GENERAL SCIENCE

Christmas Crystals

Delicate patterns of snowflakes, glistening icicles and bright winter stars are magnificent natural decorations at the time of the great winter festival of Christmas.

By BARBARA TUFTY

See Front Cover

➤THE ICY CRYSTALS of winter provide some of the most splendid designs and geometric symmetry of all seasons, brightening the Christian festival of Christmas with delicate radiance and subtle beauty.

As the earth spins through space, the sun's rays of heat and light fall aslant over the northern lands, plunging it into a time of darkness and sleep, when the forces of cold unfold their creations of ice, snow and frost.

At 8:41 p.m. EST on Tuesday, Dec. 21, the rays of the sun will fall perpendicularly upon the Tropic of Capricorn, the farthest point over which the sun travels south of the equator. This dark day, shortest of the year, is known as the winter solstice, and astronomically marks the first day of winter.

This is the time when the northern world seems dark, and life has retreated into shadowy burrows and caves, into seeds and roots of plants, or south into warmer and greener lands.

The bright colors of summer and autumn have given way to muted tones of browns, tans, blacks, grays and whites, as bare-branched trees stand like etchings against the pale gray sky. The soft light of winter twilight is reflected across snow-filled fields, and shadows are soft blue and violet.

Season of Austere Beauty

This is the season of austere beauty, when life of nature is reduced to its simplest terms. Now you can see serene clean lines of the hills or rough hewn edges of rocks, unencumbered by the foliage and affluence of summer. The busy plant activity of growing leaves, unfolding flowers and preparing seeds is over, and plants now take a much needed rest.

The buzzing and droning of insects is finished, and many small egg pouches and cocoons lie silently tucked away under a doorstep or behind a sliver of bark.

Song sparrows, thrushes and other migrating birds have flown south to warmer lands, leaving their hardier, more raucous relatives—the bluejays, starlings and crows—to squabble over the scarce seeds and morsels of food. The bright-eyed juncos, nuthatches and chickadees also stay during the winter, often appearing at feeding boxes.

Chipmunks, woodchucks and other hibernating animals of the forest have curled into balls deep in their earth burrows. Their breathing, heartbeat and other body functions have been lowered to the barest possible minimum to keep the tiny flame of life alive during the austere months.

The cold-blooded creatures—lizards, frogs, toads, salamanders and snakes—that have no control over their body heat, lie in near frozen state in rock dens, under the ground, or encased in mud at the bottom of a pond.

The world seems empty, silent, deserted. Yet the fields and woodlands are filled with intense life and activity. Stimulated by the cold and hunger, creatures abroad at this season have their senses highly sharpened as they go about their business with great caution to hunt or be hunted.

The hare, the fox, and the weasel grow protective coats of fur, often white, blending with the snow so they can creep up on their prey or hide from the sharp eyes of their enemies. Deer come out at night to nibble tender twigs and bark. Bears often wake from their deep slumber to grumble about in a warm spell. Even insects in caterpillar stage, like the wooly bear, emerge during a thaw to crawl about on a forest log.

Preparations for Spring

Take a careful look at the barren, leafless trees and you see that even they are not so dead and lifeless as you thought. With the forethought of nature, plants make advance preparations for the greenery of next spring. One tree may bear millions of winter buds formed before the freezing cold sets in.

In each bud lies all elements needed for next spring's growth—a supply of sugar for quick energy food, clusters of cells possessing the ability to divide rapidly and develop into leaves, and a protective envelope of scales to keep the tender tissues from drying out in the drought of winter, when the water of life is locked in ice.

Each tree or shrub bears its own particular shaped buds—the dogwood has neat hard buds shaped like toadstools, the lilacs develop fat sticky buds, and magnolias have fuzzy silken buds all winter long. Beech trees encase their buds in thick bronze scales, and shagbark hickory bud scales have long graceful points. Inside these scales, tender embryo leaves are packed in an economy of space—some pleated like fairy fans, others rolled like cigars.

Another kind of activity flourishes during the winter season—that of magnificent formations of frozen water, spreading out over cold window panes, dripping in long shimmering icicles under the eaves, locking up brooks and streams, quieting lakes, and covering trees and shrubs with white silent snow or glistening ice, as shown on this week's front cover.

As winter approaches and the atmosphere cools, water exhibits a remarkable behavior pattern that keeps plants, animals, even human beings, alive on this planet, which could well be known as the water planet.

As temperatures drop, the cooling water becomes denser or heavier than warmer water, and thus plunges to the bottom of ponds, lakes or rivers. It keeps on becoming denser until it reaches maximum density at 39 degrees F. Here an extraordinary thing happens—suddenly the water becomes less dense, and as it continues to cool and changes from liquid into solid state at 32 degrees F., it floats, rising to the surface with about 10% of its mass sticking above water.

If ice were not lighter than water, it

Albert Starkweather

RADIANCE STREAMS FROM SKY—Stars are most brilliant in the winter season, shining like Christmas ornaments in the branches of trees.

would sink underwater and accumulate in cold dark chunks at the bottom of our water sources, unable to be warmed and thawed by the rays of the sun in spring. The plants and animals of the water would be frozen, and the accumulating blocks of ice could plunge much of the world into Ice Age conditions.

Another marvel of frozen water is the formation of billions of snowflakes, no two of which are exactly alike. These softly falling flakes can be austerely simple or intricately complex. Many are shaped like six-pointed stars, others are in the shape of six-sided prismatic columns or thin geometric plates. Each shape depends on the temperature of the atmosphere in which the individual flake was formed.

These cool fragile flakes accumulate into an efficient insulation material—blankets of snow, warm cover indeed for sleeping plants and protection for the grouse and other wildlife creatures seeking shelter from freezing nights.

Snow Keeps in Warmth

This overcoat of snow keeps in the warmth stored up in the earth during summer, mainly because innumerable tiny cells or pockets in the airy snowflakes hold the air prisoner and virtually eliminate the escape of heat into the atmosphere. For example, a thermometer registering 27 degrees below zero F. in the open air when plunged about seven inches into a snow drift showed a temperature 24 degrees above zero—a difference of 51 degrees.

Winter is the growing season of millions of other ice forms—those fragile fern shapes and fairy gardens that spread across the window panes, the frost flowers that bunch up along a frozen path, the frost columns that push up mounds of soil into tiny pillared caverns and sugar-like edgings around fallen leaves, dried seed pods and rocks.

Winter is the season when stars in the frosted sky seem most brilliant, when they seem to swing so close to earth that they become caught in the branches of trees, forming ornaments on outdoor Christmas evergreens more beautiful than man could ever make.

Perhaps the stars seem more brilliant because no foliage hinders our clear view of the winter sky, or perhaps because the cold air is so dry and hence clear at this season. But mostly it is because the richest region of the heavenly constellations is in full view on winter evenings. There is mighty Orion, the warrior, with the three stars of his belt. The Great Square of Pegasus, the winged horse, fills the sky. Cassiopeia, the queen, sits on her broken throne in full splendor. Across the sky flows the Milky Way, brilliant in the frosty air.

Now the North Star shines in bright radiance, for centuries considered the steady guiding star around which the whole bright firmament seems to rotate. Yet even this star is not constant, as the earth tipples and wavers through the ages. Thousands of years ago, the constant star was Thuban, one of the bright stars in the Dragon constellation, toward which the low doors of the Egyptian tombs were pointed. In another 12,000 years earth's constant star will be Vega in Lyra.

It was into this radiant December sky that, nearly 2,000 years ago, a "star" of surpassing beauty appeared, and seemed to hover above a manger in Bethlehem.

For centuries, astronomers have been asked to account for this light that led the Wise Men to the Messiah. They have made many suggestions. Some say it was a comet, others a supernova, a brilliant meteor or an unusual configuration of planets.

Whatever it was, it forever remains in Christian thought as a beloved symbol of Christmas, a symbol of light, returning life and hope for Peace on Earth.

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CHEMISTRY

Gel Aids Crystal Growth

➤ A NEW METHOD is being added to the large number of techniques already at the disposal of the crystal-growing technologist: crystal growth from gel.

It is under development by Dr. Heinz K. Henisch, professor of applied physics in the Materials Research Laboratory of the Pennsylvania State University, and Dr. Rustum Roy, professor of geochemistry and head of the laboratory. The method is especially suitable for use with some of the materials which defy established growth processes, such as those which resist all plausible solvents or cannot stand heat.

In its basic form, the gel method is simple enough to find a place in high school science fairs. It depends essentially on the diffusion and reaction of chemicals within a silica gel. A simple form of gel can be made by adding acid to commercial "waterglass."

Under proper control, the process yields crystals of high optical perfection. Some had never been seen and studied before; others, though known, have been grown in larger sizes and greater perfection than hitherto possible.

Among the materials investigated thus far are lead iodide, lead hydroxyiodide, mercuric iodide, various thallim iodides, lead sulphide, calcite, aragonite, silver oxalate and a variety of tartrates and citrates, all in pure form or with controlled additives of various elements which modify the crystal properties. Several show light sensitive electrical properties which may be of practical interest.

For many years the growth of artificial crystals of a great variety of materials has been important in the electronics industry.

The gel used is, in effect, a three-dimensional network of quartz which plays no important chemical part in the reaction. Because it is jelly-like, it yields to the growing crystals and permits them to grow without external restraint. The gel also prevents turbulence which is often a disturbing factor when crystals are grown in a solution.

Before a crystal can grow, it must "nucleate" or form a center core on which new layers can be deposited. Light can influence nucleation. Growth tubes kept in darkness develop few crystals.

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