

METHODS FOR PREPARING REPLICAS
OF SNOW AND ICE CRYSTALS

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THE PREPARATION OF SNOW CRYSTAL REPLICAS

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Snow crystals, which seem to defy all natural laws of melting and evaporation, will be the subject of our discussion this time. Under the microscope these crystals appear to have all the properties of the natural crystals that fall from the sky in such abundance and almost limitless variety. The "crystals" of our discussion are plastic replicas made by coating the actual crystals with a thin plastic membrane, which hardens and traps the crystal within a tough, horny, transparent skin, literally fossilizing the crystal and thus producing a permanent and exact copy of its outside surfaces.

The replica technique is an extremely useful method for preparing a permanent record of snow crystals, whether they occur in a laboratory cold chamber, our backyard, on a distant mountain, in the polar regions, or high in the sky where they might be gathered with an airplane. The technique is extremely simple and, with proper procedures, nearly foolproof.

The method is based on the use of a synthetic resin, called polyvinyl formal,* dissolved in the solvent, ethylene dichloride.

This solvent has the property of evaporating readily at cold temperatures, but more important — of causing no damage to the structure of even the most delicate snow crystals. It also has the very useful property of not only wetting the surface of snow crystals, but it will actually creep up over their surfaces when they are bulky and project above the layer of solution used to preserve them. In this manner the final replicas possess a 3-dimensional structure. This feature is very important because some crystals such as the type called capped columns have a shape which would be difficult to preserve, if this phenomenon did not occur.

The replica solution should have a concentration of 0.5 to 3 per cent by weight, depending on the bulk and size of the crystals to be preserved. The tiny twinkling diamond dust crystals, which are of microscopic size, are best preserved in the more dilute solutions. Large particles like graupel, snow flakes, and large stellar crystals require the 2 or 3 per cent solutions.

There are many methods that may be used for preparing snow and ice crystal replicas. Since in this series we are primarily concerned with simple cold chamber experiments, we will describe the method to be followed for making replicas of microscopic crystals formed under controlled conditions. The crystals formed in a cold chamber ordinarily range in size from 25 to 250 microns (0.001" to 0.010" in major cross section) and thus are similar to naturally formed "Diamond Dust," the type of crystals which often form at low levels on very cold days in the middle and polar latitudes and also comprise ice fog. Thus it becomes quite easy to prepare snow crystal replicas in any climate or region of the world, even in places where natural snow crystals never form under natural conditions. Fortunately, this technique is also the simplest and most effective procedure for preparing storm sample replicas in regions where natural snow occurs.

If an open top cold chamber is used for preparing snow crystals (such as described in Part I of this series — *Weatherwise*, April 1955), the replica solution is held in a

container near the top of the chamber in such a position that it never gets colder than -5°C (23°F).

The container should preferably be of glass with a screw type wide-mouthed cover lined with aluminum. The jar should have a capacity of 2-4 oz. with solution depth of 2-2½". Glass microscope slides with 1 x 3" surface are excellent for collecting the crystals.

Several clean microscope slides may be stored in the cold solution so they are ready to be used as needed.

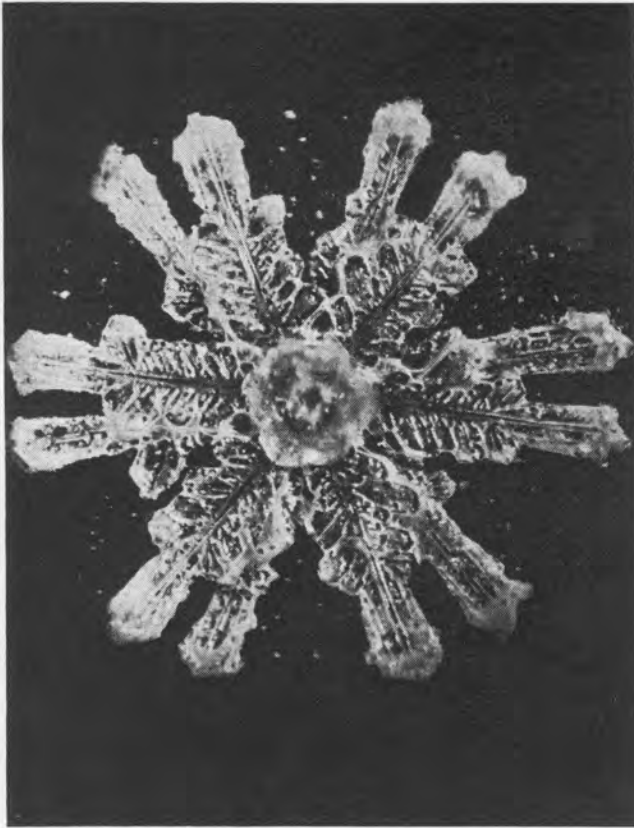
A half-inch high cardboard tray with its bottom covered with a layer of absorbent paper or blotting paper should be prepared and placed on the floor of the chamber. This is used for holding the sampling slide when replicas are being made. This box and liner should preferably be black so as to blend with the black cloth lining of the chamber.

MAKING THE REPLICAS

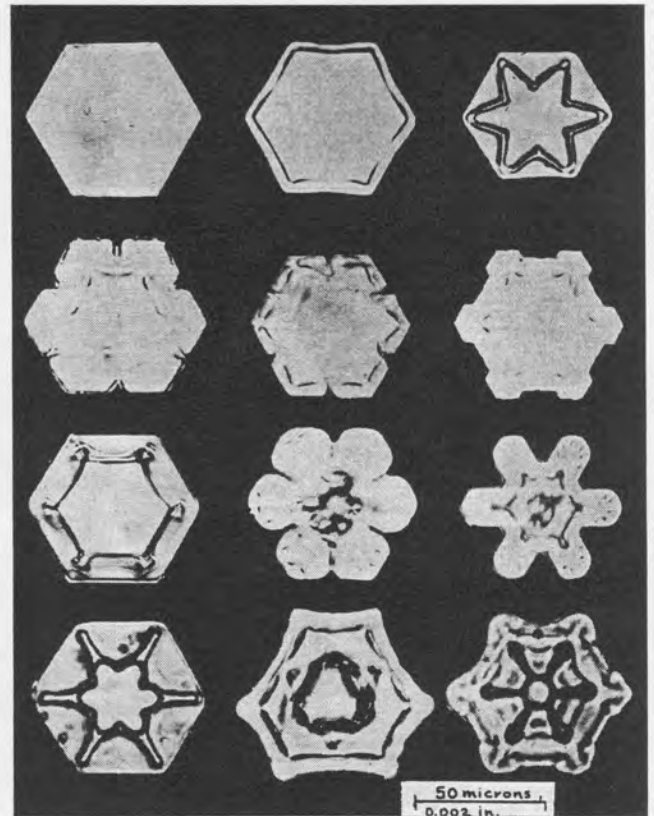
Assuming that the cold chamber is cooled to the range of -15 to -20°C . and that a one per cent replica solution containing a clean glass microscope slide is cooled to -5°C . near the top of the chamber; a supercooled cloud is formed in the chamber, and treated with some appropriate seeding agent such as dry ice, silver iodide, copper sulfide, or other source of effective nuclei for initiating the formation of large numbers of ice crystals. The cold wet slide is swiftly withdrawn from the replica solution, lowered to the bottom of the chamber, and placed so that its flat surface is slightly tilted. This may be accomplished by resting the upper dry edge of the slide on the top edge of the cardboard tray. In this position the replica solution drains toward the bottom of the slide, although all of the surface which had been immersed in the solution remains wet for several minutes. While in this condition additional moisture should be continuously supplied to the ice crystal cloud so that the crystals grow rapidly and fall out onto the floor of the chamber. A certain proportion will thus fall on the surface of the wet slide. Care should be exercised that the moist air supplied to the chamber is not directed toward the sampling slide, but rather to the region on the opposite side of the chamber. With properly oriented indirect illumination, it is possible to watch the crystals fall into the replica solution wetting the slide. After the slide has been exposed to the falling ice crystals for a few minutes, a fairly high concentration of crystals will have landed on the wet film with most of them being covered by the solution either from sinking into it or by the surface creep phenomenon.

The slide may then be placed in a vertical position, the excess ridge of liquid which has drained to its lower edge removed by contact with the absorbent pad on the bottom of the cardboard tray, and the slide then allowed to dry while inclined on a nearly vertical position. Evaporation of the ethylene dichloride solution requires from five to twenty minutes, depending on such things as the size of the chamber, its temperature, ventilation, and the degree of saturation of the air with the evaporating solvent. The best replicas form under conditions in which the solvent evaporates rapidly.

Good replicas require that sufficient solution is present for both surfaces to be coated; the solvent evaporates



Replica flake



Snow crystals formed in cold chamber from dry ice seeding

Photos by author

rapidly and the dry residue remains clear and transparent. If the replica solvent shows a tendency for whitening, the replicas are generally poor since this indicates moisture depositing in the evaporating coating. This tends to happen when the initial solution is too cold, when evaporation proceeds too rapidly, or when the film is contacted by too much liquid moisture.

If good replicas are obtained, they are best studied with a projection microscope on the ground glass screen of a photomicrographic camera or directly under a microscope. A 42 x objective and 4 x ocular provide suitable enlargement for adequate observation or photography.

THE PREPARATION OF REPLICAS OF NATURAL SNOW

Samples of snow falling in natural storms may be obtained in the same manner as is used in the cold chamber. If anything, the method is even simpler. Larger sampling surfaces are desirable, ranging from 2 x 3" microscope slides, 3 1/4 x 4" lantern slide plates, sheets of window glass, squares of black surfaced cardboard, sheets of polyethylene or other thin plastic sheets mounted on cardboard, stretched on an embroidery hoop or over the

open end of a tin can. A small puddle of 1 or 2 per cent solution cooled to about -5° C. is poured onto the cold surface, permitted to flow around to form a thin film, and then exposed to the falling snow. Sampling time may vary from a few seconds to several minutes, depending on the intensity of the storm and/or the length of sampling period selected.

After exposure, the sample is put into a well ventilated place, sheltered from falling or blowing snow, having a temperature colder than 0° C. but preferably not colder than -5° C. The film surrounding the replicas should be transparent when completely dry. Dryness is indicated when the odor of ethylene dichloride has disappeared. Not until this is the case should the replicas be permitted to warm above the melting point of the ice. When melting occurs, the water from the crystal evaporates through the thin surface film which constitutes the upper layer of the "fossil" crystal. This hollow cavity reflects and scatters light in an almost identical manner as that of the original crystals.

*Trade name: Formvar 15-95, Shawinigan Products, Corp., Springfield, Mass.