at much lower altitudes in a cloud than are the natural nuclei. This article will not attempt to explain the theories involved in this complicated set of phenomena. The explanation has been given in several outstanding scientific papers by authorities in the field such as Langmuir, Schaeffer, Vonnegut, Krick, etc. A very good popular explanation is that by Roscoe Fleming in *Public Power* for October 1950.

Another still common but apparently less efficient method, that was actually in use before silver iodide, involves using dry ice dispersed from an airplane. It has the big disadvantage of requiring expensive airborne equipment, and gives dispersal on vertical surfaces rather than over a large volume. It further requires operation under the most unfavorable flying conditions. Although silver iodide can be dispersed from a plane, the usual practice is to employ ground generators.

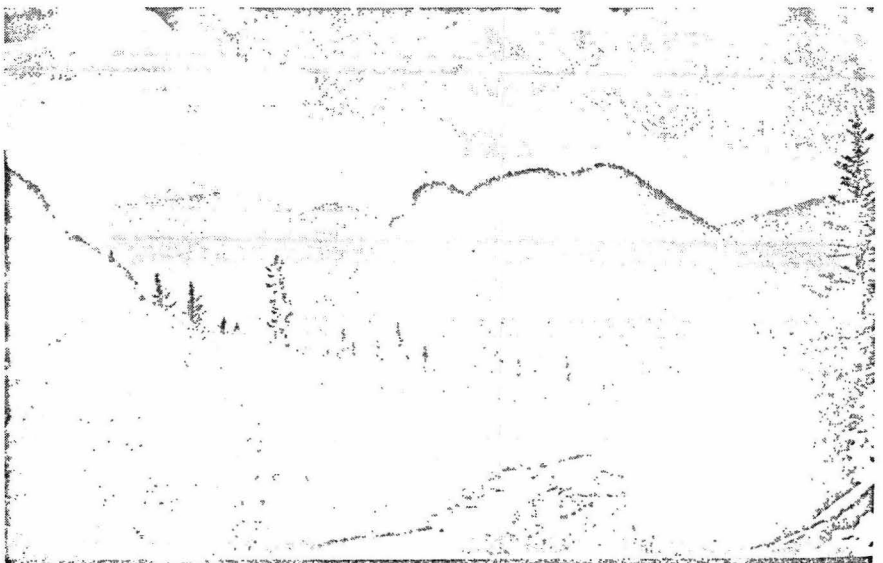
The need for additional, reliable water supplies in most of the far west is quite obvious to those who live in its vast arid and semi-arid sections. The need is probably also evident to those who live in the more humid regions of our country but have travelled through the west, have seen pictures of it, or have read of the antagonisms that develop between some western states over a relatively small quantity of water. This crying need is the reason there



● **SNOWFIELD** in the high Rockies. Photographs like this are used to estimate snow cover and subsequent spring runoff flow.



● **MAIN stream diversion dam** on a western river. A stream like this constitutes a life-giving water supply in an arid region.



● **WATER source** at the Continental Divide. This photograph was taken in the summer. Winter is something else again.

have been so many large scale operations carried on in California, eastern Oregon, Arizona, New Mexico, and Colorado during the past two years. It is understood an operation on the vast King Ranch in Texas is contemplated for this year. It appears that the operations will snowball into such a multitude that the state of Colorado as an example, may be almost completely covered by contracts from the Continental Divide to the Kansas and Nebraska line on the east. About the eastern one-third of Colorado is practically all dry land farming. It was part of the dust bowl of the early thirties. Large parts of the remainder up to the eastern edge of the Rockies are irrigated. There are even extensive

ter type his total fee would be larger than in the other two types. Any kind of a contract might be negotiated but most possibilities would be some of the examples given, or a combination of them. As a numerical example of cost it was proposed in one case that for doubling the average annual runoff from an increased snow pack the third type of contract would cost \$100,000 or nothing. The quantity of extra water under consideration was about 350,000 acre feet. In most regions this is very cheap water provided the farmers wouldn't get it naturally.

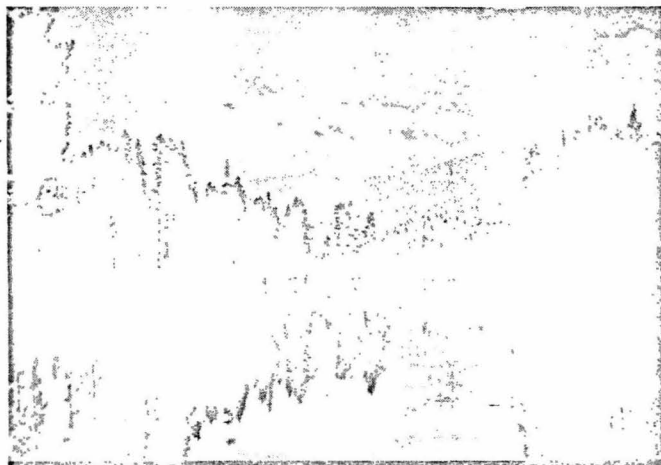
The Need for Water

It is easy to see why the desire to try these methods of getting ad-

to measure total precipitation and runoff but we don't know how much is natural and how much artificial in these operations. It is a satisfactory yardstick to measure these components of the total that we need. No one seems to have devised that yardstick yet that is acceptable to all scientists. Methods are available, which over a span of perhaps 3 to 5 years, may prove something, although longer periods would provide better results. In the case of rainfall, however, the accuracy of results would depend for one thing on the adequacy of coverage in the target and adjacent areas by gages of long and reliable past records. Really good coverage does not exist in most regions that might be



● **GRAND Valley canal in Colorado. To the right is Colorado River—every drop needed.**



● **INCREASES in snow pack are attempted in high water supply areas like this one.**

mesas within the Rockies that are largely irrigated. Colorado is second only to California in the acreage irrigated in the United States.

Types of Rain-Making Contracts

There seem to be several types of contracts available to those who hire the operators. One is a flat fee for a service covering a definite time interval in months or perhaps a year. In this case the contractor does not necessarily guarantee any specific results. Another type might be called a minimum-maximum contract. A minimum fee is paid no matter what happens, but if a stated increase (perhaps doubling an annual average) is proven then the maximum is due. A third type could be called a double-or-nothing contract, since that is just about the way payments would be made. If the goal is to increase an annual average, a certain sum would be due if accomplished. If not, then nothing is due. Of course, if the operator came through on this lat-

ditional moisture is spreading and has reached pandemic proportions. Many regions of our west suffer almost continual drought for many years in succession. Other areas have "mined" their water tables to supplement surface supplies to such extents that critical situations are developing. In other areas there just isn't enough surface water to irrigate properly all irrigable land or to supply cities and towns with enough domestic water. The new artificial precipitation science looks like manna from heaven if all the advertising, as well as statements from some outstanding scientists, prove correct.

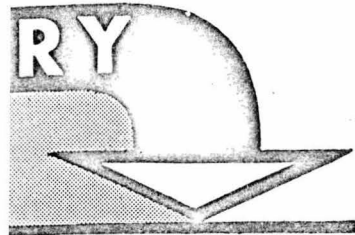
Because there is disagreement, however, between top-notch scientists regarding the possibilities and long range worth of weather control through artificial nucleation, it is evident that proper scientific evaluation must be made over a reasonable period of years. How much of the increases claimed in precipitation is natural and how much is purely artificial? It is relatively easy

affected. At any rate some evaluation is better than none, and unless the present large scale operations are properly evaluated by qualified neutral agencies, then a marvelous opportunity will be lost and we may never have an unbiased answer. People are skeptical for the most part of evaluations carried out by operators who are in the business to make a profit, no matter how honest and sincere they may be.

Needed Legislation

Because of the need for evaluation, so the public will be properly informed in the near future, there is need for legislation. As a bare minimum the legislation should require registering or licensing operators in order to keep track of them and their areas of operation. It should require also, a central agency to receive regular reports from operators as to when and where they operate in order to have proper data on which to evaluate the results. If there isn't such an

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pensive for wide emulation; the Highway Commission spent some \$50,000 on them. Yet they mitigate the harshness of life at Ocracoke and provide a real service to the islanders in connection with North Carolina's recent \$200,000,000 road bond issue. The "expensive" roads illustrate the kind of ingenuity by which road builders can end the isolation of such relatively inaccessible spots.

Nor have the roads, as some people feared, "spoiled" the natural beauty of Ocracoke. One of the islanders writes: "Ocracoke's 'Main Street' remains untouched by modern cement; it is a beautiful narrow lane of sand, winding under age-old water oaks through groves of myrtle and youpon, bordered by quaint white fences that yard-in some of the old homes of the island, first settled between 1710 and 1715 by fishermen and pilots.

"And for those who fear modernization, let them be reminded that there still exists 16 long miles of sand along the Atlantic Ocean from Hatteras Inlet to Ocracoke Inlet—uninhabited except by the wild ponies and the sea gulls and an occasional sports-fisherman."

Making Rain

(Continued from page 38)

agency set up in a state, then the public will never be able to go to a source for an answer it will rely on unless the Federal government takes over the job.

At the present time the State of Colorado has a committee working on a proposal to regulate artificial weather modification. This was submitted to the legislature in the form of a bill and was passed by both houses in March. The spirit of the bill is to encourage experimentation and development in every reasonable way. A very minimum of regulation is spelled out but a commission is proposed which will be able, as the need arises, to adopt the necessary regulations to protect the public interest. The commission recommended would be composed of one representative, appointed by the Governor, from each of the four Congressional districts in the State, and the State Engineer. The commission, among other things, is empowered to hire an individual or organization to evaluate scientifically operations carried out in Colorado. The Commissioner of Agriculture actually handles the admin-

istration of the Act on recommendations of the commission. The commission will recommend licenses and hear cases involving license revocation or charges against an operator. It will also have power to require an operator to cease activities in any area where it could be shown excess moisture would be against the public interest at a particular time.

The committee that worked out the proposal consisted of varied interests within the state. It invited in other parties who might offer criticisms or recommendations to make a better bill. The principal opposition appeared to be from groups already contracting for extra rain or snow and who resented governmental interference in the way they spend their money. They did not seem to realize that the entire public is concerned deeply in these activities and that the intent of such a bill is not to hamper experimentation and development but to provide reasonable safeguards of the public interest. If the opponents are paying for something they would have gotten anyway, they will probably be glad to learn about it one of these days. The bill can not conceivably keep any group from getting a legitimate rain-increasing job done and spending as much for it as they see fit.

A bill has been introduced in the Federal Senate, known as the Weather Control Act of 1951, by Senator Anderson of New Mexico, that gives the Federal Government pretty complete control over anything done along this line. It also sets up a commission under the Secretary of Commerce with very great powers for rigid control of the conduct of experiments and operations. It further would protect any contractor (operator) from damage suits growing out of his activities. The Government would stand these if proven.

This commission would be empowered to carry out, or have carried out, research in all aspects of weather control including processes, devices, and materials, as well as the utilization of weather control in agriculture, industry, commerce, and military operations. It would also have the power to issue and revoke licenses. Not the least of the contemplated powers of such a commission would be to fix fees, rates, or charges in weather modification contracts. It could issue injunctions in any case where it felt the general welfare would thus be served. It

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could also require reports of all activities and methods of operators, and inspect the activities at any time. In other words, this proposed commission would have practically absolute authority in the control of any weather modification or weather research activities carried on in the United States.

It is understood that several states in addition to Colorado are considering legislation at this time to regulate in one way or another the operations of those engaged in artificial nucleation. Arizona, California, and Wyoming are three known to have under consideration such bills. At a meeting of the Western Interstate Committee on Agriculture held in Santa Fe, New Mexico, last October, the following resolution was passed regarding artificial nucleation:

"Since the business of artificial nucleation of clouds to create rainfall has relatively recent beginning and has not progressed to a status where regulation is indicated, although some preliminary supervision by a proper state agency would appear desirable, your committee recommends that:

- (a) Research and development work in artificial rainmaking be encouraged;
- (b) Legislation be adopted, if necessary, to provide for the registration with a proper state agency of (a) persons or organizations engaged in the business of operating artificial nucleation equipment with provision for information on areas of operation, and (b) of persons or organizations selling equipment and supplies for artificial nucleation or possessing equipment and supplies used in connection therewith."

It is believed by many people that the first statement in the resolution is not strong enough. Apparently some Congressmen feel that *strong* regulation is indicated, and a number of others in positions to know, feel definitely that a reasonable minimum of regulation is needed. While unduly restrictive legislation would undoubtedly hamper and discourage free experiment and development, that being proposed in Colorado would not. It is so flexible that it will enable rules and regulations to be developed as the need arises. It does give the reasonable minimum protection, however, to which the general public is entitled at this time.