METEOROLOGY

No Two Alike

Snowflakes, Falling in Such Countless Numbers, Have Never Produced Duplicates in All the Winters

By DR. FRANK THONE

See Front Cover

SNOW has such untellable beauty, as it sifts down from gray clouds, or lies glistening under the morning sun after the storm, that we almost forgive the roughness of Winter, since he comes with such a gift. Remote still are the February days when we shall think it burdensome; at first snowfall the white flakes are words of silent poetry, marvellous in their likeness one to another, yet infinite in their variety.

From the viewpoint of sober science no less than through one's esthetic eye, the tiny crystals of ice that we call snow are exactly that—marvellously alike, yet infinitely different. Many thousands have examined snow crystals with magnifying-glasses, and some few patient souls have slid them under microscopes and obtained permanent photographic records of their forms. But nobody yet has ever seen or photographed a snow crystal that was an exact twin of another snow crystal.

It is entirely legitimate to suppose that in all the snows that have fallen through all the thousands of winters this old world has known there have never been two snow crystals that were exactly alike.

No Proof

To be sure, it is not very likely that anybody will ever undertake to make rigid proof of the truth or falsity of that assumption. The numerical chances, on a statistical basis, could be expressed in figures vaster than those the astronomers use—so vast they would have no meaning.

And to test the matter experimentally, by photographing great numbers of snow crystals and comparing their pictures, would be a task of many lifetimes. The late W. A. Bentley, solitary Vermont genius who devoted all his winters to snow-crystal photography, was able to accumulate only a few thousand plates he considered worth keeping.

To be sure, Mr. Bentley was not concerned about hunting duplicate snow crystals. He just liked to photograph perfect specimens when he could find them, and he has left a monument to his memory in the book, Snow Crystals, which he produced in collaboration with Prof. W. J. Humphreys of the U. S. Weather Bureau. But among the many hundreds of pictures in this book and in all the other negatives that were not used in its production, duplicates simply cannot be found.

"Good" Storm Needed

If you want to try the game of snow-crystal hunting (all you need is a dark coatsleeve and a good pocket lens) you will soon discover that not every snowstorm yields good specimens. The heavy, wet snow that sometimes falls, mixed with rain often as not, will disappoint you. Its big flakes are made up of whole masses of individual crystals all matted together and already half melted. The opposite kind of storm, the dry blizzard that drives the snow horizontally like bullets, tears the crystals to pieces and all you get are the fragments, often rolled into pellets by drifting along the ground.

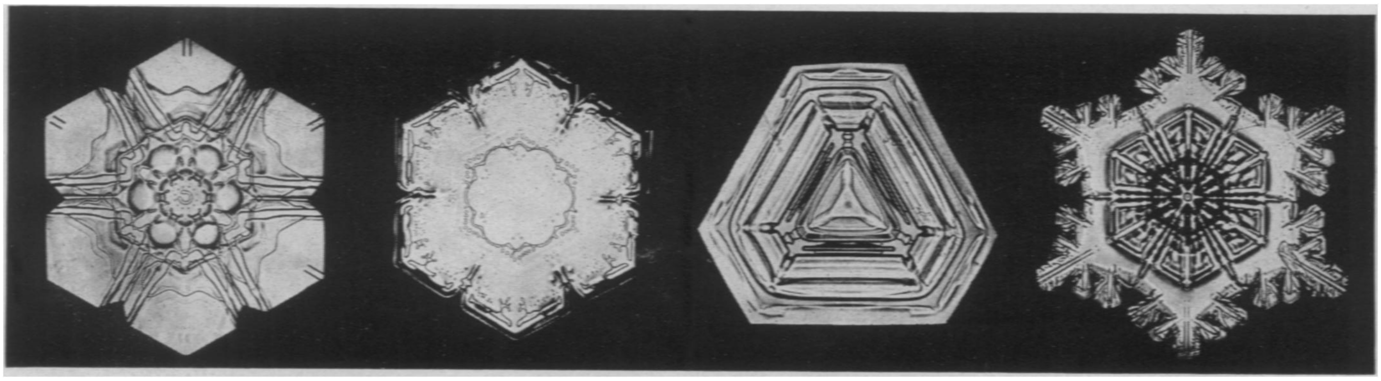
But the satisfactory, "in-between" kind of snowstorm will powder you with tiny flakes which on lens-examination show themselves as individual six-pointed crystals, or as a few of them loosely hooked together. Remember always to hold your breath as you peer through your magnifier; they will vanish like Cinderella's jewels if you let your animal warmth blow over them.

One thing will impress you quite early in your snow study—the wide range of pattern complexity. Some of the crystals are of a most severe simplicity, just six-sided little plates, almost as plain as the white hexagons in a tile floor. Others are six-pointed stars with spikes straight or but little branched. Others again are wonderfully complex, each of the six arms looking like a fairy feather or fernleaf.

Variety of Conditions

These pattern differences, the scientists say, are due to differences in the conditions under which the snow crystals formed. In general, the colder the air in which water vapor is condensing into snow crystals, the more slowly the crystals will form and the plainer their outlines will be. The fanciest, laciest, most fragile of the crystals are those formed most rapidly in air that is not very cold, and usually rather close to the ground.

Every snow crystal, like every raindrop, has to start with a nucleus of some sort—usually a microscopically tiny dust grain. On the electrically charged surface of this nucleus the first thin layer of water molecules condenses and freezes. Other molecules add themselves, millions of them. The three atoms in each one of them—two hydrogens, one



oxygen—so orient themselves with respect to the other water molecules that a six-sided arrangement results. This has been shown by X-ray studies on ice. And this minute hexagonal pattern, far beyond the range of any possible microscope, determines the six-sided shape of the relatively enormous snow crystal.

Earthbound Snow

The same condensation and crystallization of water on solid surfaces manifests itself at ground level as various forms of frost. Frost might almost be described as earthbound snow. Windowpanes in old-fashioned houses, that were not too well warmed at night when the fire in the heating-stove went out, offered ideal condensation surfaces. Leaves on the ground, on foggy autumn nights that turn sharply chill, are apt to be rimmed with rime in the morning—silver patterns that might have driven Cellini mad with envy.

The ice that forms on trees and telephone wires during one type of winter storm, however, has a wholly different history. Frost, rime, the fairy forest on the windowpane, come from the condensation of water vapor in the air directly into ice crystals. The coating of sleet ("glaze" is a better, more accurate term) on branches and wires is formed from liquid water—rain falling onto solid objects that are colder than the freezing-point of water. Sleet, properly speaking, consists of solid little pellets of clear ice, which are simply raindrops frozen by passing through a layer of cold air as they fall.

But to get back to our snow crystals: Another thing you will notice, if you look at all carefully, is that not only are there no duplicates, but even the parts of the individual flake are not exactly alike. There is often a tendency for three of the points to be emphasized more than the other three. This reaches an extreme in some flakes that are almost triangles.

Furthermore, there is no exact symmetry in any part. Each side, or point, or arm of the six-sided figure has some little individual marking or a deviation that saves it from a dead mechanical exactness. Crystals in general display this paradox of following a pattern yet not following it absolutely and slavishly—a hint of the unpredictability of behavior that we find in living things.

Your snow crystal is not only different from all others of its kind, and different internally among its own parts, it is not the same from moment to moment. Like a living organism, it is constantly either adding to or subtracting from its substance, constantly changing its form. You will not be able to see this in the short time you have it under your lens, but it is so nevertheless.

Lost Substance

We have seen how the crystal was born and grew through the process of water-vapor condensation around an original nucleus. So long as there is more water vapor present to feed it, and its temperature and other conditions remain suitable, it will continue to grow. If it becomes too warm, of course, it will begin to melt. But even in very cold air, if it is dry enough, the snow crystal (or any piece of ice, for that matter) loses some of its substance. The molecules of which it is composed escape directly from the solid state into the air as water vapor. This change from solid to vapor without passing through a liquid state is called sublimation. It goes on constantly and rather rapidly when snow or ice is exposed to dry air. Many other substances besides ice can be sublimated.

We commonly think of massive ice as something that is formed by the direct freezing of large quantities of water. The thick coating over our rivers in the North, the tremendous blocks that pile up along the shores of the Great Lakes, make vivid impress on our imaginations.

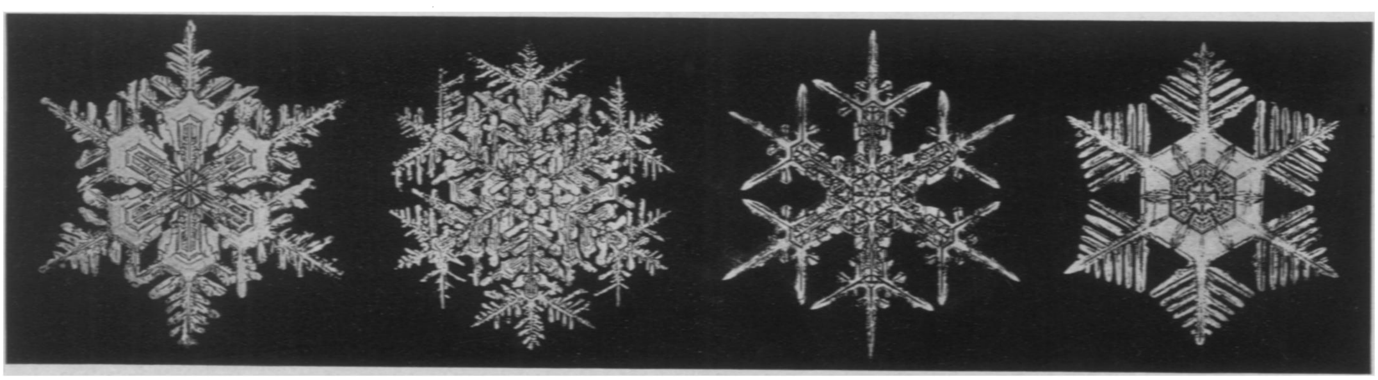
Yet the mightiest masses of ice on earth, the glaciers of high mountains and the ice caps of Greenland and Antarctica, were not formed from liquid water at all but from the packing, partial melting, and re-freezing of snow. So it was also in the earth's great Ice Ages, when vast sheets of ice a mile or more thick lay for tens of thousands of years over whole continents. Wherever snow lies unmelted the whole summer through, and survives season after season with constant additions of more snow in the winters, it will eventually pack down into solid ice. And if there is slope enough the ice field will begin to move—and you have a glacier.

If you like to juggle big figures, try to estimate how many individual snow crystals it would take to make a pint (a pound) of water. Then figure how many pounds in an ordinary iceburg—say one as big as an average office building. Then recall that that iceberg was just a little piece of the end of a glacier several miles long. Then extend your glacier over the whole of North America as far south as the Ohio river and over the Old World down to the Alps, and pile it up a mile thick.

How Many?

How many separate snow crystals to make a whole Ice Age? You'll have to do your figuring in billions to the billionth power! Yet that's how Ice Ages happen.

When you get back from that excursion into the astounding, consider a humbler, more familiar paradox of snow: it is made of ice, yet it can keep things warm. Temperatures under a snow



COUNTLESS FORMS

Like lace made in fairyland are the patterns of snowflakes. Catch one on a dark coat sleeve and look at it through a magnifying glass. But hold your breath or it will vanish like Cinderella's jewels.

cover, even in zero weather, are appreciably higher than they are up in the wind. The mountaineer in his snow-buried hut, the Eskimo in his snow-block igloo, don't worry so long as they have something to keep up a bit of fire. The snow, caging quantities of air between its fluffy flakes, is an excellent heat insulator—less durable than asbestos or felt, but of a comparable order of efficiency.

Protects Plants

Snow's function in protecting plants in winter is not so much in keeping them warm as in preventing too rapid fluctuations between freezing and thawing, which is very damaging to plants, and also in shielding them from dry, cold winds that might deprive them of vitally necessary water. Winter drought can be the cruellest drought. Farmers with winter wheat in their fields worry when the snow cover disappears, even though the temperature may not be severe. But the mercury can drop to fifty below zero, for all they care, if the crop is safely blanketed under a foot or so of snow.

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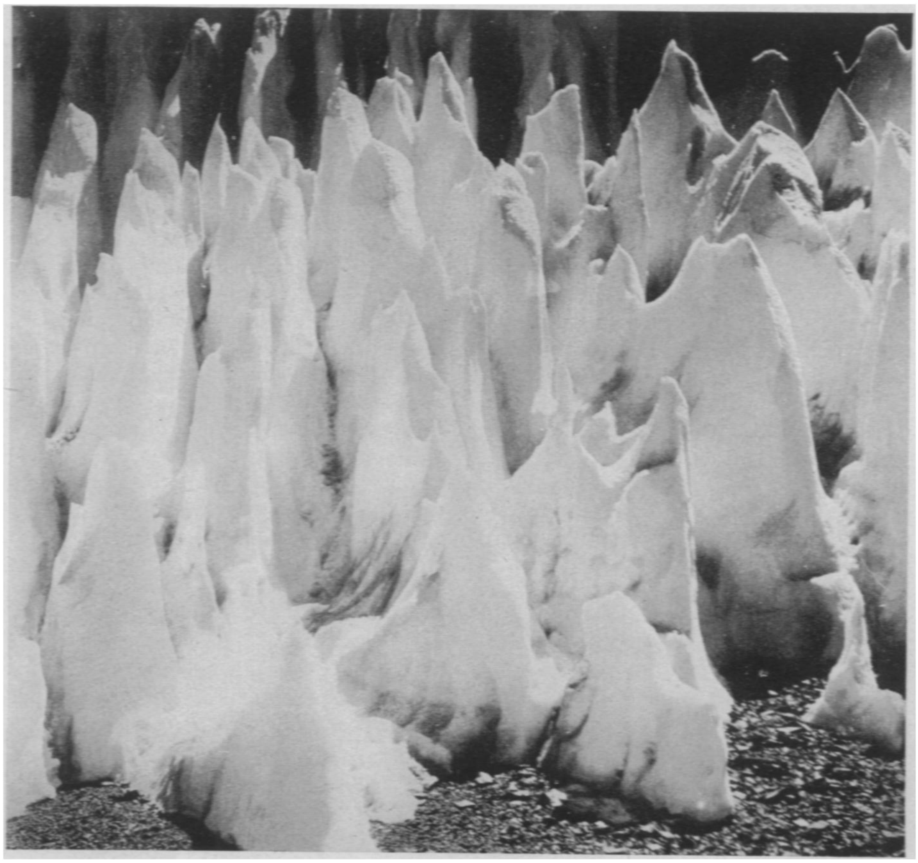

PENITENTIAL SNOW

"Nieve penitente" is often found in mountain regions. Unequal melting leaves steep mounds that look like white-robed figures bowed in prayer.

PUBLIC HEALTH

Possibility of Parrot Fever Vaccination in Mouse Studies

PROTECTIVE vaccination against parrot fever or psittacosis might be possible in the future by using parrot fever virus made inactive by formalin, it appears from studies reported by Dr. K. F. Meyer, of the University of California's George William Hooper Foundation, at the meeting of the American Society of Tropical Medicine.

Three injections of a specially prepared vaccine, Dr. Meyer reported, protected 90 per cent. of a group of mice against deadly doses of parrot fever virus.

Resistance to parrot fever is extremely variable and difficult to understand, it appears from Dr. Meyer's report. An attack of the disease does not always protect against a second attack. Two cases of second attacks have been reported in laboratory workers. Children have a definite resistance to parrot fever, which seems to get less as they grow older. Bird breeders are supposed to be immune to the disease but probably are not. Investigation showed that they often are sick with a malady like influenza which Dr. Meyer believes really is parrot fever. The symptoms of the two diseases are so much alike that parrot fever has probably often masqueraded as influenza.

Not all those exposed to the disease get it. One member of a family may die from parrot fever caught from a pet bird and others of the same family hardly seem to be ill. On the other hand, the disease has occurred in laboratory personnel when every effort was made to protect them from it during parrot fever investigations.

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A botanist observes that poison ivy was very little used by Indians, but tribes in Iowa did use it to poultice some kinds of swellings.