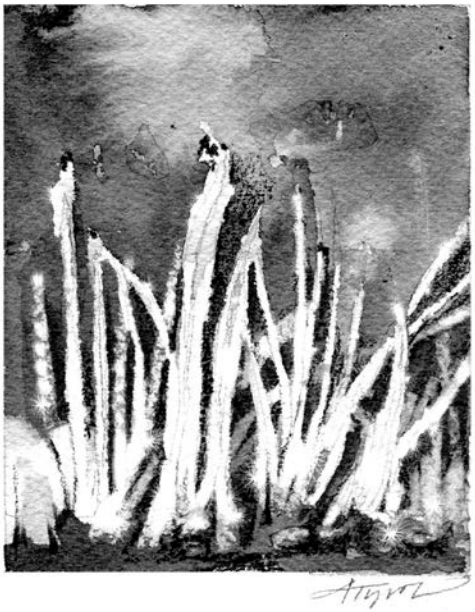
The Outside Story



In Cold, Wet Woods, Needle Ice Sprouts

By: Rachel Sargent

The bare ground of the trail wound through dead leaves and patchy snow. At a short overhang in the trail, I noticed spiky threads of ice growing up from the soil in crunchy clusters. A careless boot revealed how fragile these formations are; the fine ice threads crumbled readily. This was needle ice, a common sight in the woods this winter.

Curious about the phenomenon, I got in touch with Dr. James R. Carter, a professor emeritus from Illinois State University. Dr. Carter has spent the last ten years observing these ice formations. His photographs and descriptions of different examples of needle ice are available at this link: http://my.ilstu.edu/~jrcarter/ice/needle/.

Carter explained that while needle ice somewhat resembles frost, it is a completely different phenomenon. Frost forms when water vapor is deposited onto a growing ice crystal; the water molecules move directly from the gas phase to the solid phase without ever becoming a liquid. Needle ice, on the other hand, forms from liquid water when a process called ice segregation occurs in the soil.

Ice segregation only happens when the soil is saturated, but the air is below freezing. These conditions are most common in late fall and early spring, but have been more common during this year's mild winter. During ice segregation, ice forms at or just below the soil surface, where water meets the colder air and freezes. As more water from the soil moves up towards the ice through capillary action, it freezes and expands, and the ice is pushed up out of the soil, forming long, fragile columns that poke out of the earth. This is why, if you look closely, you may see a layer of dirt on the top of each column, lifted up as the needle ice grew.

A delicate balance of temperature, water, and soil type is needed for needle ice to develop. You won't see it if the ground is completely frozen, if there is not enough water in the soil to supply the growing ice needles, or if the soil pore size isn't just right. The soil grains need to be porous enough to allow water to move up through them, but tightly packed enough to retain water, "You might think of it as the Goldilocks effect," said Carter. Needle ice can also form on other substrates, such as rocks, if they have the right porosity.

Carter grows needle ice in a freezer, usually on pebbles. He has a method for determining if a pebble has the right composition. “I use the test of touching my tongue to a pebble. On rare occasions I find one that sticks to my tongue because the pore space is such that capillary attraction takes water off my tongue and wicks it into the rock. I find that most of the rocks that stick to my tongue will grow pebble ice in my refrigerator setup.”

Another characteristic of needle ice is that it often forms on bare ground, such as a well-worn hiking trail. Once established on a bare area, it may remove surrounding plants through a process called “turf exfoliation.” The growing ice needles at the edge of the bare area lift plants up and away from the soil, producing even more bare ground. Small rocks may also be moved this way.

On your next cold weather walk, keep an eye out for needle ice, especially in areas where bare soil crunches under your boots. And if you’d like to grow your own needle ice, check out James Carter’s website, then try licking a few pebbles. If one sticks on your tongue, it’s probably a good candidate for your own freezer experiment.

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