References and Notes

1. The rocks formed during an era are called an erathem [J. Gilluly, A. C. Waters, A. O. Woodford, *Principles of Geology* (Freeman, San Francisco, ed. 3, 1968), p. 107].
2. The sandstone classification is according to R. L. Folk, *Petrology of Sedimentary Rocks* (Hemphill's, Austin, Texas, 1968), p. 124.
3. Wacke is a sandstone containing more than 10 percent clay matrix; arenite is a sandstone containing less than 10 percent clay matrix [C. M. Gilbert, in *Petrography*, H. Williams, F. J. Turner, C. M. Gilbert, Eds. (Freeman, San Francisco, 1954), p. 290].

4. I thank Paul Edwin Potter for his guidance.

3 August 1972

Artificial Cloud Formation in the Atmosphere

Abstract. *An artificial cloud in the cloudless atmosphere at a temperature below 0°C was formed by introducing pellets of Dry Ice into air containing more water vapor than would be present at the saturation point with respect to ice. Such clouds could be utilized to establish radiative equilibrium between ground and air so as to inhibit the cooling of selective arctic surface regions under clear skies.*

The formation of a cloud in the atmosphere at a temperature below 0°C can be accomplished by the introduction into the air of ice crystals containing more water vapor than would be present at the saturation point with respect to ice. Seeding with Dry Ice powder or liquid propane, which produces temperatures of approximately −80°C (*1*), results in the condensation of water vapor from the air followed by the spontaneous freezing of the water droplets thus formed. In ice-supersaturated air, such ice crystals grow to larger sizes and the cloud is formed. In order to find out whether the air is ice-saturated or not, it is useful to employ a radiosonde in addition to another small balloon onto which is attached a small piece of Dry Ice in a thin cloth bag. When the Dry Ice penetrates the ice-saturated air, it forms a condensation trail which produces a small-scale seeding of the atmosphere. If the trail persists or grows, this indicates that the air is ice-supersaturated. This is a usable technique to compensate for the relatively unreliable measurement of humidity by radiosonde hygristor sensors (humidity sensors) at lower temperatures.

The preliminary experiment was carried out on 18 January 1972 in the Fairbanks area. At 13:00 A.S.T. a rawinsonde balloon onto which was attached about 200 g of Dry Ice detected ice-saturated air in a layer between 1000 and 2000 feet (300 and 600 m) from the ground. The radiosonde reported an isothermal temperature of −26°C in this layer.

Using a light aircraft, we seeded about 5 kg of Dry Ice powder in the clear sky at a height of 2000 feet (temperature, −20°C) above the ground level (ground temperature, −32°C) at 13:40 A.S.T. Just after seeding, we observed the formation of cloud cells which grew and merged into a larger, uniform thin cloud. The size of the cloud at 20 minutes after seeding was approximately 1 km in diameter with a thickness of a few hundred feet (Fig. 1). There was no other cloud in the sky, and there was a slight wind from the east-southeast. The cloud grew into a thicker depth (apparently 500 feet or more) and drifted out of sight 1½ hours later.

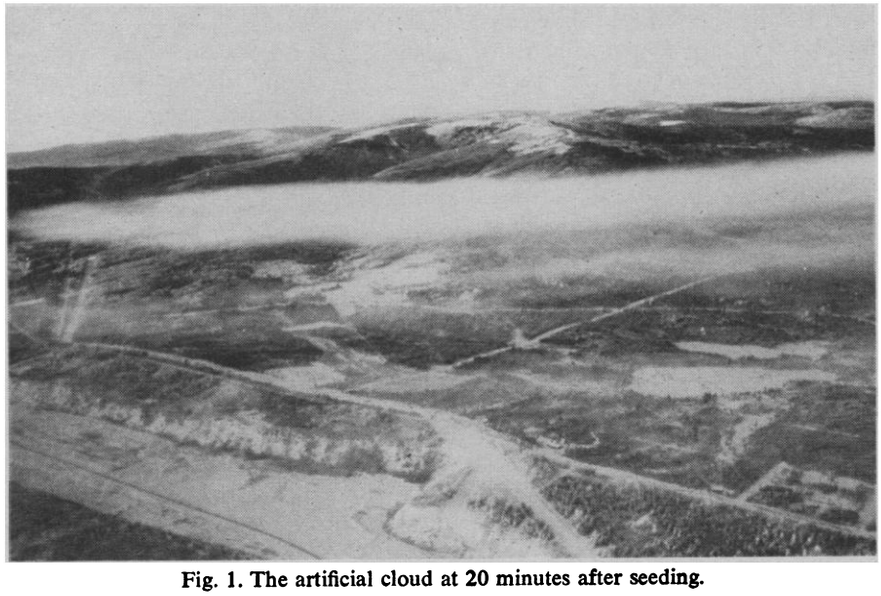

Fig. 1. The artificial cloud at 20 minutes after seeding.

In the subarctic winter months (late November to early February) the maximum solar elevation is only a few degrees, for example, 2 deg in Fairbanks, Alaska. Because of the low sun angle and the short duration of daylight, the incoming solar radiation is negligible and therefore the warming effect of the solar radiation is small. On the other hand, under clear skies the ground loses infrared radiation steadily, and the amount lost is sufficient to produce radiative cooling at the rate of 1.5°C per hour (*2*). This radiative cooling leads to the establishment of strong surface inversions and ground temperatures as low as −40°C. In cities, such as Fairbanks, Alaska, where human activity produces large quantities of water vapor, such low temperatures and strong inversions lead to the formation of ice fog (*3*). Episodes of ice fog have been found to persist for several days to a few weeks and to produce severe visibility problems at airports and along roadways. This ice fog consists of ice crystals without liquid water droplets (*3*); no successful ice fog dissipation technique has yet been reported.

If an artificial cloud can be formed when the skies are clear, then the radiative cooling can be inhibited, thereby preventing the possibilities of an ice fog episode. The cloud should be optically thick and should last until the weather systems bring in sufficient extra moisture for natural cloud formation. An artificial cloud may also be used to dissipate already existing ice fog. Because of the strong temperature inversion characteristics under ice fog conditions, the artificial cloud will be considerably warmer than the ground. If the cloud is optically thick, it will establish radiative equilibrium in the space between the cloud and ground, and eventually there may be a warming of the ground surface of several degrees. This temperature rise should be sufficient to remove most of the ice fog, since a temperature rise of 10°C will more than double the capacity of air for water vapor.

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References and Notes

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2. G. Wendler and K. O. L. F. Jayaweera, *Pure Appl. Geophys.* **85**, 170 (1972).
3. T. Ohtake, *Univ. Alaska Geophys. Inst. Rep. UAG R-221* (1970), p. 177.

4. We thank Dr. G. Wendler for helpful discussions and the staff of the National Weather Service, Fairbanks, Alaska, for their cooperation. This work was supported in part by grant GA-28404 from the National Science Foundation.

6 April 1972

Detergent Effects on a Reverse Transcriptase Activity and on Inhibition by Rifamycin Derivatives

Abstract. *A reverse transcriptase activity, extracted from virus-transformed cells, is activated by very low concentrations of nonionic detergents. These same detergents also significantly reduce the effectiveness of certain rifamycin derivatives as inhibitors of the polymerase activity when the detergents are present at micelle-forming concentrations.*

The bacterial DNA-dependent RNA polymerase is specifically inhibited by certain rifamycin derivatives (*1*). Such specificity for a particular polymerase has encouraged attempts to test many rifamycin derivatives for specific inhibition of the viral reverse transcriptase (*2*). This testing of derivatives has been done in the presence of nonionic detergents with whole virus particles as the source of reverse transcriptase activity.

In our study, one previously tested and two new rifamycin derivatives (*3*) are compared for their inhibitory effect on an RNA-instructed DNA polymerase (RIDP) from transformed tissue culture cells (*4*) as a function of nonionic detergent concentrations. We were able to show that nonionic detergents are important activators of the RIDP. However, at detergent concentrations significantly greater than those required to activate the RIDP, the rifamycin derivatives lose inhibitory effectiveness. This loss of effectiveness could be correlated to the formation of detergent micelles.

As used in this report RIDP activity is defined by the assay given in the caption to Fig. 1. The activity was extracted (*5*) from UC1-B tissue culture cells transformed by Moloney leukemia virus (*6*), but could not be detected in uninfected, nontransformed cells. The extraction procedure normally included sonication of washed cells, precipitation at 50 percent saturated ammonium sulfate, resuspension, and solubilization of the RIPD activity with a nonionic detergent.

The nonionic detergent concentration in the RIDP assay strongly influenced the RIDP activity. As the concentration of detergent in the assay was reduced below approximately 0.05 m*M*, an increasing amount of RIDP activity was lost (Fig. 1). The detergent requirement for full activity could not be satisfied by polyethylene glycol. This activation by detergents was not altered by as much as a fourfold increase in the protein concentration of the assay [bovine serum albumin (BSA) added] or

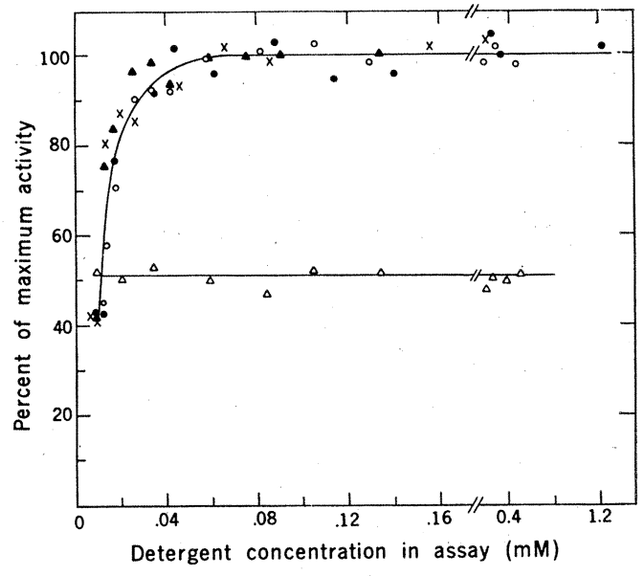

Fig. 1. Effect of nonionic detergents on RIDP activity. Assays were done in 100-μl volumes which consisted of 82 to 94 m*M* tris-HCl (*p*H 7.8), 100 m*M* KCl, 0.2 m*M* dithiothreitol, 0.02 m*M* [^{3}H]deoxythymidine triphosphate (1 c/mmole), 10 μg of polyriboadenylate·oligodeoxythymidylate per milliliter, 0.1 m*M* $MnCl_2$, and 2 to 4 percent glycerol. The detergents were added to the assays to yield the concentrations indicated. Assays were started by the addition of a chosen amount of enzyme extract and were incubated for 30 minutes at 37°C. All points on each curve were determined from at least duplicate assays. The maximum activity for each detergent was determined by averaging the activities in assays with detergent concentrations $\geq$ 0.06 m*M*. (○) The detergent added in the assay was Triton X-100, an octylphenoxypolyethoxyethanol (Rohm and Haas) with an average of nine to ten polyoxyethylene residues and a molecular weight of ~ 650. The RIDP was solubilized and stored in 0.125 percent Triton X-100 and diluted to 0.0032 percent for addition to the assays; the protein concentration was 0.45 μg per assay, the maximum activity was 200 pmole hour^{-1} μg^{-1}, and the dimethyl sulfoxide concentration was 0.24 to 0.40 percent. (●) The detergent added in the assay was Triton DN-65 (Rohm and Haas), a nonionic detergent prepared by reacting 1 mole of a mixture of *n*-octyl and *n*-decyl alcohols with approximately 7 moles of ethylene oxide and approximately 2 moles of propylene oxide; the molecular weight was ~ 570. The RIDP was solubilized and stored in 0.1 percent Triton DN-65 and diluted to 0.0025 percent for addition to the assays; the protein content was 0.38 μg per assay, the maximum activity was 250 pmole hour^{-1} μg^{-1}, and the dimethyl sulfoxide concentration was 0.25 to 0.30 percent. (×) The detergent added in the assay was Triton X-1017, prepared by chromatographing Triton X-100 according to the method of Kelly and Greenwald (*7*) and pooling molecules containing 10 to 17 polyoxyethylene residues (yield, 17.6 percent); the molecular weight was ~ 790. The RIDP was solubilized and stored in 0.1 percent Triton X-1017 and diluted to 0.0025 percent for addition to the assays; the protein content was 0.50 μg per assay, and the maximum activity was 266 pmole hour^{-1} μg^{-1}. (▲) The detergent added in the assay was Brij-35 (Sigma), a polyoxyethylene-23 lauryl ether with a molecular weight of ~ 1200. The RIDP was solubilized and stored in 0.1 percent Triton DN-65 and diluted to 0.0025 percent for addition to the assay. The concentration of Triton DN-65 (0.0088 m*M*) added with the enzyme was included in the detergent concentration given in the figure. The protein concentration was 0.38 μg per assay and the maximum activity was 132 pmole hour^{-1} μg^{-1}. (△) Instead of a detergent, polyethylene glycol-400 [molecular weight ~ 400 (Fisher)] was added in the assay. The RIDP was solubilized and stored in 0.1 percent Triton DN-65 and diluted to 0.0025 percent for addition to the assay. The concentration contributed by the Triton DN-65 (0.0088 m*M*) added with the enzyme was included in the detergent concentration indicated. The protein was 0.38 μg per assay and the maximum activity (determined from the maximum activity with the Triton DN-65) was 132 pmole hour^{-1} μg^{-1}.