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From the Editor

RICK C. WEST (ABOVE)

NATIONAL GEOGRAPHIC and insects go way back together. In 1915, for instance, the magazine reported on a locust plague in Jerusalem. Maybe that's why scientist and photographer Mark Moffett feels so at home with us.

"I was a biologist from diaper age," says Moffett, whose photographic essay about fighting flies appears in this issue. "The insects in my backyard were much more convenient to study than whales and chimpanzees."

Moffett's junior high science project (right) was an insect collection that would make an entomologist proud. By age 17 Moffett was far from his yard, working as an assistant to reptile and insect experts in Central and South America. He earned his doctorate at Harvard University, thanks in part to a National Geographic Society grant to roam Asia studying marauder ants. From the field in 1985 he sent a few rolls of film to our headquarters for processing. A sharp-eyed editor named Mary Smith spotted his work—and a star was born.

Moffett approaches his tiny subjects with an eye for big-game-type drama: Marauder ants stage coordinated assaults on their prey; leafcutter ants create mulch to grow fungus on which they feed; tarantulas with specially adapted feet walk across rising Amazon floodwaters to find new homes.

"I believe NATIONAL GEOGRAPHIC is the only place that offers the scope for visual stories like these," says Moffett. "The magazine takes the space to play stories from start to finish. You see insects dueling, but you also see the battle-scarred survivors. As a scientist, I'm just glad a resource like NATIONAL GEOGRAPHIC exists."

Of course this magazine has flourished in large part because of the talent and resourcefulness of writers, researchers, and photographers like Mark Moffett—whether they found their youthful inspiration on their stomachs scrutinizing ants and plants or on their backs gazing up at the heavens.

Bill Allen

AGING

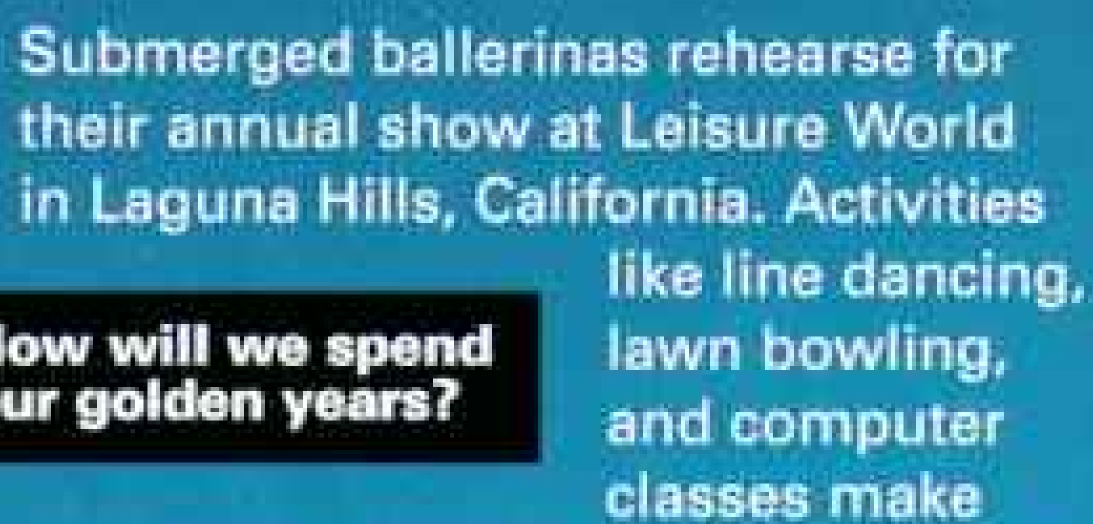
NEW ANSWERS TO OLD QUESTIONS

What are our limits?

Defying his 85 years as well as gravity, Carol Johnston practices pole vaulting in Walnut, California. Still competitive, he holds the world record—7'6"—for his age. He and 34 million others over 65 in the United States are leading a revolution, remaining vigorous and living longer than any previous generation. While science explores how to add even more healthy years to the human life span, a graying society faces inevitable changes in attitude and lifestyle.

Classic aircraft pilot Hal Wright, age 93, delivers copies of his newspaper, *Sierra Booster,* to rural subscribers around Loyalton, California. Reporter, writer, editor, and ad salesman, Wright is lively proof that birthdays are no reliable measure of the complicated, individual process of aging. Asked when he's going to slow down, he replies, "What for? I wouldn't know what to do with my time."

How do we define old age?

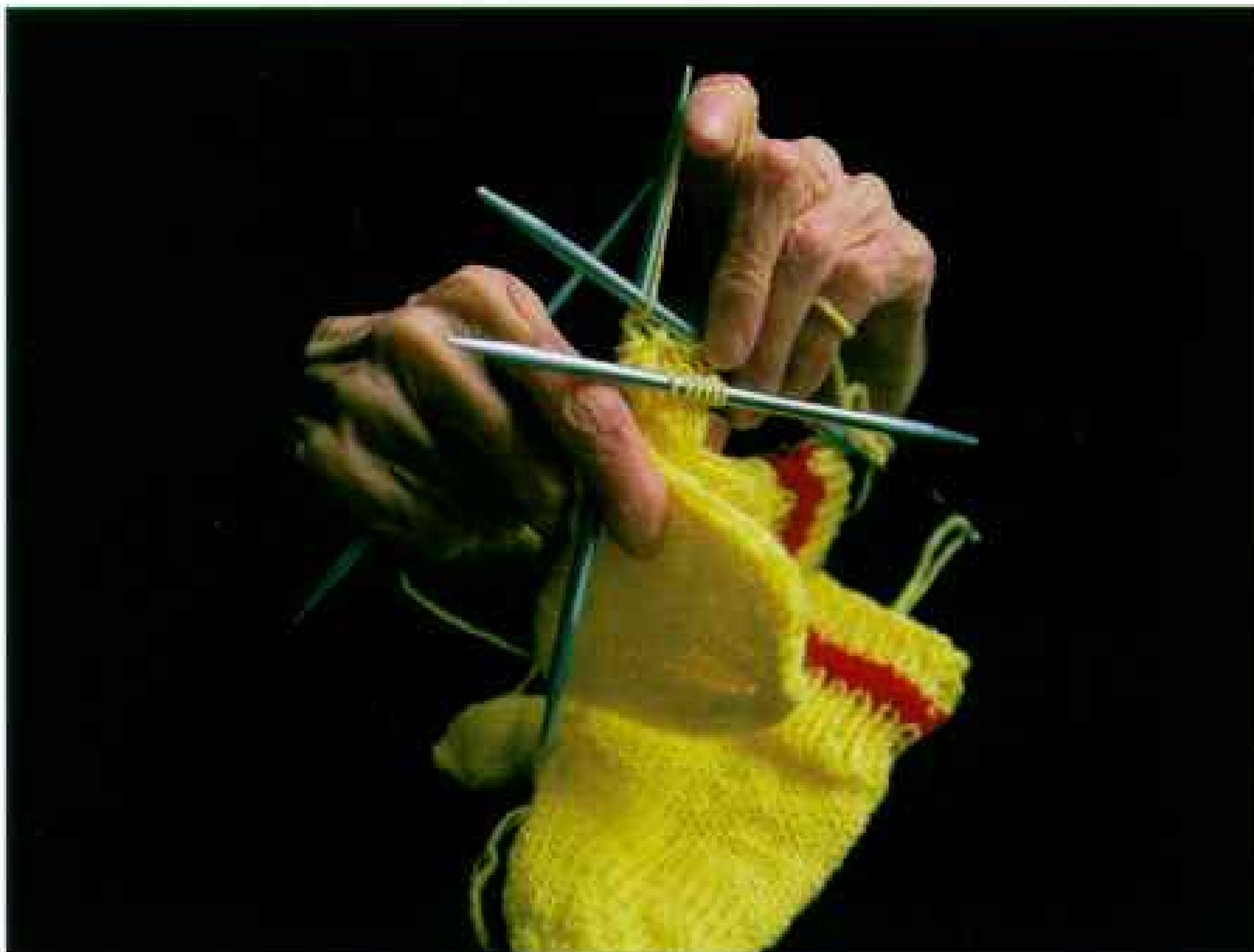


How will we spend our golden years?

Submerged ballerinas rehearse for their annual show at Leisure World in Laguna Hills, California. Activities like line dancing, lawn bowling, and computer classes make retirement communities increasingly popular among people with decades of free time to fill. "Anyone who's bored here is a stick in the mud," says 65-year-old Barbara Hack, at left.

A task normally taken in stride is too much for 87-year-old Edwin Genero, who suffers from Alzheimer's disease. For a decade his 43-year-old daughter, Charmaine, tended to his increasing needs in her Arlington, Virginia, home. "Sometimes you cry your eyes out," she admits. "But then you say, 'All right, this is what we have to deal with.'" Earlier this year she moved him to a nursing home. More families than ever will confront such situations as the elder population grows.

How will we care for the disabled?



"I'm quite busy in my old age," says Sister Matthia Gores, 103, who knits mittens for charity in Mankato, Minnesota. Since she began counting, she has made more than 1,500 pairs. Along with others in her convent, she is taking part in a long-term study of aging.

By RICK WEISS
Photographs by KAREN KASMAUSKI

Sister Esther Boor scoots down a corridor toward the ceramics studio in this sprawling Roman Catholic convent, her black veil fluttering behind her. She has been taking great pleasure in pottery since she retired from her career as a schoolteacher. That was six years ago, she says, doing the math quickly in her head. Back when she was 96.

It takes me a moment to do the reverse math—and then to do it again—to realize that this spry, sneakered nun with her full head of white hair was born six years before the turn of the century.

"I thought it was time to slow down a little," she says as she bustles about the studio.

Sister Esther is one of 122 School Sisters of Notre Dame who have graciously allowed me to visit for a few days at their convent in rural Mankato, Minnesota. It is a religious community, but my interest is purely secular—indeed almost morbid. These and about 550 other School Sisters across the country have volunteered to be research subjects in a unique study. All have agreed to take a battery of tests as they grow older, then donate their brains after they die, to help scientists understand the biological mystery of how we age.

The Mankato convent, on a hilltop that overlooks vast fields of soybeans, is home to many sisters surprisingly active for their age.

There is Sister Matthia, 103, whose nimble fingers have for the past several years knit a pair of mittens every day for charity. When I arrived, she was on her 1,378th pair. And there is Sister Liguori, 89, and Sister Clarissa, 87, biological sisters who laugh and joke about their antics in elementary school, which they remember as though it all happened last year.

But not every sister has defied Father Time. In a quiet room at the convent I meet a group of six nuns sitting in wheelchairs pulled up to a large round table. Most are younger than their "supersisters," yet their backs are hunched, their eyes are glazed, and some have a trickle of spittle in the corners of their mouths. Alzheimer's disease, strokes, and osteoporosis have robbed them of their minds and their freedom to move about.

Why? Or more precisely: Why them? What is it about some people that makes them such easy targets for the arrows of time, while others remain so resilient for so long?

David Snowdon, the University of Kentucky epidemiologist who directs the million-dollar-a-year Nun Study, is finding out. His research—along with other scientists' studies of worms, flies, mice, and monkeys—is helping answer the fundamental questions of how and why we decline as we age and whether there is anything we can do about it.

Snowdon, a gregarious researcher who greets most of the sisters by name when he visits, looks a little out of place at this staid convent, with his boyish face, crumpled suit, and long, unkempt hair. But the convent is a perfect place to study aging, he says, because all the nuns have such similar backgrounds. All have spent their years eating similar food, getting similar educations, and working similar careers, while shunning cigarettes, alcohol, marriage, and childbearing. With those lifestyle variables all canceled out, it's easier to figure out which biological factors make the difference between those who age quickly and those who don't.

Already Snowdon's study has led to the unexpected discovery that some of the memory loss and dementia that afflict people with Alzheimer's disease may be due not to Alzheimer's itself but to tiny unnoticed strokes. Since many strokes are preventable, the finding has shaken the image of Alzheimer's as an unstoppable disease. Snowdon's work suggests that something as simple as taking an aspirin a day might prevent the symptoms of Alzheimer's in some people, not by curing it but by preventing the strokes that do the bulk of the damage.

"I never would have imagined spending my career with a convent full of aging nuns," says Snowdon, in mock self-deprecation. "But this place is like a gold mine. We're just starting to dig in, and we're already getting the answers to so many questions."

THE QUEST TO UNDERSTAND the nature of aging—and the corollary quest to avoid growing old—dates back at least to biblical times, when the elderly King David was advised to allow a young virgin to warm him.

Sages, scientists, and snake-oil salesmen have offered countless other antidotes since then. In the third century Taoist philosophers recommended ingesting cinnabar, the toxic ore of mercury, a prescription that may have ended more lives than it prolonged. Medieval Latin alchemists tried in vain to make gold digestible, in the belief that its absorption into the body would add years to life. In the 17th century a more affordable remedy for aging won popularity—smelling fresh earth upon awakening each day.

But many gerontologists of old sided with Sir Francis Bacon, who believed that life span was determined by how quickly one used up one's personal store of "vital spirits." Still others focused on the possibility of getting vital-spirit refills from fountains of youth, mythologized in many cultures long before Juan Ponce de León dropped anchor off the Florida shore to look for his imagined fountain.

Today many advocates of life extension are pinning their hopes on molecular biologists, who with remarkable speed are teasing apart the hormonal, cellular, and genetic underpinnings of old age. Their promising assault on the biology of aging is stirring up some difficult ethical and economic questions:

Are longer lives necessarily better lives?

Who should decide how long a person should live?

How would future generations fare in a world where the elderly—no matter how beloved—refused to depart?

Ready or not, a global experiment in life extension is under way. Thanks largely to

Quiet faith and fond memories comfort members of the Mankato convent at the wake of Sister Mary Bertha Nosbush. "The community we have is a key to why our sisters do well as they get older," says Sister Rita Schwalbe, a spokeswoman for the aging study. "They have that moral support that gives them an extra push." Subjects of the study take periodic tests. After death their brains offer additional data on their mental capacity; the stained tissue below awaits microscopic examination. "We're seeing evidence that the chain of events leading to Alzheimer's goes way back to mid and early life," says David Snowdon, the University of Kentucky epidemiologist heading the study.

advances in public health, average life expectancy has already lengthened more in the past 100 years than in the 2,000 years before that.

Ancient Romans lived an average of 22 years. Today a global citizen can expect to live, on average, to 65—from a low of 38 in Sierra Leone to a high of 80 in Japan. In the United States the average man lives to 72, while his female counterpart typically makes it to 79, up from a U.S. average of 47 in 1900.

The worldwide increase in longevity is fueling a population explosion of the elderly. By 2030, when even the youngest of the baby boomers will be senior citizens, the number of Americans 65 or older may exceed 70 million—more than double today's number. Those over 85 are increasing even faster. Only about 4 million of these "oldest old" are alive in the United States today, but their numbers could double by 2030 and double again in the 20 years after that.

In the meantime, a steady drop in global birthrates means that proportionally fewer young and middle-aged citizens will be around in the next century to care for the record number of seniors. How the world will deal with that imbalance remains to be seen, but Singapore has already decided on its approach. Last June that country opened a special court called the Tribunal for the Maintenance of Parents—a place where senior citizens can press legal claims against their children for not taking proper care of them in their dotage.

AGE CAN BE a nebulous concept, but its contours are undeniable in a pair of stark black-and-white images projected before me on a video monitor. One is a cross section of a brain from a 65-year-old person, the other of a brain from an 83-year-old. "Look at this," says Susan Resnick, a researcher with the National Institute on Aging (NIA). "You don't have to be a brain surgeon to see that the older one is smaller."

I am visiting Resnick at the NIA's Gerontology Research Center in Baltimore. The center is a mecca for aging research and home to the Baltimore Longitudinal Study on Aging, the world's largest and longest running effort to track all the events that add up to old age.

I look at the magnetic resonance images on the screen, and, indeed, the younger brain completely fills the skull and is mostly solid, with small pockets of fluid as is normal for a brain. But the 83-year-old brain has pulled away from the skull, and the fluid-filled pockets have grown considerably larger.

I wonder aloud whether those expanding ponds of fluid are the places where all those forgotten names end up after dinner parties, and Resnick says that in a sense I may be right. Researchers suspect that the bigger the pockets, the bigger a person's chances of being demented. Tests of cognitive function in older people may soon answer that question.

A good study on aging must track the same people year after year as they age. And that's exactly what's been happening in Baltimore since 1958, with newer tests being added as they are developed. More than 1,100 individuals currently participate in the study. Every two years they return to Baltimore from wherever they live (some have made the trip from as far away as India) for a full two and a half days of medical and psychological tests.

By doggedly following its varied participants over the years, the Baltimore study has painted a full-spectrum picture of normal aging and the specific problems that come, sooner or later, with old age.

The results read like a monologue from the world's worst hypochondriac, says Reubin

RICK WEISS is a science and medicine writer for the *Washington Post*. This is his first assignment for the magazine. Photographer KAREN KASMAUSKI's work has illustrated numerous NATIONAL GEOGRAPHIC articles, including "Viruses" in July 1994. Both contributors are aging baby boomers.

Aging in animals may ultimately help scientists understand what happens in humans. Savannah River cooters (top) can live 50 years. "They don't become doddering old turtles though," says University of Georgia ecologist Whit Gibbons, who marks their shells for identification. "The oldest ones we catch are hardly different from younger ones. So why do they die?"

Kokanee salmon age dramatically during migration on the Colorado River. Silvery to start, they burn out by the time they have spawned (above, at left). "On the breeding creek they're like very old people except that they reproduce," says University of Colorado biologist Richard Jones.

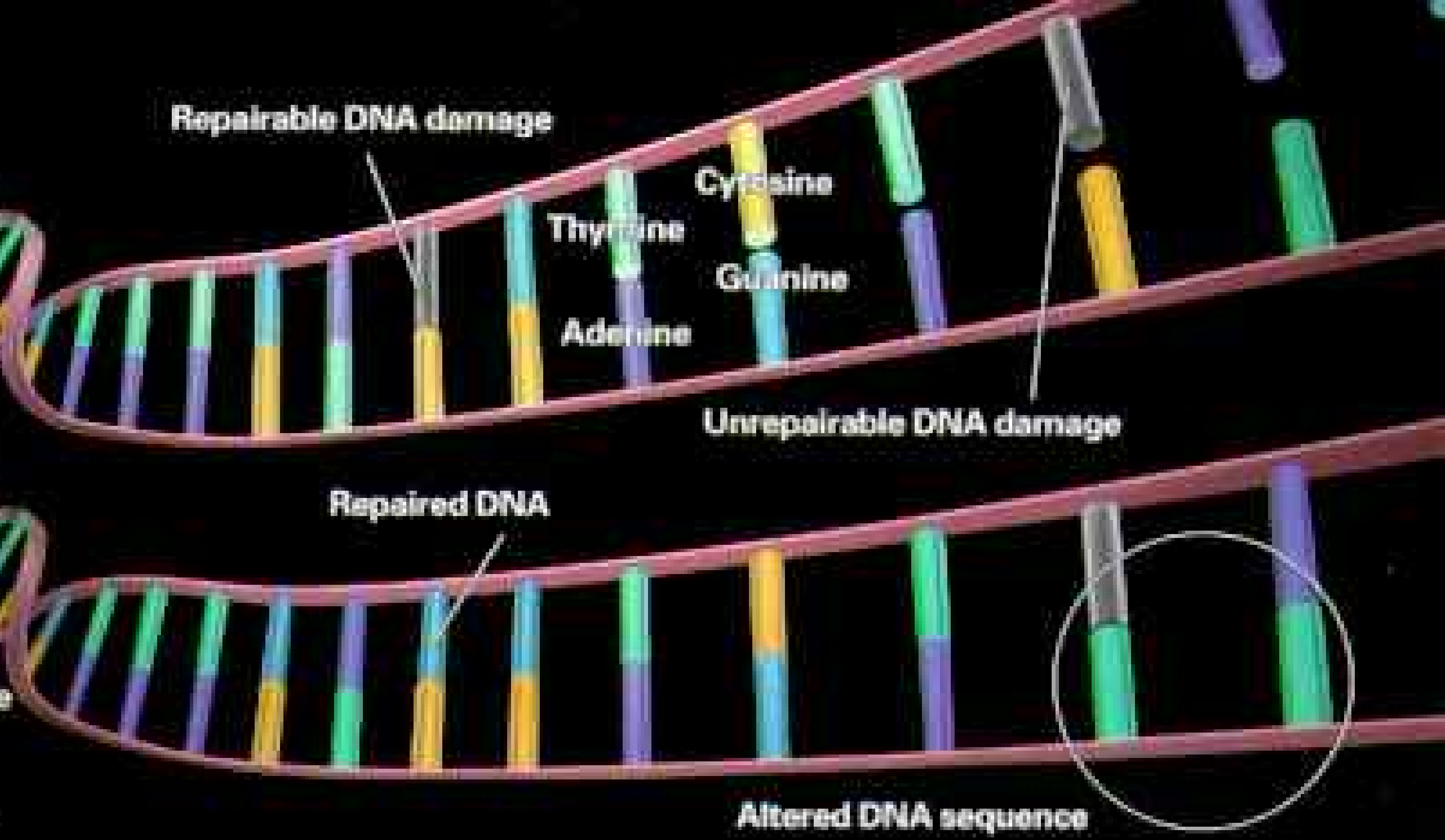
Andres, the NIA gerontologist who serves as the project's clinical director. Vision declines as the lenses thicken. The ears lose their ability to hear higher pitched tones, and later low pitches too. The senses of smell and taste grow dull. Skin becomes thinner and begins to sag as the underlying scaffolding of structural proteins becomes brittle and collapses. Muscles waste away and fat accumulates, especially around the abdomen. Bones become riddled with cavities and prone to breaking, while joints wear out. The heart grows weak and can't pump as efficiently as it once did. And virtually every other organ goes into a gradual tailspin—especially the kidneys and lungs, which for some reason wear out especially quickly.

"It may not be a coincidence," Andres tells me, "that Mother Nature provided us with a duplicate set of both of those organs."

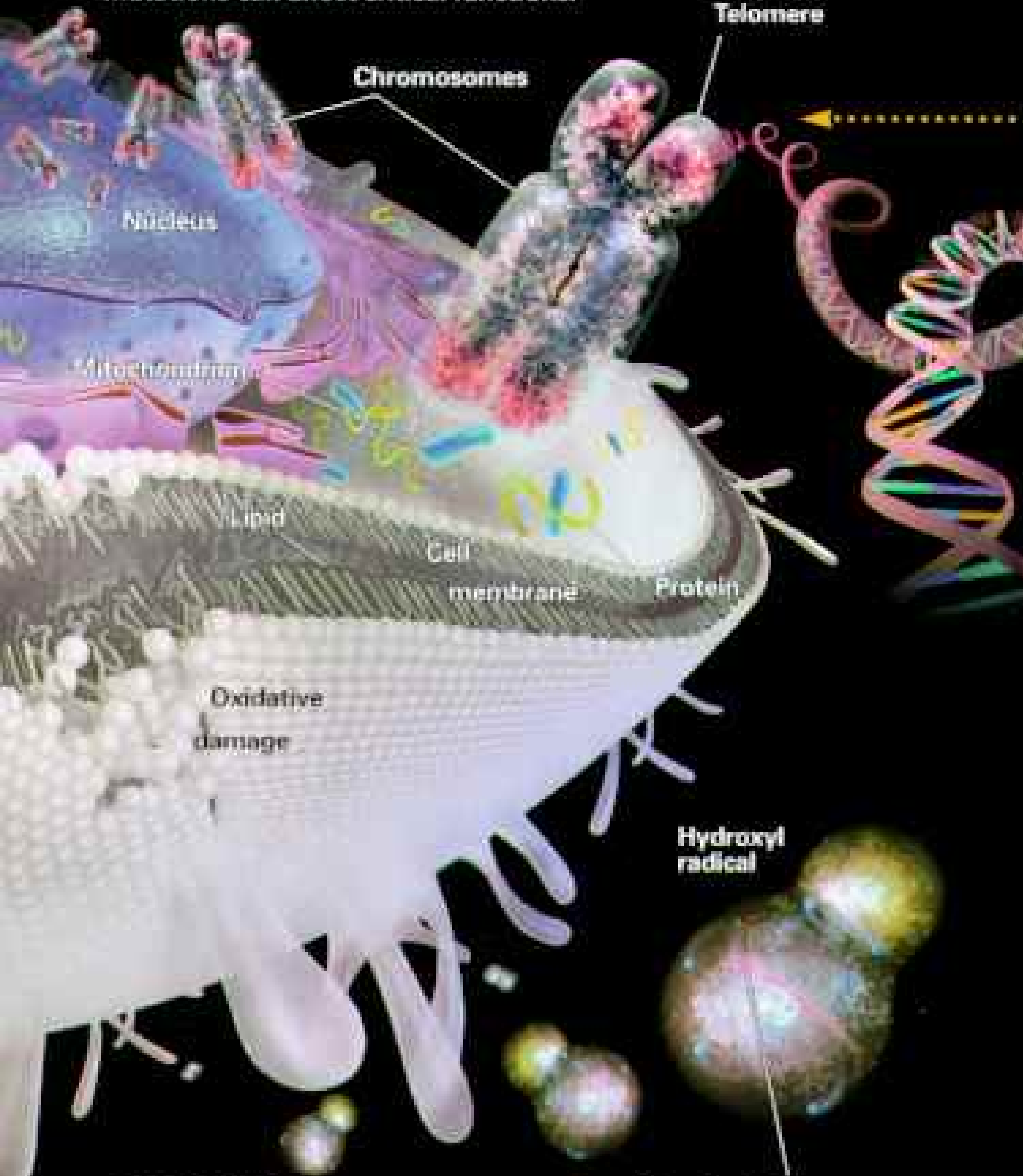
Andres pauses for a moment, putting down the colored marking pens that he's been using to show me the age-related demise of all the body's organ systems. Depressing as it may seem at first, he tells me, there may be something hopeful about the fact that virtually every part of the body declines with age. It suggests that there may be a fairly universal process that is responsible for many aspects of aging and that by putting the brakes on that process we might halt many of the sundry hallmarks of decrepitude. Indeed, he says, a researcher in Wisconsin thought he might have identified that key back in 1990. And in an experiment on 21 older men he came as close as anyone ever has to turning back time.

The researcher was Daniel Rudman, at the Medical College of Wisconsin in Milwaukee. Rudman knew that as people got older, their pituitary glands produced smaller and smaller quantities of a substance called human growth hormone. He wondered: Might the symptoms of aging be caused by that drop in human growth hormone levels?

For six months Rudman gave 12 men, ages 61 to 81, injections of the growth hormone three times a week, raising blood levels of the substance to those typical of young adults. The results were astonishing: The men's muscle mass increased by almost 9 percent, fat decreased by more than 14 percent, and skin thickness increased by 7 percent—changes that were equivalent to turning the clock back 10 to 20 years. Headlines hinted that



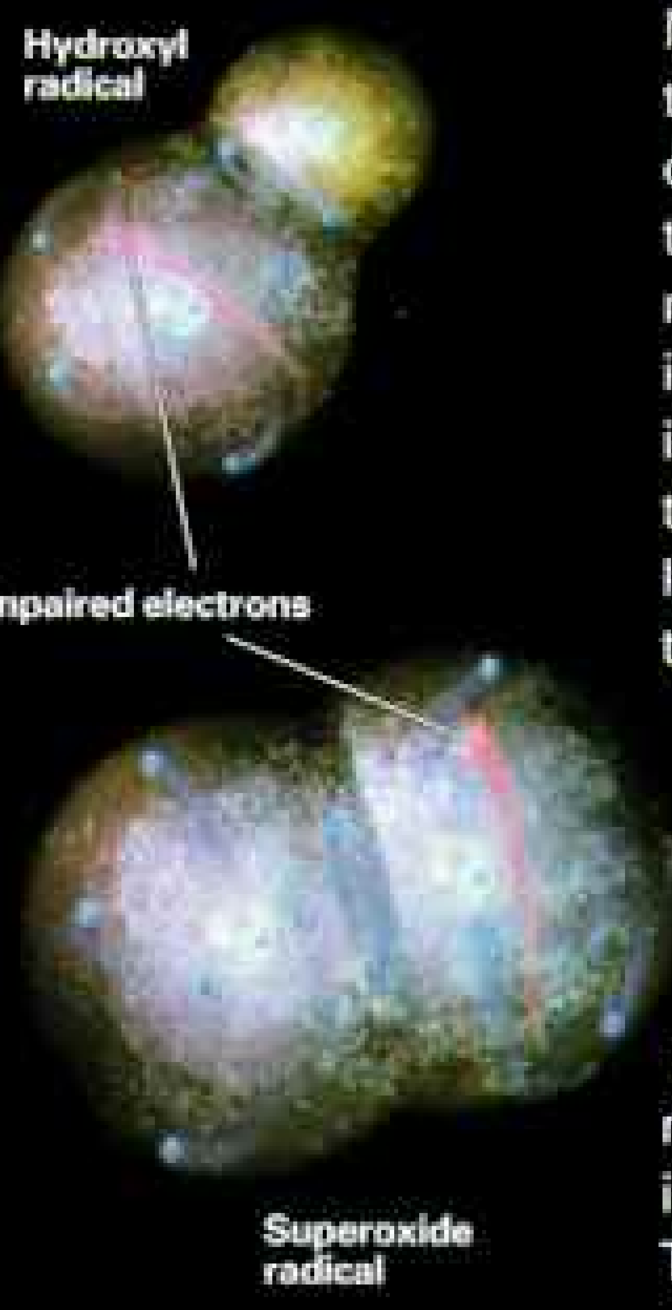
DNA REPAIR
A cell's chromosomes are the 46 coils of DNA in its nucleus. They hold all the information about the cell in the sequence of their paired nucleotides—cytosine always paired with guanine, and adenine with thymine. Radiation and molecules called free radicals can damage the double helix of DNA—straightened out here like a ladder. Repairable damage knocks out one nucleotide, which the DNA can restore by using the complementary nucleotide as a guide. Unrepairable damage occurs during cell division, when the helix splits down the middle. The DNA will insert a nucleotide at random, often causing a mutation. Accumulated mutations can affect critical functions.



TELOMERES
Before a cell divides, it copies its chromosomes to give each new cell a complete set. In most cells, however, this process does not include the long spirals of DNA called telomeres, which protect the ends of every chromosome. Telomeres get shorter with each cell division. Finally, some scientists believe, they are so short the cell can no longer divide, and it becomes vulnerable to damage and decay.

WHY DO WE AGE?

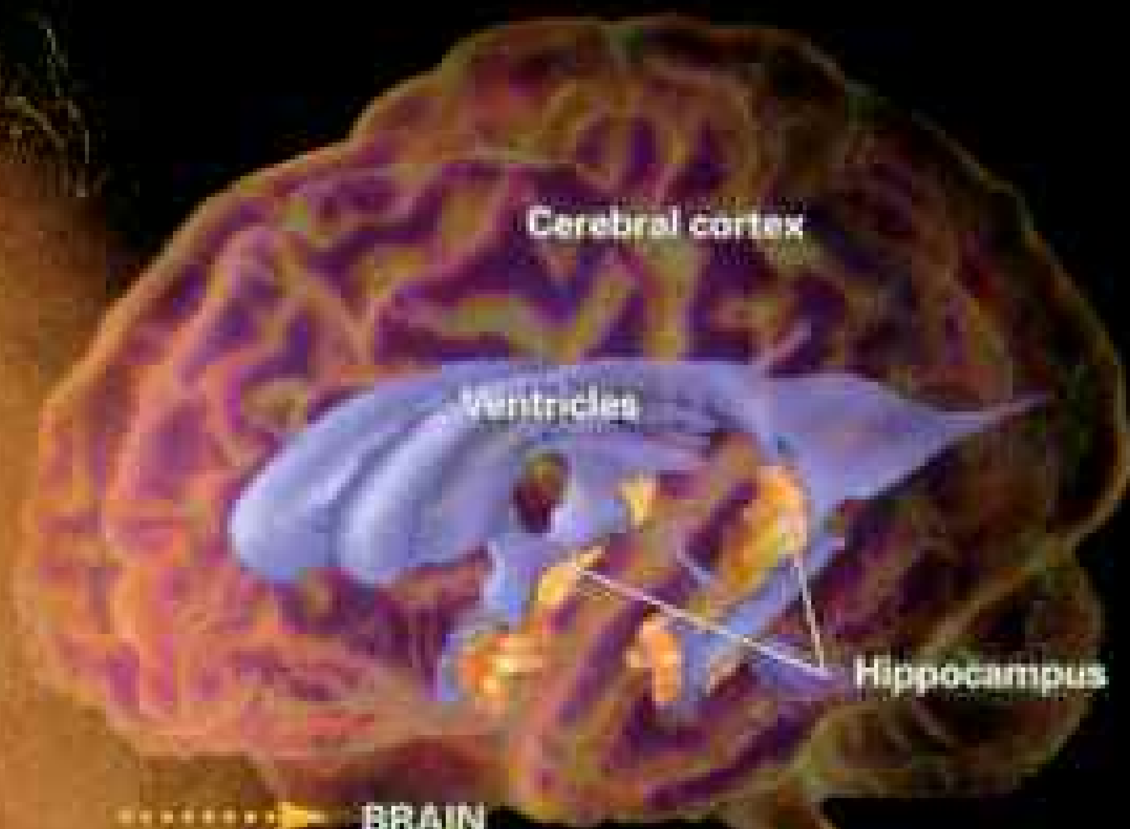
No one knows what causes the human clock to wind down. As scientists begin to probe our life-sustaining mechanisms, which are intricate, interlocking, and involve the very molecules that build our bodies, speculation abounds. "Explaining the complexities of our own experience of aging is a long way off," says James Fozard of the National Institute on Aging (NIA). "We're talking about little organisms in petri dishes now, not you and me walking around as we get older." The processes shown here may hold some clues.



FREE RADICALS
Nutrients and oxygen interact in the mitochondria to make energy for a cell. By-products include free radicals, such as molecules of hydroxyl (an oxygen and a hydrogen atom) and superoxide (two oxygen atoms), each with an unpaired electron. Most free radicals are mopped up by chemicals called antioxidants. Those that escape may steal or surrender electrons to rebalance their structure. In doing so, they can damage DNA, proteins, and the double layer of lipids that forms the cell membrane.

ART BY KEITH KASNOT

HAIR
As the cells that nourish it atrophy, hair thins in both sexes. Graying and balding are largely controlled by genes.



THE EAR
Loss of hearing normally begins in the 30s, as the eardrum and the three tiny bones of the middle ear lose some of their flexibility. Men tend to suffer earlier and more severely than women.

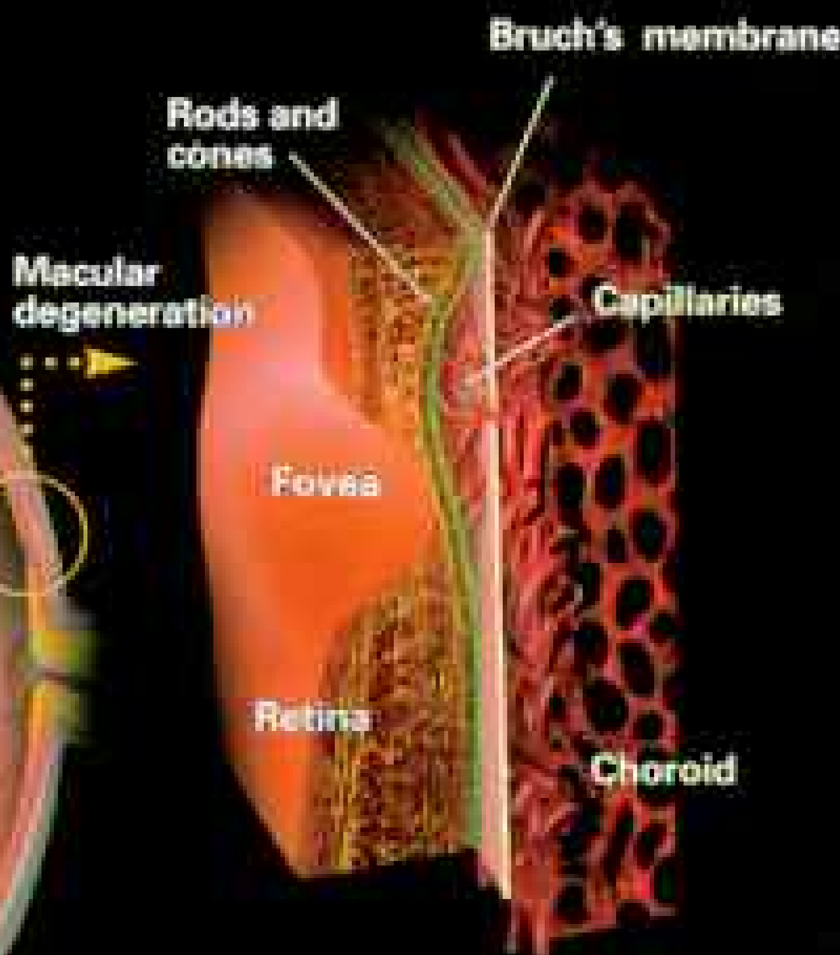
BRAIN
The aging brain slowly loses tissue in some regions. Reaching its maximum of about three pounds at age 20, it weighs 5 to 10 percent less by age 90. As tissue is lost in the cerebral cortex, the valleys widen and the hills narrow. The hippocampus, a critical memory center, is also affected. Ventricles, the brain's fluid-filled spaces, get larger. These changes may account, in part, for slowing reactions and faltering long- and short-term memory. Problem solving stays sharp at least until age 70. Personality does not change with time: An irritable 30-year-old will still be touchy at 70.

SKIN
Most complaints focus on sun damage: wrinkles, dryness, and dark spots. "The best way to prevent that is to pretend you're a Victorian lady and carry a parasol at all times," says Fozard.

NOSE AND TONGUE
The ability to smell and taste declines with age, but the reasons are not well understood.

HOW DO WE AGE?

"The scientific study of aging is a young discipline. It's only about 50 years old," says Fozard, director of the NIA's Baltimore Longitudinal Study of Aging, which began in 1958. Fozard and other specialists track the health of more than 1,100 volunteers of all ages in the longest such project in the U.S. This and similar studies reveal that much of what was once considered part of the normal aging process is the result of disease and unhealthy lifestyles. They have also identified many of the changes in the body that occur inevitably with time.



THE EYE
The pupil's ability to control light entering the eye diminishes. Also, as the lens thickens, muscles can no longer contract it sufficiently to focus on objects up close. Many of the elderly get cataracts, a clouding of the lens, which now can be surgically replaced. Some develop macular degeneration, which blinds the part of the retina responsible for critical central vision: the macula and its bull's-eye, the fovea. In one type of this disease, capillaries in the choroid layer break through Bruch's membrane, disabling the retina's light-sensitive rods and cones.

ARTERIES
Walls thicken. Cholesterol builds up along with calcium, reducing elasticity. "Even if you're a vegetarian, your arteries will harden," says David Snowdon. This raises blood pressure, which increases the risk of heart attack or stroke.

Cholesterol and calcium buildup

Carotid artery

HEART
Though its maximum rate slows, the healthy heart compensates for aging in subtle ways that keep its output the same as when it was younger. The heart walls thicken, for instance, putting more muscle into pushing the blood through stiffening arteries. The older heart cannot squeeze as hard as it once could. Yet when the body moves—even just to stand up—blood still must get to the active muscles. To make this happen, the walls of the ventricles stretch, allowing more blood to move through the heart per beat.

Wall

Ventricles

LUNGS
Losing elasticity, lungs cannot inflate or deflate completely. Between ages 20 and 80 their capacity may fall 40 percent, regardless of exercise. Coughing is more difficult as the diaphragm weakens.

METABOLISM
As cells become less sensitive to insulin, the body's ability to metabolize sugar declines. This often leads to a false diagnosis of diabetes.

Pancreas

Osteoporotic bone tissue

Normal bone tissue

Ovaries

HORMONES
At menopause a woman's ovaries produce less estrogen and progesterone, initiating abrupt changes in the body. In particular, bones lose some of their strength, and the risk of heart disease grows, catching up with that of men at about age 60. A man's testosterone level falls gradually, beginning in his 30s, and sex drive and reproductive capacity often decline. Eighty percent of all 80-year-old males have an enlarged prostate gland. Men's breasts also tend to swell.

BONES
Bone cells are constantly lost and replaced throughout life. At about age 35 loss accelerates, ultimately overtaking replacement. Menopause intensifies the loss; bones can become porous and brittle—a condition called osteoporosis.

Cartilage

Osteoarthritic knee

Normal knee

JOINTS
Wear and tear results in osteoarthritis in many older people. Cartilage gradually erodes, and bone grinds against bone without a cushion. Joints become stiff and movement is painful.

MUSCLES
Muscle mass decreases 5 to 10 percent during every decade of increasingly sedentary adult life: A 75-year-old's hand grip is normally only three-fourths as strong as that of a 30-year-old. Regular exercise slows the decline.

ART BY KEITH KASNOT

the era of eternal youthfulness might be nigh.

But it wasn't long before the growth hormone joined the ranks of other erstwhile fountains of youth. Many of the men developed side effects, including carpal tunnel syndrome (an inflammation of the nerves), diabetes-like symptoms, and the unexpected growth of breasts. Moreover, as soon as the men stopped taking the hormone—which costs $10,000 to $20,000 for a year's supply—its benefits quickly disappeared. The muscles melted away. The fat came back. The old men were simply old men again.

Since then, the anti-aging spotlight has swung to other hormones that also naturally decline with age, such as DHEA (dehydroepiandrosterone, the function of which remains largely unknown) and melatonin (made by the pineal gland in the brain, where it seems to play a role in setting the body's biological clock). Both hormones have attracted a lot of media attention.

But while replacement doses of certain hormones may eventually be shown to have specific benefits, as with estrogen replacement to protect against heart disease and osteoporosis in some menopausal women, the scientific consensus for now is that no single hormone holds the secret to youthfulness.

I LEAVE BALTIMORE a little despondent. Some people may hold aging at bay for a while. But for every Sister Esther there are countless others already disabled by the time they hit 60.

So I am heartened by my visit to Caleb Finch at the University of Southern California in Los Angeles. Finch is a world-renowned biologist who has gained a special perspective on aging by studying the process in hundreds of species, from African elephants to bristlecone pines.

"There is no reason to believe that there's an intrinsic limit to how long we can live," Finch tells me in his office, where an hourglass hints at his interest in biology's battle against time. "Life span," he tells me, "is completely malleable."

That doesn't mean that many people are already exceeding the 120-year life span generally thought to be the upper limit of reasonable expectation. In fact Finch wishes everyone would forget all the apocryphal stories they've heard about remote villages where, thanks to good yogurt or other secrets to long life, the indigenous people supposedly live to 150 or more. Some of these villages had found it was good business to lie about their residents' ages, Finch tells me, as it brought planeloads of tourists with money to spend, not to mention a parade of researchers.

The oldest person ever documented was Jeanne Calment of Arles, France, a soft-spoken but sassy senior who reportedly quit smoking cigarettes just five years before her death last August at 122.

That humans have the potential to live that long—longer than any other mammal and far longer than the maximum known life spans of most other species—is partly a tribute to our being such an intensely social species. In most species individuals don't live very long after they've grown old and infertile. Once an animal has lost its capacity to have offspring, the prime directive of evolution, there is little incentive for nature to favor its continued survival.

But for social species like ours, there are benefits to having adults survive longer than it takes to raise their young. Grandparents generally make fine baby-sitters, for example, freeing the parents to gather food and protect their territory. And in some species only the oldest few may remember where water or other resources can be found during extreme droughts or other shortfalls that occur only a few times in a century.

No matter how useful they may be, however, old people do eventually become weaker and more prone to medical problems and accidents. So if scientists hope to extend the maximum human life span beyond Madame Calment's record, Finch says, they will probably have to find out what causes that decline. Biologists argue vigorously over what, exactly, that fundamental mechanism of aging is.

One camp says that aging is linked to genetic programming. The other says that aging is mostly a matter of physical wear and tear—especially from exposure to oxygen, a Jekyll-and-Hyde element both necessary and damaging to most organisms.

Either way, scientists have the potential to slow the process down, but which hypothesis should they focus on?

Life spans in other species may hold some clues, Finch says. Fruit flies live for 30 to 40

days. Field mice typically live three years. Gerbils six years. Mountain goats, 14. Dolphins, 25. African elephants, 48. A pattern emerges, with smaller species generally living shorter lives than bigger ones. Do these smaller species have faster running programs, or are they more prone to wear and tear?

One way to find out, Finch says, is to study the exceptions—such as species that are small but nevertheless long-lived—and see what sets them apart from their peers. Something like turtles.

Many species of turtles and tortoises live a long time for their size. Some freshwater turtles survive 50 years or more, and Galápagos tortoises sometimes exceed 100. But they are of particular interest to gerontologists because they show virtually no signs of aging throughout their lives. They don't get disabled, weak, or fat, and most stay fertile and keep laying eggs until they die. In many respects they are models for how people would like to age: Stay healthy

Longer, healthier lives could result from knowledge gained in laboratories. At the University of Wisconsin–Madison an x-ray scan of a rhesus monkey, shown in a time exposure, will reveal the effects of a calorically restricted diet on the body. Severe calorie cuts have lengthened the life span of mice by 50 percent. Genetically altered to produce an abundance of antioxidants, a fruit fly at Southern Methodist University will live 30 percent longer than normal.

Identical yet individual, 77-year-old Kirsten, at left, and Grethe Hermansen respond as one during a coordination test in their Copenhagen home, part of a Danish study of aging in twins. "We have found that about a quarter of the variation in how long we live can be explained by genetic factors," says epidemiologist Kaare Christensen, who directs the research.

and active for a very long time, then die quickly from an accident or a fatal disease.

"What we've found," says Whit Gibbons, a biologist at the University of Georgia's Savannah River Ecology Laboratory, "is that no matter how long they live, turtles show no indications of senility or senescence."

How do they do it? One possibility is that turtles are genetically programmed to live longer than other animals.

The idea that aging might be linked to a biological program got its first big boost in the 1960s, when biologist Leonard Hayflick, now of the University of California, San Francisco, showed that cells taken from long-lived species will divide many more times in a culture dish than will cells taken from shorter lived species. It is as though each cell contains a program telling it how many times it is allowed to divide, then ticks off each division like clockwork until that limit is reached. After that the cells become senescent, and the body starts to decline.

Turtles are among a handful of animals, including some fish, that keep growing for as long as they live. That suggests that their cells don't have the same genetic constraints that seem programmed into the cells of many shorter lived animals and supports the idea that turtle life span is indeed a function of a longer running program.

But another possibility is that turtles manage to "stay young" longer because they are resistant to biological wear and tear—which would provide support for the other major theory of aging. Might they, for example, suffer less damage from oxygen?

Oxygen is essential for animal life, stoking the energy-producing reactors inside cells. But as a result of those fierce metabolic reactions, some oxygen molecules become electrically charged. These so-called free radicals can melt patches of cell membranes and damage snippets of genetic material. Many experts believe that free radicals are to blame for much of the progressive physical and mental decline we call aging.

Turtles, which are cold-blooded, have a very

slow metabolism. It may be no coincidence that many other animals with slow metabolism also enjoy relatively long life spans, including various species of snakes, fish, and frogs. No one knows, however, whether individual people with slightly slower metabolic rates live significantly longer than their fast-burning counterparts. And the rule is not perfect: Some birds with very high metabolic rates, for example, live quite a long time.

Ongoing studies may determine whether turtles' longevity is due primarily to their cells' genetic programming or to their cold-blooded chemistry—or to some entirely different evolutionary adaptation. But if turtle studies are going to lead to life extension for people, Gibbons sees a certain irony in the situation.

After all, people are the only serious threat to the survival of these otherwise long-lived reptiles. People capture them for pets, kill them for their shells, and drain their wetlands to build homes for the aged.

"If turtles know what's good for them," Gibbons says, "they won't give away their secret."

Mutations good and bad could offer information leading to cures for many diseases of old age. Caterina Segala, 80, and some other residents of Limone, Italy, carry a gene that boosts the effects of beneficial cholesterol, lowering the risk of heart disease. In San Diego 12-year-old Courtney Arciaga shows off her basketball skills. A mysterious mutation at conception has given her symptoms of the very old, such as a wizened appearance.

I NEVER THOUGHT I'd be looking for a fountain of youth in a dish full of worms, but that's what I'm doing in Boulder, Colorado.

The worms are nematodes only a millimeter long—a tiny squiggle of a species called *Caenorhabditis elegans*. Although they live in soil and feed on putrefying bacteria, they are surprisingly beautiful when viewed through a microscope, shimmering and translucent as they wriggle across my field of view in a shallow dish of nutrients. Most impressive, the ones I am looking at are almost 40 days old, or about twice the normal nematode life span.

Their longevity is due to a single mutation in one of their 13,000 genes—a gene aptly named *age-1*. Tom Johnson, the University of Colorado researcher whose lab I am visiting, explains that *age-1* is one of several recently isolated nematode genes that, when mutated, can greatly extend a worm's life span. The discovery gave credence to the notion that aging may be controlled by a molecular program.

It has been known for some time that genes can influence life span. A good way to predict how long a person will live is to find out how long his parents lived, evidence that longevity is at least partly inherited. Some genes affect life expectancy indirectly, by altering the odds of getting a deadly disease. But lately scientists have discovered a few genetic mutations that appear to affect aging specifically.

Last year, for example, researchers identified a mutation that causes Werner's syndrome, a disease that mimics certain aspects of the human aging process. People with Werner's grow wrinkled and gray while they are still in their 20s, develop cataracts a few years later, get cancer and heart disease in their 30s and 40s, and usually die before their 50th birthday.

Recent studies suggest that the Werner's mutation shortens life by interfering with the body's ability to repair the damage caused by metabolism, while the *age-1* mutation lengthens life by enhancing the ability to reduce, resist, or repair the damage done. Could the secret of longevity lie in something as basic as the ability to counteract the ill effects of metabolism? And if so, is there a way to cool that metabolic furnace without changing our genes?

RICK WEINDRUCH of the University of Wisconsin–Madison is a trim, bearded, blue-jeaned scientist and marathon runner who believes the answer to those questions is yes. His secret to long life? Eat less.

Expanding on studies done in the 1930s, Weindruch and his colleagues have shown that by reducing caloric intake 60 percent, laboratory mice can be made to live as much as 50 percent longer than normal. It is the only proven method of extending life span in mammals so far. And although it has not yet been studied systematically in people, Weindruch and others suspect it would have the same effect as it does in mice: longer life, stronger immune systems, lower and delayed incidence of diabetes, cancer, and other ailments of old age.

The diet is tricky, Weindruch tells me, since it's hard to cut out that many calories and still get all the nutrients you need. But it works—possibly by decreasing the damage that comes with metabolism.

Lately, Weindruch has been putting mice on restricted diets in their middle age. "I have a history of starting caloric restriction studies on animals that are the same age as I am," the 47-year-old jokes as we head over to the building where his mice are kept.

Inside the low-profile brick complex, Weindruch shows me huge barrels of yellow powder, the nutritional staple for his subjects. Enriched with all the vitamins and minerals a mouse needs, it is mixed with hot water and a gelling agent to make a cheesecake-like substance with only one-third the standard number of calories for a lab mouse. Then he leads me into a room with stacks of wire cages filled with charcoal-colored mice.

"Look at these coats," Weindruch says, admiring the animals' fur. "They look like young mice, but they're not. This guy is 32 months old," already a few months older than most mice of this type can be expected to live. "Seventy percent of his group are still alive, compared with 28 percent of the controls who have been eating standard diets. And that's even though he ate a normal diet until he was a year old—middle-aged for a mouse."

We walk into another room, where the control mice have been kept. It's full of cages, but nearly all are empty. "Here we're down to 21 animals from the original 75," Weindruch tells me. "And you can see what kind of shape they're in." Some are limping, others have bald spots or tumors. (When I call Weindruch for an update four months later, he tells me that all the elderly controls have died, but 15 of the geriatric mice on restricted diets are still going strong. After another four months, eight of those were still alive—as old in "mouse years" as a person over a hundred.)

We leave the mouse lab and head to the nearby Wisconsin Regional Primate Research Center, where similar experiments are under way on a group of aging rhesus monkeys. The experiments must run much longer than the mouse studies because rhesus monkeys typically live for 30 years or more, but the results after eight years of caloric restriction in these middle-aged monkeys parallel those from the rodent work.

There is a downside to caloric restriction, however, which is obvious even to a casual observer who visits during mealtime. The monkeys go crazy when the food shows up, grasping at their meager rations. I think about what it would take to cut even 30 percent of the calories from my daily fare. I broach this problem over lunch with Weindruch. He puts down his fork and concedes that hunger may be the biggest roadblock to human life extension by caloric restriction.

"Even a guy like me, who has studied this for 20 years, can't pull it off," he confides with just a hint of shame. "I'm unable to subject myself to what I subject my animals to."

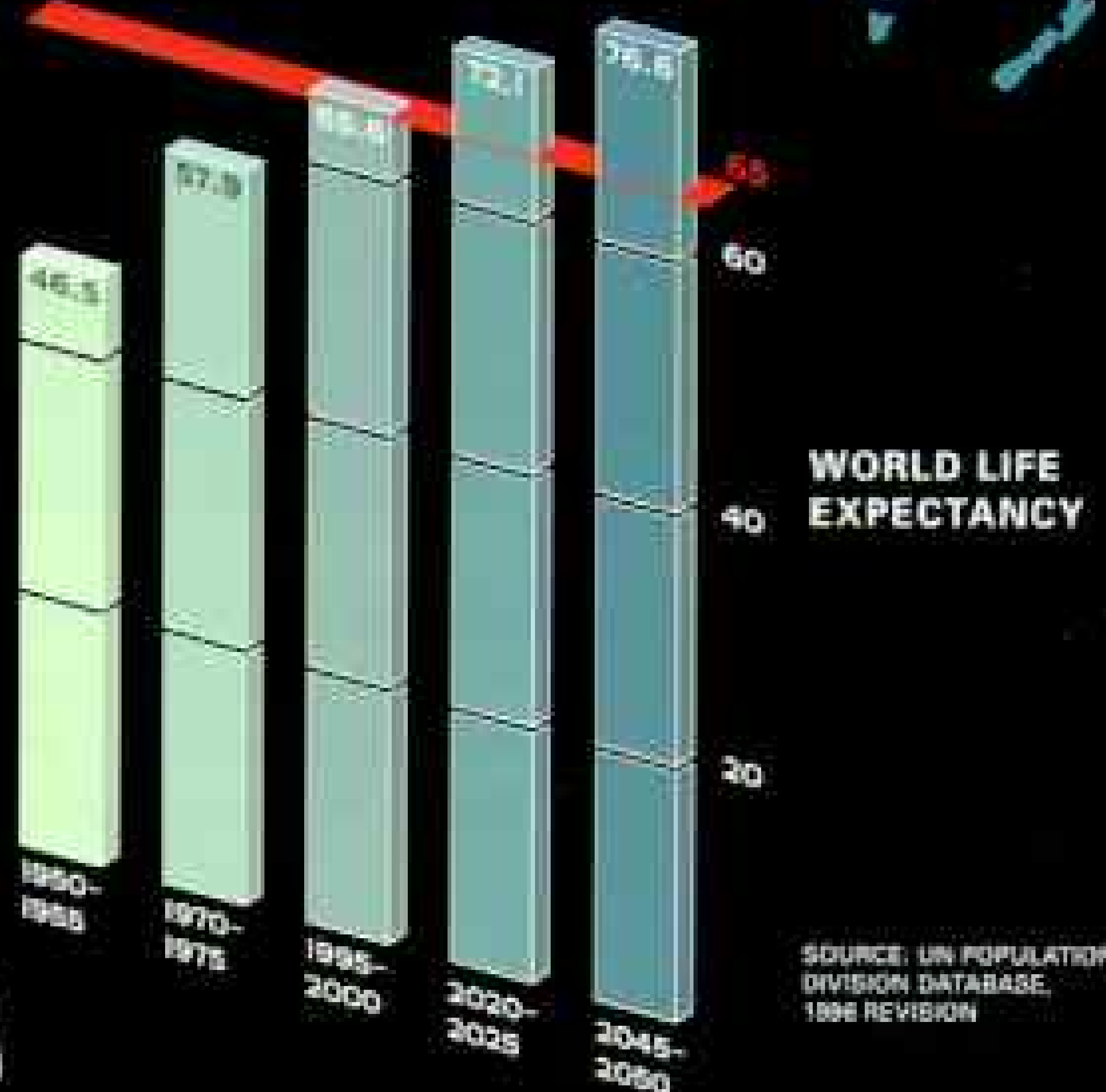
Weindruch recommends a diet low in fat (to minimize the number of calories consumed) and high in fruits and vegetables (in part because they are rich in free-radical-quenching antioxidants). I look down at my calorie-laden shrimp salad and my life practically passes before my eyes. But I am hungry, so I eat.

MIRIAM NELSON, a physiologist at the U.S. Department of Agriculture's Human Nutrition Research Center on Aging in Boston, doesn't need to eat like a bird. She's already found her fountain of youth.

I am talking to Nelson at the physiology laboratory on the Tufts University campus. Here she and colleagues Maria Fiatarone and William Evans have conducted a remarkable series of experiments with frail elderly people.

The room is filled with treadmills, exercise

LIFE EXPECTANCY
AT BIRTH
IN SELECTED
COUNTRIES, 1996



THE ELDER BOOM

At mid-century world life expectancy at birth was 46.5 years. Today better nutrition and medical care have lengthened lives around the globe (top). On average, people live longest in Japan, where 83-year-old retired farmer Fukashi Kanematsu fishes as a hobby. Life expectancy will likely increase in the next century (graph, above)—the world's over-65 population is expected to nearly double by 2020.

"Quality of life is what we're working for," says 83-year-old Grace Boyd, at left—widow of early cowboy movie star Hopalong Cassidy—who teaches tai chi at a Leisure World near Los Angeles. "No one is asking for a hundred years if they can't enjoy them." A martial art practiced for centuries in China, tai chi reduces falls by enhancing balance and strength.

bikes, and weights, but this gym's "members" are elderly research subjects who normally find it tiring just to climb the stairs. By training these seniors in a specially designed weight-lifting regimen, Nelson and her fellow researchers have shown that even 90-year-old weaklings can regain the strength and vitality they had 30 years earlier. And they can do it without all the special equipment in this room, by doing simple exercises in and around their own homes.

"Much of what we think of as aging is really just a by-product of inactivity and poor nutrition," says Nelson. "And it's not that hard to change that."

In one study of a hundred nursing-home residents ages 72 to 98, just ten weeks of weight training more than doubled the participants' muscle strength and increased their walking speed and their ability to climb stairs. Another study of 40 mostly sedentary women ages 50 to 70, which involved just twice-a-week exercises for a year, led to substantial increases in muscle mass, strength, balance, and bone density—the same kinds of changes that have been produced by injections of human growth hormone, but without any of the side effects.

"When we started, we were afraid we'd rip ligaments, pop tendons, tear muscles," Nelson says. "But all we got was stronger, healthier people."

In fact it seems that exercise naturally induces many of the anti-aging mechanisms that scientists have been trying to understand individually through their studies of hormone supplements, caloric restriction, and longevity genes like *age-1*. Exercise builds muscles and burns fat, makes the heart and lungs work

Rigged with sensors and safety harness, 72-year-old Alice Pueschner glides through a test of balance at the University of Oregon. "I'm an insane bicyclist," she says, explaining her agility. Researchers want to know why people tend to fall more often as they age. In 1994, 20 billion dollars was spent in the U.S. on care of the elderly who had suffered fall-related fractures.

more efficiently, lowers the concentration of sugars circulating in the blood that can gum up the body's systems, increases the flow of thought-provoking blood to the brain, and makes bones stronger and more dense.

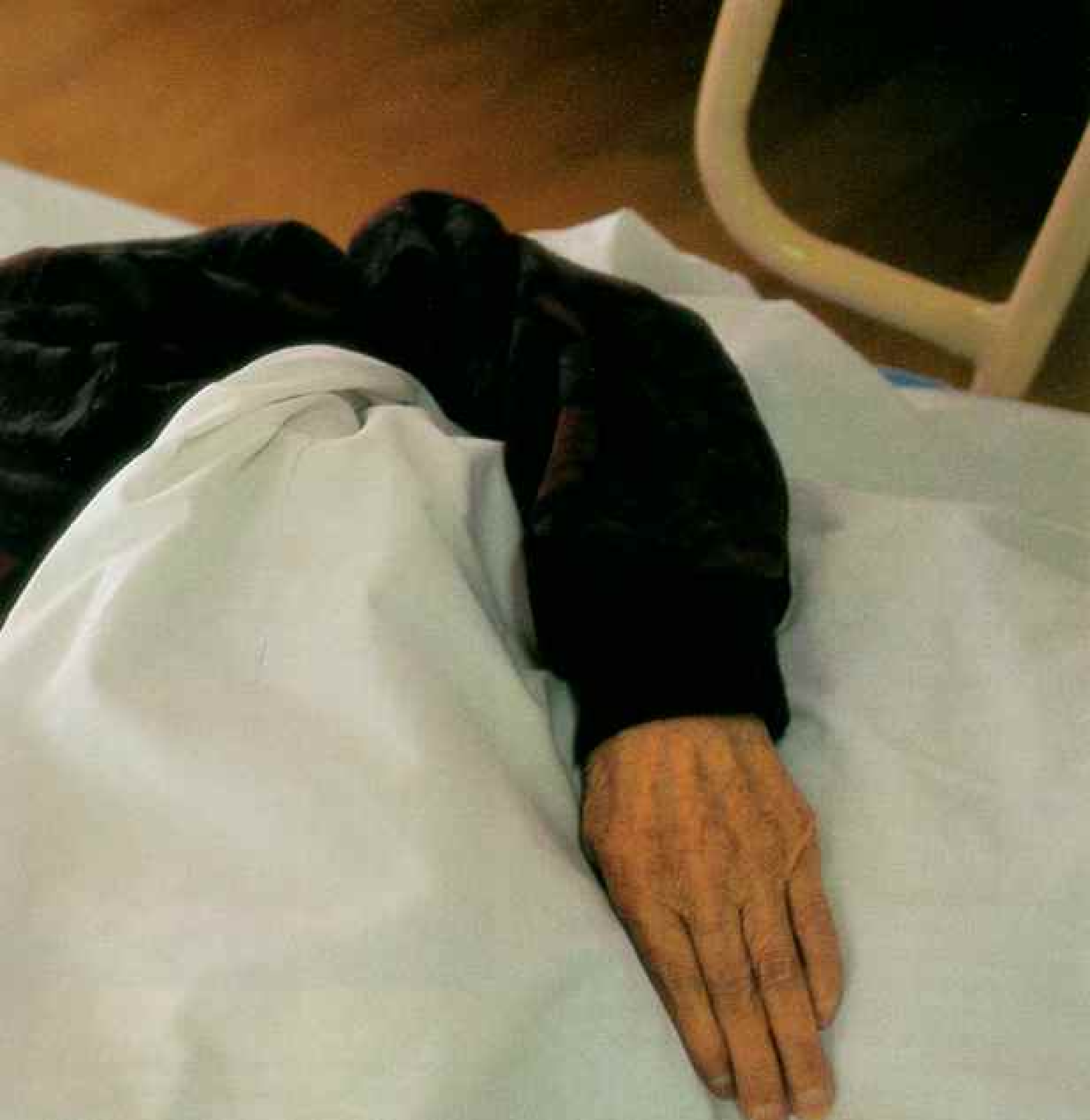
Alas, exercise also increases the body's metabolic rate—that candle of life that the fast-living burn at both ends. Yet moderate exercise may automatically offset that increase, by stimulating the production of little molecules called antioxidants.

Most cells in the body make various antioxidants to sop up the free-radical molecules generated by metabolism. Among them are enzymes such as superoxide dismutase (SOD for short) and catalase. Can antioxidants add years to life?

In one experiment fruit flies genetically engineered to produce large amounts of these natural antioxidants lived 30 percent longer than normal flies. And these geriatric flies didn't retire in wheelchairs. They hopped around in their glass vials like flies half their age. Studies later showed that their tissues had far less free-radical damage than normal—evidence the antioxidants were doing their job.

No one knows whether antioxidants can extend life in people, but some antioxidant dietary supplements like vitamins E and C have been shown to reduce the risk of heart disease, cataracts, and the skin changes that can precede cancer. It may be that antioxidants—whether taken in pill form or produced naturally by the body—offer an antidote to the damage that exercise causes, for the net effect of moderate exercise is clearly positive.

And it's not only the body that with exercise



A peaceful slumber embraces 87-year-old Yoshi Seki after her bath and lunch at an adult day-care center in Yamato, Japan. Later she will join in social activities—a card game, perhaps, or karaoke. Partly paralyzed by a stroke, Seki also receives therapy here. She comes three days a week, freeing family members for other duties. With the fastest aging population in the industrialized world, Japan has made elder care a national priority and subsidizes centers such as this.

A handstand is child's play for lifelong gymnast George Nissen, entertaining his grandson Jake in San Diego. Inventor of the trampoline, he is still launching new products at age 83. "People think I'm nuts," he says. "But gee, I could have 20 years to go." Keeping both his body and mind in fine shape, he may well turn that possibility into reality.

can be made to act younger than its age. Studies show that the aphorism "Use it or lose it" applies equally well to the mind. Rats kept in a visually and intellectually stimulating environment, such as one with complicated mazes, stay smarter in old age than do rats kept in ordinary cages.

The same has been shown to be true for people. Adults who keep reading, learning, and interacting with others are far less likely to lose their memory or decline into senility than those who retreat into themselves as they age. It seems the mind is like a muscle that can best be kept in shape through regular exercise.

BACK AT THE CONVENT in Mankato, I walk across a frozen lawn to the chapel for early Mass. An electrifying sunrise, streaked with hot pink and orange, lights the totally silent and peaceful morning.

Inside, the sisters enter slowly from the hallway that leads from their quarters. Some walk unaided, others hold on to metal walkers for support, and still others arrive in wheelchairs pushed by sisters not much younger than themselves.

I now know that these differences in vitality can be traced partly to genes—the random patterns of inheritance that account for so much of human diversity. And I know that some of the variation is due to differences in physical and mental activity.

But looking at these sisters makes me realize that aging is more than a matter of biology and life history, of genes and environment. It is also a matter of sociology—of how a person shares the experience of old age with others.

Gerontologists are just starting to appreciate the ways that social and psychological factors can contribute to the quality of life in old age, and even to longevity. Studies have shown that seniors who have emotional support from friends and family have lower levels of stress hormones circulating in their blood and are less likely to die in the near future than are those who feel lonely and isolated.

Scientists don't know all the ways that emotions and attitudes influence physical health. But health does seem to be enhanced by giving and sharing. Older adults stay happier and healthier when they have pets, for example, especially if they actively take care of those pets. There is something about the act of caring for others that seems to enhance one's "vital spirit." And that life-giving generosity is alive and well, I realize, among the participants in the Nun Study, who will give up their brains after they die so others may benefit.

"Lord, who are we that you care for us?" reads Sister Ann Marie Merth, leading this morning's prayers in the chapel. "Mere mortals

that you keep us in mind. Human beings who are merely a breath, whose lives fade like a passing shadow. . . ."

The words could be sad, but somehow in this chapel of graying sisters they are not. In this community, where the old and the older take care of each other, it seems that the secret to aging well is to find a graceful balance between trying to stay young and accepting the ephemeral nature of life.

I recall a talk I had with Sister Esther Boor, the lively centenarian, about the pleasure she takes in playing card games. "I like to win," she told me, "but it doesn't bother me if I lose." It seemed to me that this was her attitude toward life itself, and that somehow it contributed to her happiness and her longevity. It is an attitude that will never show up in Snowdon's studies of the sisters' brains. But it is one that already inspires him in his work.

"I just love these sisters," Snowdon says of his subjects, who tease him by constantly asking when he's going to find a girlfriend and get married. "These are the gems in the gold mine," he tells me, these sisters who have spent their lives in service to others and who have found a way to keep on serving after they die.

"'This is my body, which will be given up for you,'" the priest intones in the chapel as the sun breaks free of the morning clouds. I watch the sisters' lips moving silently along with his words. "Do this," they say, "in memory of me." □

For more about new research on aging, join our online forum at www.nationalgeographic.com.

Wilderness Rafting

CHALLENGING THE CHAOS of white water, Andrei Ivanov steers a craft called a *bublik*—Russian for bagel—down Uzbekistan's Oygaing River. In a week-long, teeth-gritting adventure, a six-man Siberian team took on rapids in Central Asia with jerry-built rafts, hockey helmets, home-sewn river wear, and a taste for adrenaline.

Siberian Style

By MICHAEL McRAE

Photographs by DUGALD BREMNER

Yuri Snegir was in serious trouble. The thundering Oygaing River had just seized his makeshift birch-log cataraft and sent it cartwheeling over a ten-foot waterfall. The overturned craft's twin pontoons—patched like secondhand inner tubes and lashed to a frame of freshly cut timbers—bucked and swirled in the cauldron below the drop. The veteran expedition leader and his young protégé, Andrei Izhitsky, were trapped in the hole upside down, held fast to their pontoons by thigh braces improvised from lengths of fire hose. Precious seconds were ticking by.

Suddenly Andrei popped to the surface gasping for air, followed immediately by Yuri's paddle—a bad sign. Several days earlier at the put-in, in eastern Uzbekistan near the river's source high in the Tian Shan range, the hard-boiled leader's send-off had been terse and unceremonious: "If you capsize, don't lose hold of your paddle."

A long minute passed before Yuri appeared, now far downstream and obviously dazed. Too weak to cling to rescue lines his teammates heaved from shore, he was swept along like a rag doll for hundreds of yards before disappearing around a bend. By the time his teammates found him, he was crawling up on the rocks—pale, shivering, and retching water. The others rushed to help him, but he was in a black mood and waved them away. They helped him struggle out of his sodden clodhoppers and homemade overalls anyway, and stripped off his flimsy green fishing waders, which bulged with water. Sitting by himself in his disintegrating long johns, he puffed cigarette after cigarette until, 15 minutes later, he'd regained his steely composure.

This was traditional Siberian wilderness rafting: short on cash, long on ingenuity and determination, pitting boats of military surplus material and foraged logs against the great white-water rivers of Central Asia and eastern Russia. Yuri and his five teammates were members of the municipal outdoor club in the Siberian city of Rubtsovsk, and passionate about their sport—as they would have to be, given the state of their equipment and their preference for extreme rivers.

With as much authority as he could manage, Yuri summoned the team. Tall and sinewy, he wore owlish glasses and a downturned mustache. He announced that two members of the group would immediately run the falls in the *bublik*, a bizarre-looking craft with two doughnut-shaped pontoons linked by 15-foot logs. Instead, the team decided to hike upriver to the previous night's camp for lunch, and, after slurping down bowls of lentil soup, all but Sergei Ushakov lay back in the sun for a smoke. The usually exuberant electronics engineer of 43 rose to speak his mind.

"Being the oldest member of this team," he began gravely, choosing his words with care, "I have a right to express my opinion. Considering the events of this day, I think everyone needs to take this river more seriously."

Until then Yuri's judgment had gone unquestioned. As

Dugald Bremner, who died earlier this year in a kayaking accident, worked as a dory guide in the Grand Canyon before embarking on a career as an adventure photographer. Michael McRae, who lives in Ashland, Oregon, is the author of *Continental Drifter: Dispatches from the Uttermost Parts of the Earth.* This is his first article for National Geographic.

BURDENED with overloaded backpacks, the team forges across the bleak beauty of a glacial pass (above) high in the Tian Shan range of Kyrgyzstan. The rafters carried everything needed—food, clothing, and the deflated components of their rafts—in loads of 100 pounds or more. Just to reach this point, they endured 36 muscle-stiffening hours on the train from Rubtsovsk, then journeyed by van to 11,300 feet, where they started the ten-mile hike across the pass. At 11,800 feet, team leader Yuri Snegir slumps on the edge of exhaustion. His breathing labored from years of smoking, he orders the group to make camp. The next day a safety line helps the men ford a tributary. "With 100 pounds on your back, you don't want to fall," said photographer Dugald Bremner.

LATE AUTUMN SNOW **softens the granite pinnacles of the Tian Shan range, rising above the Oygaing River to 14,700 feet. With many rapids rated Class VI in the Russian system, the Oygaing is runnable only by the most skilled rafters. Flowing 50 miles west from its headwaters, it joins other rivers to empty into the Aral Sea.**

chairman of Rubtsovsk's outdoor club, he had been decorated for outstanding leadership by the governing body of the former state recreation system. He'd held the prestigious status of journeyman machinist in a military factory. But after the Soviet Union broke up, Yuri had decided to open a consumer electronics shop. Most of the others had also been forced to improvise. Andrei Izhitsky was a part-time construction laborer, as was Andrei Ivanov. Yevgeny Ulyanov found some work as a lathe operator. Dima Skubach was unemployed. Only Sergei had displayed a flair for private enterprise: He'd started what has become a successful tour company.

This was the team's final outing of the year. They'd chosen the Oygaing-Pskem drainage mainly for its southerly location (it was late autumn, and some Siberian rivers would soon be snowbound) but also because of its remoteness and exceptionally challenging white water. Both rivers include rapids rated Class VI in the Russian system, meaning unnavigable by all but the most experienced boaters. The last Rubtsovsk team to try, in 1988, quit after four days, driven out by hideous weather.

Fueled on rations of borscht, raw garlic, pork fat, and boatman's vodka—grain alcohol diluted with river water—the team planned to cover a hundred river miles in two weeks. They'd brought no sunglasses, one flashlight among them, and precious few garments that would pass muster in Western boating circles. The canvas and rubberized fabric for their homemade raft pontoons had been scrounged from factories and military plants. And while aluminum tubing is readily available in Russia, in this

case the team avoided carrying the extra weight by cutting trees for raft frames after reaching the river. Green birch is favored for its strength and resilience.

Photographer Dugald Bremner and I, with Latvian-born interpreter George Aukon, a Grand Canyon river guide, met the team at the train depot in Taraz, formerly Zhambyl, Kazakhstan, a city of 300,000. Sergei had arranged for the team to stay at the home of a friend, Ludmila Sheleva, a sunny woman in her 70s. A retired doctor and a widow, she lived in a farmhouse with her two little dogs. She put us in the whitewashed guest cottage by a weedy cabbage patch.

That evening we dined on satisfying potato soup and hunks of coarse bread, and afterward Sergei and I shared the *banya,* a dimly lit bathhouse that doubled as the laundry shed. Steam from the

hissing boiler swirled around the room's bare lightbulb, and the sweat streamed down Sergei's bushy red beard and broad chest.

Nicknamed Boroda, or "beard," Sergei was the group's philosopher and sage—as outgoing and warm as Yuri was dark and joyless. "Sometimes we need to go out in nature and find some difficulty and say, 'Wake up!' to our internal energy," he said, dousing himself with a bucket of icy water. "We face difficulties that test us, but even they are a gift from God. It's all experience, and it's up to you to make what you will of it."

WE ROLLED OUT of Taraz in a hired van the next morning while the roosters were still crowing. Crossing into Kyrgyzstan a half hour later, our driver, Misha, geared down for the climb into the Tian Shan. At 11,300 feet the road became impassable. We had four hours of daylight, six hours of hiking ahead, and snow was beginning to fall.

As we prepared to hoist our packs, two figures on horseback appeared, descending from the heights. They were Kyrgyz hunters, dressed in greasy fur coats and packing battered carbines. From the look of their bulging saddlebags they'd had a successful hunt. Their whippet-thin dogs growled at us suspiciously but kept their distance.

"We're crossing the pass and could use some help with all of this," George hailed them in Russian, gesturing at our enormous packs.

"Forget it," the men said. "We're not interested."

"We can pay you. We have money and food."

The hunters looked back at the pass, now obscured by blowing snow. "Nah, we don't need anything you have," they said, wheeling their horses and trotting away.

The storm soon closed in with a vengeance. Yuri decided to cache the heaviest gear and return for it the next day. Yet even with lighter loads, the going was slow.

"This is why we should have brought pack animals," George said, trudging across the glacier. Growing up in Latvia, he had developed strong opinions about the Russian psyche. "They're forever creating their own problems and taking pride in powering through stoically and with great strength. You always hear about them, 'First

"IT'S A SIBERIAN SUPERPUMP," says Sergei Ushakov (left) of the "dry bag" the team used to trap air to fill the bublik. At the river the two inflatables—canvas-covered bladders—are carefully lashed to a birch frame (top left). Once launched, the bublik glides easily over boulders (right). "It's like an army tank for water," says interpreter George Aukon. "It goes everywhere."

comes the action, then later the thinking.' "

Unable to see even 20 yards in what had become a blizzard, we bivouacked just below the pass. The Russians, packed like puppies in their leaky tents, passed a cold, wet night but powered on all the next day to the Oygaing. There we hunkered down listening to sleet crackle on the tent canopies or huddling around the campfire in steaming clothes, drinking sweet tea or smoking harsh Russian cigarettes.

Finally, in the morning, the sun appeared, revealing our campsite to be a lovely spot. Wild roses with plump red hips grew everywhere, and the birch and sumac were turning fall colors. The roaring turquoise river tumbled through a valley littered with colossal boulders that had hurtled down from the Tian Shan's crumbling peaks.

In the bright, warm air of morning the Russians emerged from their tents for calisthenics. While Sergei performed stretching exercises, Dima and the two Andreis cranked out 35 push-ups each and pressed boulders overhead and behind their necks.

When Yuri and his fit young disciples took off to retrieve the cached gear, Andrei Izhitsky, nursing a sore knee, stayed behind with Dugald, George, and me to supervise construction of the raft frames. He'd built his first raft at age 13 for his school's outdoor club. Under the Soviet system most schools had a club, and so did factories and municipalities.

Late the following day—

BUCKING like white-water wranglers, two raftsmen fight the current astride the twin pontoons of a cataraft. Highly maneuverable, it corners quickly around tight turns, but deep holes at the bottom of a drop can spell danger. Nose-diving into the river, it can buckle and flip, leaving paddlers flailing.

with the team reassembled, the frames built, pontoons inflated, and the last toast raised to success—we turned in, ready to face the Oygaing.

"FORWART!" George barked at the first rapid below the put-in. "Now beck! BECK!!" The flotilla was at last under way, six days after leaving Taraz. Following George's staccato orders, I backpaddled furiously. Our cataraft turned nimbly through a pair of boulders midstream and skirted the standing wave below. Meanwhile, the bublik barged right through on our tail, its monstrous pontoons looking ludicrously outsized in the shallow water. Still, the big doughnuts allowed Dima and Andrei Ivanov to slide over boulders that we had to dodge, and wiggle through tight passages by swinging left or right—or turning around entirely. It made no difference which end went first.

Now that we were making good time, Yuri seemed to mellow. Sitting by the fire one evening, he told me he'd run the toughest rivers in Siberia but was proudest of his leadership awards, one of which was for the 1991 Bashkaus River Expedition. "We ran one waterfall in our bublik that no one had completed before," he recalled, describing every inch of it in detail.

Did the rapid have a name?

"*D-d-da,*" he stuttered. "It is called Vladimir's Heart." He fell silent. Then, standing, he said, "There is work to be done" and strode away.

Yuri's speech impediment came as a surprise. It probably explained what I took for stony silences. But why had retelling the story triggered his stammer? George filled me in. The rapid was named for Vladimir Cherepanov, Yuri's paddling partner on a 1990 Bashkaus expedition. The two had attempted the

falls, but something had gone wrong. Their cataraft overturned below the falls. Yuri had survived; his close friend had drowned. Other men might have hung up their helmets and quit the sport.

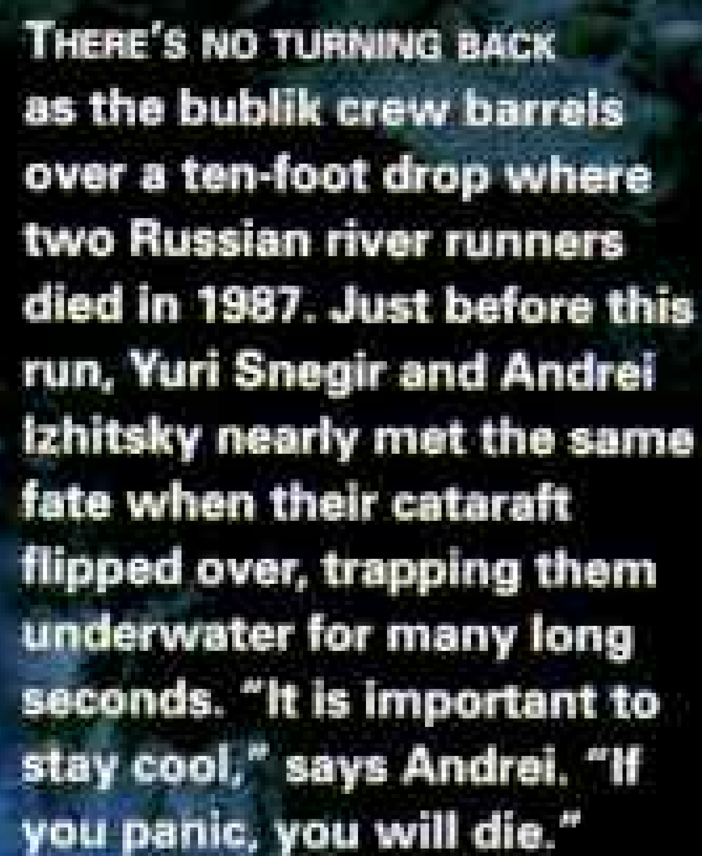
After two days on the river, we faced the first serious rapid: a fang of black rock ten feet tall jutting up in midstream and splitting the current into two channels. One, to the right, spilled over a low drop, while the other funneled into a tight sluiceway bounded by a cliff. Immediately below the obstruction, the river hooked a sharp left.

Yuri impatiently ran the rapid with Andrei Izhitsky—without announcing his departure—and pulled up on the opposite shore. The others followed, leaving George and me still deliberating about the safest line. Yuri bellowed at us to hurry up.

Our cataraft bucked like a mustang heading into the run. I nearly lost my paddle, then, reeling, almost went overboard. "BECKPEDDLE," George screamed. It was too late; without my help we missed the critical S-turn, were forced left, and became wedged between the cliff and the black spire.

"Hoo, boy," George said, "this is bad." The others were waiting around the bend ahead of us, out of sight and of no help.

In desperation, I reached up, tugged at the nose of my now leaking pontoon, and the boat moved ahead six inches. Clawing at the rocks, we inched our way forward and popped out of the channel—only to be smashed sideways into a flat-faced boulder at the apex of the river's left turn. A loose line on the boat became ensnared between submerged rocks. Held in place, and with the full force of the current slamming into us, George's pontoon began to be sucked under. He leaped onto my pontoon, cut the line, and we swirled free.



THERE'S NO TURNING BACK as the bublik crew barrels over a ten-foot drop where two Russian river runners died in 1987. Just before this run, Yuri Snegir and Andrei Izhitsky nearly met the same fate when their cataraft flipped over, trapping them underwater for many long seconds. "It is important to stay cool," says Andrei. "If you panic, you will die."

[illegible]

Yuri had already turned back to his boat, unconcerned, by the time we hauled our crippled boat ashore. George was livid. "This is not a team!" he fumed. "From here on, we make our own decisions."

By all reports what lay ahead was radical, continuous white water. According to a map sketched by a 1975 team from Novosibirsk, the next 12 miles of river poured through a steep-walled canyon.

"Now we will send scouts to see what lies ahead," Sergei said. After a rollicking bit of Class IV water the riverbed tilted steeply, and the channel became choked with boulders the size of motor homes. George's altimeter readings indicated that the gradient exceeded 300 feet per mile. It would be madness to attempt that. Even Yuri agreed. The Russians stoutly spoke of portaging past the steep section, but by then everyone knew the expedition was over. They'd made it only 25 miles in a week's time and would be overdue at home. But for George, Dugald, and me it was enough to give us a taste of traditional Siberian rafting—garlic, borscht, birch logs and all.

A six-wheel-drive troop transporter rumbled up the track to our camp two mornings later. George and Yuri jumped down from the vehicle and told us to get a move on. They'd hiked to a potato-farming collective and cut a deal with the driver. We struck camp, packed up the boats, and bid the Oygaing a hasty farewell.

Bouncing down narrow mountain roads, we were a group of 21: a dozen Uzbek field hands, six Siberian rafters, a Latvian, and two Americans, along with backpacks, suitcases, sacks of potatoes, and Dugald's fully stuffed kayak. The workers shared their sweet wine and balls of dried goat cheese with us, and a group of giggling Uzbek women in a passing orchard wagon bombarded us with succulent red apples. It was a time of high spirits, but Yuri again seemed to withdraw into himself.

I recalled a conversation we'd had the previous night by the campfire. I had asked him what he enjoys most about running rivers. "That is a difficult question," he'd replied. "It's my favorite thing to do. I gain moral satisfaction from challenging nature and winning. Nature is always stronger, but in this I have endured. I have come through alive. Also, only on the river do I feel my professionalism and experience. Here I am a specialist."

In Tashkent, when the team left our rooming house to catch the train north, Yuri shouldered his bulging pack, shook my extended hand perfunctorily, and walked out. He was going home, not to receive a hero's laurels but to sell TVs. □

CAMARADERIE AND A CAMPFIRE glow at river's edge. As the team settles in for the night, Dima Skubach tunes his guitar and sings an old rafters' song: "If some tragedy befalls us . . . I will not think of anything but my friend. My soul, my hand, and my heart I will give to him."

Photographer Dugald Bremner Dies

I met Dugald Bremner last year when we assigned him to photograph this article. His artistry and resourcefulness marked him as a future star.

On June 3, just ten days after this layout was approved, the world-class kayaker drowned when his craft was sucked into an underwater crevice on Silver Creek, a tributary of California's South Fork American River. He was

MICHAEL McRAE

doing what he loved, shooting photographs while shooting rapids. He never knew that we had just given him another magazine assignment.

Staff photographer Sam Abell brought Dugald to us after seeing his work at a photography seminar. Writer Scott Thybony recalled Dugald's charm: "Women remember him reciting Shakespearean sonnets; men remember his irreverent wit."

We will miss him.

THE EDITOR

Symbol of independence, the fleur-de-lis is proudly displayed on faces, flags, and T-shirts in Montreal

Quebec's

on St. Jean-Baptiste Day among French-speaking Québécois who want to secede from Canada.

Quandary

By IAN DARRAGH
Photographs by MAGGIE STEBER

PEALS OF LAUGHTER filled the room. Louis Wauthier, our caller, was slipping his own risqué variations into the *contredanse* we were performing at the folk evening in Chicoutimi, Quebec. As in square dancing, in the contredanse, which originated in 18th-century France, you're supposed to unquestioningly obey the caller's commands. But Wauthier, who was wearing the brightly colored sash of the voyageurs—the early French explorers of Quebec—was pushing the limits. We had started by forming into long, parallel lines. After swinging our partners and promenading up the middle, we completed a series of intricate figures at an increasingly frantic pace. Now Wauthier was ordering us to stand *dos à dos* (back-to-back), urging us to move closer until we were touching. After an initial gasp of surprise, everyone complied, and I found myself derriere to derriere with an attractive grandmother in a flowing dress out of the 1890s, with plumed feathers in her hat.

Suddenly my partner gave me a sharp push with her backside, sending me sprawling across the floor. She had understood the caller's command in French a split second before me and had obeyed all too enthusiastically. As the fiddle and accordion players led us on with their fast-paced jig, I picked myself up off the floor, moved down the line, and, with some relief, changed partners.

This was Chicoutimi's winter carnival, a yearly celebration of Québécois culture, and although it was past ten o'clock, kids as young as six and grandmothers in their seventies were stepping and swinging with unflagging energy to dances such as *L'oiseau dans la cage* and *Le p'tit train de Jonquière.* At the beginning of the evening's festivities we had been divided into three teams. Each was given a family name common in the region—Tremblay, Bouchard, or Simard—connecting us to the first French settlers in 1838. Between dances we had competed in log sawing and other contests, with much cheering and good-natured rivalry. As I looked around at the laughing, sweaty faces, I thought: This could only happen in Quebec.

Largest of Canada's ten provinces, Quebec is the only predominantly French-speaking political entity in North America aside from the islands of St.-Pierre and Miquelon in the mouth of the Gulf of St. Lawrence—tiny vestiges of France's New World empire. In recent years the province has been the focus of the nation's worst unity crisis since its birth in 1867. In a referendum held in October 1995, Quebecers voted by a mere one percentage point to stay within Canada, but a majority of French speakers—60 percent—voted for independence.

That the Canadian federation has survived this long has to do with various compromises made on behalf of Quebec. The province retains its own distinct legal system and has been given special powers over immigration, enabling it to attract French-speaking newcomers. In the past 20 years, however, these compromises have worn thin, and constitutional amendments to patch things up have failed to win approval. Canada has come to resemble a bickering family, with one member periodically threatening to pack up and leave.

"We are on the edge of a precipice," Bernard Morin, an engineer from Jonquière told me. What he meant was that if Quebec leaves the federation, the Atlantic provinces will have no land link to the rest of Canada. Prosperous British Columbia—with its thriving trade with the Pacific Rim—might also secede, and the entire nation could become unglued.

To federalists the prospect of another Quebec referendum on independence is a sword of Damocles hanging over the province—and Canada—creating unbearable uncertainty that has stifled investment. But sovereigntists see referendums as the ultimate instrument of democracy. Lucien Bouchard, Quebec's premier, has vowed to hold another referendum shortly after the next provincial election (in

IAN DARRAGH, a native of Montreal, was editor of *Canadian Geographic* magazine from 1989 to 1995. This is his first story for NATIONAL GEOGRAPHIC. Texas-born photographer MAGGIE STEBER now lives in New York City. Her coverage of the Cherokee appeared in the May 1995 issue.

Chanting "Don't mess with my vote," Quebecers loyal to Canada demand an inquiry into voting irregularities during the 1995 referendum on Quebec's future. Fraud charges were made in four electoral districts. Traumatized by how close Quebec came to seceding, English-speaking Quebecers are becoming more outspoken about protecting their rights.

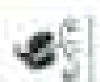
1998 or 1999 at the latest) "to ensure Quebec enters the next millennium as a sovereign country." If Quebec leaves Canada, a growing number of Quebecers, including aboriginal peoples who want to remain Canadian, say the province should be partitioned.

I WANTED TO FIND OUT why support for sovereignty has intensified among the Québécois, as French-speaking Quebecers are known. My search for answers began in the Saguenay, because this isolated valley surrounded by the ancient rocks of the Laurentian Mountains is the heartland of the separatist movement. Of the 300,000 people who live here, 98 percent are French speaking, and in the last two referendums, in 1980 and 1995, 70 percent of them voted for independence.

In Chicoutimi, the largest city, I stayed at the home of André and Ginette Bergeron. Both were born in the Saguenay, speak only French, and come from large families. André, a retired physical education teacher, has six brothers and six sisters. Ginette, who manages a day care in a nearby school, has two brothers and seven sisters. It was Ginette who took me to the *soirée folklorique* at the winter carnival.

"The people of the Saguenay know how to have fun," Ginette told me over one of her multicourse meals. We started with soup and crusty rolls, moved on to *tourtière Lac St.-Jean*—a pie filled with beef, chicken, veal, pork, and potatoes—and ended with chocolate cake, all topped off with a plate of cheeses and grapes. Through it all Ginette never neglected my wine glass. "We love music and celebrating," she said. "At the carnival the dancing goes on till four in the morning."

Every evening the Bergerons visit back and forth, and family members are greeted at the door with a bear hug and kisses on both cheeks. After a few days I grew used to the Bergerons' rapidly spoken French, sprinkled with local phrases and English words. I learned that "*jaser*" *(Continued on page 55)*



A relic of British pomp and pageantry, the marching band of the Royal 22nd Regiment performs during a flag-lowering ceremony at the Citadel in Quebec City, with the Château Frontenac Hotel as a backdrop. Founded in 1914 by French Canadians, the Royal 22nd has

served overseas in both World Wars, in Korea, and in United Nations' peacekeeping. Most members are French-speaking Quebecers, and if the province breaks away, they will face a dilemma: Resign, join a new army, or exit Quebec as an intact Canadian unit?

Quebec is the "cash cow" of Canada, many Québécois think, convinced that they pay more taxes to Ottawa, the national capital, than they receive in benefits. Yet even Quebec government studies show that the province receives a net cash flow of at least two billion dollars

U.S. from Ottawa, while other studies reckon it to be much higher. Quebec's dairy farmers are themselves guaranteed a 47 percent national market share for processed milk. Despite such subsidies, support for independence remains strong in rural French-speaking areas.

The Cree and Inuit of northern Quebec held their own plebiscites and voted to remain in Canada.

Cree

Inuit

Chicoutimi

Jonquière

Quebec

Montreal

Pontiac

Yes to separation

No to separation

Forestry (pulp and paper)

Hydroelectric station

Manufacturing center

Mining center

Native American community

Major airport

Passenger railroad

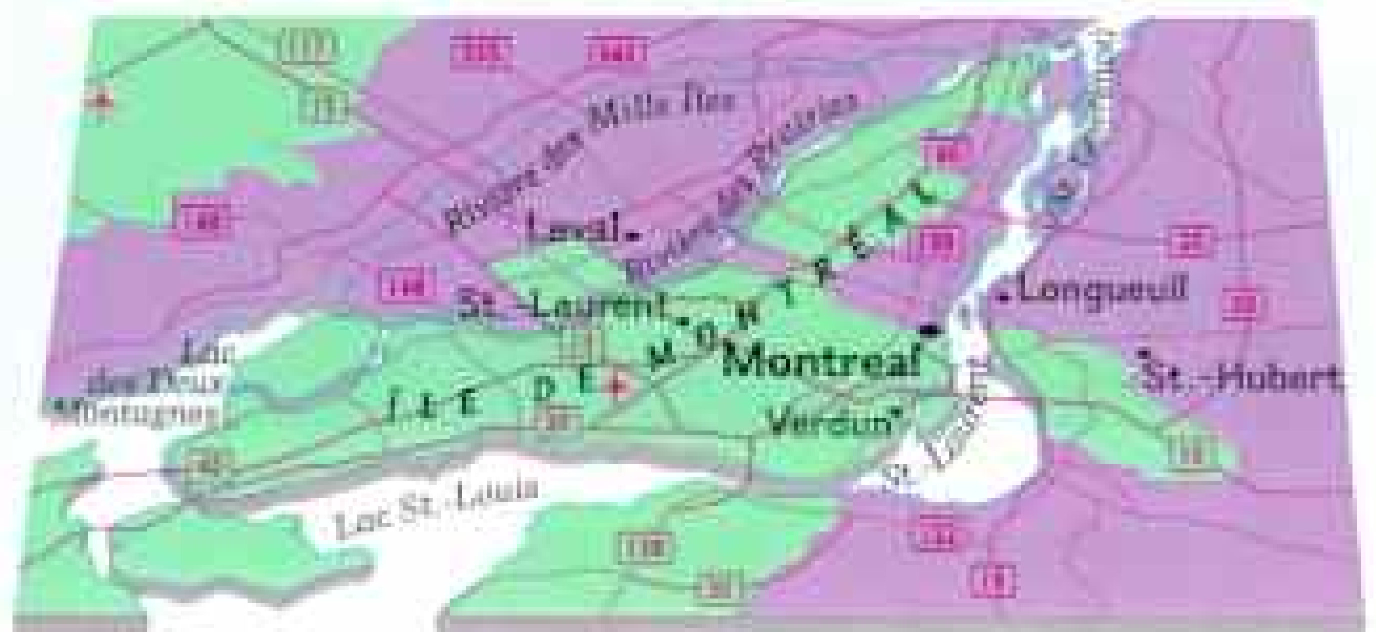
Power transmission line

Scale varies in this perspective.

NATIONAL GEOGRAPHIC MAPS

Stay or Split?

Fault lines opened up by the October 1995 referendum, which divided families and communities, have still not mended. The final tally was nearly a dead heat: 50.58 percent to 49.42 percent to stay within the Canadian federation. Separatist leader Jacques Parizeau bitterly blamed "the ethnic vote" for frustrating the will of "true Quebecers" (meaning French-speaking whites), who voted 60 percent for independence. English speakers and immigrants, about 18 percent of the population of 7.4 million, voted solidly "No."



The young business crowd unwinds at a club atop one of Montreal's highest skyscrapers. "This city is politically stressed out," says club manager Robert Ryan. "But whether you speak English or French doesn't matter up here."

(Continued from page 49) (like jaw in English) meant to chew the fat with *"la gang."* When I was offered a *caribou*, it was not a four-legged mammal but high-octane wine fortified with pure alcohol. *"C'est frette!"* (rather than the formal *"Il fait très froid"*) meant it was so cold I'd better put on my long underwear.

"To me it's not just an issue of language," said Miville Larouche, Ginette's brother-in-law and a chemistry teacher, who dropped by one evening. The conversation, inevitably, had turned to the subject of independence. "I have nothing against speaking English, or Chinese for that matter, because those are the languages of commerce. It's a question of preserving our culture. I have a strong feeling of belonging to Quebec. I know we're a people. We're different. Inside me there is Latin blood. The French fact is there. You will speak with people here who will become very passionate."

During animated discussions around the kitchen table, I discovered that a focus of this passion is nationalism. "It's a question of emotion, of a common project," said Miville, while André and Ginette nodded in agreement. "We have everything we need to make a country: a common language and culture. We have the natural resources." Indeed the Saguenay region itself is one of the largest producers of aluminum in the world, thanks to cheap hydroelectric power generated by Quebec's swift-flowing rivers.

Miville thinks sovereignty makes economic sense. "If we send all our taxes just to Quebec, we could create a much better country," he said. "Instead of having two ministries of industry, health, and so on, we would have just one. We would avoid the constant power struggle between public servants in Ottawa and Quebec." In fact, studies show that Quebec receives more (estimates range from two billion to four billion dollars U.S.) from Ottawa than it pays in taxes.

TO SEE THE SAGUENAY FIRSTHAND, I asked André's brother-in-law, Bernard Morin, a licensed pilot, to take me on a flight. After circling the rugged mountains north of Chicoutimi, we flew east along the sheer cliffs of the Saguenay River. Every time I see those cliffs, gouged by glaciers some 10,000 years ago, they take my breath away. My grandmother was born at Tadoussac at the mouth of the Saguenay, and I've always had a special affection for this river, which to me is the most majestic in Canada. For now, I thought, it still is in Canada.

We skimmed over the pretty village of Ste.-Rose-du-Nord, nestled into a cleft in the granite. Just offshore was a suburb of fishing huts laid out in neat rows on the ice. Snowmobile tracks crisscrossed the snow like a gigantic spiderweb. Circling back, we passed over La Baie, where a plume of steam rose from one of the Saguenay's two pulp mills. A freighter docked at Alcan Aluminium Ltd.'s deepwater port was bringing in processed bauxite from Jamaica to feed Alcan's smelters.

Unlike most members of his wife's family, Bernard, who works for the federal government promoting industrial development, voted "No" to sovereignty. "I really don't know why, with this high rate of unemployment, we have the self-confidence to say we can go it alone," he told me over dinner at his house. Automation is making the aluminum industry more efficient, but it's also putting people out of work. In 1996 the Saguenay's unemployment rate spiked to 15 percent. "It's crazy," he said. "You can't isolate yourself. All the world's economies are tied together now."

When I spoke to students at the University of Quebec at Chicoutimi, I found no such lack of confidence. Out of a class of 30, only one spoke in favor of federalism, despite the dire warnings from economists about the cost of independence: a devalued Canadian dollar, higher interest rates, a crushing public debt, the flight of foreign investment. The students dismissed these arguments. "We're not afraid of taking our future into our own hands," one of them declared.

My trip to the Saguenay was the first time I'd ever sat down face-to-face with sovereignists and asked them why they wanted to break up our country. In the end it seemed to come down to a gut feeling. Ghislain Bouchard, a Saguenay playwright and neighbor of the Bergerons, put it this way: "It's not a collective hysteria. More and more we Québécois want

Derelict buildings, empty lots, and "For Sale" signs disfigure parts of Montreal, once Canada's financial capital. Soup kitchens (below) feed 24,000 every day, and 22 percent of Montrealers live below the poverty line, the highest rate in Canada. "Everybody's on standby," laments one businessman. "The city's dead, and it's all because of this instability."

to control our own destiny. There's a terrible moment when inside yourself you realize that the Canadian flag, and all it represents, doesn't mean anything any more."

I kept in touch with my new friends in the Saguenay and was saddened to learn that André Bergeron died of cancer last spring. I will remember his hospitality and our long talks about Quebec's future.

IN SHARP CONTRAST to the people of the Saguenay, 58 percent of Montrealers voted against independence in 1995. The morning I drove into my hometown—and that of nearly half Quebec's people—the city seemed like a faded beauty queen looking back wistfully on her glory days of Expo 67, when she hosted a magical world's fair. Back then Montreal was not only Canada's largest metropolis but also its financial capital, a distinction since surrendered to Toronto.

"Look at all the boarded up shops and restaurants downtown," said Sid Stevens, a Montrealer born and bred. "We've never seen this before. You start wondering, how much worse can it get?" As manager of one of the city's largest food banks, Stevens has his finger on the city's pulse at street level.

We went for a walk along St.-Laurent Boulevard in search of a smoked meat sandwich at the Main deli and counted more than a dozen empty storefronts in two blocks. "Montreal is

"It's heartbreaking to leave family and friends," said Elaine Perzow (left), taping up a box while movers load her possessions into a waiting truck. Tired of Quebec's endless separatist debates, Perzow and her husband sold their house in Montreal and moved their family to British Columbia. Demographics favor independence, since many who oppose it—as well as newcomers such as a family of Chilean refugees (below right)—eventually head down Highway 401 to Toronto and points west in search of brighter economic prospects.

the economic engine, the heartbeat of Quebec," Stevens told me between bites of his sandwich. "But now it's on life support." He listed the main problems: one in five Montrealers out of work, 22 percent living below the poverty line—the highest rate of any city in Canada. The city's office vacancy rate has risen to 20 percent; companies are either not investing or simply packing up and moving out of the province. "Food banks are Montreal's fastest growing industry," Stevens said. "We now feed about 150,000 a year." That's a tenfold increase in a decade.

For many Montrealers—including my parents, brother and sister, and four cousins—the solution has been to leave. More than 325,000 people have moved out since 1971; often it is the younger generation of English-speaking Quebecers, those unencumbered by houses and children, who are voting with their feet. Peter Bean, a recent graduate in law from McGill University in Montreal, and his wife, Glenna Smith, are typical. They have fled to Ottawa, a two-hour drive west on the Ontario side of the Ottawa River.

Although they were born in Quebec and will always consider Montreal home, Peter and Glenna said they feel like second-class citizens in their own province, that the government in Quebec City doesn't consider them "true Québécois." Peter has taken a job with one of Ottawa's largest law firms. Glenna, convinced she wouldn't get promoted at the Montreal bank where she worked because she doesn't have a French name, has found a new job in Ottawa with scope for advancement. "Our generation is leaving," she said, "because we see more opportunities outside Quebec."

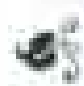
Quebec's language laws are an irritant, requiring French on outdoor signs and in the workplace and mandating French-language versions of software, websites, and films. The complex regulations are enforced by bureaucrats known in the English community as "tongue troopers." Their vigilance has led to some absurd situations: During Passover in 1996, stores in Montreal were ordered to take kosher products off their shelves because they were labeled in Hebrew and English but not French. The affair was quickly dubbed "matzohgate."

Quebecers like Peter and Glenna are tired of the unending political debates. "It's not a referendum; it's a never-endum!" Peter said. "They're going to keep doing it till they get the answer they want."

SINCE THE 1995 REFERENDUM, it has become clear just how close Canada came to splitting apart. Jacques Parizeau, a hard-line sovereigntist, was premier of Quebec during the referendum campaign. Last May he revealed in a memoir that he had received secret assurances that the French government would quickly recognize a sovereign Quebec and would influence other francophone nations to follow suit. Parizeau's strategy was to initiate a wave of international recognition so that Quebec's independence would become a *fait accompli*. The province's minister of finance had quietly set aside a reserve of 27 billion dollars to buy Quebec bonds in case they were dumped by panicky investors. A week before the referendum, a letter was sent to Quebec-born soldiers in the Canadian Army urging them to transfer their loyalties to a new Quebec army in the event of a "Yes" vote, and embassies in Canada were asked to recognize Quebec's right to self-determination.

Now the debate has shifted to setting the practical ground rules for independence: What majority would be required in the next referendum? Would a unilateral declaration of independence violate the Canadian constitution? The federal government has referred that question to the Supreme Court of Canada. Lucien Bouchard says Quebec's future is for its citizens alone to decide in a referendum and not by a "foreign" court of law.

What if Quebec was to ignore the constitution and the Supreme Court? Jean Chrétien, Prime Minister of Canada and a fellow Quebecer, says that if a clear majority choose independence in a fair vote, he is not prepared to launch a civil war to preserve the nation.



"We will have our own country. You can count on my determination." Lucien Bouchard (opposite), Quebec's premier, rallied separatists to their cause just before the referendum. A lawyer from the isolated Saguenay district, Bouchard draws much of his support from rural areas, such as Île d'Orléans (above) on the St. Lawrence River near Quebec City.

Mark Kotler, an English-speaking businessman I met, wants Canada to stay whole. Kotler is a Montrealer, and he has no intention of leaving the city. If Quebec separates, he intends to ensure that Montreal stays in Canada, either as a city-state or part of a new province. Kotler has formed Action Canada, one of about ten grassroots partitionist organizations that have sprung up across Quebec in places where a majority voted to stay in Canada.

As we talked in his office in the printing plant he owns, faxes were coming in from prospective Action Canada members (membership now stands at 4,000). Partitionists like Kotler have persuaded some 35 municipalities, including the city of St.-Laurent (population 72,000) on the Island of Montreal, to support their cause.

Kotler said that separation from Canada would not be as painless as some sovereigntists would like to believe. An independent Quebec, he said, must relinquish areas of the province that are pro-Canada, principally the Island of Montreal, the Eastern Townships along the Vermont border, western Quebec (including Pontiac County), and the homelands of the Cree and Inuit in the north.

"The government in Quebec City should have its knuckles rapped. Appeasement never works where nationalism is concerned," Kotler said, suggesting that the federal government should take the initiative and clearly spell out the boundaries of an independent Quebec.

"Drawing lines on a map will not be so simple," countered Daniel Latouche, a political scientist and former adviser to the Quebec government. "Partition is a straightforward appeal to violence," he warned, implying that it could lead Quebec into Bosnia-style warring enclaves. "How far would you go? Would you divide apartment buildings?" He pointed out that his mother lives on the west end of the Island of Montreal, which voted overwhelmingly "No" in 1995. "Would she end up living in a separate country?"

TO TAKE STOCK of one of the disputed regions, I left Montreal and drove 11 hours north to the Cree village of Oujé-Bougoumou, which means "the place where people gather." A special assembly of the Grand Council of the Cree, their elected governing body, was being held to discuss the expansion of logging into the ancestral lands of the Cree, encompassing 144,000 square miles in the James Bay and Hudson Bay watersheds—an area about the size of Japan. This would be an opportunity to talk to Cree leaders, who planned to attend the assembly.

A roadside shrine in the village of Grondines on the St. Lawrence River is a legacy of a time when Quebec was solidly Roman Catholic. All that has changed in the space of a generation, and now 19 percent of couples live in common-law relationships, while 44 percent of

children are born out of wedlock. "So powerful was the Catholic Church in Quebec that its collapse has left a deep void," observes Lysiane Gagnon, a columnist with Montreal's La Presse. *Nationalism, she believes, has become the new religion of many Québécois.*

Just before entering Oujé-Bougoumou, a new village of 500 laid out in the shape of the head of an eagle, I stopped by the side of the road. High overhead were 24 power lines, part of a network carrying 10,000 megawatts of electricity from generating stations on the La Grande River to light up cities in southern Quebec and the northeastern United States.* Transmission towers marched across the valley floor as far as the distant ridge of mountains. Snow-covered openings in the boreal forest—clear-cuts—stood out like white scars. Elsewhere, row after row of young trees revealed the orderly signature of plantation forests on lands leased by timber companies. The landscape brought home to me the radical changes Quebec's 12,000 Cree have faced in the past two decades.

And now there's the issue of separatism. "Quebec independence is the greatest threat to the Cree since the arrival of Europeans in North America," Matthew Coon Come, the Grand Chief of the Cree, told me. We were having lunch in Oujé-Bougoumou's wood-paneled restaurant, with a fine view overlooking Lake Opémisca.

Wiry and articulate, Coon Come is equally at home working his family's trapline near Lake Mistassini or making a presentation to legislators in a suit and tie. He has emerged as a forceful defender of Cree interests since his successful campaign to stop the damming of the Great Whale River, the second phase of the James Bay hydroelectric project.

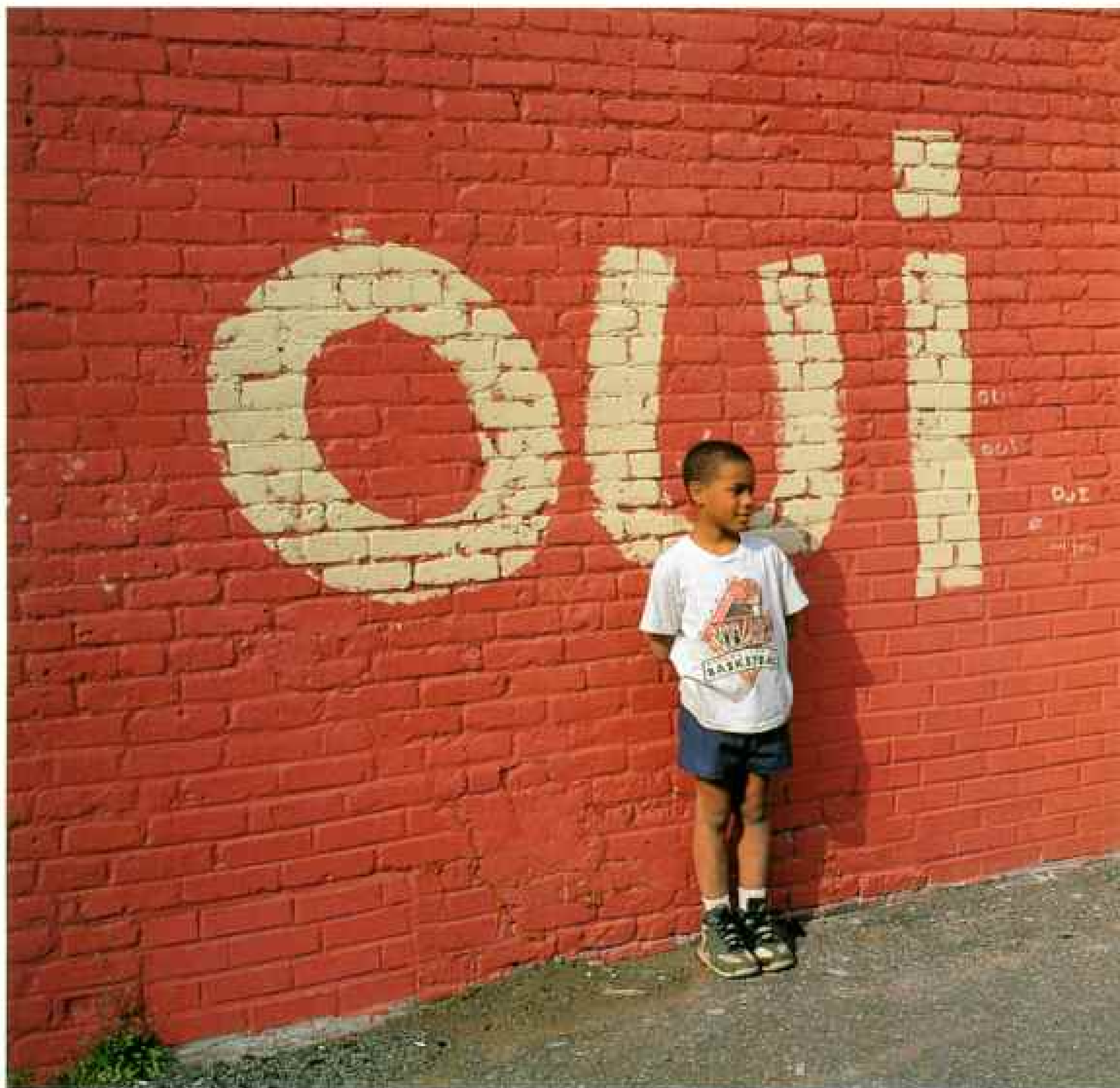
Quebec's native people have treaties with the federal government, which is obliged to fund housing, health services, and education on reserve lands. Given the Cree's difficulties in obtaining compensation from the province for lands flooded for hydro projects or logged for timber, Coon Come does not believe the government of an independent Quebec would assume those treaty obligations. His people share that mistrust. The Cree held their own referendum in October 1995, and 96.3 percent voted to stay within Canada.

"We are not the ones who want to split up this country," Coon Come said. "But if Quebecers have the right to self-determination, certainly the Cree do. We cannot simply be traded from one country to another as though we were cattle in a field."

If Quebec secedes, the Cree say the hydro installations will revert to the original owners of the land. Quebec's position is that its territorial integrity is protected under international law and that the Cree gave up their

*See "James Bay: Where Two Worlds Collide," by John G. Mitchell, NATIONAL GEOGRAPHIC, Special Edition on Water, November 1993.

In northern Quebec, where cousins cool off in Lake Opémisca, Cree communities voted to remain in Canada. For transportation giant Bombardier, whose wall of snowmobiles waits shipment from its Valcourt plant (opposite), separation might affect free trade with the U.S. and require renegotiation of the NAFTA treaty, warns CEO Laurent Beaudoin.



aboriginal land rights in 1975 when, in exchange for 133 million dollars, they signed an agreement authorizing the James Bay project.

Like the Cree, the province's other aboriginal groups—including the Inuit, Mohawk, and Montagnais—say that their ancestral lands, which encompass two-thirds of Quebec, will not be transferred to a new republic without their consent.

WHEN I RETURNED to Montreal, spring was bursting out after one of the coldest Aprils on record. Awakening from hibernation, people thronged along Ste.-Catherine Street, stopping to smell the lilies, mums, and azaleas at outdoor stalls and poking into bookstores. Through a plate glass window I watched a baker, with deft twists, making a fresh batch of bagels. He placed the circles of dough on a long plank and slid them into a wood-fired oven for that famed Montreal taste of real wood smoke. One restaurant had opened on the corner of Atwater, but amid the empty storefronts and vacant lots the once elegant Seville and York theaters were still boarded up and plastered with posters. On a wall of the York someone had spray painted "Anglos go home," which someone else had edited to "Anglos are home."

In 1945 Hugh MacLennan, a Montreal novelist, attributed the gulf between the French

A war of words erupted on the walls and airwaves of Montreal before the last referendum, but there was a remarkable lack of violence. To win the next vote—expected within two years—separatists will have to gain the trust of the city's large immigrant population.

and English in Quebec to "two solitudes"—language and religion. Today politics, suspicion, and racism are the deeper solitudes: francophone federalists against francophone sovereigntists as much as English against French; Anglo and French Quebecers against aboriginal peoples; and Montreal, with its large immigrant population, against the homogeneous outlying regions.

Most anglophones who could not, or would not, speak French left after the first Parti Québécois government was elected in 1976—an exodus of 200,000 in four years. The majority who remain, like Mark Kotler, speak French in business dealings and ensure that their children are bilingual. They have accepted French as the working language and that some measures are needed to protect it. The stereotype of the English boss who refuses even to say "*Bonjour*" is dead.

Nor are the old religious prejudices a major consideration any more. While the silver spires of cathedrals still grace cities and towns, religion, as André Bergeron's family illustrates, has lost its central place in Quebec culture. André's parents were devout Catholics. He and his wife stopped going to church shortly after their marriage, and their three children have abandoned Catholicism.

While Premier Lucien Bouchard declares that the Québécois are *un peuple* (a people) and that Canada is made up of two nations and two founding peoples, native leaders like Matthew Coon Come insist that aboriginal peoples were also founders of Quebec and Canada. And Jews such as Mark Kotler respond that Quebec society is made up of not one or two but many peoples.

Yet Quebecers—whatever their origin—seem attached to the province for many of the same reasons.

"Quebec has a *joie de vivre* that no other place has," Mark Kotler told me, echoing Ginette Bergeron of Chicoutimi. "There's more street life here. People in Quebec know how to party. They're not straitlaced. If you go down to St.-Denis Street in Montreal on any night in the summer when the festivals are on, you will see a friendship between the French and English you would not believe. I just wouldn't want to live anywhere else."

Kotler's remark made me wish more Quebecers would wander down to St.-Denis Street on a summer evening. But looming on the horizon is yet another divisive vote on Quebec's future. I recalled the words of Bernard Morin of Jonquière: "The red warning lamp for Canada went on with the last referendum, and it will flash as long as we continue with the politics of fear and confrontation." □

Flies That Fight

Article and photographs by MARK W. MOFFETT

"I see two males, and they're really going at it!" came the shout from Gary Dodson. I crouched down to witness a battle as old as time—a clash of antlers, then jostle and counterjostle. It ended with the panicked departure of the loser. Lost in the drama of the moment, entomologists like Gary and me forget that we are not observing giant elk or deer. These are New Guinea's half-inch-long antlered flies—harmless relatives of the Mediterranean fruit fly and other fruit pests. Astonishing in their similarities to their antlered mammal counterparts, male antlered flies fight over breeding territories and release a special breeding scent from glands, visible on the fly at right as a lump on the underside of his abdomen. With their weird projections and rainbow colors, these are flies worthy of Dr. Seuss.

Love makes war

Fly expert Gary Dodson of Indiana's Ball State University and I were watching Phytalmia cervicornis, *a species we nicknamed the "stag fly" for its deerlike, pronged antlers. Stag flies stake out territories on the recently felled trunks of particular rain forest trees, the wood of which forms the diet of the larvae. The most aggressive males seize prime spots on a log, perhaps distinguished from less desirable locales by an odor of decay.*

As in deer, fly antlers vary in size (though they are never shed). Small males have small antlers and little chance in battle. The smallest have only knobs beneath their eyes (top) and seem to mate only when larger males are not present.

Disputes on a log may have a female audience (bottom left, at left), and the winner will mate with any females entering his domain. The long stalk connecting a mating pair (right) is the female's oviscape, a casing that protects her egg-laying apparatus, the ovipositor. A mated female unsheathes her ovipositor (bottom right) to lay eggs in the log's bark. The male guards her, keeping adversaries at bay and ensuring that her offspring will be his. If another male mated with her now, his genes would dominate.

Combat ready

As a teenager fascinated by insects, I first learned of antlered flies while reading The Malay Archipelago *by the great 19th-century naturalist Alfred Russel Wallace. It was Wallace's friend Charles Darwin who coined the term "sexual selection" to describe the evolution of ornaments used within a species in love and war. The Irish elk, now extinct, showed one of the most extreme examples. Males had antlers spanning as much as 12 feet. One species of New Guinea antlered fly,* Phytalmia alcicornis, *rivals the Irish elk at a smaller scale. Its elaborate antlers can be so cumbersome that they may hinder the fly's everyday activities. I once saw a male that appeared to be so burdened by its rack that an ant caught it.*

A stormy courtship

In Queensland, Australia, I gave Phytalmia mouldsi *the nickname "goat fly" for its smallish horns. Yet goat flies jostle ferociously, stilting high on their legs (facing page). Although males of most antlered flies mount females without preamble, goat flies have a spread-winged courtship (bottom, viewed from over the female's shoulder). Even after mating, males straddle females to keep contenders away. In a blur of wings (top) one male tries to push another male off an egg-laying female. In an experiment (center), Gary Dodson glues extensions to the antlers of a small male to test whether he would gain advantage in battle.*

Eye to eye

Antlered flies aren't the only extravagant ones: Stalk-eyed flies of the diopsid family go hammerhead sharks one better by carrying their eyes at the tips of needle-thin stalks.

In Malaysia, these females of the genus Teleopsis *gather on rootlets near streams, the harem of a single male (above left, at top). Intruders challenge the resident male with a fly's version of "stare down," approaching until the two are eye to eye. The males of another Southeast Asian species,* Cyrtodiopsis whitei *(above), issue eye-to-eye provocations as well. If the flies are the same size, combat follows. If not, the one with longer*

eyestalks forces the other to back off. And so, generation after generation, sexual selection picks diopsid winners—and eyestalks evolve to outlandish lengths. □

PORTRAIT OF

In a remote slice of Ukraine's Carpathian Mountains live the Hutsuls of Kryvorivnya village. Known for independence born of isolation, they've sustained their culture through centuries of domination by foreign lands.

THE HUTSULS OF UKRAINE

By LIDA SUCHÝ   Photographs by LIDA SUCHÝ and MIŠO SUCHÝ

A Village

Descending a path as somber as his task, a villager carts the draped coffin of his neighbor to the lowland cemetery for burial. In the village of Kryvorivnya, the land shapes the lives of the people. While the village's valley is marked by paved roads and fledgling prosperity, its distant hills preserve the rough-hewn ways of subsistence farmsteads where all burdens must be carried by horse or by hand.

"To be a Hutsul means to live in the mountains and to love the mountains."

—Vasyl Kotsulym

"It's as though I'm flying above the mountains like a bird," says 14-year-old Vasyl Kotsulym, testing his balance on the back of the family horse, Dove. With peaks topping 6,000 feet these highlands have long harbored independent souls, from feudal peasants fleeing serfdom to Ukrainian insurgents fighting Nazi and Soviet repression.

When I first hiked the hills of Kryvorivnya, it was strange to feel so familiar with a place I'd never been. The village lies in southwestern Ukraine, land of my father's youth. Though his family fled to the United States more than 50 years ago to escape Soviet occupation, he held this place in his heart, raised me to speak Ukrainian, and told me of the Hutsuls—highlanders who have preserved a distinct culture and identity despite centuries of despotic foreign rule. In 1992, after Ukraine regained its independence, my father and I visited Kryvorivnya. I've been returning ever since.

In Ukrainian, *kryvo* means "curved" and *rivnya* means "straight." This village of some 2,000 people spreads up into the mountains from a thin strip of flat land along the Chornyi Cheremosh River, whose curves suddenly straighten near the center of town. Along the river is one main road lined with homes, a few shops, and a museum honoring the town's history as host to leading Ukrainian writers and activists. Yet the din of river and cars quickly fades as I walk up the narrow footpaths that crisscross the surrounding mountains. When I hear only the wind or the ringing of cowbells, I am *na horbakh*, on the hills—the highlands of Kryvorivnya, where homesteads appear as scattered dots on steep hillsides.

It takes me more than two hours to hike from the valley to Paraska Bodnaruk's home in an upper part of Kryvorivnya called Cream Land. Widowed seven years ago, Paraska still wrests a life from the thin soil. Her hands are like shovels—large, hard, utilitarian. She tends cows, scythes hay, chops wood, and prepares meals of bread, cheese, and

cornmeal porridge, always leaving a moment to cuddle the grandchildren she helps raise. Paraska survives as many Hutsuls do, on a barter system and a bare minimum she is proud to produce herself.

Down in the valley I stay with the Potjak family, whose four generations live in three houses side by side. The Potjaks gather nightly in the kitchen to plan their chores for the following day and occasionally watch news on a blurry TV. Like many in Kryvorivnya, some family members work for state agencies, yet they also continue to work the land—often a more reliable provider than erratic state paychecks.

In the Soviet era Hutsul land was confiscated, and many religious and cultural traditions were banned. As land now returns to the people, customs once practiced in secret are reviving as well. Most cherished is the two-week Christmas caroling season, when Hutsul horns again blare with exuberance. One Christmas my husband, Mišo, and I joined the Potjak family as village carolers arrived at the house. Grandfather Vasyl Potjak welcomed them in to tables bent with traditional delicacies that I knew so well from special occasions at my parents' home in upstate New York. Before the feast we enjoyed the carolers' songs, finished by a prayer.

After a day of making portraits with my bulky 8-by-10 camera, I often go to the home of artist Paraska Plitka-Horytsvit, whose name means "mountain flower." Her house brims with works depicting the life of Hutsul women. Yet the bright palette of her art contrasts sharply with her life. Accused of insurgency by the KGB at age 18, she spent nine years in a labor camp. Now 70 and nearly blind, she has completed 15 books of poetry and art and is writing a dictionary of the Hutsul dialect. Paraska captured for me the essence of the Hutsuls, calling them "the fine people of these mountains, who know how to do everything themselves."

"I help my neighbor and my neighbor helps me. This is the way it has been here since ancient times."

—Ivan Hotych

The passage of time is borne with patience in Kryvorivnya, where upland villagers wait hours for a priest to walk up from the valley. Though homes are sprinkled across hillsides, family ties and a sense of duty bind villagers together. "Without help from others, no one can carry on, either in times of joy or in times of sorrow," says Ivan Hotych (above). "He who thinks only of himself is not respected."

Under barren trees and bitter skies villagers gather on the third day of mourning for Vasylyna Kharuk, whose wood coffin must be tipped to exit her narrow doorway. *Podavniky*, small loaves tied to candlesticks with handkerchiefs, honor the soul of the dead—one of

many pre-Christian traditions still practiced here. Each loss is keenly felt among the Hutsul people, who revere their ancestors. About 200,000 Hutsuls live scattered in villages throughout the Carpathians of southern Ukraine and northern Romania, in a region that is slightly larger than Delaware.

"Oh, Carpathian Mountains that gave birth to me, soul and bones, you fill me with joy, you make me young, with you I am happy."

—Paraska Plitka-Horytsvit

Bent close to the land that inspires her, artist Paraska Plitka-Horytsvit, who survived a Soviet labor camp, depicts Hutsul life, often on the back of old Soviet propaganda posters. On their wedding day, Vasyl and Vasylyna Zelenchuk wear another form of Hutsul art—traditional wedding clothes whose ornate embroidery "reflects the beauty of the mountains, meadows, streams, and sky," says the bride.

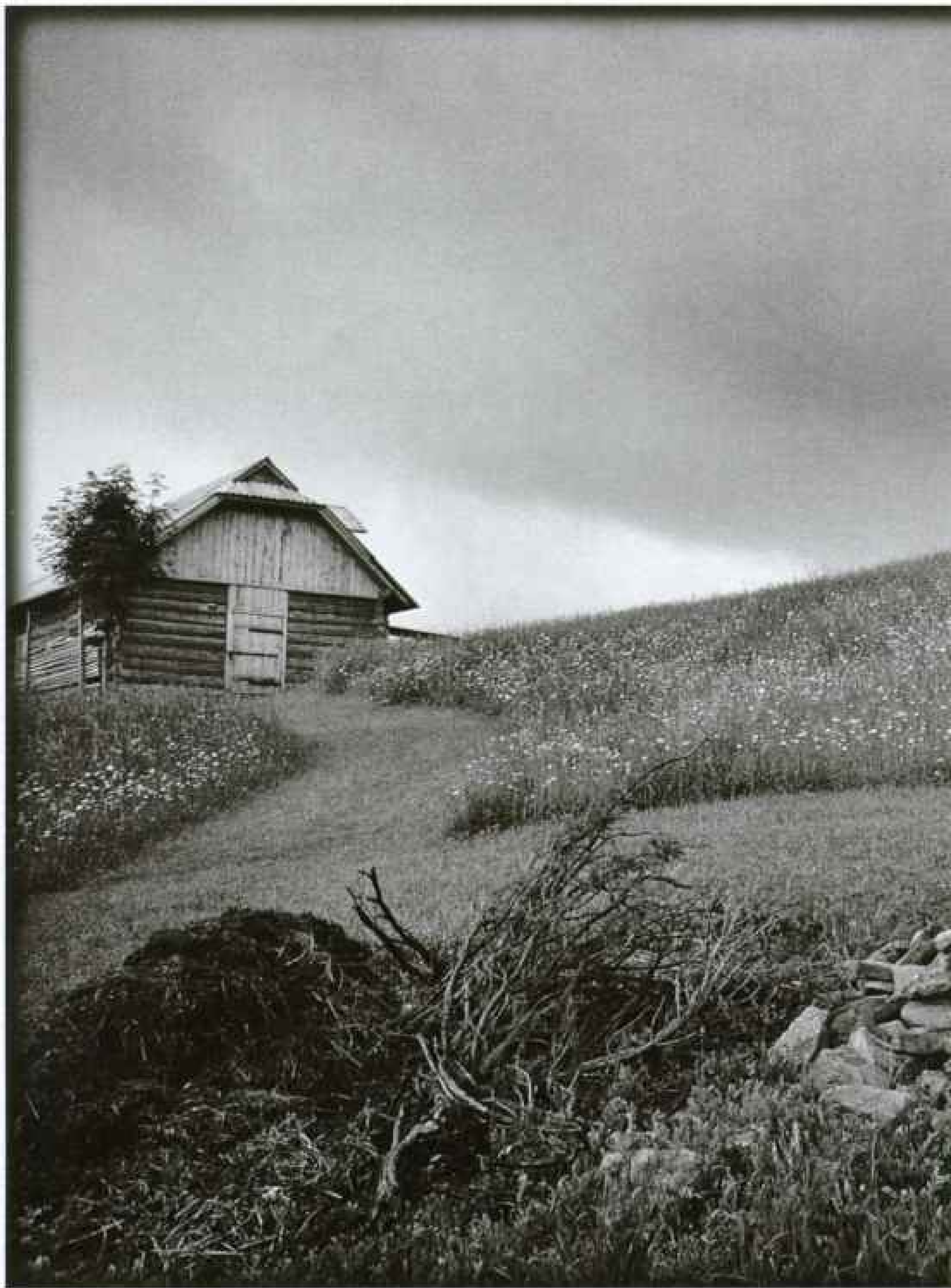
"For me it's important to work the land because she feeds us. I can't imagine any other kind of life."

—Paraska Bodnaruk

A weighty mantle of hand-scythed hay is summer's vital harvest for widow Paraska Bodnaruk, who does the labor of two on her small farm. Family helps ease her burdens, as when a son-in-law shares the bulk of a squirming pig (right) or when grandson Ivanko brightens her doorstep (above). "Because we work hard," says Paraska, "we have plenty in our home."

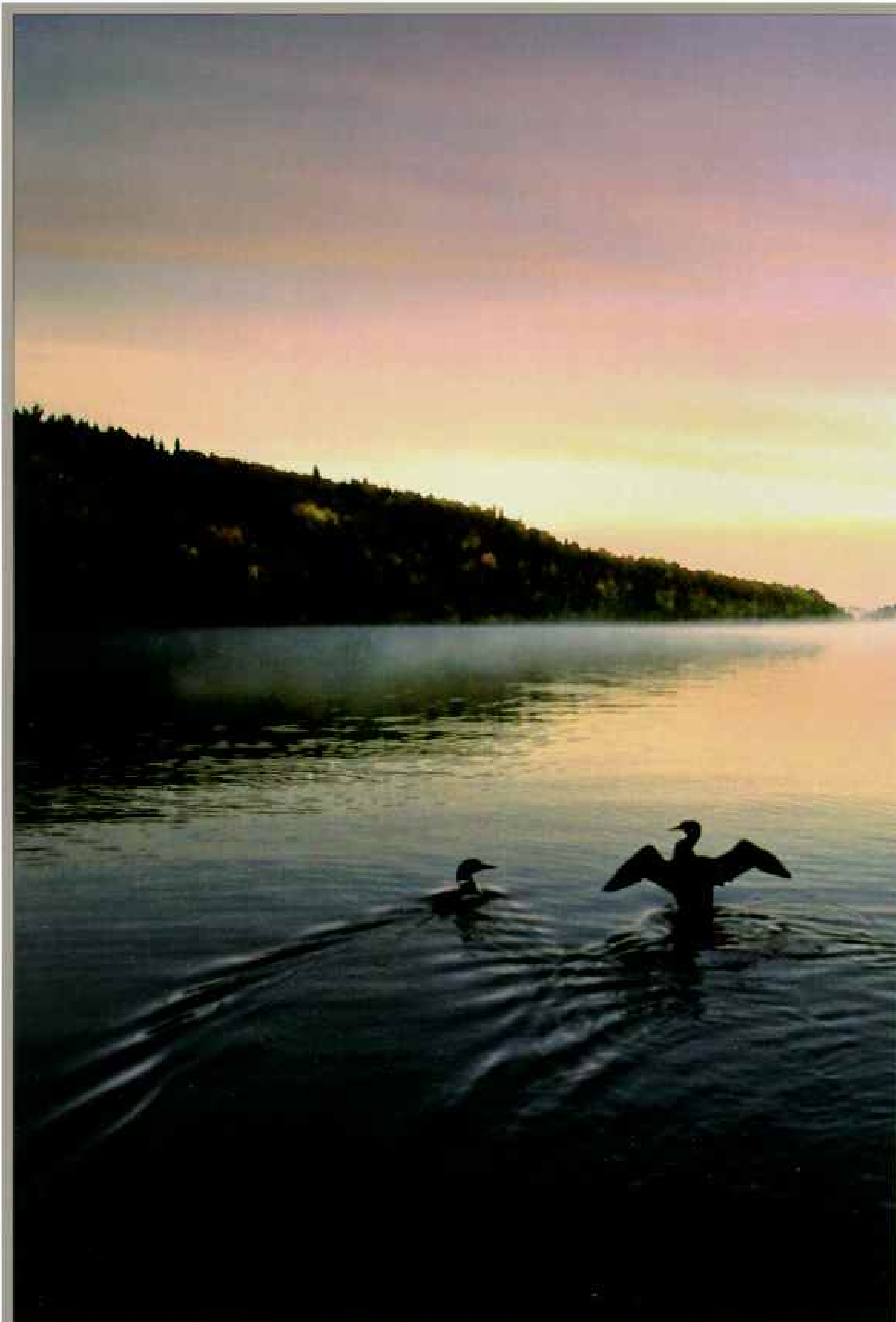
Generational memory runs deep in the Potjak family kitchen, where faded portraits of ancestors and Taras Shevchenko—the 19th-century champion of Ukrainian identity—hold a place of honor. "Our family is a second school for our children," says Marijka Potjak,

who reads near her daughter Kalynka while Marijka's grandmother knits on a perch above the warm woodstove. Four generations gather here each evening to work and tell stories. Says Marijka, "Our parents pass on to us their life experience, and we help them in their old age."



"The day had died in the endless spaces, and it was impossible to tell whether time was passing." So wrote Ukrainian novelist Mykhailo Kotsiubynsky in his 1913 classic of Hutsul life, *Shadows of Forgotten Ancestors*. Today the presence of new barns on tended meadows

attests to the passing of time and the trickle of people back to the hills. Ancestral lands were forcibly taken by the Soviets in the 1950s for use as state-run collective farms, or *kolhospy*. Now the Hutsuls of Kryvorivnya are regaining their fields, which beckon with familiar paths. □



DAY 10: COMMON LOONS IN BOUNDARY WATERS CANOE AREA WILDERNESS

North Woods *Journal*

In autumn I set out to make one photograph—one single exposure—each day for 90 days. I hoped with patience and endurance to renew my vision of the natural world.

ARTICLE AND PHOTOGRAPHS BY JIM BRANDENBURG

IN A DARK SPRUCE forest—two lakes and a portage from my bush camp—I have discovered a place of mystery and wonder. In those quiet woods I sense the primeval, as if no one has stood there before. So it seemed natural to go there on the first day of my photographic journey.

I had set myself the challenge that for 90 days between the autumnal equinox and winter solstice I would make only one photograph a day. There would be no second exposure, no second chance. My work would be stripped to the bone and rely on whatever photographic and woods skills I have.

My quest was both arbitrary and rigid. Arbitrary in that no one had compelled me, or even asked me, to perform it. Rigid in that once engaged, the constraints I had chosen would force me to examine myself and my art in a manner I'd never before attempted. The wild and isolated place in which I live, outside the small, end-of-the-road town of Ely, Minnesota, would never look the same to me.

I arose before dawn that first morning. A cool mist licked my face as I paddled the two lakes. The forest was calm as I stalked through somber bogs. While the day still smelled of dawn, I reached my secret spot, a spruce forest the likes of which can still be found stretching unbroken to far-off Hudson Bay.

Perhaps because this forest is not so overtly beautiful—no vistas, no magnificent, towering trees, no coursing waterways—it remains untrammeled. And perhaps that is why I have always felt that something spiritual lives there, something slightly dark and old.

Green pillows of ankle-deep moss rise above the forest floor. Bent grasses hint at the passing of unseen winds and spirits. Spires of black spruce, limbless to beyond the height of a moose, rise out of the moss and point toward the sky, their broken branches draped with a haunting thin gauze of lichens. Poisonous red-capped mushrooms stand like miniature tables and chairs—fungus furniture that on some secret night might have hosted the "little people" who are so much a part of the folklore of the native Ojibwa and my Norwegian ancestors.

I passed up some tempting photographs that morning—a row of juvenile grouse sitting at attention on a log, some energetic gray jays willing to pose comically. Instead, I waited to make a photograph of moss, mushrooms, and trees. Although the subjects could not move, as I set up my tripod and framed the scene, I saw that their essence was fleeting. They were as elusive to capture as the image of a white wolf in a snowfall. My shutter opened and then closed. My journey had begun.

Like Henry David Thoreau,

Chased by the Light, a book elaborating on JIM BRANDENBURG'S experiences, will be published by Creative Editions in fall 1998.

The morning of day 57, ravens led me to the doe. Her eye was brilliant still, though lifeless. The poacher had cut away the prized back loin, leaving the rest to scavengers.

who had gone to the woods because he "wished to live deliberately, to front only the essential facts of life" and to "transact some private business with the fewest obstacles," I went to see if I could find what had drawn me so long ago to my art and to see if I had become as perceptive of nature as I had hoped. "To anticipate, not the sunrise and the dawn merely, but, if possible, Nature herself," as Thoreau wrote.

The success or failure of my effort is here for you to judge. It has been an intensely personal project: When it was conceived, I had no particular thought of publishing the results, and I feel somewhat vulnerable in sharing it.

Yet I felt I had to break out of the pattern my photography was stuck in, felt compelled to let go of life's clutter and a world lit by computer screens instead of the sun. I wanted to wander the forest again, to see what was over the next rise, to follow animal tracks in the snow as I had done so happily as a boy. Each photograph would be a true original, like a painting—not the best selected from rolls and rolls of similar frames. I sensed there would be lessons learned.

There were, and they were not always those I had imagined. Some were merely lessons remembered, recapturing things I had forgotten, such as remaining open to chance and recognizing that in nature not all beauty is giant in scale.

One such lesson occurred on day 25. Although I had tried to devote my full attention to this project, business and life itself kept intruding. On this day I was forced to find a subject without the luxury of allowing the proper time to lead me to it. Walking to a granite ridge not far from home, I searched for a scene "worthy" of my one photograph. I was tense, and more than a little irritable. And then a breeze blew.

If you have been in a paper birch forest far from roads and man-made noise, you know that tatters of birch bark rattle in the breeze like parchment scrolls clattering to the floor. Hearing that sound, I turned to a tree just behind me. Torn and hanging from it was a sheet of chalky white bark, revealing the apricot colored underlayer.

Pressed by time, I "settled" for this subject, composing the shot and tripping the shutter almost in haste. But

Hard frost at dawn, day 40. Sedges had moved in after a beaver dam collapsed and the pond

drained away. Such glades offer welcome respite when I'm slogging through tangled spruce forest.

when I later viewed the printed image, I was pleased to be reminded of something I had long ago learned: Sometimes less truly is more.

If the birch-bark photograph was one of haste, many, many others spoke of patience, even frustration. One of my favorites was made late on day 23 when I despaired of capturing anything of value. The day was dark and gloomy, and my mood reflected the weather. I had slogged through the dripping forest all day long. Tired, hungry, and wet, I was near tears. I was mentally beating myself for having passed up several deer portraits and the chance to photograph a playful otter. But none of those scenes spoke to me at the time.

Then, perhaps because I had been patient and centered and without comfort, like Native Americans on a vision quest, I became open to new possibility. This was revealed by a single red maple leaf floating on a dark-water pond. My spirits rose the instant I saw it. Although what little light there was was fleeing rapidly, I studied the scene from every angle. Finally, unsure of my choice, I made the shot anyway, thankful at least that the long day had ended.

Once more I was surprised by the result. The image seems to have a lyrical quality: Reflected rhythms of spiky grass and brooding sky play against the warm stillness of the leaf. I know that what I see isn't what you will see—for me this photograph is a lesson in patience and diligence. It speaks to me of intimacy as well and reminds me to look closely at the world.

If some of the scenes asked me to turn inward, many demanded that I look outward to embrace nature viscerally, even to participate. While I wandered through the woodland, the land's wild residents struggled daily.

You will see a picture of a dead doe's lost gaze. I had heard a gunshot at midnight, and the dawn's fussing of ravens and eagles led me to the scene of the crime. A deer had been wantonly killed by a poacher. You will see another lifeless deer in these pages, this one brought down by wolves in an old and necessary drama. When I arrived, the body had just been opened and was still steaming in the below-zero air.

The photograph of day 10: A young loon dances at sunrise, a loon that only moments before was struggling in the water, its neck and bill entangled in fishline. I paddled my canoe to it, took the loon in hand, and removed an embedded fishhook and the attached line. I placed the loon back in the water and watched as it swam off to a nervous and protective parent. Then the young one stopped, turned toward me, and, as I released the shutter, flapped its wings as if in gratitude.

All around me I witnessed cycles of life and death—with deer becoming wolves, bones becoming soil, lichens eating rocks, herons stalking fish. Irate wolves chased ravens, which in turn teased indifferent eagles, while I wandered in the knowledge that my every sense would lead me to them so that I might paint them on film.

These experiences rekindled in me a deep primordial feeling, perhaps the same feeling an ancient hunter had, an emotion that I first experienced as a boy tracking foxes across the snow-covered prairie where I was raised.

Like my animal neighbors, I struggled with the pace of those ever quickening days. More often than not I ended up capturing the day's image under its waning light. The last two photographs happened at winter solstice—the sun hovering at low noon on the year's shortest day and the moonlit forest just after midnight during the longest night. They mark the end of my project and of an ancient measure of time, a period when this wild forest grows darker and life in the north grows tenuous, melancholy, and sometimes brutal.

In the end this project changed me. I feel aftershocks of memory now when I revisit the scenes where these photographs were made, and the emotions experienced at that instant of the shutter's click well up anew inside me.

Today I replay those moments while once more being chased by the light of a swift and hungry day.

BLACK SPRUCE, DAY 1, 9:15 A.M.

JACK PINE, DAY 2, 2:50 P.M.

EVENING PRIMROSE, DAY 3, 8:50 P.M.

TURKEY VULTURE, DAY 4, 8:30 A.M.

RAVEN FEATHER, DAY 5, 5:15 P.M.

RUFFED GROUSE, DAY 6, 2:10 P.M.

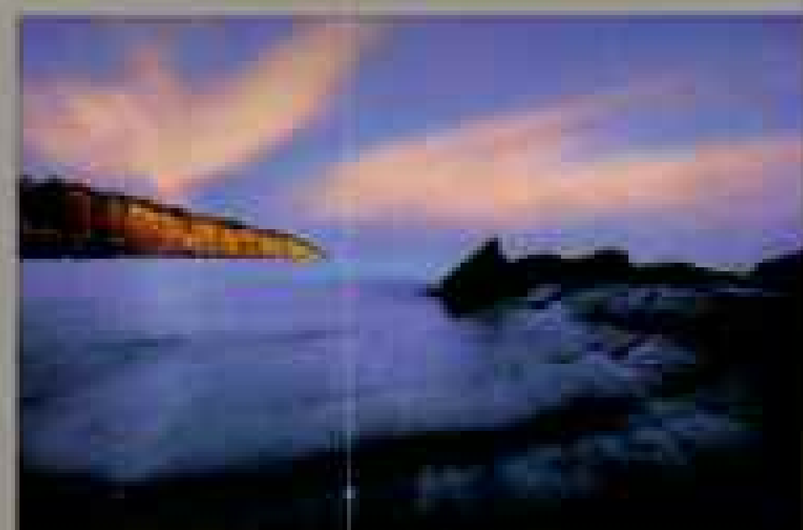
CEDAR GROVE, DAY 7, 2:00 P.M.

RUFFED GROUSE, DAY 8, 3:55 P.M.

COMMON MERGANSERS, DAY 9, 7:15 A.M.

COMMON LOONS, DAY 10, 7:10 A.M.

MUSHROOMS AND SPHAGNUM, DAY 11, 6:30 P.M.


SHOVEL POINT, LAKE SUPERIOR, DAY 12, 9:50 P.M.

GREAT BLUE HERON, DAY 13, 2:55 P.M.

BALD EAGLE, DAY 14, 9:45 A.M.

PAPER BIRCH, DAY 15, 4:30 P.M.

MARSHALL MOUNTAIN, DAY 16, 4:50 P.M.

RAVEN LAKE, DAY 17, 7:45 A.M.

SUNSET, DAY 18, 6:30 P.M.

ROSE HIPS, DAY 19, 3:10 P.M.

BLACK SPRUCE IN HEAVY RAIN, DAY 24, 12:30 P.M.

QUAKING ASPEN, DAY 21, 5:40 P.M.

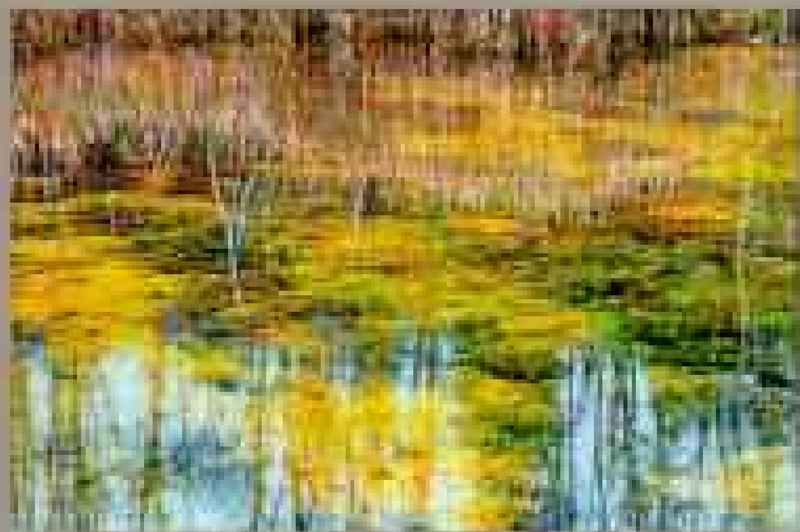
BLACK DUCKS AND MALLARDS, DAY 22, 2:30 P.M.

DISCOVERY LAKE, DAY 26, 3:59 P.M.

WHITE-TAILED DEER, DAY 28, 12:15 P.M.

NORTHERN WHITE CEDAR, DAY 29, 10:23 A.M.

WILLOW, DAY 30, 1:22 P.M.



POND, DAY 32, 4:31 P.M.

REINDEER MOSS, DAY 33, 5:11 P.M.

OXEYE DAISIES, DAY 34, 8:09 A.M.

LICHENS AND POLYPODY FERNS, DAY 35, 3:24 P.M.

WATERFALL, DAY 36, 6:17 P.M.

PAPER BIRCH, DAY 25, 4:30 P.M.

NORTHERN LIGHTS, DAY 38, 4:04 A.M.

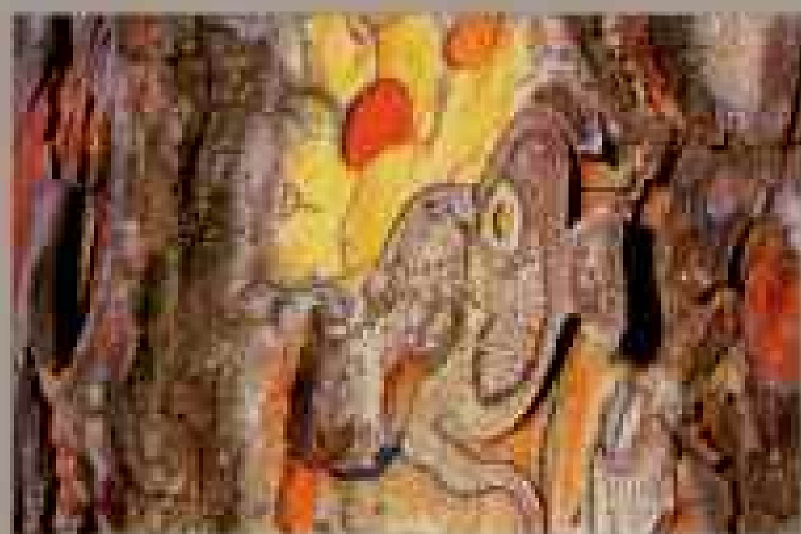
JUDD LAKE, DAY 39, 8:04 A.M.

FROSTY MEADOW, DAY 40, 7:42 A.M.

BEAVER WORK, DAY 46, 3:58 P.M.

RED SQUIRREL, DAY 41, 3:28 P.M.

ICE BY STREAM, DAY 48, 12:12 P.M.


RED PINE, DAY 20, 6:30 P.M.

DEER SKULL, DAY 27, 5:47 P.M.

LICHENS, DAY 31, 6:33 P.M.

SUNSET, DAY 37, 6:06 P.M.

MAPLE LEAF IN POND, DAY 23, 6:05 P.M.

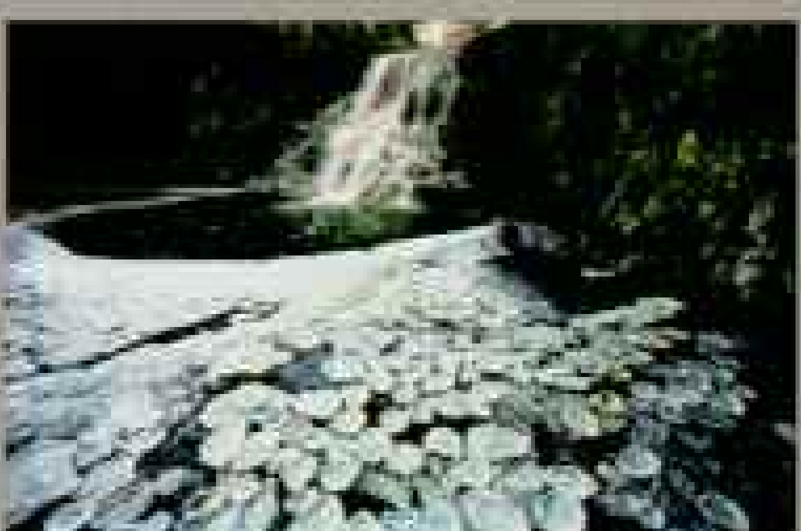
HAIRY WOODPECKER, DAY 41, 3:15 P.M.

MINK, DAY 42, 2:38 P.M.

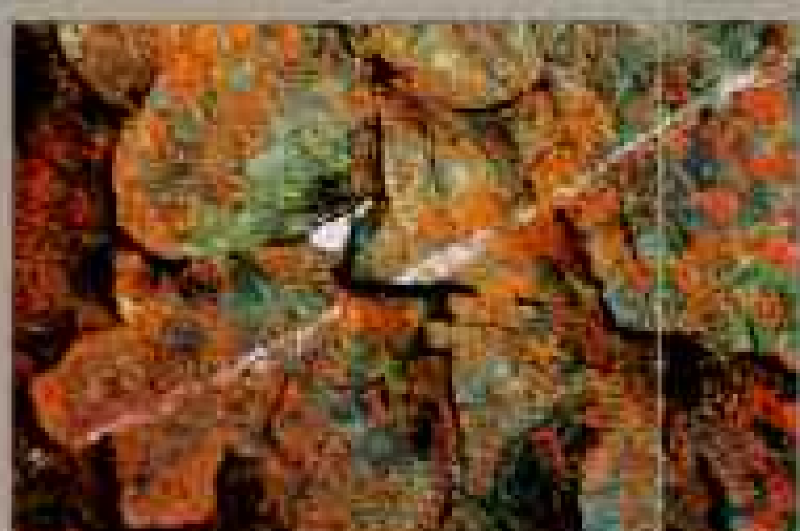
BOUNDARY WATERS, DAY 43, 4:41 P.M.

LAKE SUPERIOR BEACH, DAY 44, 4:22 P.M.

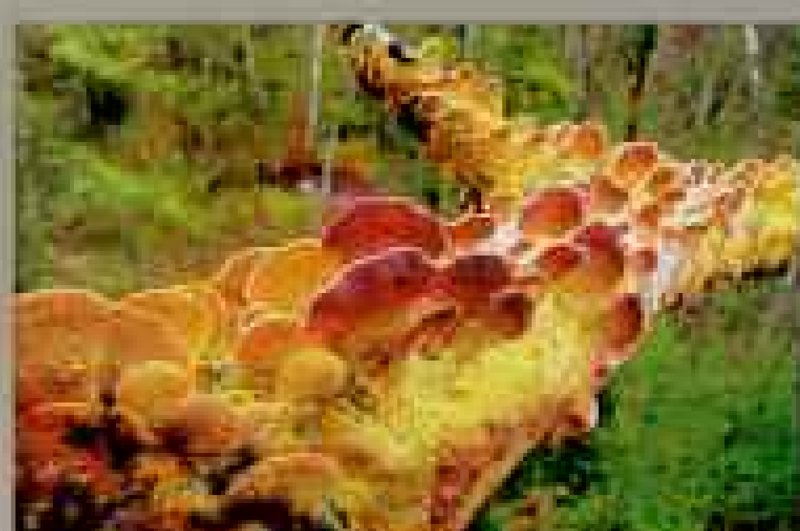
WOODPECKER, DAY 45, 2:23 P.M.


PANCAKE ICE ON POND, DAY 49, 8:22 A.M.

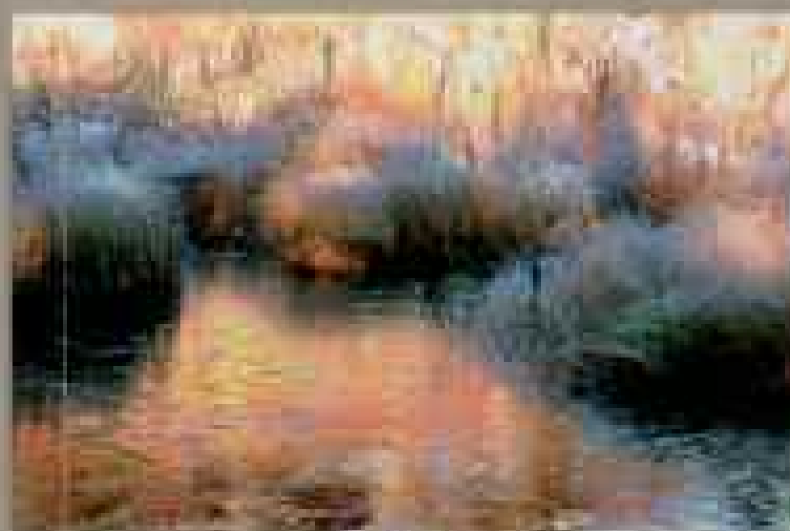
NUTHATCH TAIL, DAY 50, 4:22 P.M.


LICHENS WITH QUARTZ, DAY 51, 3:57 P.M.

CEDAR GROVE, DAY 52, 3:58 P.M.


BRACKET FUNGUS, DAY 53, 2:32 P.M.

GRAY WOLF CHASING COMMON RAVENS, DAY 78, 8:46 A.M.



POND ICE, DAY 54, 10:58 A.M.

FALLEN LEAF, DAY 56, 3:43 P.M.

LICHENS, DAY 58, 3:36 P.M.

WHITE SPRUCE, DAY 60, 1:58 P.M.

BURNTSIDE LAKE, DAY 61, 3:14 P.M.

CANOEING AT MINUS 1°F, DAY 62, 8:06 A.M.

GRAY WOLF, DAY 66, 8:14 A.M.

RAVENS AND BALD EAGLE, DAY 67, 2:05 P.M.

RAVENS AND BALD EAGLE, DAY 68, 12:10 P.M.

FOX TRACKS, DAY 69, 11:29 A.M.

GRAY WOLF, DAY 70, 8:57 A.M.

TRACK OF INJURED WOLF, DAY 71, 4:26 P.M.

FROZEN FALLS, DAY 72, 1:49 P.M.

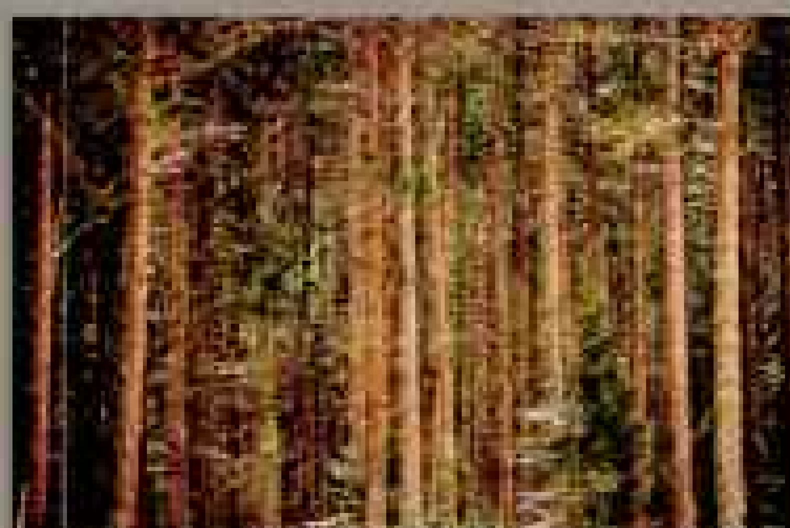
WHITE IRON LAKE, DAY 73, 3:04 P.M.

LONG SHADOWS, DAY 74, 12:34 P.M.

MOOSE LAKE, DAY 75, 11:38 A.M.

DISCOVERY LAKE, DAY 76, 3:05 P.M.

SNOWFALL ON THE NOTCH, DAY 77, 3:54 P.M.



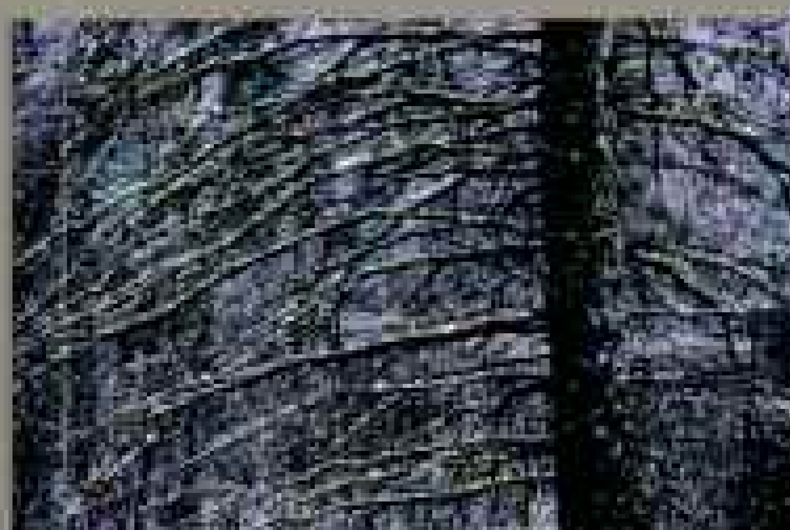
RED PINE GROVE, DAY 79, 11:13 A.M.

COYOTE AND RAVENS, DAY 80, 8:30 A.M.

PINE GROSBEAKS, DAY 81, 2:38 P.M.

TREE MARKED BY BEAR, DAY 82, 10:43 A.M.

FROST ON GLASS, BUSH CAMP, DAY 83, 12:55 P.M.



WHITE SPRUCE, DAY 84, 4:22 P.M.

TREE SKELETONS, DAY 85, 4:48 P.M.

WOLF KILLED DEER, DAY 86, 2:37 P.M.

POACHER KILLED DEER, DAY 57, 9:25 A.M.

ABANDONED BEAVER DAM, DAY 58, 1:52 P.M.

BUBBLES UNDER ICE, DAY 59, 9:48 A.M.

WOLF AND FOX TRACKS, DAY 63, 8:14 A.M.

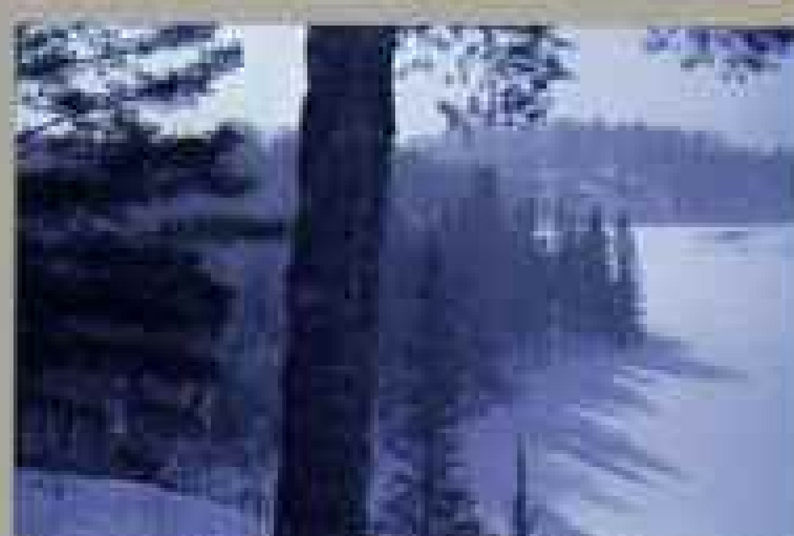
GRAY WOLF TESTING ICE, DAY 64, 8:42 A.M.

WOLF WITH DEER CARCASS, DAY 65, 8:52 A.M.

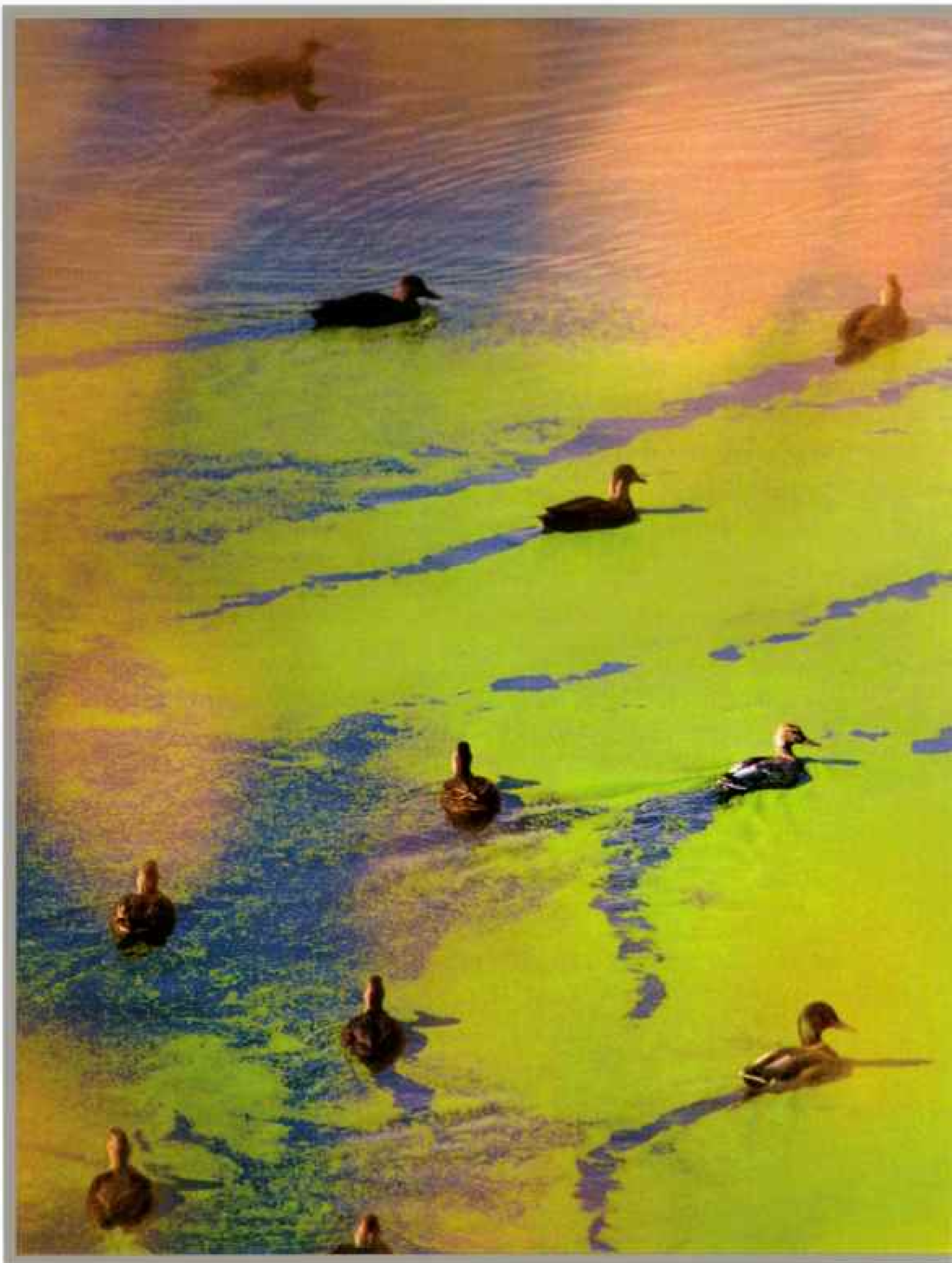
YEAR'S SHORTEST DAY, DAY 89, NOON

GRAY JAY, DAY 87, 12:34 P.M.

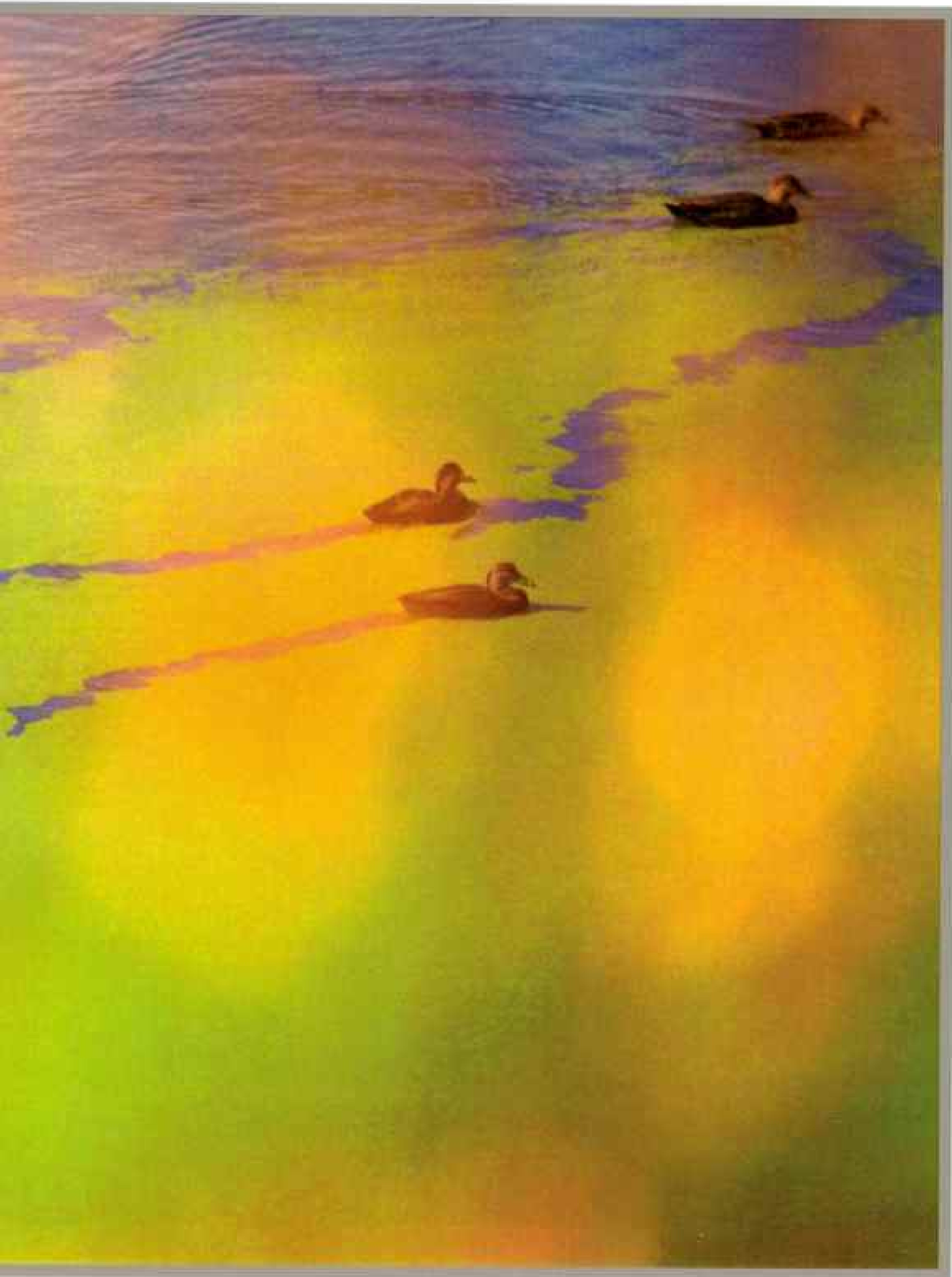
FULL MOON, DAY 88, 7:15 A.M.



YEAR'S LONGEST NIGHT, DAY 90, 1:40 A.M.



I visited here four straight days before making a picture. These mallards and less abundant



American black ducks would soon migrate, but I had 68 days to go and many, many more miles.

Article and photographs by ROBERT CAPUTO

As dust-scoured as the Himalaya that surround him, a boy drives his family's goats into the village of Tangye with a smartly aimed rock. He may not choose to follow the flock home much longer. Change buffets this 750-square-mile realm, open to outsiders after decades of isolation.

Nepal's Forgotten Corner

Mustang

At the annual Tiji festival, celebrants including Mustang's raja, seated at left, and crown prince wear traditional white silk *khatas*. Custom also decrees the colors that decorate Buddhist monuments like these rising over Tangye's barley fields.

Cymbals clanging and horns blowing, a procession of Buddhist monks emerged from the gate of the walled town of Lo Manthang. Behind them five other monks in masks carried bowls containing evil spirits captured during three days of dancing and chanting. The Raja of Mustang, sunlight glittering off his golden robe and long turquoise earring, strode through the gate with the regal indifference of a feudal lord, and behind him came the joyous crowd of spectators. The annual spring festival of Tiji was approaching its climax.

Reaching the fields beyond town, the raja ceremoniously fired an ancient flintlock. The head dancer dashed the bowls one by one to the ground, vanquishing demons that might visit fire, flood, drought, famine, and earthquakes upon the people. The raja pulled a pistol from beneath his robe and fired it several times into the air. The crowd erupted in cheers.

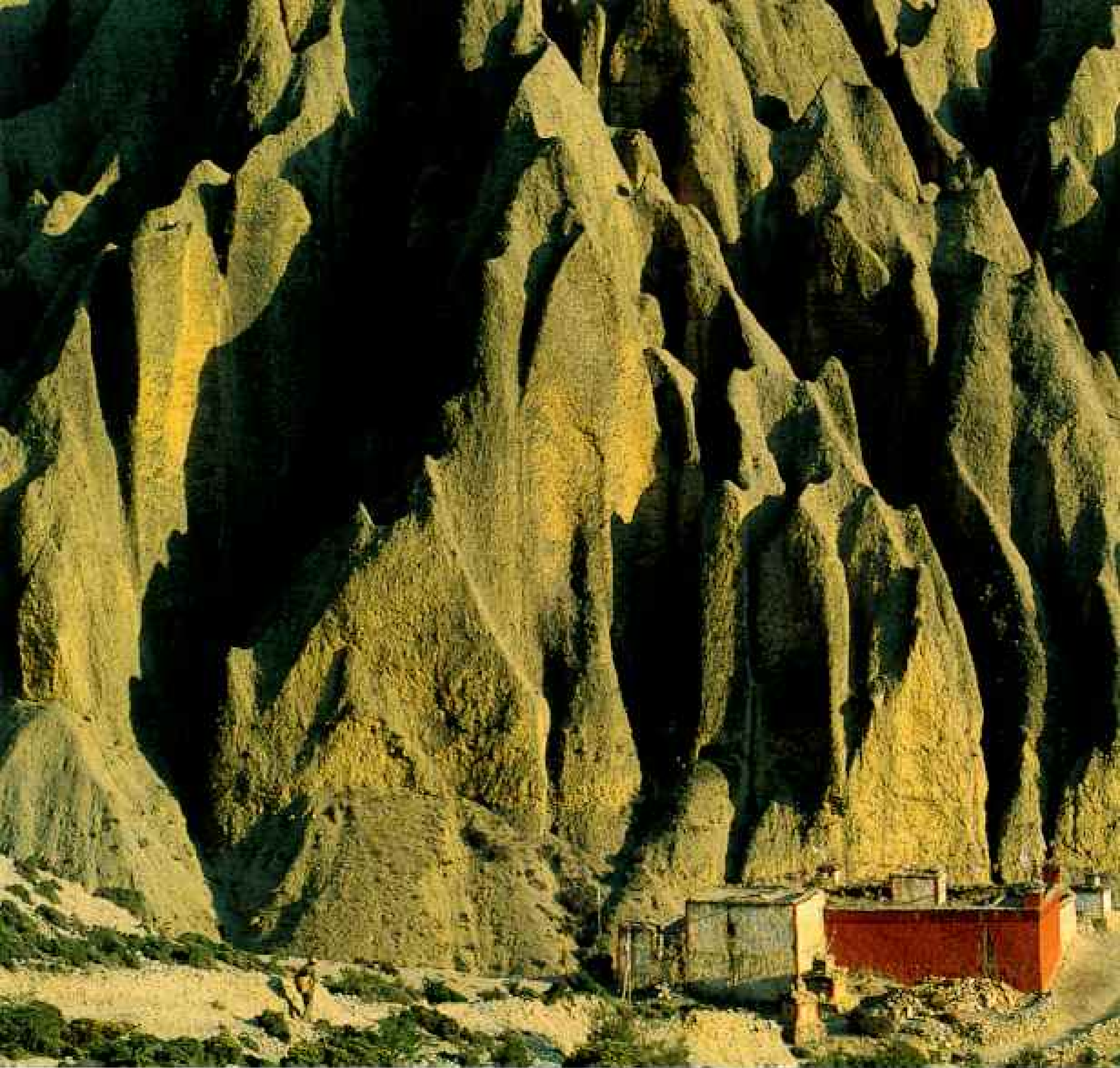
The exorcism complete, we followed the noisy procession back to Lo Manthang for the last part of the rite: Everyone had to jump over the fire that burned in the town gate to prevent demons from following us back inside.

Robert Caputo, who is based in Washington, D.C., has written and photographed six stories for National Geographic, all previously in Africa.

Founded about 1420, Lo Manthang is the capital of Mustang (pronounced moo-stong), a remote enclave of Tibetan Buddhist culture in northern Nepal. The town lies on a windswept plain at 12,400 feet, near the Tibetan border and far from any road—and, until quite recently, so far from the modern world that it seemed locked in the rhythms of the past. Even today the visitor to Lo Manthang watches life proceed much as it has for centuries: The thousand or so residents emerge from their whitewashed mud houses early and walk out through the single gate in the town's thick wall to pasture their animals or work in irrigated fields of grain.

There's little else beyond those fields. Mustang lies north of the main Himalayan massif and so is cut off from the Indian monsoon that waters much of Nepal. It's a high-altitude desert of scree and dirt, a barren expanse of innumerable gorges and cliffs, where farmers husband every drop of precious water channeled from the surrounding snowcapped mountains and scratch a meager living out of the scant arable land.

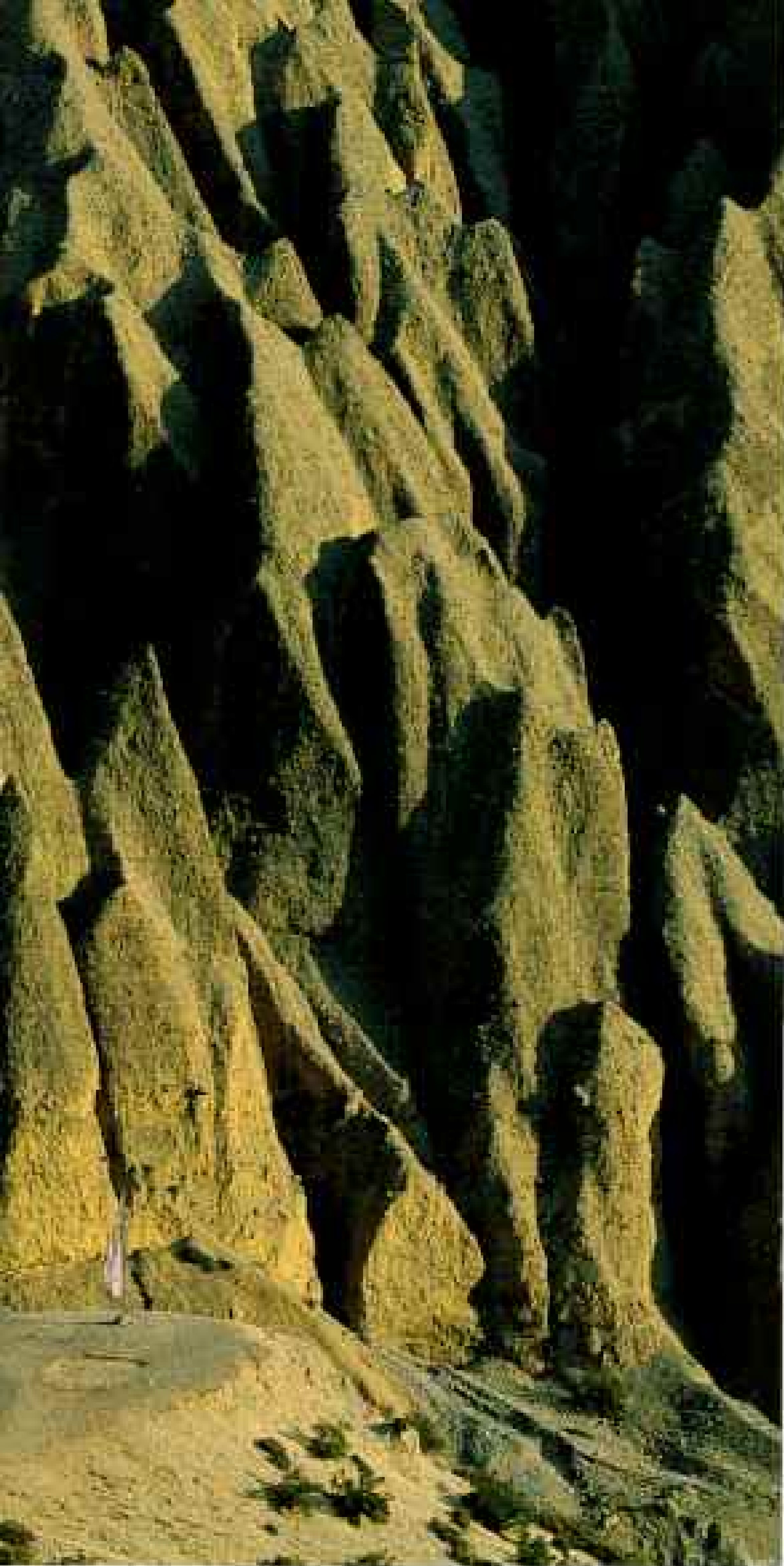
Remoteness has insulated Mustang from foreign influences, especially during the 31 years it was officially closed to outsiders. When



the Chinese invaded Tibet in the 1950s, a band of Tibetan resistance fighters, backed by the CIA, used Mustang as their base of operations. The Chinese closed the Tibetan border in 1960 and pressured the Nepalese government to seal Mustang off from the rest of Nepal. This isolation ended in 1991, when a new government in Kathmandu opened the region to restricted tourism. Mustang's 5,600 people now find themselves in the midst of what to many is an unsettling transition.

The border with Tibet is still sensitive, and Mustang's historic ties there have been largely severed. Monks who would have trained in Tibet now study in India or Kathmandu. Deep religious traditions are being diluted as people are exposed to urban culture and materialism. At the same time, the increasing presence of the Nepalese government—in the form of teachers, bureaucrats, and police—is slowly eating away at the authority traditionally vested in the raja, the inheritor of a more than 600-year-old position somewhere between divine and human.

I MADE TWO TRIPS to Mustang and discovered that the Tiji festival is one of its most important traditions, bringing people from all over the area to the spring rite of cleansing and renewal after the planting is done. The last night of the festival I went to talk with Tashi Tenzing, the 72-year-old abbot of



Linking India and China, the Kali Gandaki River carves a path through this roadless district of Nepal. For centuries trade caravans brought prosperity to Mustang (pronounced moo-STONG), sustaining large monasteries like Luri (left) and supporting masterful art like the portrait of the wrathful deity Mahakala (below) at Chudzong. A Nepali rendering of Lo Manthang gave the region its Western name.

Lo Manthang's only active monastery and the highest religious figure in the land. He had become a monk when he was 11 and studied in Tibet for ten years. Now he is deeply worried about the changes coming to his land. Even monks wear Chinese-imitation Converse All Star sneakers beneath their robes, and in one chapel a photograph of the Dalai Lama rests on an empty Johnnie Walker bottle beneath a huge 1970s poster of Al Pacino in love beads.

Sitting cross-legged on a platform at one end of a small room decorated with holy paintings, Tashi Tenzing spoke of his concerns. "Religion does not mean as much to people nowadays. When the people see Tiji, for most it is only a show. Especially the young people—they just

Festive Exorcism in Mustang's Capital

Copper horns 12 feet long (bottom) herald the Tiji ceremony, traditionally held in early spring. Spectators, some of whom have walked for days from distant villages, assemble outside the raja's palace (top) to watch monks in brocade robes and yak-hair boots dance and chant (left). Every gesture, drumbeat (center), and prayer must be ritually exact in order to summon and expel malevolent spirits. Lo Manthang's abbot worries that Mustang's young are entertained but unmoved by the spiritual practices.

think about money. But Tiji is very old and very important. And not just for the people of Lo Manthang. It is for the whole world, not just Buddhists but Hindus, Christians, Muslims, everybody. It is a ritual for peace—and to protect us all from danger."

I had arrived in Lo Manthang several days before the festival. It had taken me nine days of trekking on foot and horseback to travel the 50 miles from Jomsom, the last airstrip and jumping-off place for Mustang. But I was in no hurry. Coming up the west side of the Kali Gandaki River, Angya Gurung, my guide and interpreter, and I stayed in small villages of whitewashed houses, usually pitching our tents behind wood stacked on the flat mud roofs.

"This is the best place to camp—out of the wind," Angya said. "Also a good way to avoid the fleas and lice."

The houses were invariably the same. A growling, but chained, mastiff guarded the low doorway, above which hung a spirit catcher—a sheep's skull decorated with holy paintings and made by a Buddhist monk to keep demons out. Storerooms for grain and stalls for livestock took up the first floor. The family lived on the second floor, with kitchen, dining area, and bedroom all in one dark chamber. Oil lamps cast a faint glow on statues of the Buddha and other deities in a tiny chapel.

One evening, camped in the village of Geling, we were invited to have tea with Tshering, the woman of the house, who was roasting barley over a dung fire. Her long black skirt and striped apron, both of homespun wool, were ragged, and her lined face spoke of a hard life of labor in the high, dry air. I made a comment about the cold as I sat down near the fire.

"You should come here in winter," Tshering laughed. "But if you did, you would hardly find anybody. Winters are too hard here."

"Almost all the people in Mustang leave in the winter," Angya explained. "There is nothing to do, and by going out they can do some trading and get a little money."

"When I was small," Tshering continued, "my father took grain to Tibet, traded it for salt, and in winter sold the salt in Nepal, like his father before him. But the Chinese stopped the salt trade. Now most of us go to India in winter. We buy sweaters in Punjab and sell them in Assam.

"With the sweater money we bought this," she said, pointing to the kettle from which she poured us yak-butter tea. "And all those pots too. And shoes. So many things we could not get before or that were too expensive.

"They have electricity there," she added. "Sometimes we watch videos. Rambo, Bruce Lee. Very nice." She leaned back against the mud wall of her house, from which posters of Indian pop stars and the rock groups Metallica and Iron Maiden stared down at us.

NO ONE IS MORE AWARE of the currents of change running through Mustang than the raja. Entering the palace, the only four-story dwelling in Lo Manthang, I climbed the rickety wooden stairs, spun the prayer wheel at the top, and waited in a courtyard guarded by the ubiquitous mastiff—stuffed, ragged, and hanging from a rafter. A short time later I was called into the raja's presence.

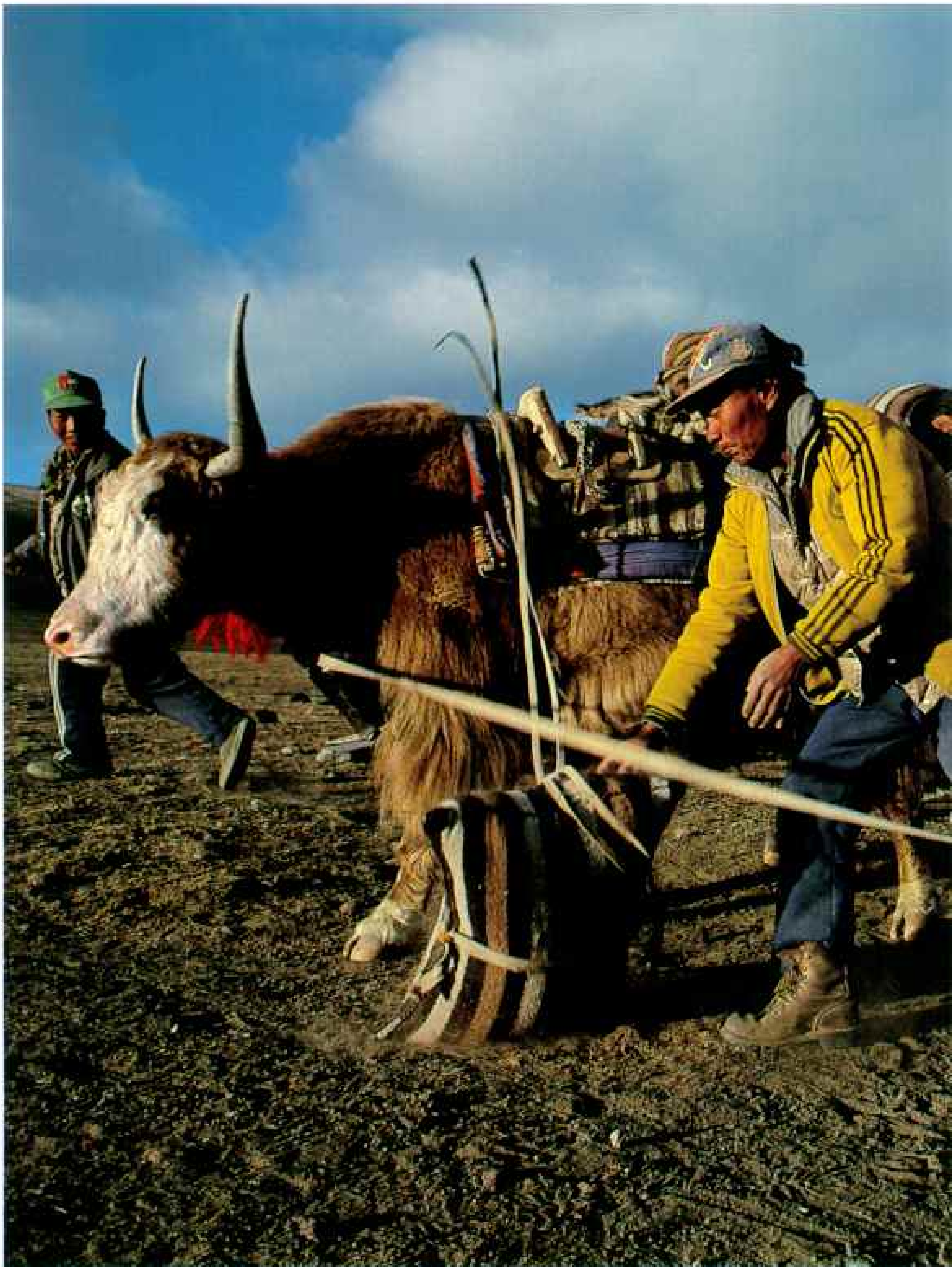
The raja, a large man in his mid-60s, had changed his golden robe for a windbreaker and slacks. He sat on a platform in the sitting room, his long braids tied around his head, his fingers continuously working a string of prayer beads. I was invited to sit next to him on a slightly lower platform. The social hierarchy in Mustang is still strong. The platforms around the dung cooking fires in every house are of varying heights, and no one may sit on a level higher than those who outrank him. Blacksmiths and butchers, who are deemed unclean, may not even enter the living area of a house but must sit on the floor by the door.

Jigme Palbar Bista is 25th in a line of succession founded by Ame Pal, who united the warring towns along the upper Kali Gandaki River and in 1380 became the first king of Lo, as Mustang was then called. Raja Jigme ascended the throne in the early 1970s. Since then he has seen his authority wane as more and more people leave Mustang to better themselves and as the Nepalese government exerts more influence.

"During my reign I have tried to reinforce our culture," the raja said. "But it is not easy. The people are changing much. It's not that they aren't interested in their traditions anymore, but that they are very poor. People have to survive."

A villager from Mustang stands to earn hundreds of times more cash as a trader in India in winter than during the rest of the year at home.

Learning prayers that may help them reach nirvana demands concentration from boys in a Lo Manthang monastery school. Mustang's walled capital houses a thousand people, twice as many sheep and goats, half as many horses and mules. Buddhism teaches that every creature may one day be released from life's endless cycle of suffering and enter paradise.



Notoriously slow and stubborn but built to survive on thin forage and even thinner air, yaks are the indispensable companions of Mustang's remaining handful of pastoral families. Moving between winter and

summer pastures in valleys 14,000 to 16,000 feet high, yaks carry household goods often acquired in trade for yak butter and wool. Herdsmen exchange dried yak dung, the region's basic fuel, for farmers' grain.

Some young people don't return, and those who do inevitably bring with them new attitudes and a sense of the world at large.

Raja Jigme expressed concern about the changes brought by greater contact with outsiders. "We need to have the tourists come because we have nothing besides our land. But the tourists bring change. Mustang will be different—not in my lifetime, for I am an old man. But for the future I am worried."

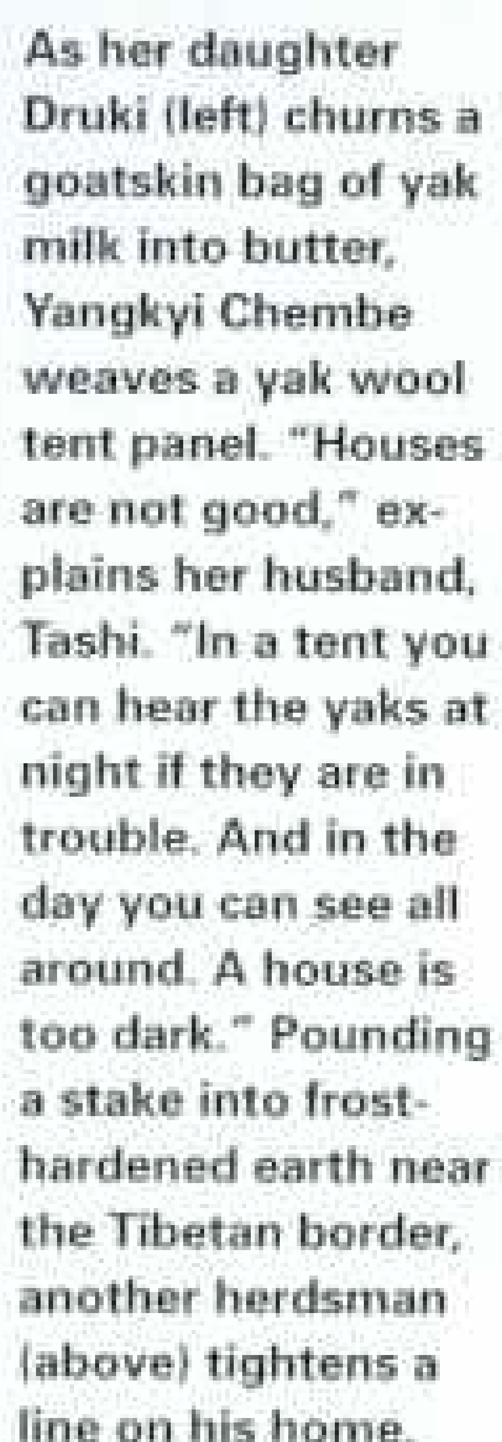
Because Mustang is small and fragile both culturally and ecologically, the Nepalese government limits the number of tourists to a thousand a year. The treks are usually organized by agencies in Kathmandu, and the visitors carry all their supplies, so there's no need even to buy food locally.

Since this system deprives the people of the financial benefits of tourism, Mustang is supposed to receive 60 percent of the $70-a-day fee each trekker pays the Nepalese government. But I was told only about 15 percent of this filters through the bureaucracy in Kathmandu.

"We want tourists to come because of the chance to get some money," said Pema Ongdi, who heads the Lo Manthang development committee. "But open tourism would be better because more people could benefit."

For Tashi Tenzing, the old abbot of Lo Manthang, the benefits come at a price. "This is the time of the tiger," he told me. "The tiger has stripes on the outside; it is very beautiful to look at, but there is nothing in the heart. And the heart is the most important thing."

At heart Mustang is still essentially a feudal kingdom that grew rich from its position astride the Kali Gandaki River—an easy route through the Himalaya for caravans of salt traders between Tibet and India. The raja and nobles who controlled this trade became



As her daughter Druki (left) churns a goatskin bag of yak milk into butter, Yangkyi Chembe weaves a yak wool tent panel. "Houses are not good," explains her husband, Tashi. "In a tent you can hear the yaks at night if they are in trouble. And in the day you can see all around. A house is too dark." Pounding a stake into frost-hardened earth near the Tibetan border, another herdsman (above) tightens a line on his home.

wealthy. At its zenith in the 15th and 16th centuries Mustang was renowned for its Buddhist art and scholarship. The temples still house ornately bound texts and fine statues, the most impressive of which is a 45-foot gilt statue of Maitreya, the Coming Buddha, in Lo Manthang's Jampa temple.

Tibetan lamas spread Buddhism throughout the realm. I had seen the results on my treks. The entrance to every village is marked by long walls of carved prayer stones and by large *chortens*, bell-shaped monuments housing sacred texts and relics. Most villages have temples, and several towns are home to monasteries that once echoed with the chants of hundreds of monks.

As its wealth and power waned, Mustang was conquered by armies from the south and incorporated into the Hindu Kingdom of Nepal at the end of the 18th century. Mustang remained an isolated backwater—the first Westerner didn't arrive until 1952. After China closed the border eight years later, there was again little contact with the outside world and virtually no development: no roads, no electricity, and only one small, ill-equipped medical clinic.

The forced isolation preserved much of Mustang's Buddhist heritage. The Chinese destroyed many sacred objects in Tibet, but temples in Mustang escaped systematic looting.

Fertile flats chiseled from rocky angles, terraced fields surround the tightly clustered stone houses of Tetang, a village of about 300 people. These fields, like all the cultivated land in the region, are brought to life

by a carefully maintained system of irrigation channels—some no wider than a foot or two—fed by snowmelt from mountain peaks and scant summer rains. Disputes over water rights are settled by the raja.

And while Buddhists in Tibet may be severely punished for having a picture of the Dalai Lama, people in Mustang are free to worship as they wish.

Most monasteries are quiet now, some abandoned, others having only a handful of monks to look after the temples and perform rituals to ward off evil spirits. No new prayer stones adorn the walls; the chortens are melting back into the earth. The people no longer have the time, resources, or inclination to maintain the sacred sites, and the royal coffers are empty.

Nowadays the power of the raja to command people to attend to public works has faded. In the past peasants had to harvest his crops for free before they could reap their own. Until very recently no one would have dreamed of disobeying this command. Now people don't feel compelled to obey, and only a few show up for the raja's harvest, even though he pays them.

Since Raja Jigme no longer holds the power known by his ancestors, disputes are more and more frequently taken to the Nepalese courts or police rather than the palace. Crown Prince Jigme S. P. Bista, the raja's stepson, does not live in Lo Manthang but in Kathmandu, where he owns a rug factory and a trekking company. Whether he will choose to return to Mustang when he ascends the throne is unknown.

On my second trip, in autumn, I rode across the broad plain that sweeps down from Lo Manthang to the Kali Gandaki River. The fields were barren, the reaping was done. Horses, donkeys, and mules were chewing at the stubble. In the threshing grounds just outside the town walls, people were whacking mounds of wheat with paddles and tossing it high by the basketful to free the grain. The air was full of chaff and cries of "*Kaiyo, kaiyo,*" by which the harvesters call the wind to aid their winnowing.

"The harvest is good this year," the head of one family grinned, brushing some chaff from his hair. "Tiji worked."

Nearby, other people stuffed grain into huge sacks made of homespun wool and then, bent nearly double from the weight, carried them through the town gate and along the narrow alleys to their homes. Along the way they were joined by children bearing baskets of dung collected in the fields for the cooking fires.

I left Mustang after the harvest. At the top of a gorge high above the De River, Angya and I performed a parting ritual called *Lungta tangen.* We climbed out onto a precarious projection, where Angya lit a fire fragrant with juniper branches and incense. From his pack he took out a bundle of square pieces of tissue paper, each of which bore a prayer and had been blessed by a monk in Lo Manthang.

One by one we tossed the papers off the cliff, calling "*Tharro*—May we reach home safely," and praying for health, long life, and good fortune. The wind roared up the gorge, catching each piece of paper as we let go.

We stood for a long time on our little perch, watching the last of our prayers disappear into the sparkling blue sky that lay like a blessing over Mustang. □

Milking closely bunched goats (above) and winnowing grain with the help of the wind (opposite), herders and farmers build lives from carefully tended resources. As traditional ties to Tibetan Buddhist culture weaken, many in Mustang turn toward India, seeking prosperity and absorbing new ideas.

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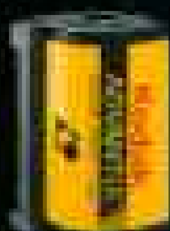

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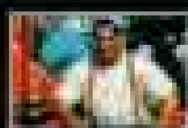

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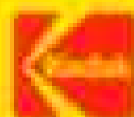

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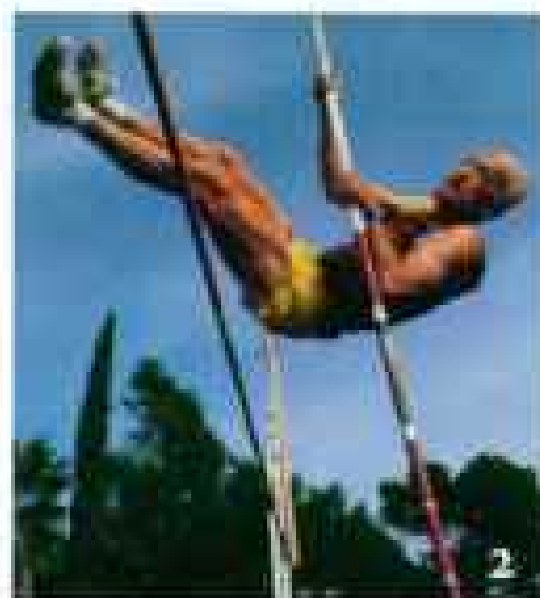

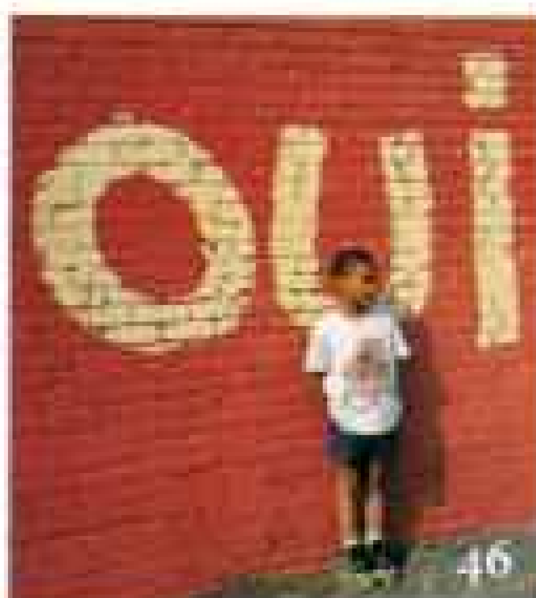

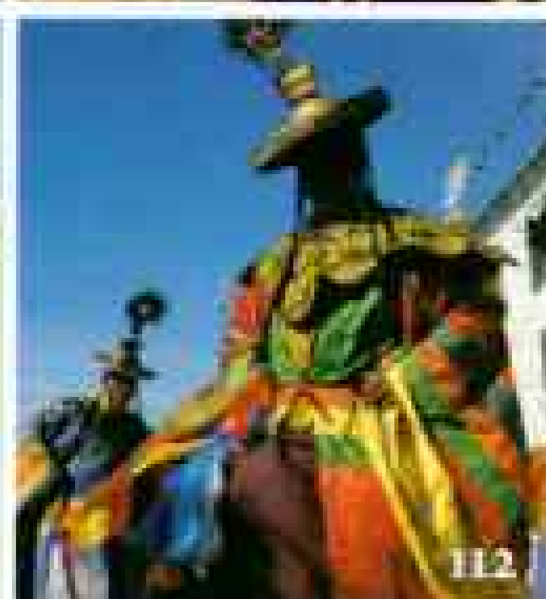

2 **Aging—New Answers to Old Questions** *In the face of an exploding elderly population, scientists study how and why humans age, and seek the secrets of longer, healthier lives.*

BY RICK WEISS PHOTOGRAPHS BY KAREN KASMAUSKI

32 **Wilderness Rafting Siberian Style** *A fearless Siberian team takes handmade equipment to the edge on the raging Oygaing River in Uzbekistan.*

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ARTICLE AND PHOTOGRAPHS BY MARK W. MOFFETT

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BY LIDA SUCHÝ PHOTOGRAPHS BY LIDA SUCHÝ AND MIŠO SUCHÝ

94 **North Woods Journal** *Deep in the Minnesota wilderness, where pine trees claw the surface of dark lakes, a native son records his habitat in a personal journey of discovery.*

ARTICLE AND PHOTOGRAPHS BY JIM BRANDENBURG

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ARTICLE AND PHOTOGRAPHS BY ROBERT CAPUTO

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The Cover

Fall lineup in the north woods: Mallards and American black ducks meander through duckweed in a Minnesota pond before heading south for the winter. Photograph by Jim Brandenburg

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Chrysler's design and engineering teams agree their new midsize car should reflect the thinking in Portofino—scrapping current plans.

September 8, 1991:
International Motor Press Association gets preview of new "cab-forward" sedans at Moran's Restaurant in New York. Journalists are, briefly, too excited to eat.

September 15, 1992:
Chrysler Concorde, Dodge Intrepid, and Eagle Vision sedans are launched. Their cab-forward profile "makes everything else look old," according to one writer.

November 6, 1992:
To get mall shoppers to stop and test their seating prototype, a group of Neon engineers offers free hot dogs.

March 12, 1993:
Two Chrysler designers, working on new compact sedan late on Friday, decide to go for Chinese food. Nine hours later they arrive in Chinatown—in New York.

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Behind the Scenes

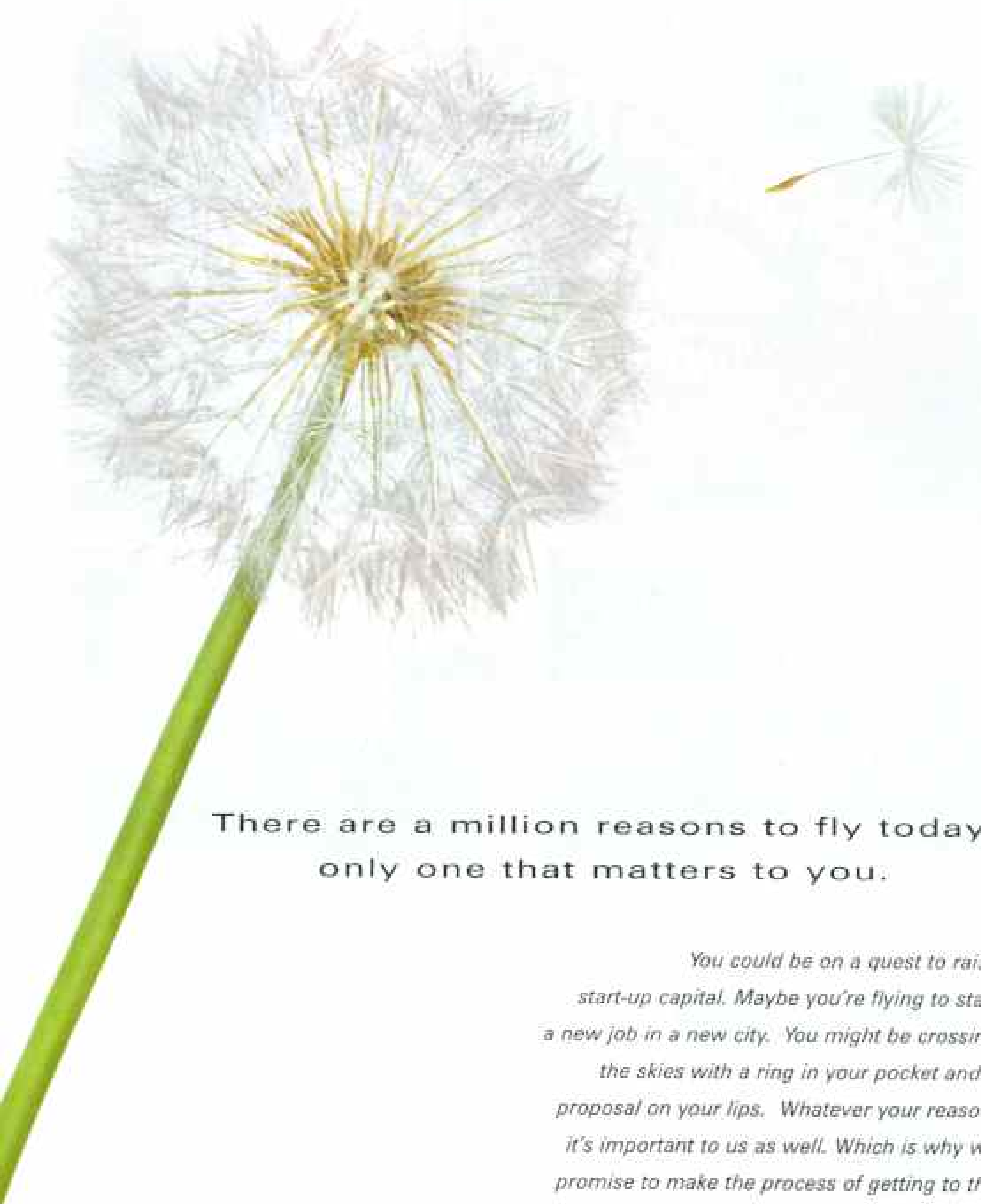
No Room for Error With These Geography Students

Dahomey? Rhodesia? When kids at James Madison High School in Vienna, Virginia (here forming the outline of Africa), noticed such outdated names on a map in their school-issued date books last year, they alerted teacher—and former Society employee—Mark Dozier. "In about ten minutes they found ten errors," says Mark. The mistakes were all over the map. "Korea was shown as one unified nation. Hawaii wasn't shown at all." The chagrined publishers destroyed 29,000 copies of the maps in stock for the next school year. They'd learned their lesson—from Mark's students.

MARK THIESSEN, NGS

Ready, Set . . . Explore!

Geography Awareness Week begins November 16. This year's theme is "Explore the World! Geography Takes You Places." Thousands of teachers have received ideas for lessons from our Geography Education Division, including an activity book and posters like "Discovering Hidden Treasures" (left), a pop-up map of great archaeological finds. Materials encourage young adventurers to explore distant sites—with keep-warm, polar-diet tips, for example—and to try some projects closer to home, like mapping squeaky spots on stairs.



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MARK THIESSEN, NGS

Exploring Explorers Hall

Did you know that the National Geographic Society has its own museum? More than 330,000 people tour Explorers Hall in our Washington, D.C., headquarters every year. Visitors can play interactive geography games and see the world's largest freestanding globe. Some contemplate dinosaur dentistry on our cast of the *Carcharodontosaurus* skull (top) found by paleontologist Paul Sereno, a Society grantee. Others get a feel for the past from a giant Olmec head (above left), a replica of one unearthed in the Mexican jungle on archaeologist Matthew Stirling's 1940 expedition. Special live demonstrations, from wildlife (above right) to folklife, are scheduled periodically to complement the museum's changing exhibits. But our bronze seal is always there (left) for any intrepid Explorers Hall visitor who cares to take a walk across the world.

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Houbara Bustard *(Chlamydotis undulata)* **Size:** Length, male, 65 - 75 cm; female, 55 - 65 cm **Weight:** Male, 1.8 - 3.2 kg; female, 1.2 - 1.7 kg **Habitat:** Semi-desert regions from the Canary Islands, across North Africa to central Asia **Surviving number:** Estimated near 100,000 Photographed by Xavier Eichaker

WILDLIFE AS CANON SEES IT

Houbara bustard males each defend an extensive territory during the breeding season. Scattered across the plains, they perform dramatic courtship displays—crown feathers ruffle up and white breast plumes fan out as they burst forward in erratic high-stepping trots. Male bustards remain solitary for the duration of the nesting season, while the female alone selects the nest site, incubates the eggs and raises the young. Throughout their broad yet patchy distribution, Houbara bustard populations have suffered marked declines, mainly from habitat changes and hunting. As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.

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BRIAN LANKER

MICHAEL NICHOLS, NGS

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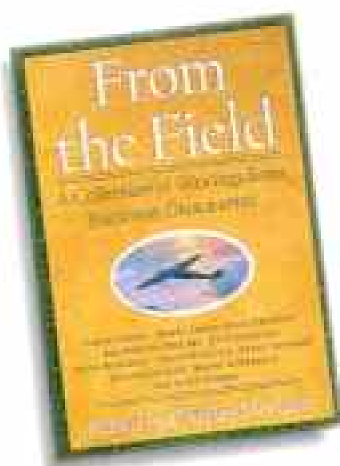
What? No Pictures?



For a magazine famous for color photographs, some of our most memorable images have appeared in black and white—in paragraph form. Former GEOGRAPHIC Editor-at-Large Charles McCarry proves it with his new anthology, *From the Field*, a collection of evocative writing from 109 years of the magazine. Writers who embody the Society's spirit of adventure are well represented: Jane Goodall (above center), Peter Benchley, Amelia Earhart, and Robert E. Peary, as well as longtime staff writers like Cathy Newman, Priit J. Vesilind, and William S. Ellis. But the magazine has also showcased those who relate adventures of the human spirit: Maya Angelou (above left), Paul Theroux, David Remnick, Joseph Conrad (above right), Archibald MacLeish, and Theodore Roosevelt.

From the Field is now available in bookstores.

MARK THIESSEN

Keeping in Touch

Some GEOGRAPHIC readers have a real feel for the magazine—they read the Braille edition, with all the text of the printed publication except ads. In 1996 the National Library Service for the Blind and Physically Handicapped, part of the Library of Congress, circulated 23 million Braille and recorded copies of periodicals and books to eligible patrons—at no charge. The GEOGRAPHIC, with over 12,000 users, was their most requested magazine. Call 1-800-424-9100 for information.

The Cover Story

We weren't always yellow bordered. The first ever NATIONAL GEOGRAPHIC cover, in October 1888, appeared on terra-cotta colored paper, though by 1905 (top) a stock called buff was our standard. In February 1910 (middle) the cover text was enclosed in a laurel-and-oak-leaf border, and the trademark rectangle was born.

Our yellow border brightened, and then in July 1959 (bottom) cover photographs became the norm.

As tastes changed, our cover's leaves were pruned. In September 1979, after nearly 70 years, they vanished for good, save for one laurel sprig that still perches atop our name.

After 109 years there's nothing wrong with a little tradition.

For a change, we'd like to talk about *your* air bags.

For more about environmentally friendly Honda products, call 1-888-CC-HONDA ext. 109 or visit www.honda.com. © 1997 Honda North America, Inc.

Take a deep breath. Relax. Get comfortable. You are about to read some good news.

Recently, Honda brought its advanced Low-Emission Vehicle (LEV) technology to everyone in America. All fifty states. Voluntarily.

It arrived in the form of the all-new 1998 Accord and the Civic. Both offer engines which meet California's strict Low-Emission Vehicle standard. But now you can buy one not just in California, but in Michigan. Texas. Ohio. Georgia. Wherever you live.

Both cars meet a 70-percent-lower emission standard for smog-contributing non-methane organic gases than is required by the most stringent federal standard. With no performance sacrifice or cost penalty.

Plus, in California and specific states throughout the Northeast, we're now offering our new Accord Ultra-Low Emission Vehicle (ULEV). It's the first auto certified by the California Air Resources Board as a ULEV, making it the cleanest gasoline-powered production car sold in the U.S.

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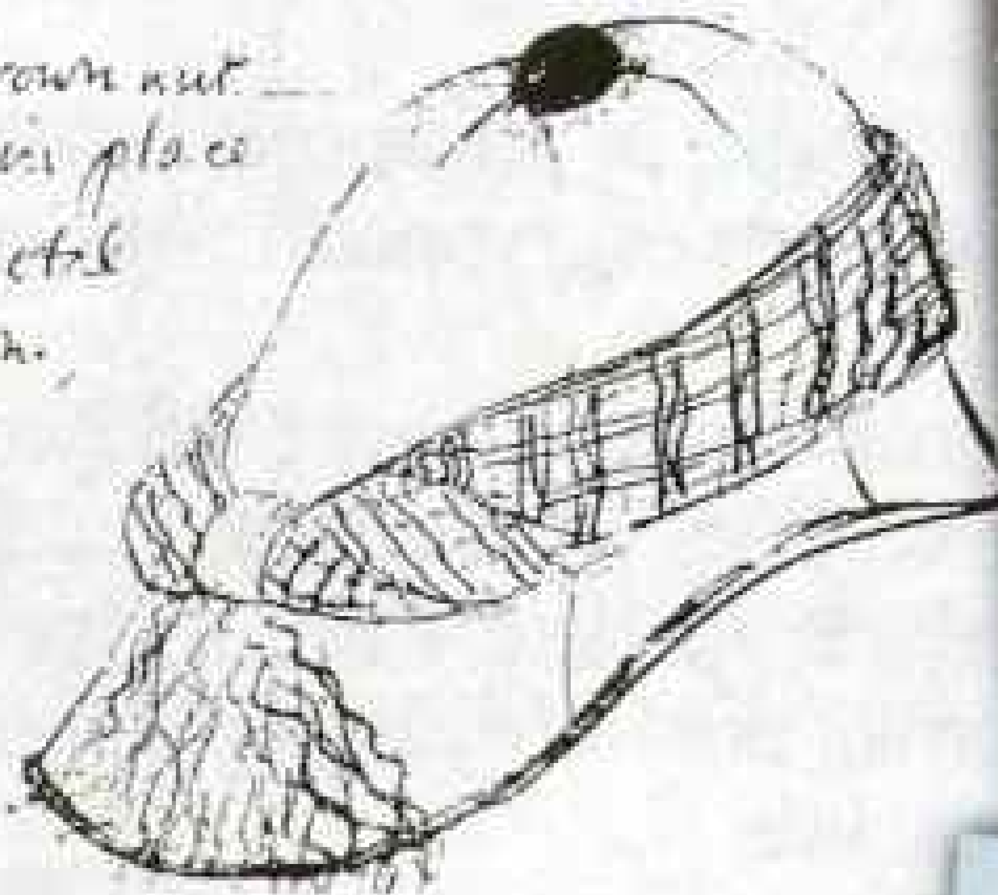
That means, based on last year's sales figures, more than 60 percent of all new Accords and Civics, some 450,000 cars, will now be more environmentally friendly.

Historically, Honda has continually been a leader in fuel-efficiency and low-emission technology. Because we always think about more than the products we make. We think about the people who use them, and the world in which they live.

Which, in the end, helps us all breathe a little easier.

HONDA
Thinking.



Proper Dress Required

"We had a lot to get right," said designer Sheelagh Killeen, whose group created almost 2,000 period costumes—in England and Kenya—for our TV movie *Forbidden Territory: Stanley's Search for Livingstone* (see On Television). They even custom-dyed fabrics to match African garb of the 1870s. Sheelagh sketched the pith helmet worn by Henry Morton Stanley (upper right) for the one worn by actor Aidan Quinn (right). Finishing touches on Quinn's costumes were made as wild hippos looked on.

SHEELAGH KILLEEN (ABOVE LEFT); ROYAL GEOGRAPHICAL SOCIETY, LONDON (TOP); OLIVER UPTON

JOHN LIVZEY, NGT

Live . . . from NGS

There's always something going on at our Washington, D.C., headquarters, and you're invited to participate. *Live . . . from NATIONAL GEOGRAPHIC*, a series of lectures, films, and concerts in our Gilbert H. Grosvenor Auditorium, offers the chance to hear the writers, photographers, and explorers who populate your magazine pages and, sometimes, your television screens. On November 18 EXPLORER host Boyd Matson (left) will relate his adventures in the field with National Geographic Television.

Other upcoming programs include live performances of music from Mexico and Scotland, David Breashears on surviving Mount Everest, and staff photographer Michael "Nick" Nichols on the thrill of shooting tigers—with a camera.

To see the fall schedule, visit our website and click on "The Society."

TEXT BY MAGGIE ZACKOWITZ

Branching Out

Two Spanish-language editions of the GEOGRAPHIC debut this fall, following the success of our two-year-old Japanese edition. We are working with publishers in Mexico City and Barcelona to make the magazines available to members in Latin America and Spain.

■ FOR INFORMATION

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The house was on the market for less than a week. They were the first to see it. He loved the Corinthian capitals, and she was taken by the leaded glass doors. The trick was to remain calm in front of the agent.

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Even though they were familiar with Jenn-Air's state-of-the-art induction technology, listening to the agent brag about it was fun nevertheless. Sure, they maintained their composure in the entranceway. But when they saw the kitchen, they just lost it. And, from that moment on, the house was off the market.

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Forum

In the July 1997 issue "Roman Empire" drew the most responses, including one by a writer who saw "the paradox of Roman history: how a people could be so brutal, yet so progressive at the same time."

Roman Empire

I'm really fascinated with your series on the Roman Empire. The history lesson is profound. The stories of Marcus Licinius Crassus and the tax evasions sound so much like home.

BILL MANDERVILLE
Des Moines, Washington

The philosopher Seneca could not have watched gladiator games in the Colosseum (page 40); he committed suicide by order of the emperor Nero in A.D. 65, ten years before Vespasian decided to build the amphitheater.

MICHELE VENTURI
Florence, Italy

The Baths of Caracalla (pages 30-31) were the model for New York City's original Pennsylvania Station, a monument that was demolished in the early 1960s. Social historian Lewis Mumford wrote, "There is never too much of that grand Roman quality in a modern city." Well, America can build them and America can lose them, just like Rome.

M. DAVID SHORE
Richmond, British Columbia

Page 24 says that Caesar defeated the Parthians at Zela. In that battle he defeated Pharnaces, king of Pontus, not Parthia.

TAMAS REVESZ
Budapest, Hungary

The article, particularly the author's puckish commentary on Latin, evoked memories of my own high school studies. For the demanding Jesuits at Fordham Prep in the Bronx in the 1950s, it wasn't enough that we translated Virgil; we also had to recite portions of the *Aeneid*, with the proper meter yet. And Virgil's hexameter was dactylic (not iambic as stated on page 30) with a good sprinkling of spondees. This minor point aside, the article, having been well written, informative, and amusing, is to be commended, absolutely.

RICHARD RODRIGUE
Yonkers, New York

Pliny the Elder did not go to Pompeii during the eruption of Vesuvius because he was "curious" (page 13). A wealthy, influential senator who happened to have a large villa on the Bay of Naples, he had been made commander of the substantial Roman fleet based there. He went to Pompeii on a rescue mission, attempting to save those trapped between the waters of the bay and the ash of the volcano.

JUSTIN ST. P. WALSH
Rye, New York

Pliny was both curious and heroic. According to his nephew's account of the eruption, he "saw at once that it was important enough for closer inspection." Then learning of a friend in need of rescue, "he changed his plans, and what he had begun in a spirit of inquiry he completed as a hero."

The caption on pages 8-9 says "a stone aqueduct still carries fresh water above the streets of Segovia, Spain." I once walked the entire length of the aqueduct and can say unequivocally there was no water running.

CHRISTA MCREYNOLDS
La Jolla, California

The carbonized loaf of bread from Herculaneum with a crosslike indentation (page 37) brought back childhood memories of Lithuania 60 years ago. When the coarse rye dough was being formed into loaves, one loaf was always marked with a cross, impressed with the edge of one's palm, as an invocation of God's blessing on this "staff of life."

VYTAUTAS MATULIONIS
Cleveland Heights, Ohio

Sumo Wrestling

I have always admired those magnificent sumo wrestlers. They give me a feeling of dignity, respect for old traditions, and fair play. This sport is simple; just a few seconds and the winner is walking from the ring as peacefully as before the match. Contestants don't provoke quarrels. They have no hatred in their eyes, and they totally accept their destiny. Unbelievable attitude these days.

ILPO KOPONEN
Leppävirta, Finland

Montserrat Volcano

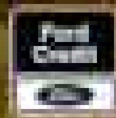
On a Sunday morning in June, I skimmed a newspaper article about the recent eruptions of the Soufriere Hills volcano on Montserrat, idly wondering why those "idiots" wouldn't leave. That afternoon I read A. R. Williams's story and understood. Her text and Vince Musi's photography were compelling; I reread the newspaper article. This time places like Cork Hill and Plymouth seemed familiar, as did "pyroclastic flow." We are all now more aware of just what the Montserratians are going through.

CANDITA LEE
Quarryville, Pennsylvania

As a Mexican with much of his family near the slopes of the Popocatépetl volcano, recently erupting, I think the plight of the Montserratians offers precious insight into the care and concern that a living mountain should receive.

MAURICIO ROUSSELON
Linares, Mexico

WHY WISH ON A STAR WHEN YOU CAN RELY ON FIVE?



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You should come back and view the carnage that took place on Wednesday last [June 25]. Nine people dead and 12 missing, hundreds of homes destroyed, hundreds in shelters for the first time.

AGNES LEMPRIERE
Salem, Montserrat

Since June, volcanic activity has escalated. As of late August scientists believed no place on the island was safe, and the British offered to evacuate the remaining residents, crowded on the island's north end.

Robotics

The first sentence contains the usual language employed by the white-collar world in referring to devices that relieve people of work that is "boring" and "nasty." Later "laborsaving" occurs; this to a worker means "job eliminating." Too often the terms used give the impression that the worker replaced by a robot has received some sort of favor. In most cases displaced workers have lost the best thing they ever had. Their jobs may have been boring, dirty, and tedious, but they enabled them to live, make mortgage payments, buy cars, send children to school, and occupy a place in the economy that, incidentally, cannot be occupied by a robot. While at present only robots can examine Mars for us, it would be incorrect to hint that in most industrial applications the advent of robotics is of any benefit to workers.

DANIEL SHANNON
Royal Oak, Michigan

A few days ago I had a pacemaker implanted in my body. After reading your article I realized that I am being controlled by a very small computerized robot, which monitors and kicks my heart about once a second.

DAVID M. PAISLEY
Camarillo, California

The Dawn of Humans

An archaeologist says that for early humans to have hunted cooperatively and employed strategies such as ambush, "speech would have been critical." Correct me if I'm wrong, but don't wolves and lions, among other predators, often flush their prey toward a concealed member of the group that initiates the kill? If so, isn't this article perpetuating the myth that humans, unlike the lowly beasts, are driven by conscious, rational thought processes, not by instinct? Come on, the world's not flat anymore.

CHRISTOPHER BAILEY
New York, New York

Regarding the mysterious elephant femur (page 111) found by Dietrich Mania in eastern Germany, it seems obvious that the 28 carefully etched lines are evidence of not only symbolic thought and a grasp of numbers and counting but also an understanding of time and seasons. A crude calendar marking the cycles of the moon would explain the number of lines. I would also theorize, however, that the elephant bone is a record of a cycle of another sort. With 7 lines moving in one direction and 21 in the other, it would appear that Mania has discovered an ancient woman's record of her menstrual cycle—truly a fascinating glimpse into a culture more rich and complex than we ever imagined.

SARA L. SPURGEON
Tucson, Arizona

Grand Managed Canyon

I just came back from rafting by dory from Lees Ferry to Lake Mead, 260 miles, 17 people, 7 days. I enjoyed Mike Long's Colorado rafting trip immensely, but I missed descriptions of the beauty: the boat floating with the current while you look at the color-changing walls, the sleeping under the stars, but mostly the climbing of rocks. Every day there were a few stops in canyons to climb to the top for unbelievable views, or to a waterfall and much needed shower, or to Indian ruins. Crystal Rapids shot us a wave to remember.

GABRIELLE WASSERMAN
Glen Cove, New York

I find it ludicrous for anyone to consider a hundred-million-dollar solution to save the endangered humpback chub. It is no wonder that our government is in debt as long as antics like this go unchecked. Enough, already.

VERNON BRABHAM
Marietta, Georgia

There are actually human beings worried about erosion in the Grand Canyon. Erosion?

GREG HUME
Seattle, Washington

My husband and I have lived in southern Arizona for over ten years now and are fairly well versed in most water issues discussed in the article. I, too, used to bemoan the loss of Glen Canyon to the waters of Lake Powell. But what those who wish to open the gates and return the canyon to its pristine predam condition don't seem to grasp is that the dam, lake, and all the changes wrought by man are nothing more than a blip in the timeline of the Grand Canyon. The inevitable flow of Colorado silt will be the dam's nemesis, not Earth First!

PAMELA OCASEK
Tucson, Arizona

Letters for FORUM *should be sent to National Geographic Magazine, Box 98198, Washington, D.C. 20090-8198, or by fax to 202-828-5460, or via the Internet to ngsforum@nationalgeographic.com. Include name, address, and daytime telephone. Letters may be edited for clarity and space.*

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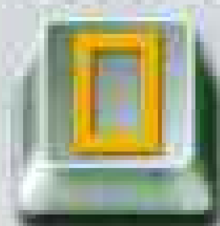

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BRIEF SUMMARY

CLINICAL PHARMACOLOGY ***Pharmacokinetics and Metabolism: Omeprazole –*** In pharmacokinetic studies of single 20 mg omeprazole doses, an increase in AUC of approximately four-fold was noted in Asian subjects compared to Caucasians. Dose adjustment, particularly where maintenance of healing of erosive esophagitis is indicated, for the hepatically impaired and Asian subjects should be considered.

INDICATIONS AND USAGE ***Duodenal Ulcer:*** PRILOSEC is indicated for short-term treatment of active duodenal ulcer. Most patients heal within 4 weeks. Some patients may require an additional 4 weeks of therapy. PRILOSEC, in combination with clarithromycin, is also indicated for treatment of patients with H. pylori infection and active duodenal ulcer to eradicate H. pylori. Eradication of H. pylori has been shown to reduce the risk of duodenal ulcer recurrence. In patients who fail therapy, susceptibility testing should be done. If resistance to clarithromycin is demonstrated or susceptibility testing is not possible, alternative antimicrobial therapy should be instituted. (See the clarithromycin package insert, MICROBIOLOGY section.) ***Gastric Ulcer:*** PRILOSEC is indicated for short-term treatment (4-8 weeks) of active benign gastric ulcer. ***Treatment of Gastroesophageal Reflux Disease (GERD): Symptomatic GERD –*** PRILOSEC is indicated for the treatment of heartburn and other symptoms associated with GERD. ***Erosive Esophagitis –*** PRILOSEC is indicated for the short-term treatment (4-8 weeks) of erosive esophagitis which has been diagnosed by endoscopy. The efficacy of PRILOSEC used for longer than 8 weeks in these patients has not been established. In the rare instance of a patient not responding to 8 weeks of treatment, it may be helpful to give up to an additional 4 weeks of treatment. If there is recurrence of erosive esophagitis or GERD symptoms (e.g., heartburn), additional 4-8 week courses of omeprazole may be considered. ***Maintenance of Healing of Erosive Esophagitis:*** PRILOSEC is indicated to maintain healing of erosive esophagitis. Controlled studies do not extend beyond 12 months. ***Pathological Hypersecretory Conditions:*** PRILOSEC is indicated for the long-term treatment of pathological hypersecretory conditions (e.g., Zollinger-Ellison syndrome, multiple endocrine adenomas and systemic mastocytosis).

CONTRAINDICATIONS ***Omeprazole:*** PRILOSEC Delayed-Release Capsules are contraindicated in patients with known hypersensitivity to any component of the formulation. ***Clarithromycin:*** Clarithromycin is contraindicated in patients with a known hypersensitivity to any macrolide antibiotic. Concomitant administration of clarithromycin with cisapride, pimozide, or terfenadine is contraindicated. There have been post-marketing reports of drug interactions when clarithromycin and/or erythromycin are co-administered with cisapride, pimozide, or terfenadine resulting in cardiac arrhythmias (QT prolongation, ventricular tachycardia, ventricular fibrillation, and torsades de pointes) most likely due to inhibition of hepatic metabolism of these drugs by erythromycin and clarithromycin. Fatalities have been reported. (Please refer to full prescribing information for clarithromycin before prescribing.)

WARNING: *Clarithromycin:* CLARITHROMYCIN SHOULD NOT BE USED IN PREGNANT WOMEN EXCEPT IN CLINICAL CIRCUMSTANCES WHERE NO ALTERNATIVE THERAPY IS APPROPRIATE. IF PREGNANCY OCCURS WHILE TAKING CLARITHROMYCIN, THE PATIENT SHOULD BE APPRISED OF THE POTENTIAL HAZARD TO THE FETUS. (See WARNINGS in prescribing information for clarithromycin.)

PRECAUTIONS ***General:*** Symptomatic response to therapy with omeprazole does not preclude the presence of gastric malignancy. Atrophic gastritis has been noted occasionally in gastric corpus biopsies from patients treated long-term with omeprazole. ***Information for Patients:*** PRILOSEC Delayed-Release Capsules should be taken before eating. Patients should be cautioned that the PRILOSEC Delayed-Release Capsule should not be opened, chewed or crushed, and should be swallowed whole. ***Drug Interactions: Other –*** Omeprazole can prolong the elimination of diazepam, warfarin and phenytoin, drugs that are metabolized by oxidation in the liver. Although in normal subjects no interaction with theophylline or propranolol was found, there have been clinical reports of interaction with other drugs metabolized via the cytochrome P-450 system (e.g., cyclosporine, disulfiram, benzodiazepines). Patients should be monitored to determine if it is necessary to adjust the dosage of these drugs when taken concomitantly with PRILOSEC. Because of its profound and long lasting inhibition of gastric acid secretion, it is theoretically possible that omeprazole may interfere with absorption of drugs where gastric pH is an important determinant of their bioavailability (e.g., ketoconazole, ampicillin esters, and iron salts). In the clinical trials, antacids were used concomitantly with the administration of PRILOSEC. ***Combination Therapy with Clarithromycin –*** Co-administration of omeprazole and clarithromycin may result in increases in plasma levels of omeprazole, clarithromycin, and 14-hydroxy-clarithromycin. (See CLINICAL PHARMACOLOGY, Pharmacokinetics: Combination Therapy with Clarithromycin in full Prescribing Information.) Concomitant administration of clarithromycin with cisapride, pimozide, or terfenadine is contraindicated. There have been reports of an interaction between erythromycin and astemizole resulting in QT prolongation and torsades de pointes. Concomitant administration of erythromycin and astemizole is contraindicated. Because clarithromycin is also metabolized by cytochrome P450, concomitant administration of clarithromycin with astemizole is not recommended. (See also CONTRAINDICATIONS, Clarithromycin, above. Please refer to full prescribing information for clarithromycin before prescribing.) ***Carcinogenesis, Mutagenesis, Impairment of Fertility:*** In two 24-month carcinogenicity studies in rats, omeprazole at daily doses of 1.7, 3.4, 13.8, 44.0 and 140.8 mg/kg/day (approximately 4 to 352 times the human dose, based on a patient weight of 50 kg and a human dose of 20 mg) produced gastric ECL cell carcinoids in a dose-related manner in both male and female rats; the incidence of this effect was markedly higher in female rats, which had higher blood levels of omeprazole. Gastric carcinoids seldom occur in the untreated rat. In addition, ECL cell hyperplasia was present in all treated groups of both sexes. In one of these studies, female rats were treated with 13.8 mg/kg/day omeprazole (approximately 35 times the human dose) for 1 year, then followed for an additional year without the drug. No carcinoids were seen in these rats. An increased incidence of treatment-related ECL cell hyperplasia was observed at the end of 1 year (94% treated vs 10% controls). By the second year the difference between treated and control rats was much smaller (46% vs 26%) but still showed more hyperplasia in the treated group. An unusual primary malignant tumor in the stomach was seen in one rat (2%). No similar tumor was seen in male or female rats treated for 2 years. For this strain of rat no similar tumor has been noted historically, but a finding involving only one tumor is difficult to interpret. A 78-week mouse carcinogenicity study of omeprazole did not show increased tumor occurrence, but the study was not conclusive. Omeprazole was not mutagenic in an in vitro Ames Salmonella typhimurium assay, an in vitro mouse lymphoma cell assay and an in vivo rat liver DNA damage assay. A mouse micronucleus test at 625 and 6250 times the human dose gave a borderline result, as did an in vivo bone marrow chromosome aberration test. A second mouse micronucleus study at 2000 times the human dose, but with different (suboptimal) sampling times, was negative. ***Pregnancy: Omeprazole: Pregnancy Category C –*** In rabbits, omeprazole in a dose range of 6.9 to 69.1 mg/kg/day (approximately 17 to 172 times the human dose) produced dose-related increases in embryo-lethality, fetal resorptions and pregnancy disruptions. In rats, dose-related embryo/fetal toxicity and postnatal developmental toxicity were observed in offspring resulting from parents treated with omeprazole 13.8 to 138.0 mg/kg/day (approximately 35 to 345 times the human dose). There are no adequate or well-controlled studies in pregnant women. Sporadic reports have been received of congenital abnormalities occurring in infants born to women who have received omeprazole during pregnancy. Omeprazole should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus. ***Clarithromycin: Pregnancy Category C –*** See WARNING (above) and full prescribing information for clarithromycin before using in pregnant women. ***Nursing Mothers:*** It is not known whether omeprazole is excreted in human milk. In rats, omeprazole administration during late gestation and lactation at doses of 13.8 to 138 mg/kg/day (35 to 345 times the human dose) resulted in decreased weight gain in pups. Because many drugs are excreted in human milk, because of the potential for serious adverse reactions in nursing infants from omeprazole, and because of the potential for tumorigenicity shown for omeprazole in rat carcinogenicity studies, a decision should be made whether to discontinue nursing or discontinue the drug, taking into account the importance of the drug to the mother. ***Pediatric Use:*** Safety and effectiveness in children have not been established.

ADVERSE REACTIONS: In the U.S. clinical trial population of 465 patients (including duodenal ulcer, Zollinger-Ellison syndrome and resistant ulcer patients), the following adverse experiences were reported to occur in 1% or more of patients on therapy with PRILOSEC. Numbers in parentheses indicate percentages of the adverse experiences considered by investigators as possibly, probably, or definitely related to the drug.

	Omeprazole (n=465)	Placebo (n=64)	Ranitidine (n=195)
Headache	6.9 (2.4)	6.3	7.7 (2.6)
Diarrhea	3.0 (1.9)	3.1 (1.6)	2.1 (0.5)
Abdominal Pain	2.4 (0.4)	3.1	2.1
Nausea	2.2 (0.9)	3.1	4.1 (0.5)
URI	1.9	1.6	2.6
Dizziness	1.5 (0.6)	0.0	2.6 (1.0)
Vomiting	1.5 (0.4)	4.7	1.5 (0.0)
Rash	1.5 (1.1)	0.0	0.0
Constipation	1.1 (0.9)	0.0	0.0
Cough	1.1	0.0	1.5
Asthenia	1.1 (0.2)	1.6 (1.6)	1.5 (1.0)
Back Pain	1.1	0.0	0.5

The following adverse reactions which occurred in 1% or more of omeprazole-treated patients have been reported in international double-blind, and open-label, clinical trials in which 2,631 patients and subjects received omeprazole.

Incidence of Adverse Experiences ≥ 1% Causal Relationship not Assessed

		Omeprazole (n=2631)	Placebo (n=120)
Body as a Whole, site unspecified	Abdominal pain	5.2	3.3
	Asthenia	1.3	0.8
Digestive System	Constipation	1.5	0.8
	Diarrhea	3.7	2.5
	Flatulence	2.7	5.8
	Nausea	4.0	6.7
	Vomiting	3.2	10.0
	Acid regurgitation	1.9	3.3
Nervous System/Psychiatric	Headache	2.9	2.5

Additional adverse experiences occurring in < 1% of patients or subjects in domestic and/or international trials, or occurring since the drug was marketed, are shown below within each body system. In many instances, the relationship to PRILOSEC® (omeprazole) was unclear. *Body As a Whole:* Fever, pain, fatigue, malaise, abdominal swelling. *Cardiovascular:* Chest pain or angina, tachycardia, bradycardia, palpitation, elevated blood pressure, peripheral edema. *Gastrointestinal:* Pancreatitis (some fatal), anorexia, irritable colon, flatulence, fecal discoloration, esophageal candidiasis, mucosal atrophy of the tongue, dry mouth. During treatment with omeprazole, gastric fundic gland polyps have been noted rarely. These polyps are benign and appear to be reversible when treatment is discontinued. Gastro-duodenal carcinoids have been reported in patients with ZE syndrome on long-term treatment with PRILOSEC. This finding is believed to be a manifestation of the underlying condition, which is known to be associated with such tumors. *Hepatic:* Mild and, rarely, marked elevations of liver function tests [ALT (SGPT), AST (SGOT), γ-glutamyl transpeptidase, alkaline phosphatase, and bilirubin (jaundice)]. In rare instances, overt liver disease has occurred, including hepatocellular, cholestatic, or mixed hepatitis, liver necrosis (some fatal), hepatic failure (some fatal), and hepatic encephalopathy. *Metabolic/Nutritional:* Hyponatremia, hypoglycemia, weight gain. *Musculoskeletal:* Muscle cramps, myalgia, muscle weakness, joint pain, leg pain. *Nervous System/Psychiatric:* Psychic disturbances including depression, aggression, hallucinations, confusion, insomnia, nervousness, tremors, apathy, somnolence, anxiety, dream abnormalities; vertigo; paresthesia; hemifacial dysesthesia. *Respiratory:* Epistaxis, pharyngeal pain. *Skin:* Rash and, very rarely, cases of severe generalized skin reactions including toxic epidermal necrolysis (TEN; some fatal), Stevens-Johnson syndrome, and erythema multiforme (some severe); skin inflammation, urticaria, angioedema, pruritus, alopecia, dry skin, hyperhidrosis. *Special Senses:* Tinnitus, taste perversion. *Urogenital:* Interstitial nephritis (some with positive rechallenge), urinary tract infection, microscopic pyuria, urinary frequency, elevated serum creatinine, proteinuria, hematuria, glycosuria, testicular pain, gynecomastia. *Hematologic:* Rare instances of pancytopenia, agranulocytosis (some fatal), thrombocytopenia, neutropenia, anemia, leucocytosis, and hemolytic anemia have been reported. **Combination Therapy with Clarithromycin:** In clinical trials using combination therapy with PRILOSEC and clarithromycin, no adverse experiences peculiar to this drug combination have been observed. Adverse experiences that have occurred have been limited to those that have been previously reported with omeprazole or clarithromycin. Adverse experiences observed in controlled clinical trials using combination therapy with PRILOSEC and clarithromycin (n=346) which differed from those previously described for omeprazole alone were: Taste perversion (15%), tongue discoloration (2%), rhinitis (2%), pharyngitis (1%) and flu syndrome (1%). For more information on clarithromycin, refer to the clarithromycin package insert, ADVERSE REACTIONS section.

OVERDOSAGE: Rare reports have been received of overdosage with omeprazole. Doses ranged from 320 mg to 900 mg (16-45 times the usual recommended clinical dose). Manifestations were variable, but included confusion, drowsiness, blurred vision, tachycardia, nausea, diaphoresis, flushing, headache, and dry mouth. Symptoms were transient, and no serious clinical outcome has been reported. No specific antidote for omeprazole overdosage is known. Omeprazole is extensively protein bound and is, therefore, not readily dialyzable. In the event of overdosage, treatment should be symptomatic and supportive.

DOSAGE AND ADMINISTRATION ***Duodenal Ulcer:*** Short-Term Treatment of Active Duodenal Ulcer: The recommended adult oral dose of PRILOSEC is 20 mg once daily. Most patients heal within 4 weeks. Some patients may require an additional 4 weeks of therapy. (See INDICATIONS AND USAGE.)

Reduction of the Risk of Duodenal Ulcer Recurrence: Combination Therapy with Clarithromycin

Days 1-14	Days 15-28
PRILOSEC 40 mg q.d. (in the morning) plus clarithromycin 500 mg t.i.d.	PRILOSEC 20 mg q.d.

Please refer to clarithromycin full prescribing information for CONTRAINDICATIONS and WARNING, and for information regarding dosing in elderly and renally impaired patients (PRECAUTIONS: General, PRECAUTIONS: Geriatric Use and PRECAUTIONS: Drug Interactions). ***Gastric Ulcer:*** The recommended adult oral dose is 40 mg once a day for 4 to 8 weeks. (See INDICATIONS AND USAGE, Gastric Ulcer.) ***Gastroesophageal Reflux Disease (GERD):*** The recommended adult oral dose for the treatment of patients with symptomatic GERD and no esophageal lesions is 20 mg daily for up to 4 weeks. The recommended adult oral dose for the treatment of patients with erosive esophagitis and accompanying symptoms due to GERD is 20 mg daily for 4 to 8 weeks. (See INDICATIONS AND USAGE.) ***Maintenance of Healing of Erosive Esophagitis:*** The recommended adult oral dose is 20 mg daily. ***Pathological Hypersecretory Conditions:*** The dosage of PRILOSEC in patients with pathological hypersecretory conditions varies with the individual patient. The recommended adult oral starting dose is 60 mg once a day. Doses should be adjusted to individual patient needs and should continue for as long as clinically indicated. Doses up to 120 mg t.i.d. have been administered. Daily dosages of greater than 80 mg should be administered in divided doses. No dosage adjustment is necessary for patients with renal impairment, hepatic dysfunction or for the elderly.

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February 1997 PRC-40/3/97 PRO4

NOTE: This summary provides important information about PRILOSEC. If you would like more information, ask your doctor or pharmacist to let you read the professional labeling and then discuss it with them.

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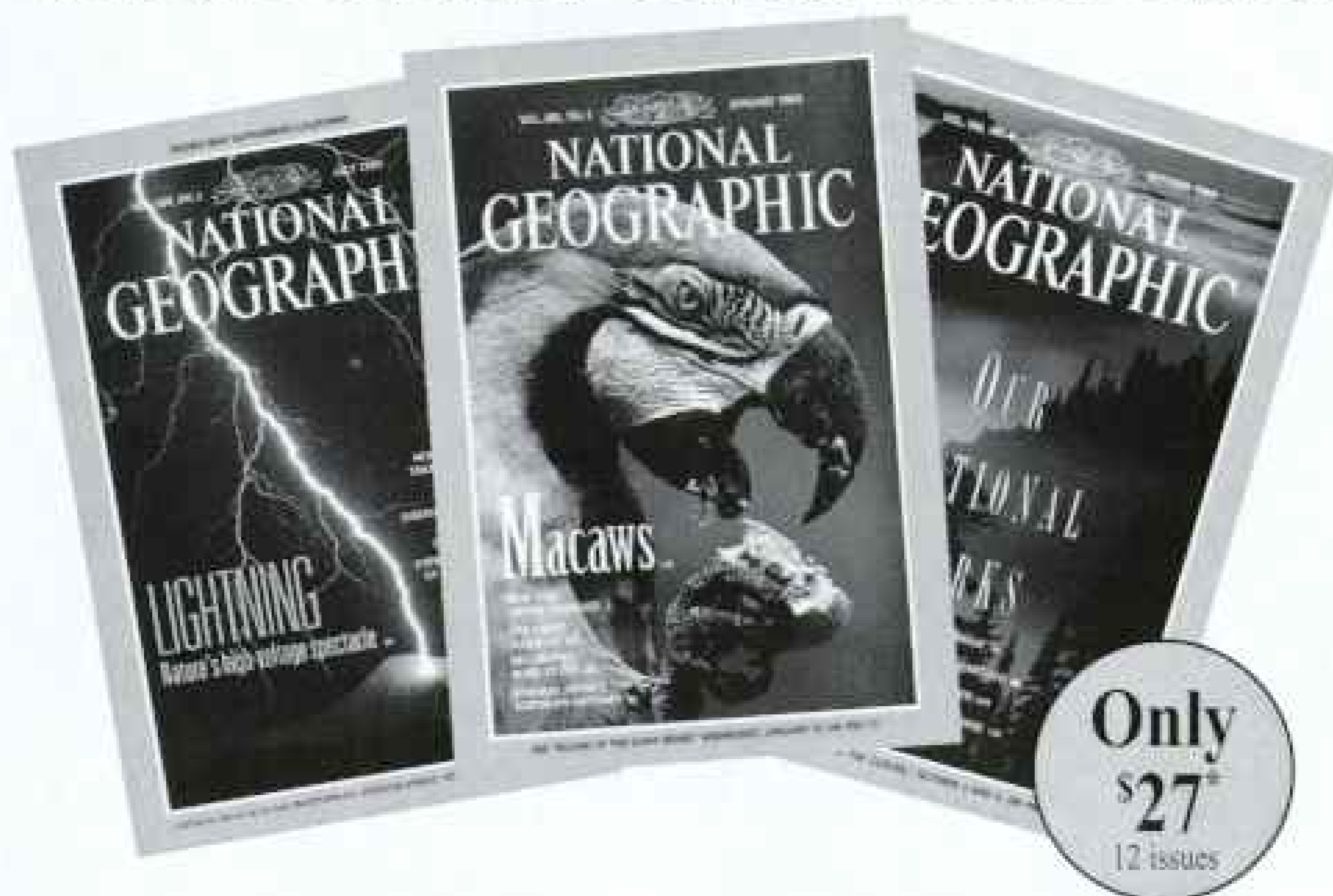

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When outlaw Jesse James robbed a bank, coins like this 1881 Morgan silver dollar were what he usually made off with.

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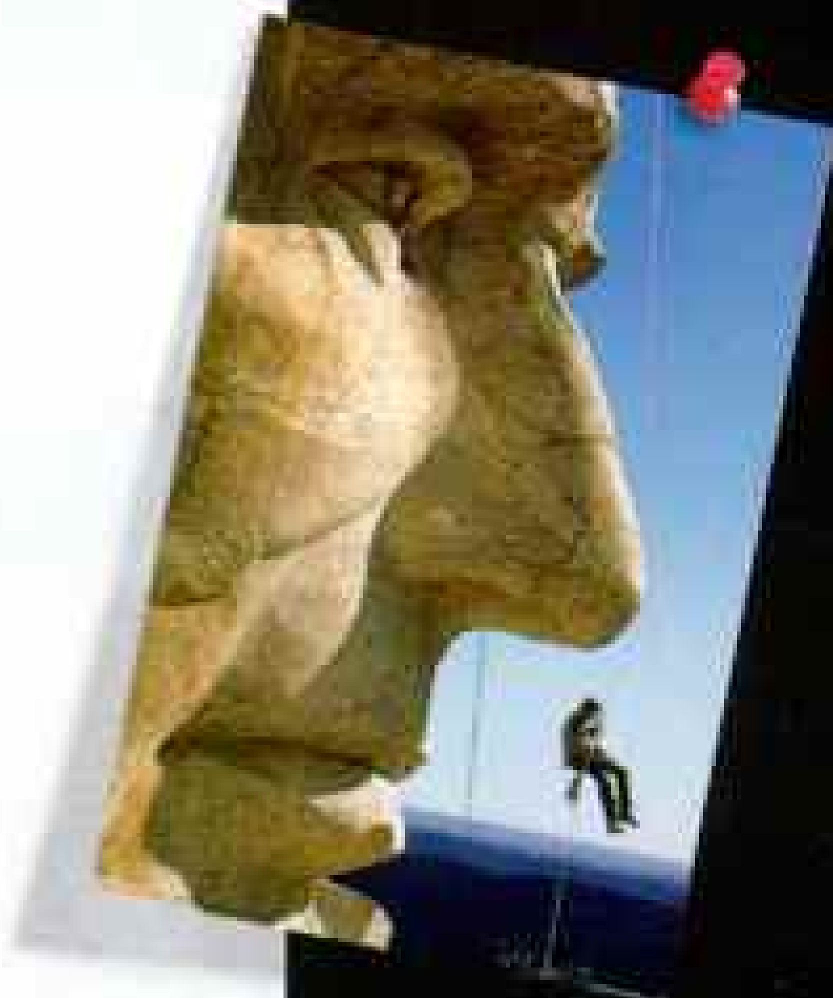
My Pentax IQZoom 160

This is the five-point passive autofocus system that measured how far away Abe was, chose the optimum setting, and kept the focus right on the nose.

This is the easy-to-read dial that gets my vote for making this compact camera easier to use and more fun to create with.

This is the six-segment metering that measured lighting, compensated for bright sunlight, and captured my photo in presidential form.

This is the power zoom lens that went from 38mm to 160mm so I could be right up at Abe's nose, without having to risk my neck in the process.



My Photo

My picture of a park ranger going nose to nose with Honest Abe.

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A Reptile Runs Into History's Record Books

Dashing about on its hind legs, this little creature, whose fossilized bones (right) were found in central Germany, was an all-time original: It's the earliest bipedal reptile known, predating dinosaurs by 50 million years.

About nine inches long from nose to tail, the newly discovered—and as yet unnamed—reptile comes from rocks about 280 million years old, says Stuart Sumida of California State University, who with David Berman of the Carnegie Museum of Natural History and a German colleague, Thomas Martens, unearthed the remains. Its hind limbs were nearly twice as long as its front legs, proportions never seen so early in the fossil record. "It could scratch its nose with its toes, but not its butt with its fingers," Sumida says.

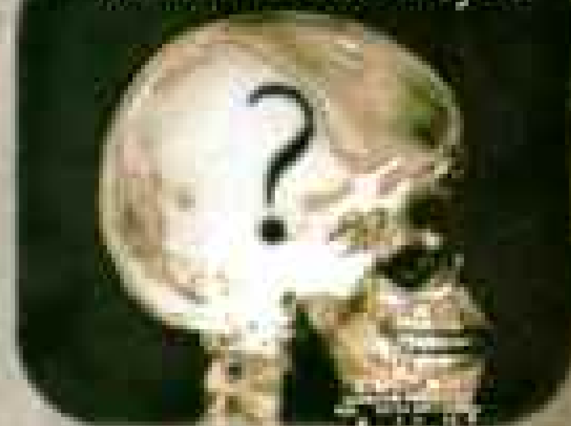
Digging in the Thuringian forest, the team found that beneath the vegetation, "the rocks are amazingly similar to those of classic red rock country in the American Southwest." When the reptile lived, Europe and North America were connected in the supercontinent Pangaea, though a mountain range limited traffic between them. But the researchers also uncovered fossils of several early land vertebrates previously found only in North America, suggesting they traveled through gaps in the mountain range.

Marine Archaeology by Robot

Lights, cameras, action: Robot Super Achille photographs an amphora from a ship that sank off Marseille in the first century B.C. The robot's images helped identify dozens of amphorae as products from Italy's Adriatic coast. In this multifaceted French experiment in diverless underwater archaeology, the support boat *Minibex* used satellite data to maintain a stable position so that its onboard computers could create three-dimensional maps of the site. Suspended from the support vessel, fans gently dislodge sediment burying the ship. A two-person minisub ferried archaeologists to the seafloor for a close look at the wreck. The French government's underwater archaeological unit DRASSM and the private firm COMEX joined in the project, one of several efforts worldwide using high-tech tools in underwater archaeology. This ship lies in water 210 feet deep, but Super Achille can explore to a depth of 2,000 feet. It can also deploy parachutes to float artifacts to the surface.

ALEXIS ROSENFELD, PHOTOOCEANS

what if my brother makes me eat a bug?



what if I'm sick of all the paperwork?

what if something happens on vacation?

what if?

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FRED HARGESHEIMER

FRED HARGESHEIMER

Downed Pilot Is Still a Hero on New Britain

At the age of 81 Fred Hargesheimer visited "his" school on the island of New Britain in Papua New Guinea, a long way from his Grass Valley, California, home. The visit last spring was his 11th—not counting his first, unplanned trip in World War II.

In June 1943, Lieutenant Hargesheimer of the U.S. Army Air Forces was shot down over the Japanese-held island while piloting a P-38 on a reconnaissance mission. He survived alone in the jungle for 31 days, then was hidden by tribesmen for months before reaching safety. The young pilot vowed to return.

Missing Five Months, Hargesheimer Returns

In 1963 he did. "I wanted to do something to repay a debt, and it seemed a logical thing to teach kids to read and write," he says. He persuaded an architect friend to design a school, raised money to get it built, then went back the following year to see it open its doors to 76 children.

Today the Airmen's Memorial School has 435 pupils in grades three through eight and 16 teachers, including two who learned to read and write there. Hargesheimer was greeted like a hero when he arrived with his daughter in the village of Ewasse (above) on this latest trip—"It might be my last, but then I said the *last* one was the last one," he says. Still at work for the villagers, he helped lay the foundation for a library. He also met the son of a man who rescued him decades ago. "If I hadn't been shot out of the sky, all this wouldn't have happened," muses the retired engineer.

Cave Burials for an Ancient Elite

For several years George Washington University archaeologist James Brady has been examining two caves in the northeast jungle of Honduras. They were used as ritual burial sites at the dawn of Mesoamerican civilization. Last year a guard watching over one of those caves stumbled upon yet another that, says Brady, reflects a common burial pattern: The remains are those of high-ranking individuals who died elsewhere. Their bones were then deposited in the long, narrow caves.

Crawling through crevices so tight that some members of Brady's team couldn't make it, archaeologists in the newly discovered cave came upon the remains of two dozen men, women, and children. The bones were once neatly stacked, but many, now cemented by calcite, had been disturbed in an ancient looting spree that left fragments of burial goods on the floor. Charcoal found nearby has been radiocarbon-dated to about 915 B.C.

JAMES BRADY

The cave is called Cueva de las Arañas—Cave of the Spiders—for its resident long-legged arachnids, each the size of a dinner plate. The walls of the chamber bear two paintings of vaguely human figures, another hint of burial rituals.

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Kodiak Island Rockets Into Space

GEORGE F. MOBLEY

Think of it as a Cape Canaveral in Alaska. With bears nearby. And whales. And seabirds.

By 1999 rockets bearing private communications satellites or military payloads may soar from a launchpad on Kodiak Island (GEOGRAPHIC, November 1993). The site, on state land near scenic Ugak Bay (right), is 30 miles from the wildlife-refuge home of most of the island's nearly 3,000 brown bears. "Rockets will fly over the ocean with payloads up to 8,000 pounds," says Pat Ladner, director of the Alaska Aerospace Development Corporation. Most of the 28 million dollars in funding is to come from the Pentagon, the rest from NASA and the state.

The project cleared many hurdles, including provisions of environmental impact laws. Federal wildlife officials—"not enthralled," as one put it—agreed to a "finding of no significant impact" by the U.S. Office of Commercial Space Transportation. Still, some fear the effect on migrating whales and seabirds wintering offshore.

Kodiak Island Borough Mayor Jerome Selby expects launch crews to spend heavily. But some residents, led by teacher Mike Sirofchuck, claim the facility has been "oversold" and takes land used for recreation for dubious commercial gain.

Wheat Fit for an Astronaut

They're not exactly "amber waves of grain." But the plants Bruce Bugbee of Utah State University has arrayed in computer-controlled growth chambers represent a new, short variety of wheat he and his colleagues bred to grow in space. Its name, Apogee, comes from the point in orbit farthest from earth.

"In space, volume is a precious resource," says Bugbee. "The shorter the plant, the closer you can put the shelves where it will be grown." Good food matters: If space travelers don't like their food, little woes could become big. And on flights to distant planets they'll have to grow and prepare their own food.

Bugbee began with Superdwarf, a poor-yielding eight-inch-high variety. After 12 years of crossbreeding, he reached Apogee, which grows to 18 inches; it yields the equivalent of 350 bushels an acre under normal light, nearly 1,000 under constant high light. What's more, Bugbee claims, "It makes good bread." Superdwarf was grown last year on the Russian space station Mir, producing flowers but no seeds. Apogee should get a space tryout soon.

GARY NEUENSWANDER, UTAH AGRICULTURAL EXPERIMENT STATION

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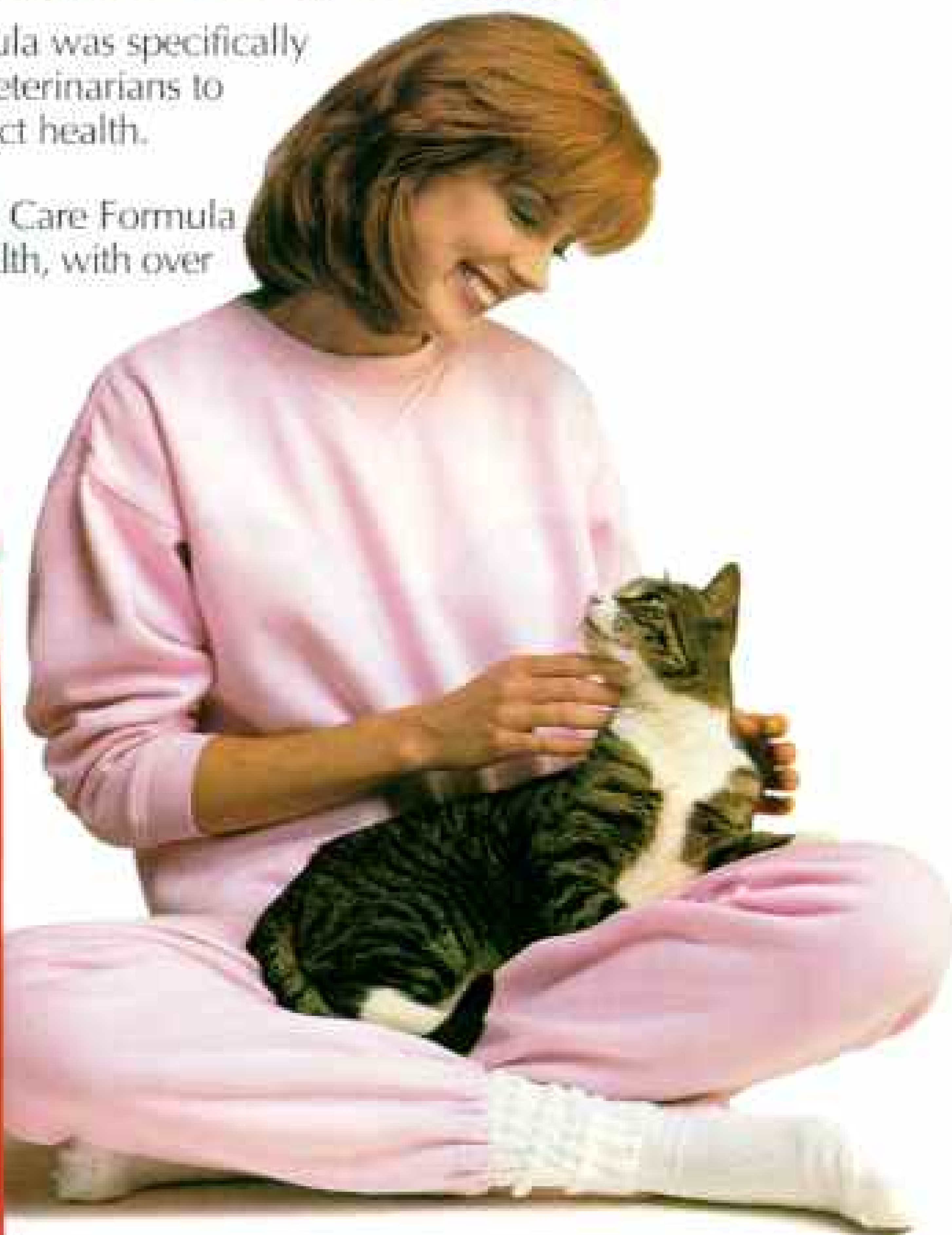

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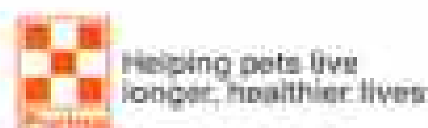

Ralston Purina Company

Riyadh, Saudi Arabia

Landsat 1990

Landsat 1972

EROS DATA CENTER, U.S. GEOLOGICAL SURVEY, SIOUX FALLS, SOUTH DAKOTA

Landsat's Views of a Changing Earth

A quarter century ago, the first Landsat satellite was launched into near-polar orbit. Since that July 1972 triumph, it and four successors have compiled an unparalleled record of change on earth. In ways unimagined at the outset, Landsat has illuminated deforestation and desertification, urbanization and natural disasters.

Take the two images above: Riyadh, Saudi Arabia, with 540,000 people in 1972, shows as a small, dark spot at left, while the beginnings of center-pivot irrigation barely register in red circles at lower right. By 1990 Riyadh, with two million people, dominates the left side; the spread of irrigation to water grain fields is clearly visible at right.

The resolution of Landsat images has vastly improved; Landsat 5 now pinpoints details as small as a hundred feet wide. An emerging industry interprets Landsat data for farmers, foresters, and city planners. "Maps are instantaneously updatable," notes Vincent Salomonson, earth sciences director at NASA's Goddard Space Flight Center. Next year NASA will launch a new, improved tool: Landsat 7 (Landsat 6, launched in 1993, failed to reach orbit).

Landsat images are invaluable in signaling environmental danger. "We can see stress from space that we can't see from the ground until it's too late," says Ray Williamson, a George Washington University researcher.

NATIONAL GEOGRAPHIC pioneered in bringing Landsat images to the public, notably "Portrait U.S.A.," the first color photomosaic of the 48 contiguous states (below), published in the July 1976 issue.

TEXT BY BORIS WEINTRAUB

NASA MOSAIC BY GENERAL ELECTRIC COMPANY

At your age, with your high cholesterol, what's your risk of a first heart attack?

If you have high cholesterol, figure your risk of a first heart attack.

Fill in your points for each risk factor.

☐ **Age: Men**
0 pts. Less than 35 — 1 pt. 35 to 39 — 2 pts. 40 to 48 — 3 pts. 49 to 53 — 4 pts. 54+

☐ **Age: Women**
0 pts. Less than 42 — 1 pt. 42 to 44 — 2 pts. 45 to 54 — 3 pts. 55 to 73 — 4 pts. 74+

☐ **Family History:**
2 pts. My family has a history of heart disease or heart attacks before the age of 60

☐ **Inactive Lifestyle:**
1 pt. I rarely exercise or do anything physically demanding

☐ **Weight:**
1 pt. I'm more than 20 lbs. over my ideal weight

☐ **Smoking:**
1 pt. I'm a smoker

☐ **Diabetic:**
1 pt. Male Diabetic
2 pts. Female Diabetic

☐ **Total Cholesterol Level:**
0 pts. Less than 240 mg/dL
1 pt. 240 to 315 mg/dL
2 pts. More than 315 mg/dL

☐ **HDL Level (good cholesterol):**
0 pts. 39 to 59 mg/dL
1 pt. 30 to 38 mg/dL
2 pts. Under 30 mg/dL
-1 pt. Over 60 mg/dL

☐ **Blood Pressure:**
I don't take blood pressure medication; my blood pressure is:
(Use your top or higher blood pressure number)
0 pts. Less than 140 mmHg
1 pt. 140 to 170 mmHg
2 pts. Greater than 170 mmHg
(or)
1 pt. I am currently taking blood pressure medication

☐ **Total Points**

If you scored 4 points or more, you could be at above average risk of a first heart attack compared to the general adult population. The more points you score, the greater your risk.

If you have already had a heart attack or have heart disease, your heart attack risk is significantly higher. **Only your doctor can evaluate your risk and recommend treatment plans to reduce your risk.** If you don't know your cholesterol level or blood pressure, ask your doctor if your levels should be checked.

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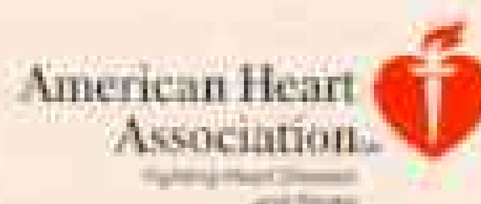

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PRAVACHOL, in combination with diet, is proven to reduce the risk of a first heart attack, reduce the risk of death from heart disease, and reduce the need for surgery to clear blocked coronary arteries (such as bypass or angioplasty) based on a landmark study including over 6,500 males with high cholesterol and no evidence of heart disease. Because PRAVACHOL is a prescription drug, you should ask your doctor or healthcare professional if PRAVACHOL is right for you. Some mild side effects, such as slight rash or stomach upset, occur in about 2–4% of patients. PRAVACHOL should not be

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Proven to help prevent first heart attacks in people with high cholesterol.

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pravastatin sodium 20 mg tablets

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taken by women who are pregnant or nursing, people who are allergic to any of its ingredients or by anyone with liver disease. Your doctor may perform simple blood tests to check your liver function before and during treatment with PRAVACHOL. Muscle pain or weakness could be a sign of a rare but serious side effect and should be reported to your doctor right away. Be sure your doctor knows about other medications you may be taking in order to avoid any possible serious drug interactions. Please see important information on the next page.

PRAVACHOL® Pravastatin Sodium Tablets

CONTRAINDICATIONS: Hypersensitivity to any component of this medication. Active liver disease or unexplained, persistent elevations in liver function tests (see **WARNINGS**). *Pregnancy and lactation:* Atherosclerosis is a chronic process and discontinuation of lipid-lowering drugs during pregnancy should have little impact on the outcome of long-term therapy of primary hypercholesterolemia. Cholesterol and other products of cholesterol biosynthesis are essential components for fetal development (including synthesis of steroids and cell membranes). Since HMG-CoA reductase inhibitors decrease cholesterol synthesis and possibly the synthesis of other biologically active substances derived from cholesterol, they may cause fetal harm when administered to pregnant women. Therefore, HMG-CoA reductase inhibitors are contraindicated during pregnancy and in nursing mothers. **Pravastatin should be administered to women of childbearing age only when such patients are highly unlikely to conceive and have been informed of the potential hazards.** If the patient becomes pregnant while taking this class of drug, therapy should be discontinued and the patient apprised of the potential hazard to the fetus.

WARNINGS: Liver Enzymes: HMG-CoA reductase inhibitors, like some other lipid-lowering therapies, have been associated with biochemical abnormalities of liver function. Increases of serum transaminase (ALT, AST) values to more than 3 times the upper limit of normal occurring on 2 or more (not necessarily sequential) occasions have been reported in 1.3% of patients treated with pravastatin in the US over an average period of 18 months. These abnormalities were not associated with cholestasis and did not appear to be related to treatment duration. In those patients in whom these abnormalities were believed to be related to pravastatin and who were discontinued from therapy, the transaminase levels usually fell slowly to pretreatment levels. These biochemical findings are usually asymptomatic although worldwide experience indicates that anorexia, weakness, and/or abdominal pain may also be present in rare patients. In the largest long-term placebo-controlled clinical trial with pravastatin (Pravastatin Primary Prevention Study, See **Clinical Pharmacology**), the overall incidence of AST and/or ALT elevations to greater than three times the upper limit of normal was 1.05% in the pravastatin group as compared to 0.70% in the placebo group. One (0.03%) pravastatin-treated patient and 2 (0.06%) placebo-treated patients were discontinued because of transaminase elevations. Of the patients with normal liver function at week 12, three of 2875 treated with pravastatin (0.10%) and one of the 2919 placebo patients (0.03%) had elevations of AST greater than three times the upper limit of normal on two consecutive measurements and/or discontinued due to elevations in transaminase levels during the 4.8 years (median treatment) of the study. **It is recommended that liver function tests be performed prior to and at 12 weeks following initiation of therapy or the elevation of dose.** Patients who develop increased transaminase levels or signs and symptoms of liver disease should be monitored with a second liver function evaluation to confirm the finding and be followed thereafter with frequent liver function tests until the abnormality(ies) return to normal. Should an increase in AST or ALT of three times the upper limit of normal or greater persist, withdrawal of pravastatin therapy is recommended. Active liver disease or unexplained transaminase elevations are contraindications to the use of pravastatin (see **CONTRAINDICATIONS**). Caution should be exercised when pravastatin is administered to patients with a history of liver disease or heavy alcohol ingestion (see **CLINICAL PHARMACOLOGY: Pharmacokinetics/Metabolism**). Such patients should be closely monitored, started at the lower end of the recommended dosing range, and titrated to the desired therapeutic effect. **Skeletal Muscle: Rare cases of rhabdomyolysis with acute renal failure secondary to myoglobinuria have been reported with pravastatin and other drugs in this class.** Uncomplicated myalgia has also been reported in pravastatin-treated patients (see **ADVERSE REACTIONS**). Myopathy, defined as muscle aching or muscle weakness in conjunction with increases in creatine phosphokinase (CPK) values to greater than 10 times the upper normal limit, was rare (< 0.1%) in pravastatin clinical trials. Myopathy should be considered in any patient with diffuse myalgias, muscle tenderness or weakness, and/or marked elevation of CPK. Patients should be advised to report promptly unexplained muscle pain, tenderness or weakness, particularly if accompanied by malaise or fever. **Pravastatin therapy should be discontinued if markedly elevated CPK levels occur or myopathy is diagnosed or suspected. Pravastatin therapy should also be temporarily withheld in any patient experiencing an acute or serious condition predisposing to the development of renal failure secondary to rhabdomyolysis, e.g., sepsis; hypotension; major surgery; trauma; severe metabolic, endocrine, or electrolyte disorders; or uncontrolled epilepsy.** The risk of myopathy during treatment with another HMG-CoA reductase inhibitor is increased with concurrent therapy with either erythromycin, cyclosporine, niacin, or fibrates. However, neither myopathy nor significant increases in CPK levels have been observed in three reports involving a total of 100 post-transplant patients (24 renal and 76 cardiac) treated for up to two years concurrently with pravastatin 10-40 mg and cyclosporine. Some of these patients also received other concomitant immunosuppressive therapies. In one single-dose study, pravastatin levels were found to be increased in cardiac transplant patients receiving cyclosporine. Further, in clinical trials involving small numbers of patients who were treated concurrently with pravastatin and niacin, there were no reports of myopathy. Also, myopathy was not reported in a trial of combination pravastatin (40 mg/day) and gemfibrozil (1200 mg/day), although 4 of 75 patients on the combination showed marked CPK elevations versus one of 73 patients receiving placebo. There was a trend toward more frequent CPK elevations and patient withdrawals due to musculoskeletal symptoms in the group receiving combined treatment as compared with the groups receiving placebo, gemfibrozil, or pravastatin monotherapy (see **PRECAUTIONS: Drug Interactions**). **The use of fibrates alone may occasionally be associated with myopathy. The combined use of pravastatin and fibrates should be avoided unless the benefit of further alterations in lipid levels is likely to outweigh the increased risk of this drug combination.**

PRECAUTIONS: General: Pravastatin may elevate creatine phosphokinase and transaminase levels (see **ADVERSE REACTIONS**). This should be considered in the differential diagnosis of chest pain in a patient on therapy with pravastatin. *Homozygous Familial Hypercholesterolemia:* Pravastatin has not been evaluated in patients with rare homozygous familial hypercholesterolemia. In this group of patients, it has been reported that HMG-CoA reductase inhibitors are less effective because the patients lack functional LDL receptors. *Renal Insufficiency:* A single 20 mg oral dose of pravastatin was administered to 24 patients with varying degrees of renal impairment (as determined by creatinine clearance). No effect was observed on the pharmacokinetics of pravastatin or its 3α-hydroxy isomeric metabolite (SQ 31,906). A small increase was seen in mean AUC values and half-life (t½) for the inactive enzymatic ring hydroxylation metabolite (SQ 31,945). Given this small sample size, the dosage administered, and the degree of individual variability, patients with renal impairment who are receiving pravastatin should be closely monitored. **Information for Patients:** Patients should be advised to report promptly unexplained muscle pain, tenderness or weakness, particularly if accompanied by malaise or fever. **Drug Interactions:** *Immunosuppressive Drugs, Gemfibrozil, Niacin (Nicotinic Acid), Erythromycin:* See **WARNINGS: Skeletal Muscle**. *Antipyrine:* Since concomitant administration of pravastatin had no effect on the clearance of antipyrine, interactions with other drugs metabolized via the same hepatic cytochrome isozymes are not expected. *Cholestyramine/Colestipol:* Concomitant administration resulted in an approximately 40 to 50% decrease in the mean AUC of pravastatin. However, when pravastatin was administered 1 hour before or 4 hours after cholestyramine or 1 hour before colestipol and a standard meal, there was no clinically significant decrease in bioavailability or therapeutic effect. (See **DOSAGE AND ADMINISTRATION: Concomitant Therapy**.) *Warfarin:* In a study involving 10 healthy male subjects given pravastatin and warfarin concomitantly for 6 days, bioavailability parameters at steady state for pravastatin (parent compound) were not altered. Pravastatin did not alter the plasma protein-binding of warfarin. Concomitant dosing did increase the AUC and Cmax of warfarin but did not produce any changes in its anticoagulant action (i.e., no increase was seen in mean prothrombin time after 6 days of concomitant therapy). However, bleeding and extreme prolongation of prothrombin time has been reported with another drug in this class. Patients receiving warfarin-type anticoagulants should have their prothrombin times closely monitored when pravastatin is initiated or the dosage of pravastatin is changed. *Cimetidine:* The AUC_{0-12hr} for pravastatin when given with cimetidine was not significantly different from the AUC for pravastatin when given alone. A significant difference was observed between the AUC's for pravastatin when given with cimetidine compared to when administered with antacid. *Digoxin:* In a crossover trial involving 18 healthy male subjects given pravastatin and digoxin concurrently for 9 days, the bioavailability parameters of digoxin were not affected. The AUC of pravastatin tended to increase, but the overall bioavailability of pravastatin plus its metabolites SQ 31,906 and SQ 31,945 was not altered. *Cyclosporine:* Some investigators have measured cyclosporine levels in patients on pravastatin, and to date, these results indicate no clinically meaningful elevations in cyclosporine levels. In one single-dose study, pravastatin levels were found to be increased in cardiac transplant patients receiving cyclosporine. *Gemfibrozil:* In a crossover study in 20 healthy male volunteers given concomitant single doses of pravastatin and gemfibrozil, there was a significant decrease in urinary excretion and protein binding of pravastatin. In addition, there was a significant increase in AUC, Cmax, and Tmax for the pravastatin metabolite SQ 31,906. Combination therapy with pravastatin and gemfibrozil is generally not recommended. In interaction studies with aspirin, antacids (1 hour prior to PRAVACHOL), cimetidine, nicotinic acid, or probucol, no statistically significant differences in bioavailability were seen when PRAVACHOL (pravastatin sodium) was administered. *Other Drugs:* During clinical trials, no noticeable drug interactions were reported when PRAVACHOL was added to: diuretics, antihypertensives, digitalis, ACE inhibitors, calcium channel blockers, beta-blockers, or nitroglycerin. **Endocrine Function:** HMG-CoA reductase inhibitors interfere with cholesterol synthesis and lower circulating cholesterol levels and, as such, might theoretically blunt adrenal or gonadal steroid hormone production. Results of clinical trials with pravastatin in males and post-menopausal females were inconsistent with regard to possible effects of the drug on basal steroid hormone levels. In a study of 21 males, the mean testosterone response to human chorionic gonadotropin was significantly reduced (p<0.004) after 16 weeks of treatment with 40 mg of pravastatin. However, the percentage of patients showing a ≥ 50% rise in plasma testosterone after human chorionic gonadotropin stimulation did not change significantly after therapy in these patients. The effects of HMG-CoA reductase inhibitors on spermatogenesis and fertility have not been studied in adequate numbers of patients. The effects, if any, of pravastatin on the pituitary-gonadal axis in pre-menopausal females are unknown. Patients treated with pravastatin who display clinical evidence of endocrine dysfunction should be evaluated appropriately. Caution should also be exercised if an HMG-CoA reductase inhibitor or other agent used to lower cholesterol levels is administered to patients also receiving other drugs (e.g., ketoconazole, spironolactone, cimetidine) that may diminish the levels or activity of steroid hormones. **CNS Toxicity:** CNS vascular lesions, characterized by perivascular hemorrhage and edema and mononuclear cell infiltration of perivascular spaces, were seen in dogs treated with pravastatin at a dose of 25 mg/kg/day, a dose that produced a plasma drug level about 50 times higher than the mean drug level in humans taking 40 mg/day. Similar CNS vascular lesions have been observed with several other drugs in this class. A chemically similar drug in this class produced optic nerve degeneration (Wallerian degeneration of retinogeniculate fibers) in clinically normal dogs in a dose-dependent fashion starting at 60 mg/kg/day, a dose that produced mean plasma drug levels about 30 times higher than the mean drug level in humans taking the highest recommended dose (as measured by total enzyme inhibitory activity). This same drug also produced vestibulocochlear Wallerian-like degeneration and retinal ganglion cell chromatolysis in dogs treated for 14 weeks at 180 mg/kg/day, a dose which resulted in a mean plasma drug level similar to that seen with the 60 mg/kg/day dose. **Carcinogenesis, Mutagenesis, Impairment of Fertility:** In a 2-year study in rats fed pravastatin at doses of 10, 30, or 100 mg/kg body weight, there was an increased incidence of hepatocellular carcinomas in males at the highest dose (p < 0.01). Although rats were given up to 125 times the human dose (HD) on a mg/kg body weight basis, serum drug levels were only 6 to 10 times higher than those measured in humans given 40 mg pravastatin as measured by AUC. The oral administration of 10, 30, or 100 mg/kg (producing plasma drug levels approximately 0.5 to 5.0 times the human drug levels at 40 mg) of pravastatin to mice for 22 months resulted in a statistically significant increase in the incidence of malignant lymphomas in treated females when all treatment groups were pooled and compared to controls (p < 0.05). The incidence was not dose-related and male mice were not affected. A chemically similar drug in this class was administered to mice for 72 weeks at 25, 100, and 400 mg/kg body weight, which resulted in mean serum drug levels approximately 3, 15, and 33 times higher than the mean human serum drug concentration (as total inhibitory activity) after a 40 mg oral dose. Liver carcinomas were significantly increased in high-dose females and mid- and high-dose males, with a maximum incidence of 90 percent in males. The incidence of adenomas of the liver was significantly increased in mid- and high-dose females. Drug treatment also significantly increased the incidence of lung adenomas in mid- and high-dose males and females. Adenomas of the eye Harderian gland (a gland of the eye of rodents) were significantly higher in high-dose mice than in controls. No evidence of mutagenicity was observed in vitro, with or without rat-liver metabolic activation, in the following studies: microbial mutagen tests, using mutant strains of *Salmonella typhimurium* or *Escherichia coli*; a forward mutation assay in L5178Y TK +/- mouse lymphoma cells; a chromosomal aberration test in hamster cells; and a gene conversion assay using *Saccharomyces cerevisiae*. In addition, there was no evidence of mutagenicity in either a dominant lethal test in mice or a micronucleus test in mice. In a study in rats, with daily doses up to 500 mg/kg, pravastatin did not produce any adverse effects on fertility or general reproductive performance. However, in a study with another HMG-CoA reductase inhibitor, there was decreased fertility in male rats treated for 34 weeks at 25 mg/kg body weight, although this effect was not observed in a subsequent fertility study when this same dose was administered for 11 weeks (the entire cycle of spermatogenesis, including epididymal maturation). In rats treated with this same reductase inhibitor at 180 mg/kg/day, seminiferous tubule degeneration (necrosis and loss of spermatogenic epithelium) was observed. Although not seen with pravastatin, two similar drugs in this class caused drug-related testicular atrophy, decreased spermatogenesis, spermatocytic degeneration, and giant cell formation in dogs. The clinical significance of these findings is unclear. **Pregnancy: Pregnancy Category X.** See **CONTRAINDICATIONS**. Safety in pregnant women has not been established. Pravastatin was not teratogenic in rats at doses up to 1000 mg/kg daily or in rabbits at doses of up to 50 mg/kg daily. These doses resulted in 20x (rabbit) or 240x (rat) the human exposure based on surface area (mg/meter²). However, in studies with another HMG-CoA reductase inhibitor, skeletal malformations were observed in rats and mice. There has been one report of severe congenital bony deformity, tracheo-esophageal fistula, and anal atresia (VATER association) in a baby born to a woman who took another HMG-CoA reductase inhibitor with dextroamphetamine sulfate during the first trimester of pregnancy. PRAVACHOL (pravastatin sodium) should be administered to women of child-bearing potential only when such patients are highly unlikely to conceive and have been informed of the potential hazards. If the woman becomes pregnant while taking PRAVACHOL (pravastatin sodium), it should be discontinued and the patient advised again as to the potential hazards to the fetus. **Nursing Mothers:** A small amount of pravastatin is excreted in human breast milk. Because of the potential for serious adverse reactions in nursing infants, women taking PRAVACHOL should not nurse (see **CONTRAINDICATIONS**). **Pediatric Use:** Safety and effectiveness in individuals less than 18 years old have not been established. Hence, treatment in patients less than 18 years old is not recommended at this time.

ADVERSE REACTIONS: Pravastatin is generally well tolerated; adverse reactions have usually been mild and transient. In 4-month long placebo-controlled trials, 1.7% of pravastatin-treated patients and 1.2% of placebo-treated patients were discontinued from treatment because of adverse experiences attributed to study drug therapy; this difference was not statistically significant. In long-term studies, the most common reasons for discontinuation were asymptomatic serum transaminase increases and mild, non-specific gastrointestinal complaints. During clinical trials the overall incidence of adverse events in the elderly was not different from the incidence observed in younger patients. **Adverse Clinical Events:** All adverse clinical events (regardless of attribution) reported in more than 2% of pravastatin-treated patients in the placebo-controlled trials are identified in the table below; also shown are the percentages of patients in whom these medical events were believed to be related or possibly related to the drug.

Body System/Event	All Events: Pravastatin (N = 900) %	All Events: Placebo (N = 411) %	Events Attributed to Study Drug: Pravastatin (N = 900) %	Events Attributed to Study Drug: Placebo (N = 411) %
Cardiovascular				
Cardiac Chest Pain	4.0	3.4	0.1	0.0
Dermatologic Rash	4.0*	1.1	1.3	0.9
Gastrointestinal				
Nausea/Vomiting	7.3	7.1	2.9	3.4
Diarrhea	6.2	5.6	2.0	1.9
Abdominal Pain	5.4	6.9	2.0	3.9
Constipation	4.0	7.1	2.4	5.1
Flatulence	3.3	3.6	2.7	3.4
Heartburn	2.9	1.9	2.0	0.7
General				
Fatigue	3.8	3.4	1.9	1.0
Chest Pain	3.7	1.9	0.3	0.2
Influenza	2.4*	0.7	0.0	0.0
Musculoskeletal				
Localized Pain	10.0	9.0	1.4	1.5
Myalgia	2.7	1.0	0.6	0.0
Nervous System				
Headache	6.2	3.9	1.7*	0.2
Dizziness	3.3	3.2	1.0	0.5
Renal/Genitourinary				
Urinary Abnormality	2.4	2.9	0.7	1.2
Respiratory				
Common Cold	7.0	6.3	0.0	0.0
Rhinitis	4.0	4.1	0.1	0.0
Cough	2.6	1.7	0.1	0.0

*Statistically significantly different from placebo.

In the Pravastatin Primary Prevention Study (West of Scotland Coronary Prevention Study) (see **CLINICAL PHARMACOLOGY: Clinical Studies**) involving 6595 patients treated with PRAVACHOL (pravastatin sodium) (N = 3302) or placebo (N = 3293), the adverse event profile in the pravastatin group was comparable to that of the placebo group over the median 4.8 years of the study. The following effects have been reported with drugs in this class; not all the effects listed below have necessarily been associated with pravastatin therapy: *Skeletal:* myopathy, rhabdomyolysis, arthralgia. *Neurological:* dysfunction of certain cranial nerves (including alteration of taste, impairment of extra-ocular movement, facial paresis), tremor, vertigo, memory loss, paresthesia, peripheral neuropathy, peripheral nerve palsy, anxiety, insomnia, depression. *Hypersensitivity Reactions:* An apparent hypersensitivity syndrome has been reported rarely which has included one or more of the following features: anaphylaxis, angioedema, lupus erythematosus-like syndrome, polymyalgia rheumatica, dermatomyositis, vasculitis, purpura, thrombocytopenia, leukopenia, hemolytic anemia, positive ANA, ESR increase, eosinophilia, arthritis, arthralgia, urticaria, asthenia, photosensitivity, fever, chills, flushing, malaise, dyspnea, toxic epidermal necrolysis, erythema multiforme, including Stevens-Johnson syndrome. *Gastrointestinal:* pancreatitis, hepatitis, including chronic active hepatitis, cholestatic jaundice, fatty change in liver, and, rarely, cirrhosis, fulminant hepatic necrosis, and hepatoma; anorexia, vomiting. *Skin:* alopecia, pruritus. A variety of skin changes (e.g., nodules, discoloration, dryness of skin/mucous membranes, changes to hair/nails) have been reported. *Reproductive:* gynecomastia, loss of libido, erectile dysfunction. *Eye:* progression of cataracts (lens opacities), ophthalmoplegia. *Laboratory Abnormalities:* elevated transaminases, alkaline phosphatase, and bilirubin; thyroid function abnormalities. **Laboratory Test Abnormalities:** Increases in serum transaminase (ALT, AST) values and CPK have been observed (see **WARNINGS**). Transient, asymptomatic eosinophilia has been reported. Eosinophil counts usually returned to normal despite continued therapy. Anemia, thrombocytopenia, and leukopenia have been reported with HMG-CoA reductase inhibitors. **Concomitant Therapy:** Pravastatin has been administered concurrently with cholestyramine, colestipol, nicotinic acid, probucol and gemfibrozil. Preliminary data suggest that the addition of either probucol or gemfibrozil to therapy with lovastatin or pravastatin is **not** associated with greater reduction in LDL-cholesterol than that achieved with lovastatin or pravastatin alone. No adverse reactions unique to the combination or in addition to those previously reported for each drug alone have been reported. Myopathy and rhabdomyolysis (with or without acute renal failure) have been reported when another HMG-CoA reductase inhibitor was used in combination with immunosuppressive drugs, gemfibrozil, erythromycin, or lipid-lowering doses of nicotinic acid. Concomitant therapy with HMG-CoA reductase inhibitors and these agents is generally not recommended. (See **WARNINGS: Skeletal Muscle** and **PRECAUTIONS: Drug Interactions**.)

OVERDOSAGE: To date, there are two reported cases of overdosage with pravastatin, both of which were asymptomatic and not associated with clinical laboratory abnormalities. If an overdose occurs, it should be treated symptomatically and supportive measures should be instituted as required.

CAUTION: Federal (USA) law prohibits dispensing without prescription.

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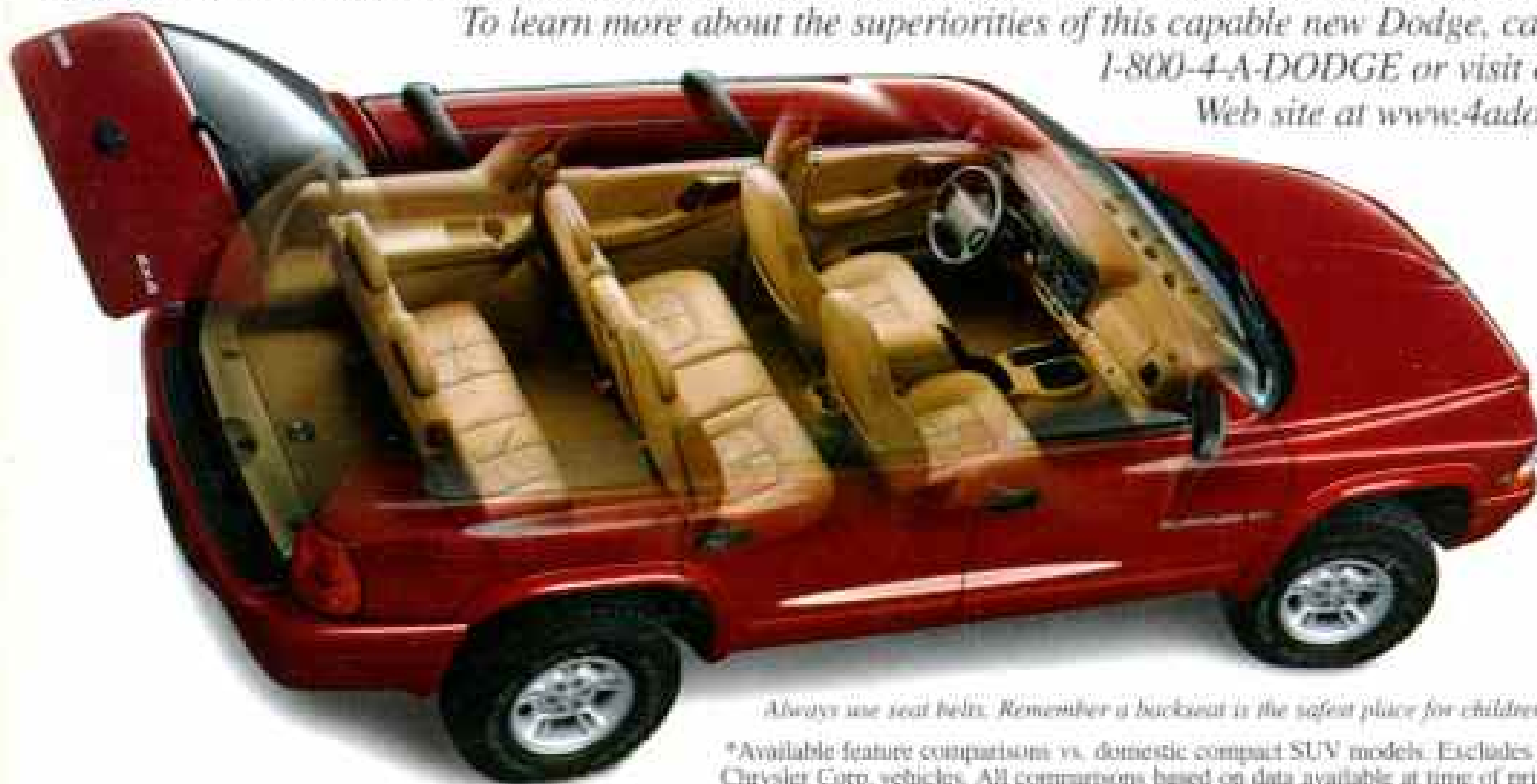

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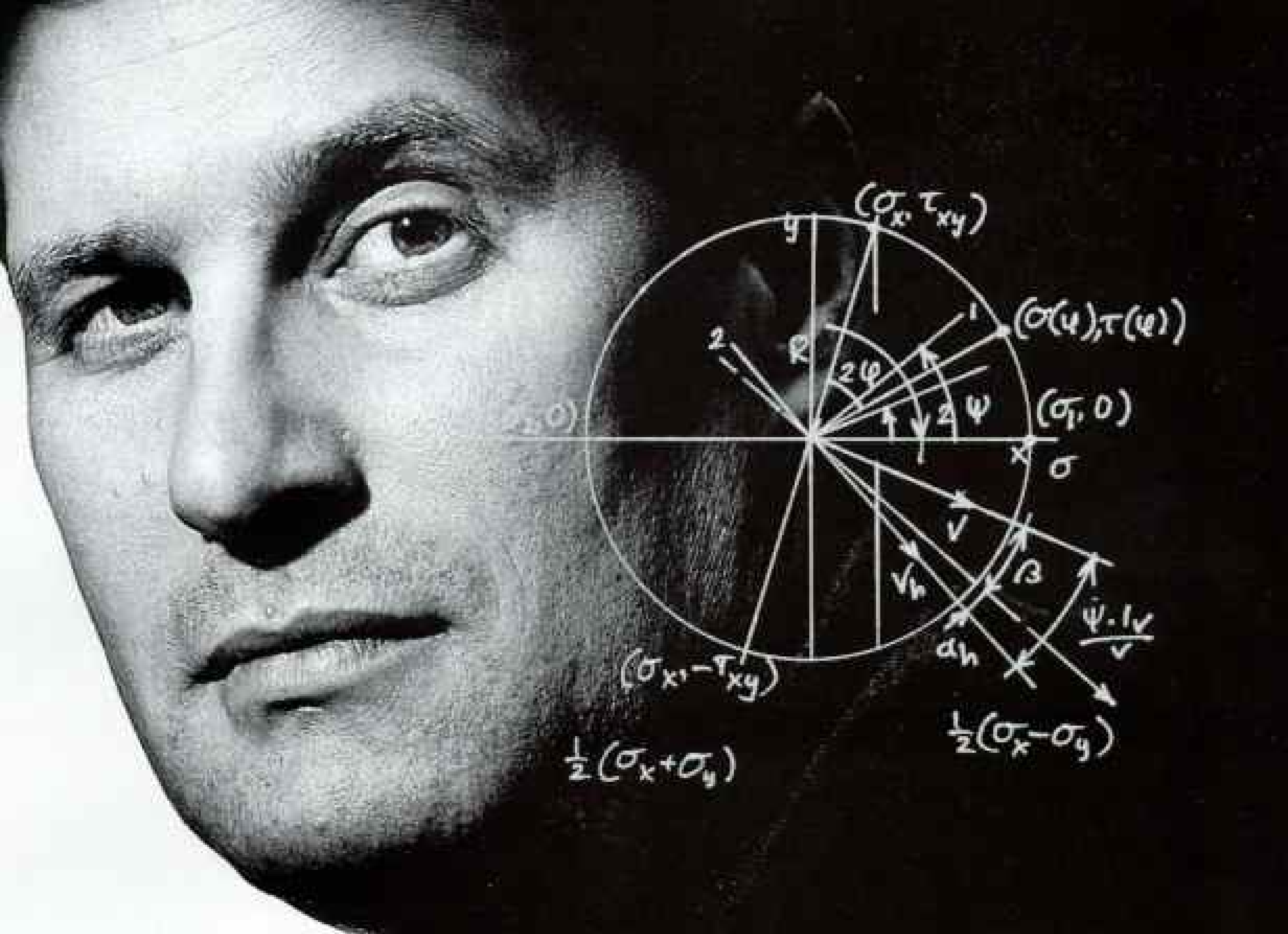

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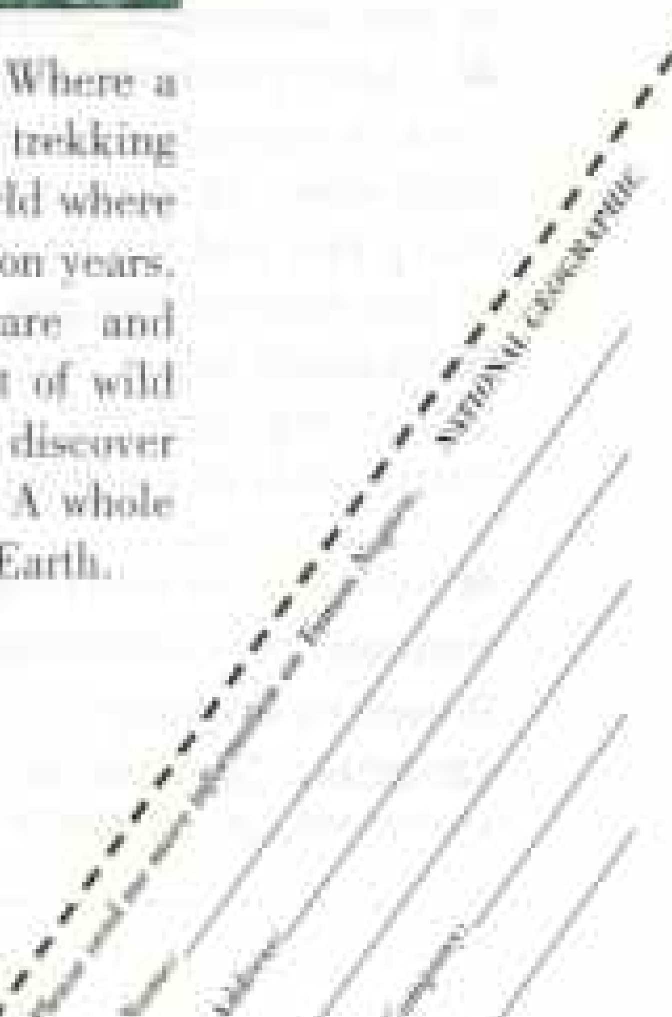

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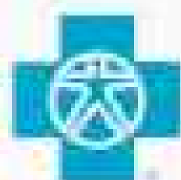

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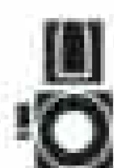

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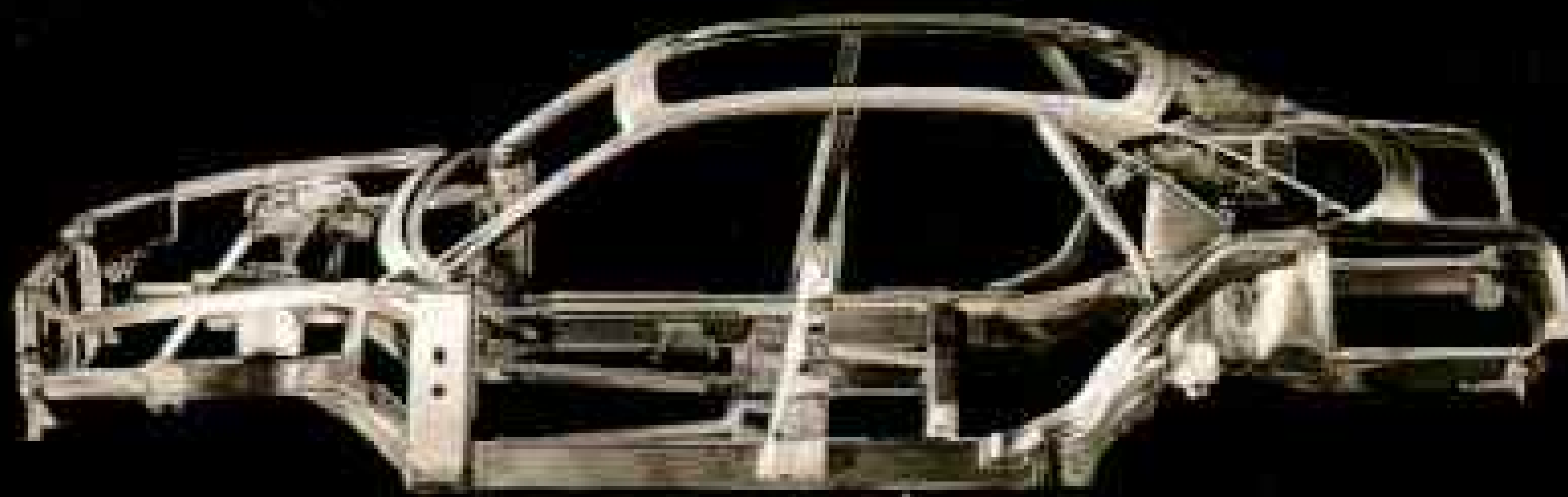

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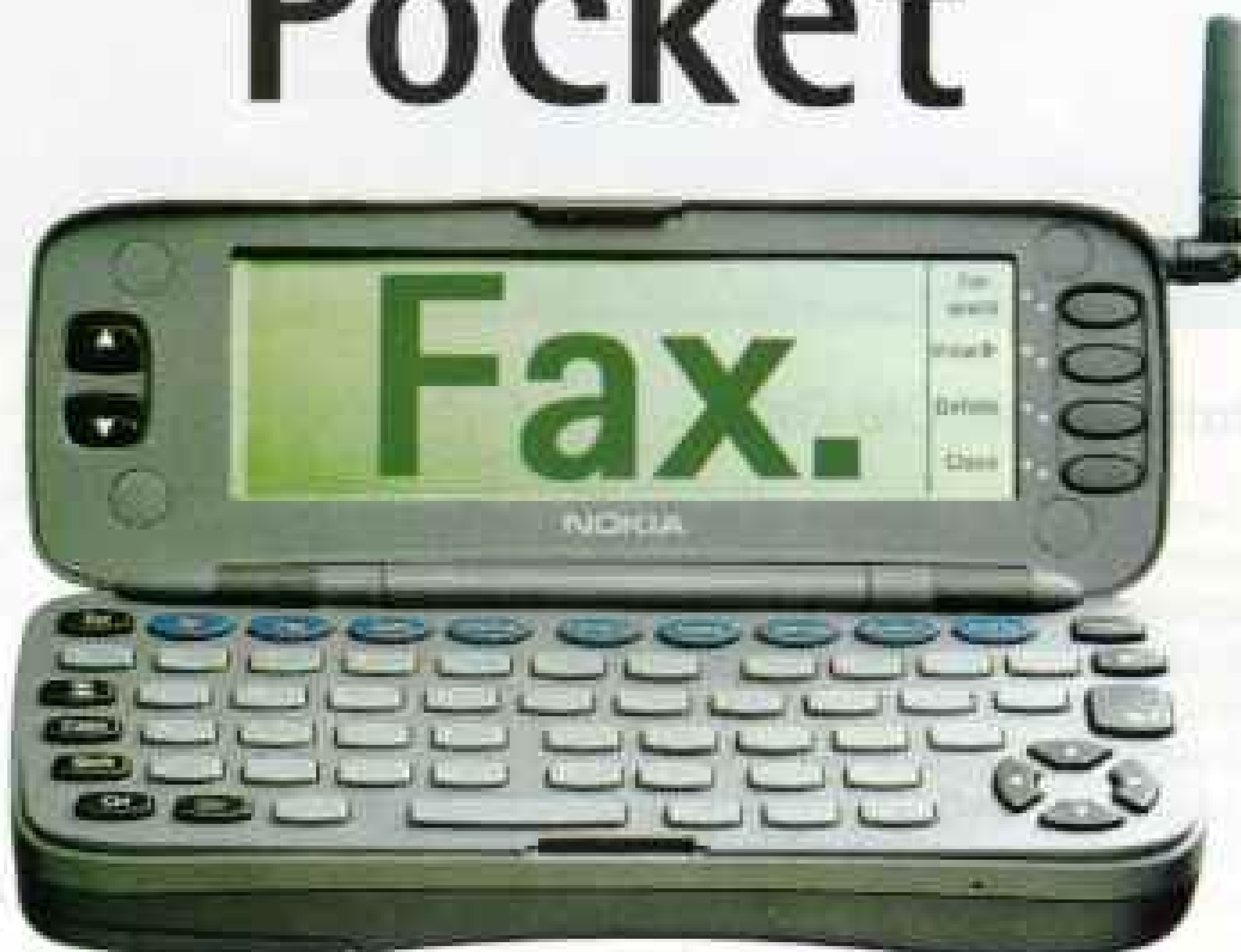

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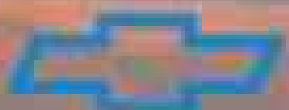

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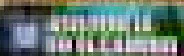

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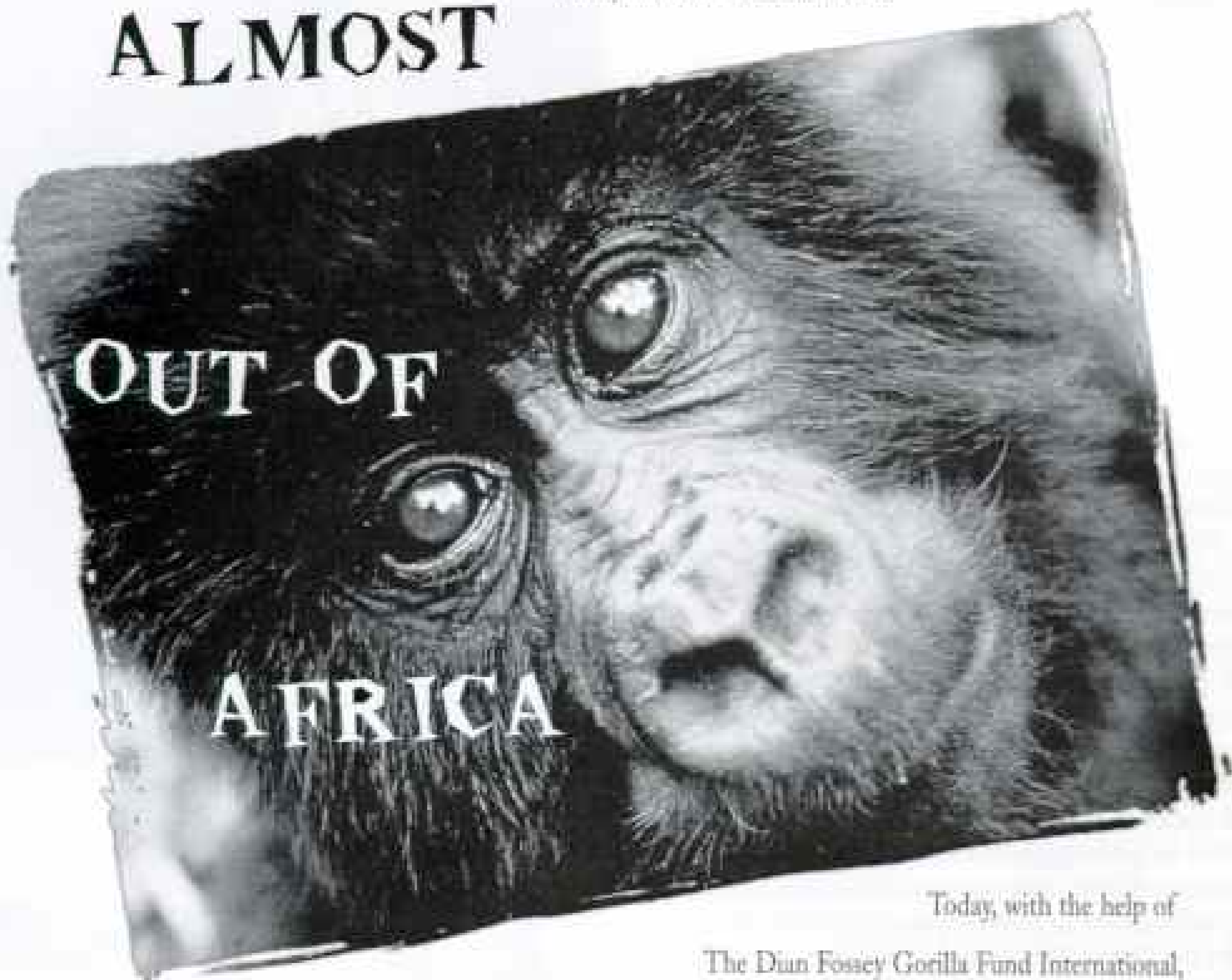

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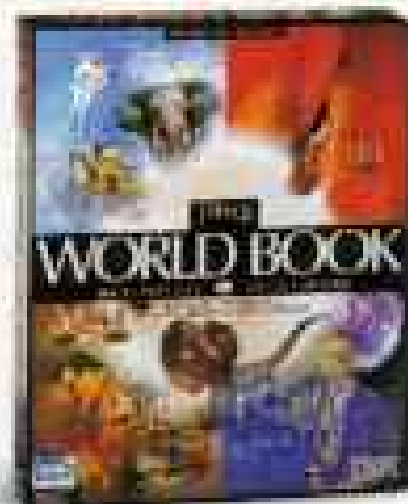

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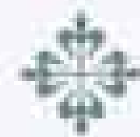

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■ FROM THE GEOGRAPHIC ARCHIVES

Making Spectacles of Themselves in Canada

With an eye for a joke, boys balance sunglasses on the muzzles of their cart dogs in Sainte-Anne-de-Beaupré, Quebec. Had they perhaps been racing outside the town, located on the St. Lawrence River, or were they hired to carry mail or give rides around this small French-Canadian community? This photograph, never published in the magazine, was acquired in 1934, probably for the following February's article "Old France in Modern Canada," which included another picture of a boy and his heavily laden dogcart.

"Sled dogs helped deliver mail in northern Ontario and Quebec until the 1960s," said one Canada Post official recently. "But we can find no records of children delivering mail anywhere in Canada."

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JIM BRANDENBURG

"Meet My Psychiatrist"

So said the late nature photographer Les Blacklock about the healing power of nature. My own counselor is a fallen centuries-old cedar a short walk from my home in northern Minnesota. It is a place I often go to collect my thoughts. On a dark and heavy day that matched my mood, I decided to visit my old friend and make a portrait.

Trained as a painter, I could only see this as an impressionistic sketch to match our elusive relationship. Since my project demanded only one frame a day (see "North Woods Journal," pages 94-111), I selected color-negative film, which is more forgiving of faulty exposure than color-transparency film. A 15-mm superwide lens stopped down to f/22 allowed me a full 15 seconds to "paint." With camera on tripod I framed the scene and waited for courage. Suddenly, a glow of light filtered through the dense cedar canopy. I pushed the button, nervously counted to seven, then picked up camera and tripod and walked toward my subject. This "panning" technique was the most risky of my 90-day photo marathon. But the blurred, foglike result renders an ethereal atmosphere very close to the feeling I get in this Hansel and Gretel forest.

—JIM BRANDENBURG

State Farm Good Neighbor Award

Seated left to right: Lorelei Jones, Brenda Jones, Darcy Swope, Laurie Poole. Standing left to right: Beverly Ann Williams, Russell Hoffman, Christine Vita Golik, Rachel Ely, Julie Gawel, Anne Godsey, Diana Mand.

The Results These Art Teachers Get Are Anything But Sketchy.

To these teachers, art is more than just drawing pictures. It's drawing conclusions. And, using a variety of mediums, they've helped their students harness their creative talents to address important social issues from race relations to recycling. For showing them that art is as much about young minds as it is about old masters, during the past year State Farm is proud to have presented our Good Neighbor Award to each of these remarkable educators.

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The Good Neighbor Award was developed in cooperation with the National Art Education Association.

*On*Television

■ FIRST IN A NEW DRAMA SERIES: FORBIDDEN TERRITORY

An African Encounter for the Ages

Stepping forward, pith-helmeted Henry Morton Stanley (played by Aidan Quinn, above), a reporter for the *New York Herald*, sees the man he has sought during eight months of arduous African travel. He utters a greeting that will become immortal: "Dr. Livingstone, I presume?"

Forbidden Territory: Stanley's Search for Livingstone is the first film made for National Geographic Presents. The series, co-produced with Hallmark Entertainment, will present made-for-TV dramas based on real-life tales of exploration and discovery. "Our aim is to portray the period, the events, and the personalities in productions that capture the panoramic sweep of feature films," says Tim Kelly, president of National Geographic Television.

OLIVER UPTON (BOTH)

The brash and driven Stanley finally caught up with Scottish missionary and explorer David Livingstone in the village of Ujiji in present-day Tanzania on November 10, 1871. Their meeting launched a poignant friendship, born of mutual respect and shared endurance. In the drama, Livingstone (played by Nigel Hawthorne, left) listens raptly to Stanley's account of his tragic childhood. Ultimately their alliance led to the discovery of the Nile's source and the end of the slave trade in Zanzibar.

■ PROGRAM GUIDE

National Geographic Presents
Dramas of real-life adventure
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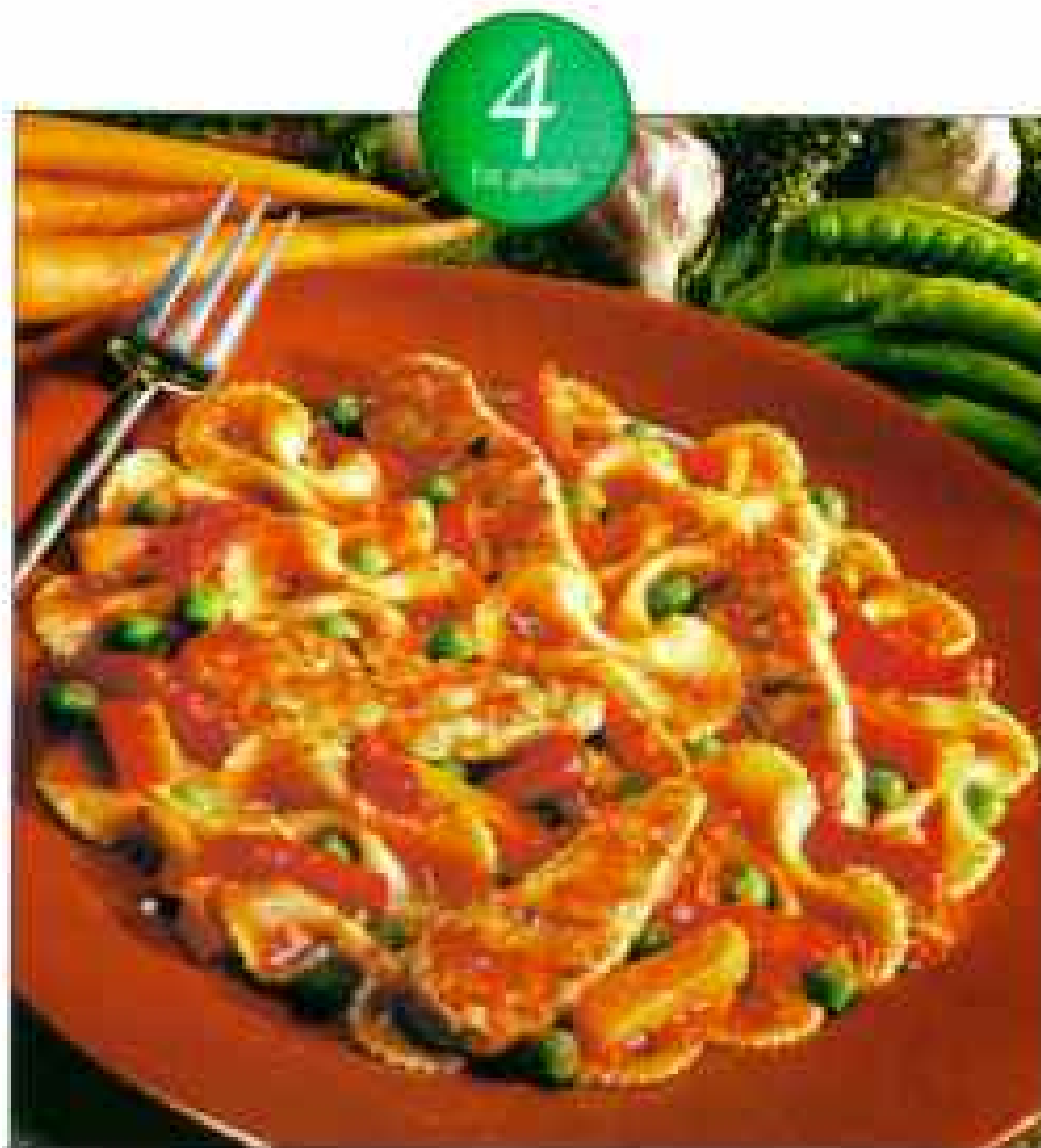

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*Earth*Almanac

JOHN PAUL PHOTOGRAPHY; ROBERT CLOSE (BELOW)

Living Rototillers Aid Old Oaks

Oak and pine forests once covered half of Scotland, but after centuries of exploitation only one percent of the forests remain. A handful of oaks more than a hundred years old survive in Rahoy Hills Wildlife Reserve. But their acorns can't take root because bracken fern chokes the ground. "Sheep and red deer that long grazed the sanctuary were fenced out of a small area three years ago," says Graeme Morison of the Scottish Wildlife Trust. They had been eating saplings and were ineffective in controlling bracken, which spreads by its roots.

Pigs to the rescue! Three rare Tamworth sows—only 170 are left in Britain—were turned loose last March in a 60-acre tract to root for insects among the oaks. Morison expects the pigs to eat large quantities of the vexing bracken and to aerate and fertilize the soil. Extremely hardy, Tamworths got the job in Rahoy Hills because they closely resemble an extinct species—the Old English forest pig—that was known as a champion digger.

Koalas Win: Next-door Airport Plan Canceled

A quiet life in the trees seems assured for the only thriving colony of koalas near Sydney, Australia. Several dozen live in the Holsworthy Military Range, proposed in the mid-1980s as a site for a new international airport. After vigorous opposition by conservationists, the government eliminated Holsworthy from consideration last September. Sydney's existing airport will be expanded to accommodate the nearly ten million passengers expected for the city's 2000 Summer Olympics.

The koalas' defenders include biologist Robert Close of the University of Western Sydney and his colleagues, who have studied the colony since 1990. An intensive burn would have been needed to trigger unexploded shells at Holsworthy, and Close feared the fire would sweep into the gorge that shelters the koalas.

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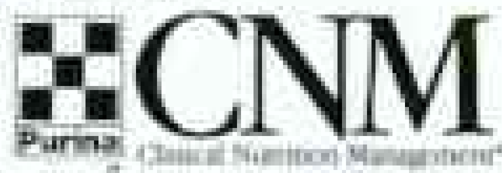

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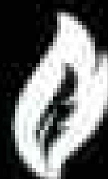

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In re U.S. Brass Corporation, Case #94-40823S, U.S. Bankruptcy Court for the Eastern District of Texas, Plano Division.

Earth Activists Win Goldman Prizes

Symbol of renewal, the Ouroboros statuette depicting a serpent biting its tail (left) was given by the Goldman Environmental Foundation to seven crusaders this year. The National Geographic Society was among 21 nominating institutions for the prizes, each worth $75,000.

In Western Samoa, Paul Cox (right, at left), a Brigham Young University ethnobotanist, and High Chief Fuiono Senio joined forces to create the 30,000-acre Falealupo Rain Forest Preserve. Cox was studying plants there in 1988 when he heard bulldozers. Village chiefs had sold their forest to loggers to raise money for a new school. "I told Fuiono that I would raise funds for the school if the Samoans would halt the logging and preserve the forest for 50 years," says Cox. He raised $85,000, and a bargain was struck. Sadly, Fuiono has since died.

Another recipient's work landed him in prison. Alexander Nikitin (bottom right), a former Soviet naval captain, mapped radioactive hazards from old Soviet nuclear submarines sunk in the Barents Sea. Nikitin was charged with treason and espionage and jailed for ten months. He was released last December but remains under investigation.

The other Goldman winners:

■ Terri Swearingen, a U.S. nurse who for more than a decade thwarted construction of the nation's largest toxic-waste incinerator, in East Liverpool, Ohio. It was eventually built in 1992.

■ Nick Carter, a Zambian conservationist who in 1996 helped engineer the world's first multinational wildlife enforcement agreement, which allows authorities to pursue poachers across borders.

■ Loir Botor Dingit, an Indonesian chief who has won government support for his fellow rattan farmers and their ecologically sound forest practices in East Kalimantan.

■ Juan Pablo Orrego, whose organization has opposed a series of dams on Chile's Bío-Bío River. The project threatens an indigenous people, the Pehuenche.

Image not available

Natural Medicine Can Be Hard on Plants

Colds, toothaches, and snakebites were once treated by Plains Indians with the roots of purple coneflowers, *Echinacea pupurea.* Now with the natural-remedy business booming, echinacea products are top-selling herbal remedies in U.S. health stores, and collectors are digging up the flowers with alarming zeal. In Oklahoma entire fields have vanished, and coneflower poachers have been evicted from nature preserves. Quality roots can sell for $21 a pound to pharmaceutical companies, which market echinacea tablets, tinctures, and teas as immune system boosters.

TEXT BY JOHN L. ELIOT

NATIONAL GEOGRAPHIC

Interactive

ONLINE

Soaring in Cyberspace: The Byte Stuff

Two cracked ribs from a horseback-riding accident were not going to stop pilot Chuck Yeager. Nor was the widespread fear that attempts to break the sound barrier would be futile and fatal. He squeezed himself into the cramped cockpit of the Bell X-1 (above) and flew into history on October 14, 1947. Yeager's feat required "the right stuff"—that famous mental alloy of fire and steel—but softer souls can taste his triumph digitally, explore his famous plane, fire the rocket engine, and watch the Machmeter race past all precedent. Check it out at *www.nationalgeographic.com/features/97/sound.*

Cyber pilots can also attempt the "elevator to God," a current prized by sailplane pilots. Riding such waves six miles above earth, visitors need sharp eyes and fast fingers to avoid the hazards of this extreme pastime. See . . . */features/97/wave.*

Explorer Johan Reinhard (right) stunned the archaeological world in 1995 when he found the frozen body of an Inca girl sacrificed to the gods five centuries ago. In this online exclusive, visitors conduct an electronic autopsy of the mummy with experts examining CT scans and the results of DNA analysis, soar above an interactive 3-D map of the Andes, and join Reinhard's current expedition at . . . */features/97/andes.*

Participate in our forum on "Aging—New Answers to Old Questions," keyed to the article in this issue, at . . . */media/ngm/9711/forum.*

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*On*Assignment

■ KINGDOM OF MUSTANG

Reaching New Heights

What was a photographer closely identified with Africa—he's shot stories for the GEOGRAPHIC in Egypt, Sudan, Ethiopia, Uganda, Namibia, Kenya, and the former Zaire—doing 15,000 feet up in Nepal's Himalaya? "Panting a lot," admits Bob Caputo, at right, here releasing Buddhist prayers to the wind with guide Angya Gurung. "The only way to get around in Mustang is walking. It was the hardest work I've ever done."

A graduate of New York University Film School, Bob took up still photography to earn money to make documentaries, and just kept going. He finally did make a film, years later—about a photo assignment.

RAM CHETAN

■ HUTSULS

Altitude Adjustment

She was pretty laid back, recalls Lida Suchý, for her first time ever on a horse. "I was photographing landscapes and needed to get some height." She had height as it was, documenting a Ukrainian mountain village of the Hutsuls; her father grew up nearby. "I'd go out with the 35-mm camera and people would say, 'Lida's going out to photograph.' But when I went out with my big 8-by-10 camera, they'd say, 'She's going out to *very* photograph!'" Lida and her husband, Mišo, live in New York State and often work as a team. She teaches photography at the Rochester Institute of Technology.

MIŠO SUCHÝ

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