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ANIMALS TAKE ON WINTER

PLUS

HOLIDAY GIFTS FROM TRASH

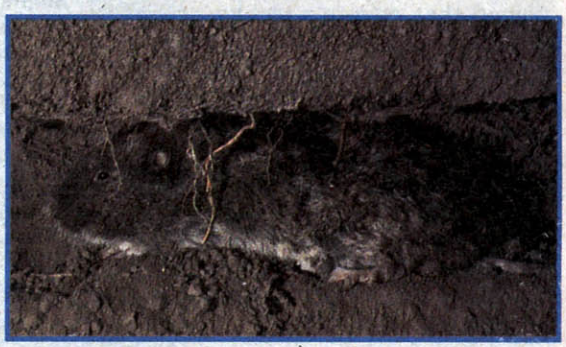
SCHOLASTIC

THE COLD FACTS OF WINTER

Conserving energy is the key to survival when sunlight is in short supply. Find out how animals survive the season in Yellowstone National Park, home of the most wintry winters in the whole United States. **Story starts on page 10.**

by James C. Halfpenny

Nicholas DeVore / Bruce Coleman Inc.



Jeff Foott / DRK Photo

This pocket gopher is shown in its typical year-round home, an underground burrow. In winter, surprisingly, many gophers make their nests *above* the surface, right in the *snowpack* (the layer of snow that covers the ground). To keep their winter Calorie-count high, they stock their burrows with basketball-sized caches of roots.

If you're wondering how snow can be warm enough to live in, try this: Place a thermometer atop some snow. A half hour later, record the temperature. Repeat, only this time *bury* the thermometer in the snow. What happens?

The coyote needs the food energy from eating this mouse to stay alive. But chasing the mouse *costs* the predator energy. The trick to survival for the coyote (for all animals) is to balance its *energy budget*—to take in as much energy as it loses. That's a life-and-death struggle in winter. With sunlight at a minimum, energy of all kinds is scarce. What's more, animals are constantly losing heat energy to the wind and cold.

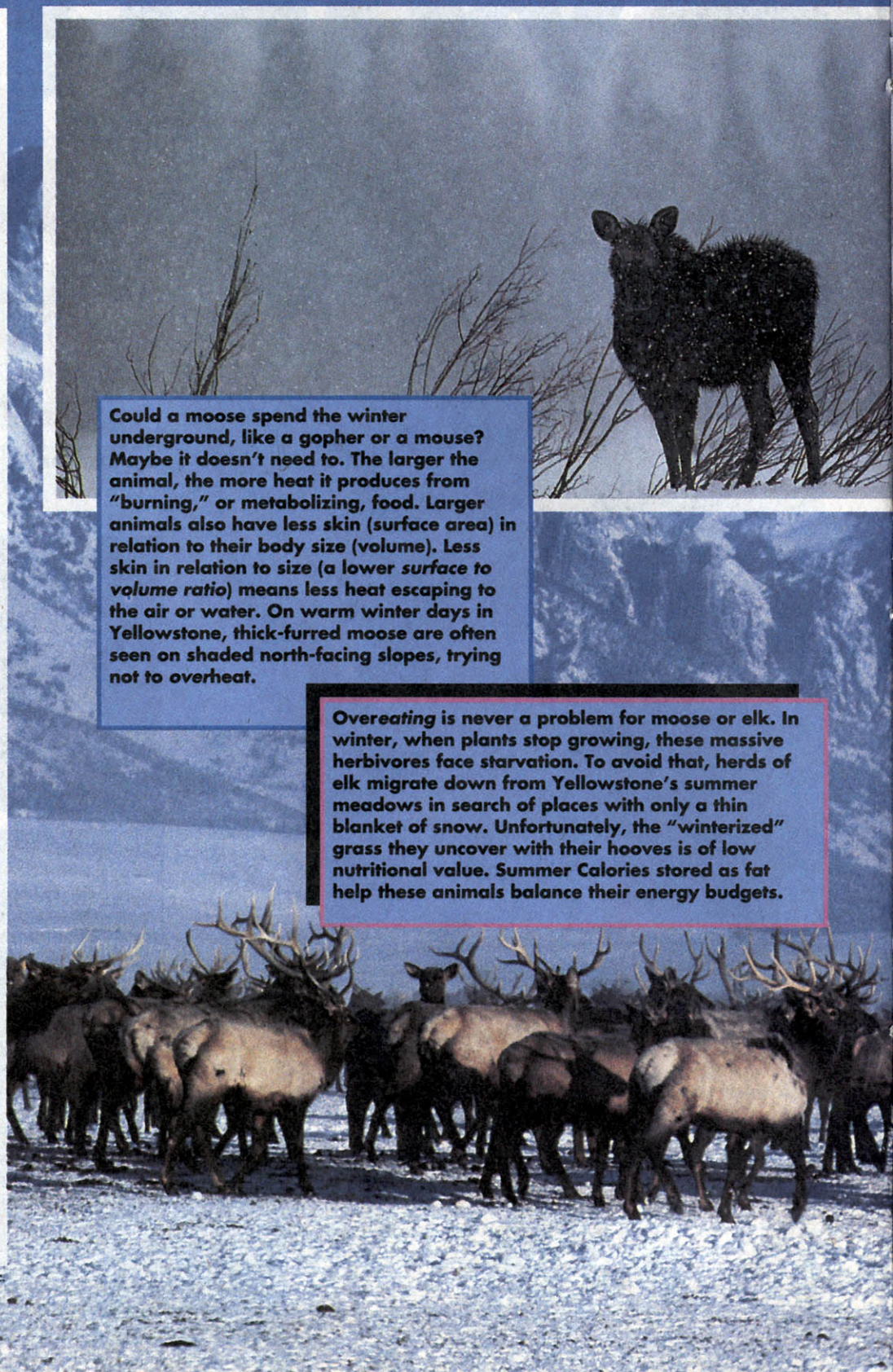
Adapted from an article that originally appeared in *Natural History* 12/91.

It was the winter of 1978-79, the coldest on record in North America. I was camped by the Lewis River in Yellowstone National Park. My goal: to learn how animals survive in a place where temperatures routinely drop below the -40°F mark.

As I welcomed the first rays of sunlight, a coyote pranced into view. It paused, listened, and then pounced, sticking its nose beneath the snow in pursuit of a vole. I knew that if I followed that coyote's tracks, they would show signs of the thick hair on its feet. The added fur is an adaptation that reduces the animal's heat loss in winter.

The growing sensation of cold in my own toes reminded me to wiggle them as protection against frostbite. At temperatures like these the body quickly loses heat.

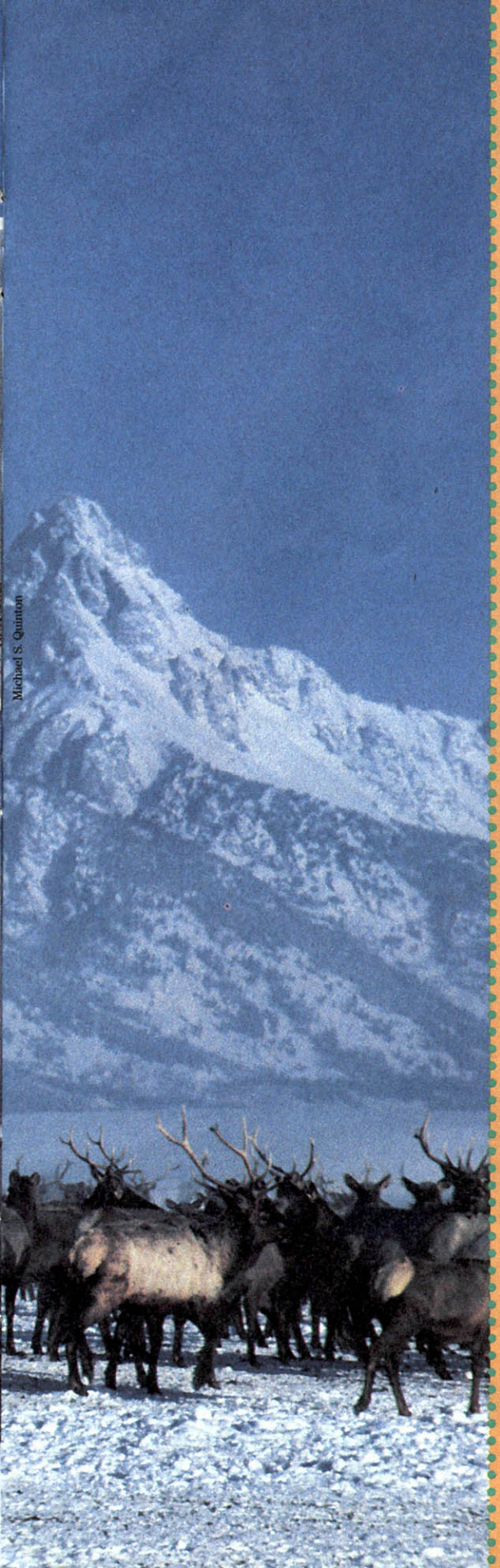
Conserving heat—energy, really—is the key to winter survival. Think about it: Winter itself results from a loss of solar energy. As Earth revolves around the Sun, the tilt of its axis causes the Northern Hemisphere to slant away from the Sun during the winter months *(see diagram, opposite page)*. This means that every sunbeam covers a larger area in winter. In other words, the energy is spread out. Each plant, each animal in each patch of wintry Earth gets a



Could a moose spend the winter underground, like a gopher or a mouse? Maybe it doesn't need to. The larger the animal, the more heat it produces from "burning," or metabolizing, food. Larger animals also have less skin (surface area) in relation to their body size (volume). Less skin in relation to size (a lower *surface to volume ratio*) means less heat escaping to the air or water. On warm winter days in Yellowstone, thick-furred moose are often seen on shaded north-facing slopes, trying not to overheat.

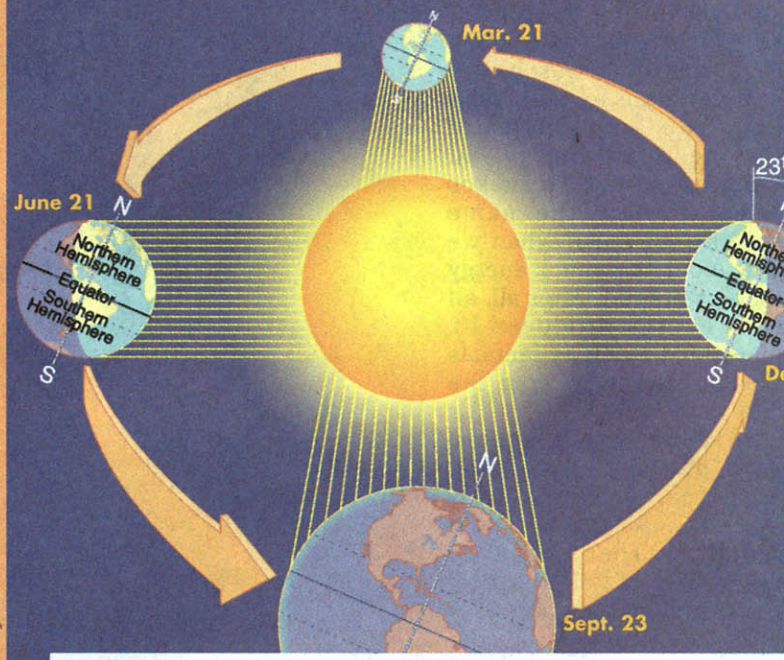
Over*eating* is never a problem for moose or elk. In winter, when plants stop growing, these massive herbivores face starvation. To avoid that, herds of elk migrate down from Yellowstone's summer meadows in search of places with only a thin blanket of snow. Unfortunately, the "winterized" grass they uncover with their hooves is of low nutritional value. Summer Calories stored as fat help these animals balance their energy budgets.

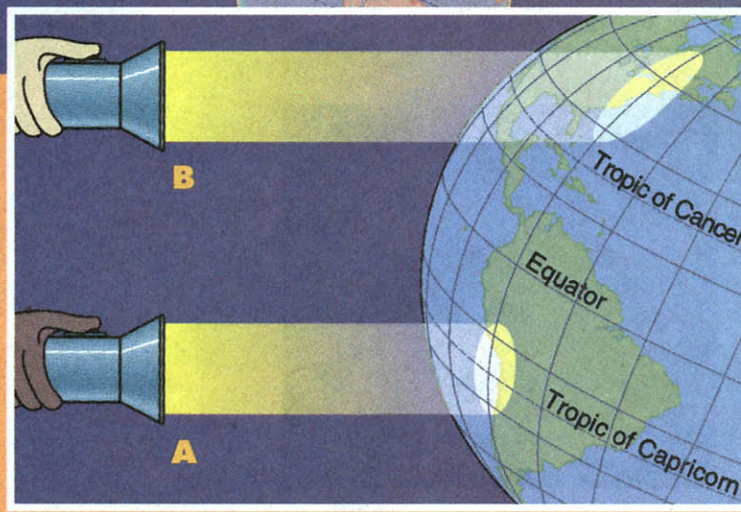
Wolfgang Bayer / Bruce Coleman Inc.



Michael S. Quinton

How earth's tilt makes our winte





Earth revolves around the Sun with its axis tilted 23½° of the vertical *(top)*. That means that in December, the Northern Hemisphere tilts *away* from the Sun. Result: The days are shorter and the Sun's rays strike the Northern Hemisphere at a sharp angle.

What effect does the angle have? Get a flashlight and a globe and you'll see. You be the Sun. To model winter, tilt the globe away from you, and shine the beam head-on at the Tropic of Capricorn *(above, A)*. Then, keeping the flashlight parallel to the floor, shine it at the latitude of, say, Wyoming *(above, B)*. How does the concentration of energy change as you move the beam north? Does the same thing happen during our summer? Try it and see.

Challenge: Use your flashlight and globe to explain why it is always warm at the equator and cold at the poles.

smaller share of the total sunlight hitting the planet, compared with what they get during other seasons.

If you want to get technical, you can measure the incoming energy—in Calories, or Cal. (It makes sense to use the same Calories we mean when we talk about how much energy there is in food. After all, all food energy produced by plants and eaten by animals comes originally from the Sun.)

In June, every square yard of the Yellowstone area receives a daily average of 7,685 Cal of solar radiation. That's equal to the number of Calories in 27 regular Milky Way bars *(see p. 4)*. In December, by contrast, every square yard of the Yellowstone area

Tom & Pat Leeson / DRK Photo

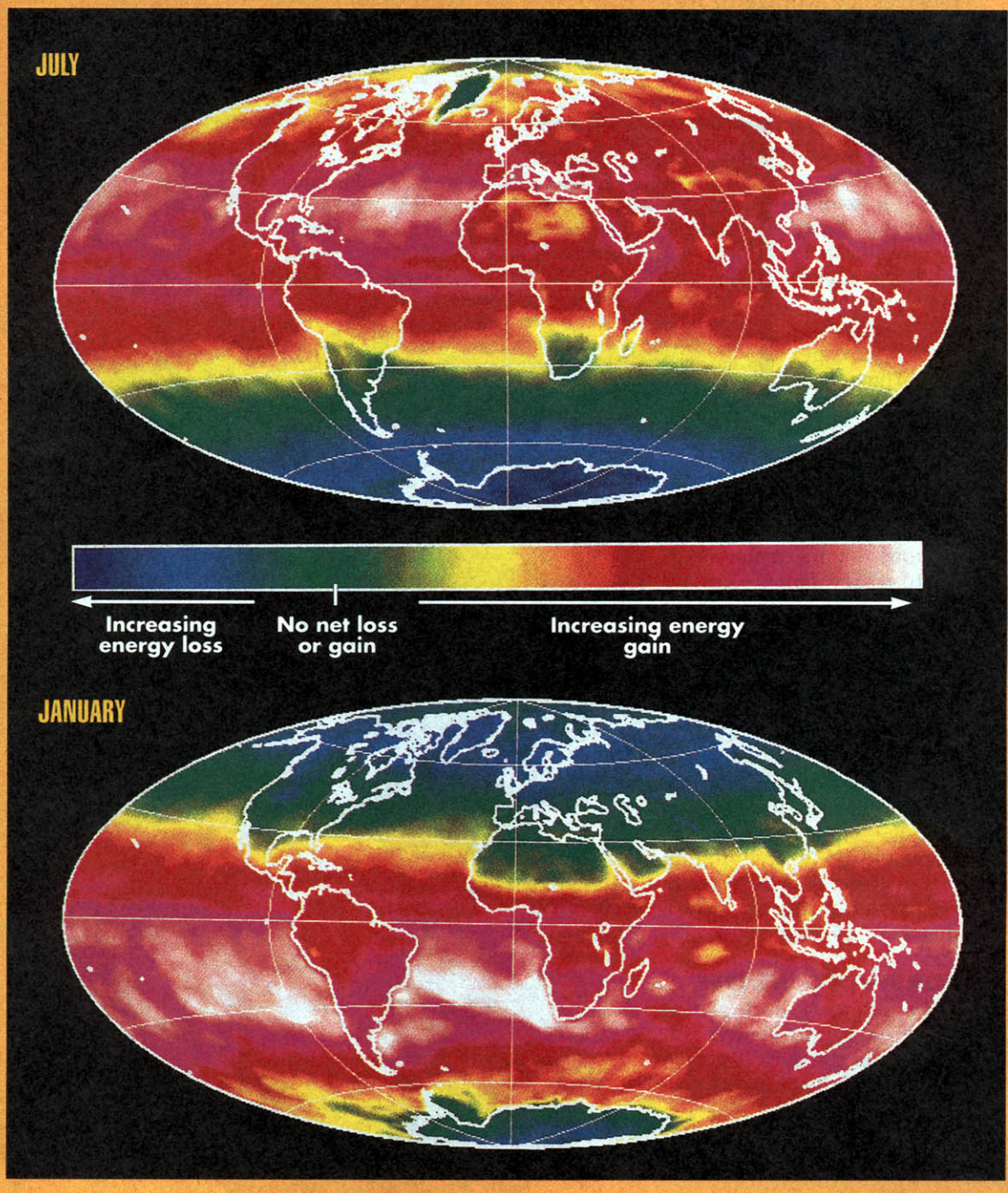
Leonard Lee Rue / Bruce Coleman Inc.

The coming of snow is the signal for the snowshoe hare to change its coat from brown *(above)* to white *(right)*. Timing is crucial. If it turns white too early in the season, the hare can turn into a sitting duck for a hungry lynx. Sitting absolutely still, though, might save the hare, since it helps enhance its camouflage.

Or the hare could bound away on its large feet. They spread the force of the animal's weight over a larger area, allowing it to move effortlessly over the snow . . . pursued, of course, by the lynx, whose own large feet give it a similar advantage in winter.

How might being scared by snowmobiles or cross-country skiers affect an animal in winter? Could it afford the energy expense of fleeing?

WHERE EARTH CHILLS OUT AND WARMS UP THROUGHOUT THE YEAR



Winter results from a decrease in solar energy *(see p. 11)*. In winter, some parts of Earth actually lose more energy than they gain; they experience a *net* loss of energy.

These computer-generated images show the net energy gained or lost by Earth in July *(top)* and January *(bottom)*. If you covered the labels, could you still tell which image shows winter in the Yellowstone area?

Imagine you're a bird that spends your summers in the park. Where could you find an equally warm *winter* home? Is warmth the only factor to consider when migrating?

receives an average of just 5,288 Cal of solar radiation—or the number of Calories in 18 regular Milky Ways.

The difference may not sound all that big to you. But keep in mind that Earth is constantly radiating energy outward (some 5,337 Cal per square yard per day). That means that in winter, Earth suffers a *net* energy *loss*. In other words, it loses more energy than it gains.

In Yellowstone, the most obvious results of this energy loss are the polar air masses that pour in from the north and the snow that covers the region for six months or more.

Keeping your energy budget balanced during winters like these is a terrible struggle. For the animals that live here, a few Calories may mean the difference between dying or lounging in the green grass of spring. Calorie-counting is truly a matter of life and death.

SURVIVING WINTER

Faced with such a dramatic energy loss each fall, animals in the park resort to one of three basic strategies:

(Continued on page 18)

Unlike some birds, chickadees don't head south when winter comes to Yellowstone. They cope with the wind, wet, and cold by doubling the number of their feathers. They fluff them up to trap warm air next to the body. And they reduce the cost of finding food to a minimum, feeding only during the warmest hours of the day. At night, chickadees lower their internal body temperature and reduce their rate of metabolism. These adjustments save precious Calories.

Michael S. Quinton

(Continued from page 14)

1 They *migrate*. Great blue herons, for example, fly south. Elk simply head for lower elevations, winding their way down from summer meadows in search of places where only a thin blanket of snow covers the grass.

2 They *hibernate*—the animal equivalent of serious "vegging." Like ground squirrels, they may retire into an underground den and go to "sleep," reducing their energy needs so much that they can survive until spring on just their fat reserves.

3 They face the cold and snow head-on, relying on special adaptations to keep from losing more energy than they take in.

When you look at the pictures on these pages, what do you see? In the competition for winter's scarce resources, who among these animals will be the winners? ■

In a season when solar energy is scarce, some animals warm up with geothermal energy from Earth's interior. Bison and other large mammals often bask in the steam from Yellowstone's hot pools and geysers.

Steven Fuller / Animals Animals