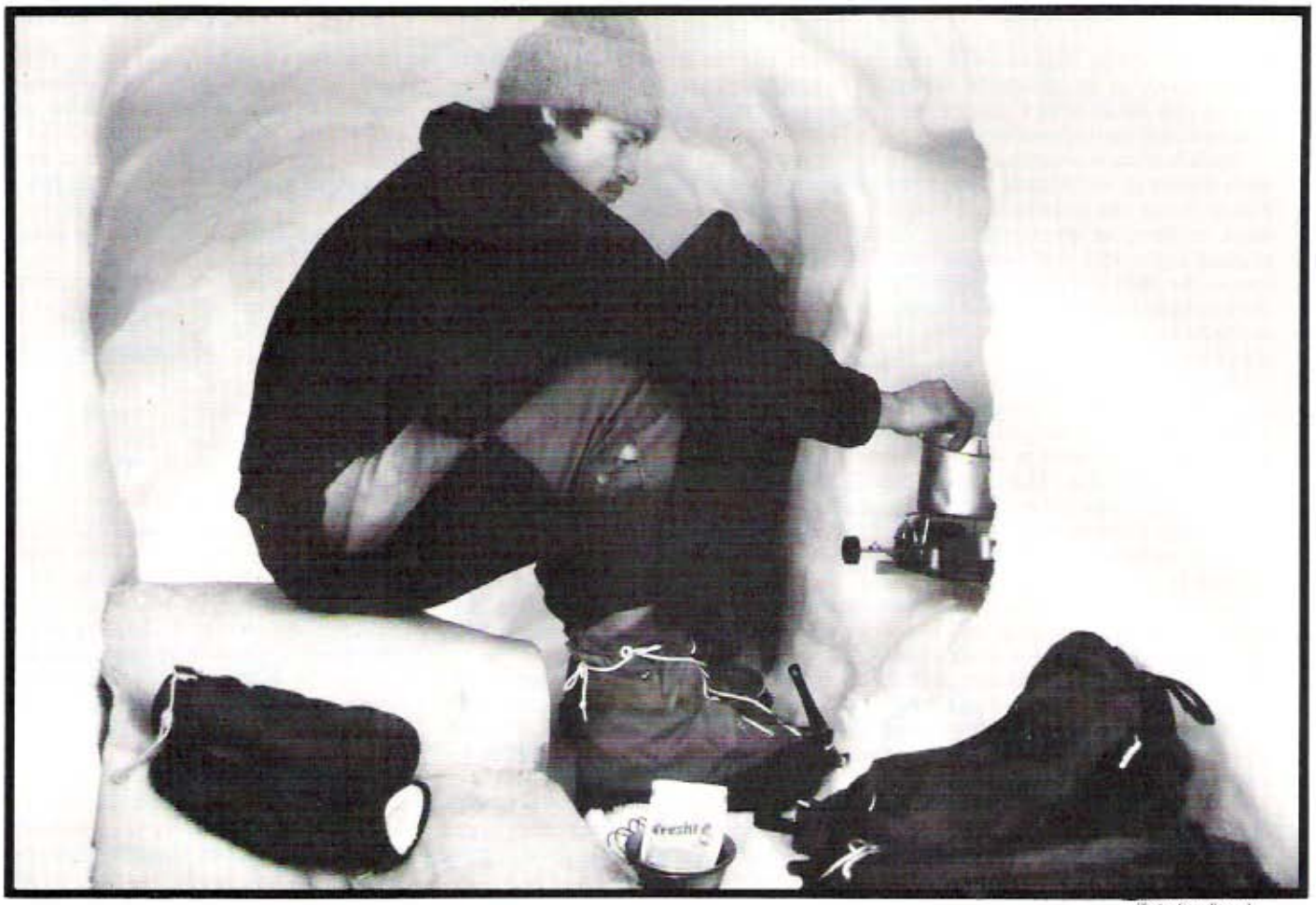


Photo: Gary Brasch

With a bench for sitting and sleeping and a small alcove for the stove, this cave is a cozy home. Note that the snow bench has metamorphosed sufficiently to support the weight of the cave dweller. The ensolite pad on the bench keeps him dry and prevents his body heat from melting the snow.

SNOW CAVES: A LESSON FROM THE PTARMIGAN

Article by DAVID SUMNER

Quiet, warm and roomy, snow caves are the next best thing to a cabin and fireplace—some people even say they are like returning to the womb.

THE PERSON WHO FIRST turned the often-used phrase "blanket of snow" wasn't talking idly; he spoke, perhaps unknowingly, as a pragmatist. In the cold of winter, snow can be a readily available shelter, warm and secure.

Consider the ptarmigan, the plump mountain grouse that molts from mottled brown to snow white and back again with the seasons. At night or during a storm, the chunky bird regularly holes up in the lee of a rocky outcrop or protective bush—or occasionally in the open—by scratching out a small, semicircular hole in the snow and snuggling down with its head curled back in the protection of its feathers.

Sometimes, after a wind-driven blizzard, ptarmigans will be all but buried by the insulating snow. In the morning or after the weather breaks (long after the birds are moving about in search of food), one can spot the abandoned remnants of their mini-snow caves: small indentations lined with dung and feathers.

The same lesson can be learned from any of the thickly furred canids of the

arctic and alpine regions—wolf, fox, coyote, husky or malamute. In winter, digging into the snow is a practical way to assure both survival and comfort.

Records of snow caves and improvised snow shelters go well back in the nation's history. Indian lore is scattered with references to them, as are accounts of the mountainmen and fur trappers who opened the West in the early 1800s. The diaries of pioneering Arctic and Antarctic explorers and of early Scandinavian ski troops also mention snow caves.

Surprisingly, especially since more and more Americans are exploring the world of winter on touring skis and snowshoes, general knowledge about snow caves is notably thin. More often than not, the shelter is treated as a last resort to be used only in emergencies, a grim alternative to spending a night in the open, exposed to wind and storm.

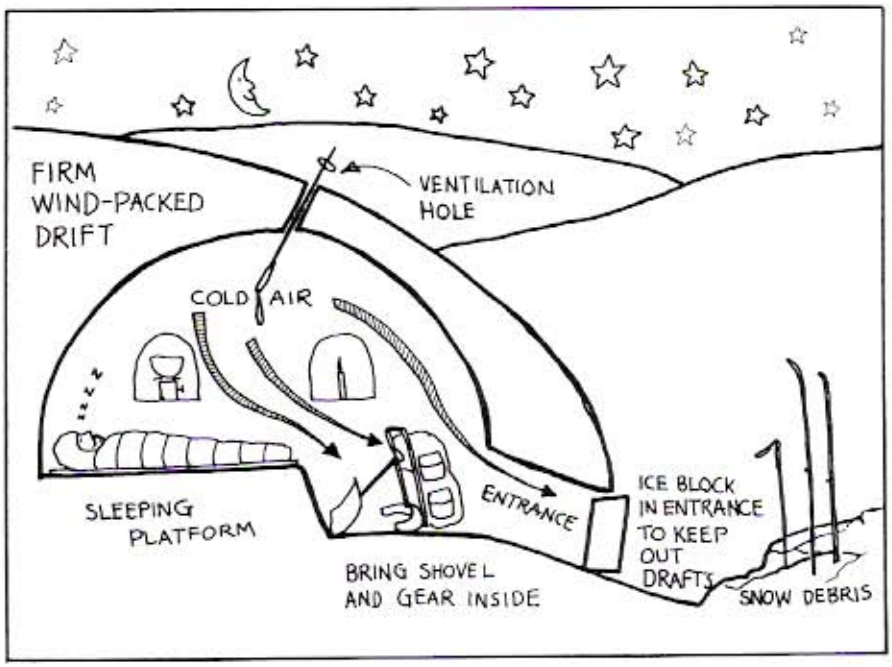
Nevertheless, of all available winter shelters, none is more snug and secure than a snow cave—except a cabin with a fireplace. No shelter is quieter, either. From inside a snow cave, neither a howling blizzard nor a human shout 20 yards away can be heard. Still, most people do not consider snow very hospitable, so the idea of sleeping in a snow cave may require some mental adjustment.

THE INSULATING PROPERTIES of snow are well known. In the Arctic, for example, it's common for areas of deep snow cover to be largely without permafrost; by contrast, areas of light snowfall often have a frost that penetrates deep into the soil year-round.

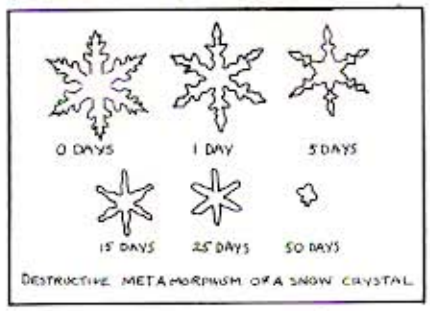
Scientists at the University of Colorado's Institute of Arctic and Alpine Research describe snow's capacity to insulate by making analogies with feathers and urethane foam. In each, the prime insulating agent is the millions of tiny, trapped, dead air pockets rather than the solid matter. Air itself has an extremely low capacity for conducting heat; as long as substance holds in air and restricts air flow, its success as an insulator is nearly assured. Wet goose down fails as an insulator not because it is soaked but because most of its air pockets have collapsed. A porous material through which air readily passes is equally inefficient at providing warmth.

Snow, however, possesses insulating qualities in abundance. A fresh layer may hold from 62 to 95 percent air, depending on its structure. (In addition to the classic crystalline hexagon, flakes fall in a variety of other forms: columns, plates, prisms and irregular particles.) Furthermore, the piling and interlocking of the flakes trap air in countless minute pockets.

Once snow has been on the ground for a time, the flakes undergo a process of change known as metamorphism. The rate of change depends on such variables as climatic conditions and the weight and structure of the snowpack, but the general nature of the process is fairly predictable. Sharp points and edges disappear. Under a microscope the snow looks like a mass of tiny kernels or globules. Old snow usually is more dense and contains a lower percentage of air than fresh snow—as little as 40 percent during the melt season. Nevertheless, because firmer bonds tend to develop between these melted flakes, the amount of air, although reduced, may be more effectively trapped, and the insulating qualities of the snow may improve.



Imagine a cave burrowed into such a medium, and the reason why these shelters are warm even in the cruelest of conditions is apparent. The original temperature of snow-trapped air is near the average air temperature during the time the snow fell, but human body heat and heat from candles and cookstoves soon produces a change.



DESTRUCTIVE METAMORPHISM OF A SNOW CRYSTAL

Fed by these heat sources, the air temperature in the snow around the interior of the cave rises toward the freezing point, even when it is well below zero outside. Because the heat migrates (or convects) slowly outward into the snowpack, the interior temperature is tolerable.

SOME WINTER CAMPERS have warmed their caves as high as 45 degrees Fahrenheit. The warmth may be welcome, but as a general practice it is not popular, for it may lead to a humid, mushy, drippy cave. Maintaining the temperatures around the freezing point is what most parties shoot for.

(It should be noted that this description does not hold for unusually cold regions. For example, Alaska or Antarctica. Since the temperature within the snow reflects mean climatic conditions, caves in such zones usually are sufficiently cold to resist all warming. Early in his book, *The Mountain of My Fear*, a classic account of his party's ascent and descent of Mount Huntington in the McKinley range, author David Roberts describes the situation at their cave: interior temperature "a chilly 16 degrees," exterior temperature "an incredible 46 degrees." Nevertheless, the four climbers holed up in the cave were close to comfortable—reading, writing in diaries, cooking, eating, sleeping and playing Monopoly. "Had an avalanche swept over us," writes Roberts, "we would have slept through it, never awakening. Had the Battle of Gettysburg been fought just below us on the Tokositna [Glacier], we might have heard the occasional faint pop of the cannon.")

In short, a snow cave works better than a tent, better than an igloo made of ice blocks and better than almost any other winter shelter. It's all irrelevant to the ptarmigan, but to a skeptic with an inquisitive mind, the knowledge can be

reassuring.

For the winter traveler, whether on skis, snowshoes or marooned in a car, three basic ingredients are necessary in planning and building a snow cave: adequate snow, ample time and waterproof clothing.

Of these three, adequate snow is the major stickler because it is not available everywhere. The depth must be sufficient, and the pack should be firm. Digging a cave early in winter before the pack has firmed up or in fresh snow (especially if it happens to be on the wet side) is not impossible, but the risk of a cave-in is there and should not be toyed with.

The ideal spot is a large, wind-packed drift, although a well-covered slope or level terrain will serve the purpose. Anywhere the snow has settled (or metamorphosed) to a stable mass will do. Depth is largely a function of comfort and snow conditions. If you cannot sit up in your cave, you will feel claustrophobic and probably will get wet from rubbing against walls and roof. If the snow is fresh or not firmly packed, however, and you construct too large a cave, you may find it coming down around your ears. The larger the interior, the greater the strain on the roof. As a rule of thumb, construct a cave no larger than necessary for comfortable—not spacious—living. Although western cave builders occasionally get away with a two-inch roof and easterners sometimes need three feet, a roof thickness of at least one foot is recommended.

In the Rockies, the Sierra and the Pacific Northwest, finding a suitable site is seldom a matter of traveling more than a hundred yards. Elsewhere in the United States, a longer search may be necessary. If you're really pressed and absolutely must have a cave, then build your own pile of snow, allow it to set (depending on temperature and snow conditions, this may take anywhere from five minutes to several hours) and then dig a cave into it. Hardy easterners have built snow caves in two inches of snow!

WHATEVER THE CASE, digging a roomy snow cave does take time, and it's wise to allow at least two hours for the job. Not only is it genuine work but much of the job must be done on your knees, which further slows progress.

Most winter campers believe the time required is the prime disadvantage of building a snow cave. Recently, a number of innovative outdoorsmen have begun experimenting with shortcuts However, these have yet to be proven out on anything more than a regional basis. To dig the standard, time-tested snow cave, a party must plan to stop their travel well before dark and face several hours of strenuous digging.

In cases where a group is moving camp daily, they may prefer to pack tents, which usually can be pitched in five minutes. The trade-off between time and weight is one that must be assessed before the start of any overnight winter trip.

Then there is the matter of staying dry while digging. For the hands, waterproof shells or gloves work well, especially if the temperature is below 20 degrees. In the wet snow of the East, cave builders often use neoprene skin-diving mittens or wear extra-large rubberized work gloves over wool inserts. In dry, cold areas, plastic sacks or even bread wrappers may do. If nothing else is handy, wear woolen mittens, which can be wrung out occasionally to provide some semblance of warmth. For the legs, a pair of rain chaps are unbeatable. If it's on the warm side, slip on a light rain parka but don't zip or snap it—you'd perspire too much.

This preparation may seem excessive, but it's far better than getting wet and then trying to dry out in a humid snow cave. Old adage: He who stays dry stays warm—and alive.

The actual digging is best done with a tough, lightweight aluminum shovel (a small grain scoop works well). Don't trust anything flimsy; a hard snowpack is quite capable of crumpling it. In an emergency, extemporized digging tools are readily available: a spare ski tip, a cooking pot. Then there is the ingenious, Norwegian-made "Tipsaw" manufactured by Weswitco, which folds out into a scoop for just this purpose. (It folds a second way to become a wood saw and a third to become an ice saw.)

Snow caves can also be dug with skis, the point of a snowshoe or a strong stick. Use the implement to break off chunks of snow inside the drift, then scoop them out with your hands. Caves have even been dug with hands alone, but these methods are not recommended.

BASIC SNOW-CAVE DESIGN is the least complex element of the process. A narrow entrance tunnel large enough for one person to crawl through and a dome-shaped room are it. Most people will want enough height so they can kneel comfortably without brushing the roof and knocking the inevitable shower of loose snow down their necks.

Yet, for reasons that probably have more to do with a predilection for order than physical comfort, a snow cave rarely stops with such simplicity. One of the true joys of the shelters is the possibility of infinite, sometimes whimsical variation. Small shelves and alcoves may be carved in the walls to accommodate gear. For larger parties, additional rooms, wings and tiers can be added until the cave becomes almost a catacomb.

The time required for these embellishments is well worth it, especially if the shelter is to serve as a base camp for an extended period. When the National Outdoor Leadership School crew made its pioneering New Year's ascent of Wyo-

Continued on page 63

THE INSTANT CAVE
(Can Condominiums Be Far Behind?)

By ERNEST WILKINSON

I have been experimenting with a method of digging a snow cave that is more efficient and involves less stooping and kneeling than standard construction techniques.

I move to the deeper snow of a slope or windblown drift and dig a large entrance hole about three feet wide and four feet high. Utilizing this enlarged entrance rather than the traditional tunnel, I can hollow out a cavern in the snow with a minimum of stooping and kneeling.

After I've removed the bulk of the snow from the cave, I trim the ceiling and walls, shaping them into a dome, and put the loose snow I've removed at the sides of the cave where I pack it into sleeping benches a foot to 18 inches high. Next, I carefully place groundcloths, sleeping pads and fluffed up bags on the benches. I then clean out and smooth a two-foot-wide trench between the benches, sloping the trench downward toward the cave exit (the same way a traditional entrance tunnel slopes down from the sleeping area to the entrance hole).

Outside the cave I gather chunks of snow and,if possible, cut snow blocks which I build into a wall blocking the entrance, making sure the wall comes up under the snow cave roof—not outside it—so as to add support. I chink any cracks with loose snow and wait for the snow to set.

When the snow has hardened, I carve a small entrance hole in the bottom of the wall. My snow cave is completed, my benches have hardened, I'm relatively dry, my sleeping bag has not been dragged through a tight tunnel, and my back is very happy.