RESEARCH IN CHEMICAL LAND TREATMENT FOR WATER CONSERVATION

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I would like to begin by thanking your organizing committee for this opportunity to talk to you about some of my Company's activities in the field of water research.

Specifically, I have been asked to outline our work on "the chemical treatment of land for water conservation." Within this broad frame of reference, I propose to outline four of our many studies relating to the development of new water sources and the more efficient utilization of existing supplies.

The first of these studies is concerned with the retardation of moisture losses, the second with increasing runoff and the third with the stabilization of windblown sands. The fourth aims at doing all of these things and something else as well.

Starting, then, with moisture loss retardation; in this area, I have chosen to talk about our efforts to develop cheaper and better canal linings to reduce the dual problems of water loss and damage to the surrounding land.

Our laboratory and field studies have led to the development of stabilized butyl rubber formulations which make highly durable sheet linings for canals at reasonable annual cost levels. Currently, we are working to develop even better and cheaper lining materials: one experimental product has shown considerable promise and is now being evaluated by the Bureau of Reclamation at Denver.

My second topic, our work on techniques for increasing runoff, centers on the concept of the Artificial Watershed. As you know, the water-producing efficiency of a natural watershed is usually quite low, because most of the precipitation falling upon it is returned to the atmosphere by evaporation and evapo-transpiration from vegetation. This situation is generally quite tolerable because our natural watersheds provide many other benefits besides water.

However, in areas in which water supply problems grow daily more critical, there is an increasing justification for using land solely or primarily for water production purposes: such a situation has existed for many years in several Caribbean Islands, where land has been cleared and water-proofed with concrete to provide water collection surfaces that harvest essentially all of the rain falling upon them. The runoff is collected and stored in surface tanks until required. Needless to say, water supplies obtained in this way are quite expensive.

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In 1957, we initiated a project to reduce the cost of obtaining water from an Artificial Watershed. We hoped to develop cheap bituminous coating materials that could be sprayed directly on the ground to produce durable water collection surfaces. We now have promising materials, plus the application techniques and spraying equipment necessary. One outcome of this work is the 10-acre watershed that we have recently installed near Las Cruces in cooperation with the U. S. Geological Survey.

Besides these spray coatings, we have also developed sheet-liners for watersheds. Stabilized butyl rubber formulations are used for this purpose, and they have been shown to make very durable collection surfaces. Some 30 such sheet-lined watersheds have already been installed in cooperation with the USDA in several western locations. Incidentally, I might mention that the Artificial Watershed has recently been approved for up to 60 percent Federal cost-sharing in part of Wyoming.

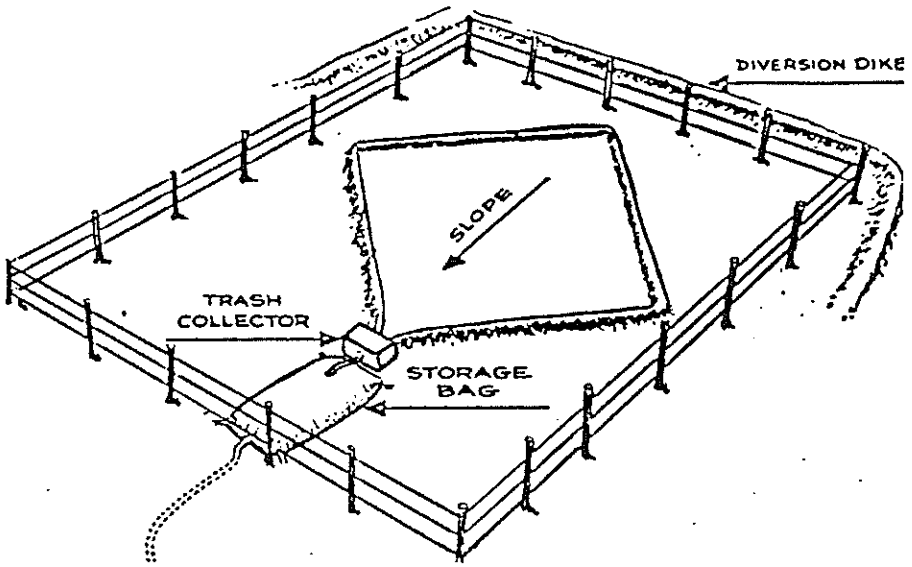
We envisage two major applications for the Artificial Watershed. Small units of the type shown in Figure 1 could provide stock-water supplies: this installation consists of a sprayed or sheet-lined catchment area, a butyl water storage bag and a drinking trough (not shown). On a more grand scale, large areas of natural watershed could be spray-coated to augment stream flows, or to reduce well drafts and salinity by ground-water recharge of the water harvest.

In conclusion of this section of my talk, I'd like to give you some idea of the cost of obtaining new water supplies from an Artificial Watershed. This will clearly depend on the cost of the coating material, the size of the installation, site factors and local rainfall level. However, rough estimates for this and other methods of obtaining new water supplies are given in Figure 2. We believe that small supplies for stock watering might be obtained at less than 50¢/M gal., exclusive of cost-sharing benefits. For larger installations, this cost should be between 10 and 30¢/M gal., based on the use of spray coatings in both instances.

My third topic concerns the techniques we have developed to stabilize windblown sands. For several years now, we have been studying the problems of stabilizing Maritime and Continental dunes with a special oil. Quite recently, we carried out an extensive series of field tests in Libya to prove out our specially designed spray vehicle and methods of application. This vehicle, which is shown in Figure 3, can carry a 4-ton load of coating material up a soft sand slope of 20° and can typically stabilize 15 acres of dune per day. Using proper methods, it appears that satisfactory stabilization can be achieved using only a few hundred gallons of oil per acre. Our experimental work on this project should be completed shortly.

My final topic concerns the idea that retards moisture losses, increases runoff, stabilizes windblown sand and does something else as well. That something else is Weather Modification to increase rainfall--artificial rain-making, if you like.

1. ARTIFICIAL WATERSHED LAYOUT



2. COMPARATIVE COSTS OF OBTAINING NEW WATER SUPPLIES

METHOD	¢/M GAL.
TANK CAR TRANSPORTATION	200-500
DESALINATION	50-200
ARTIFICIAL W/S (STOCK PONDS)	40-50*
SURFACE WATER DEVELOPMENT (NEW PROJECTS)	30-40
ARTIFICIAL W/S (LARGE SCALE)	10-30*

* COSTS QUOTED ARE FOR BITUMEN SPRAY COATINGS

The principle involved is illustrated in Figure 4. I am sure that you have all seen thermal up-currents rising above a road on a hot day. These thermals form because a black surface is a particular strong absorber of the sun's energy, which it then re-emits as long-wave radiation causing strong heating of the air above.

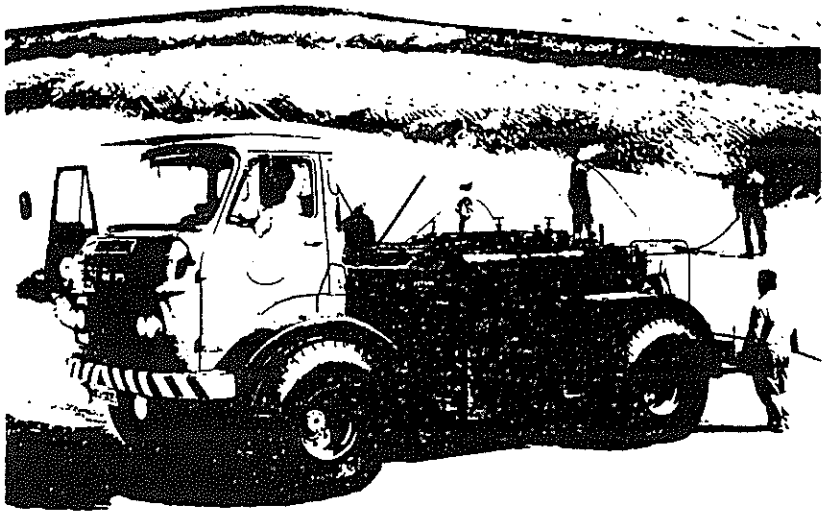
If we were to construct a very large black surface of perhaps 20-100 square miles, we could create a large, strong convective up-draft. If warm moist air were present at ground level, the updraft would carry it from ground level up to higher and cooler altitudes. If the lifted parcel of air were cooled sufficiently, condensation would occur leading to cloud formation and rain--and there you have it--artificial rainmaking.

To do this, we need to lay down a coating to blacken, seal and stabilize the soil. Any rain falling on the coating could be collected to provide bulk water supplies. However, it is anticipated that the major part of the additional rainfall induced will fall downwind of the coating, raising the annual precipitation level in the surrounding area.

We are currently carrying out computer studies of the meteorology of this concept and are developing cheap coating materials and application techniques. We are quite hopeful that we may be able to carry out a 20-50 square mile pilot demonstration of the idea in the near future.

Summing up, I have made brief reference to some of our activities in the field of water research. I have mentioned our canal lining materials, our water harvesting techniques to produce new bulk water supplies, our dune stabilization work and our large-scale Weather Modification Project.

3. DUNE STABILIZATION SPRAY VEHICLE



DOUGLAS 4 X 4 VEHICLE – SPRAYING OPERATION

4. PRINCIPLE OF WEATHER MODIFICATION SCHEME