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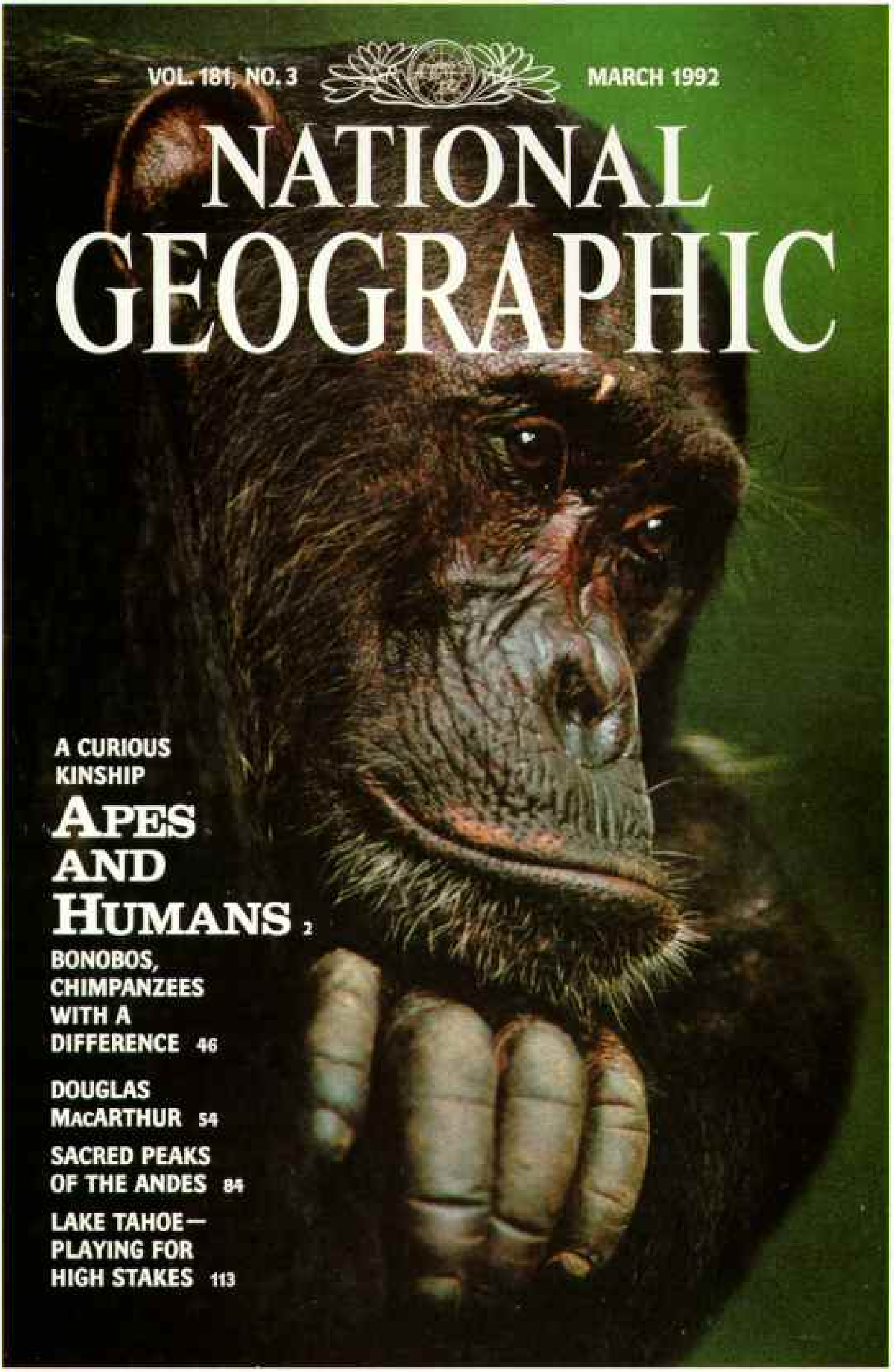

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NATIONAL GEOGRAPHIC

MARCH 1992

COVER: Face of a philosopher, personality of a spoiled child, a male named Frodo belongs to a family of chimpanzees observed by Jane Goodall for 30 years at Gombe National Park in Tanzania. Photograph by Michael Nichols.

A Curious APES

By EUGENE LINDEN

Photographs by MICHAEL NICHOLS

MAGNUM

Kinship AND HUMANS

Drawn by empathy for their nearest animal relatives, humans are learning more about ape behavior—and their own. Fascination exceeds prudence in Zaire, where mesmerized tourists approach a mountain gorilla too close for the good of both.

As wholly dependent as a human infant, a newborn mountain gorilla will stay cradled in its mother's embrace for three months. Each gorilla in the Virunga Mountains of Rwanda, Zaire, and Uganda owes a debt to the late Dian Fossey. Although her obsession with gorillas earned her many enemies, she opened a window on the social nature of these largest primates. Her accounts—in the GEOGRAPHIC, *in Society television programs, and in a book—helped banish stereotypes of gorillas as stupid and ferocious, revealing instead the animals' complex range of emotions and behaviors.*

When poaching took a toll, Fossey alerted the world. Later researchers helped set up antipoaching patrols, educate local people, and bring in tourist dollars for conservation. The mountain gorilla population rose from 239 individuals in 1981 to 320 today, and baby Pasika, sixth offspring of 27-year-old Papoose, has a better chance in life.

The touch—an exquisite moment for Jane Goodall—came when a chimpanzee she had never seen before reached out his hand to her. The old male had been caged alone for years in an African zoo.

"He's desperate for contact with other living beings," Goodall says, "so he manipulates zoogoers, throwing feces to make them jump and shriek."

Drawing on her unparalleled understanding of chimps in the wild, Goodall comforted and quieted the raging animal by bowing in a chimp gesture of submission.

After 30 years Goodall has turned the day-to-day work at Gombe National Park in Tanzania over to others. She now campaigns for better protection of wild apes and better care of captives. "I've learned so much from observing chimpanzees," she says. "I feel it's my responsibility to give them something back."

Kissing hands and cadging alcoholic drinks, 28-year-old Mr. Jiggs roller-skates through a New Jersey audience. Like many captive chimps, Jiggs has been transformed by training into an artificial human.

Actually a female, Jiggs came to the U. S. as a one-year-old from the Congo and was raised by owner Ron Winters like a child.

"I used child psychology," he says. "Lots of love and discipline."

Winters developed a small radio-controlled unit, still strapped on Jiggs's back, to deliver electric shocks when she "misbehaved."

"I never have to use it anymore," he says. "She's happy and good because she's never in a cage."

To guard against biting, he had her front teeth removed, and before shows he clamps her molars shut.

TWENTY YEARS AGO I met a chimpanzee named Bruno. He was one of a group of chimps being taught American Sign Language to determine if apes could communicate with humans. Last year I went to see him again. The experiment is long past, and Bruno was moved in 1982 to a medical laboratory, but he is still using the signs. Now it's the lab technicians who are learning sign language; they want to communicate with him.

I looked at Bruno's bright, quick eyes. They seem human, but he is not human. "You cannot look closely at a great ape,"

Since 1961 the Society has been instrumental in advancing the study of great apes in the field by funding the groundbreaking research of Jane Goodall, Dian Fossey, Biruté Galdikas, and many others. Their revelations about ape anatomy and behavior inspire us to look more closely at ourselves—and at our treatment of these, our closest animal kin. —THE EDITOR

primatologist John Mitani once told me, "and fail to sense something very special." Perhaps the first place to look for apes is within ourselves. Little wonder that we feel this sense of recognition. In anatomy and behavior they are our closest relatives.

This kinship has both fascinated and disturbed us. Over years of study, apes have revealed as much about humans as about themselves. Apes may hold the key to understanding our origins and the roots of what we consider the human characteristics of friendship, love, aggression, language, and tool use. The knuckle-walking African apes are so closely related to one another and to us that some taxonomists suggest that we all should be lumped together in the same family. Oddly, though, some ape researchers oppose this reclassification, not because they think it is inaccurate but because they fear it would offend people who want to think that humans

Doting baby-sitter, Titus, a powerful mountain gorilla male, plays gently with an infant while females doze nearby, oblivious to Diane Doran, a successor to Fossey as director of the Karisoke Research Centre.

Observed since birth, the 17-year-old silverback recently displaced the dominant male in his group and acquired the females that he leads and protects on daily forays to feed on vegetation. Here he breaks branches of a giant senecio (right) to get at the pith.

occupy a special place in the natural order.

Our attitudes toward apes are radically ambivalent. We acknowledge our ancestral ties in anything from serious scientific experiments to the most frivolous entertainment. But our relationship is full of contradictions: While some humans seek to safeguard apes in the wild, others destroy their habitat; in captivity, we discover potential uses for them that we hesitate to employ.

Since Charles Darwin suggested a common ancestry for apes and humans over a hundred years ago, dedicated researchers have uncovered many similarities between them. Jane Goodall first observed tool use among chimps

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EUGENE LINDEN, a senior writer for *Time* magazine, has written three books on apes, the latest *Silent Partners*. This is his first article for the GEOGRAPHIC. Photographer MICHAEL "NICK" NICHOLS has a particular interest in primate research. His most recent story for the magazine was on New Mexico's Lechuguilla Cave (March 1991).

To the edge of extinction

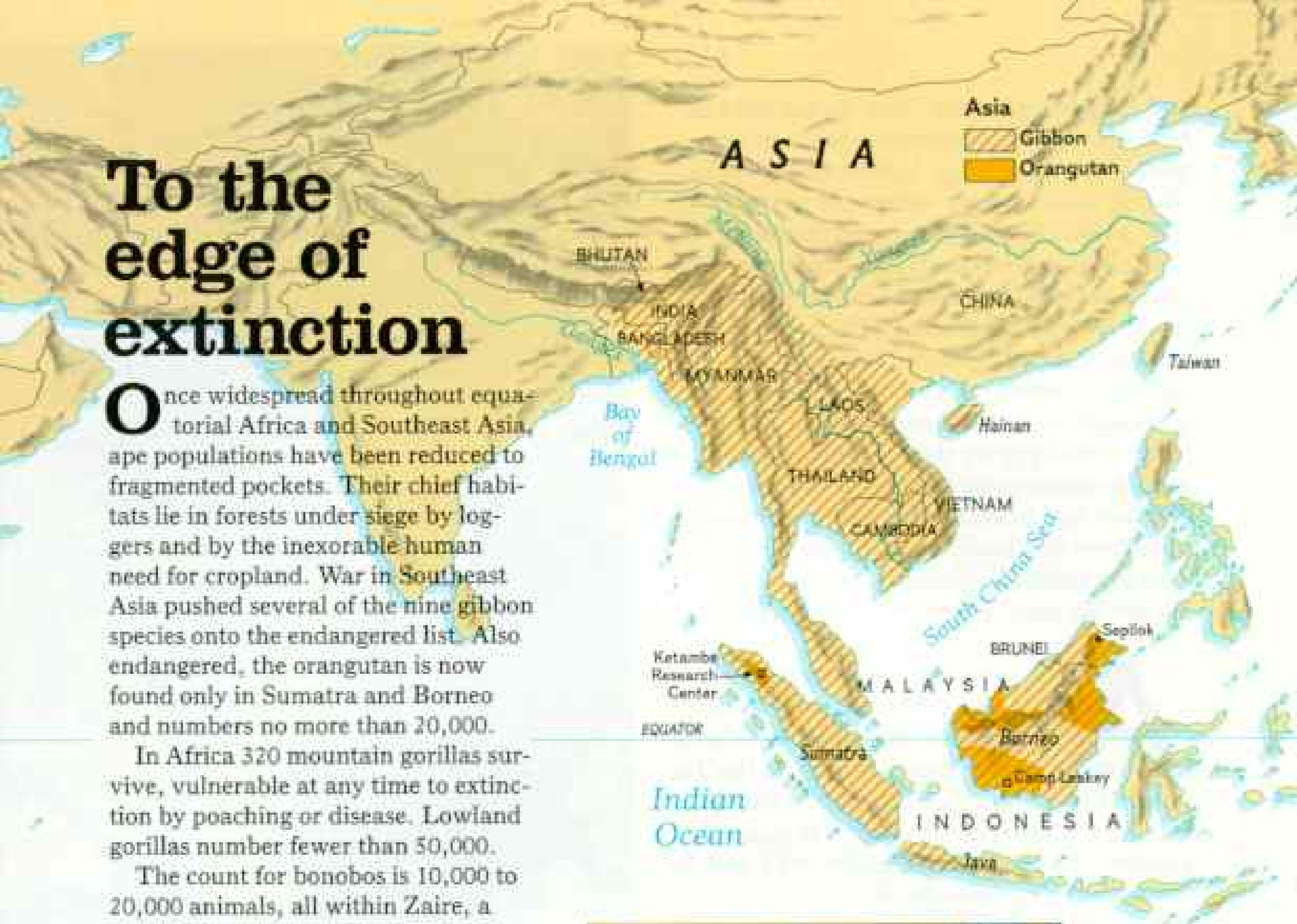
Once widespread throughout equatorial Africa and Southeast Asia, ape populations have been reduced to fragmented pockets. Their chief habitats lie in forests under siege by loggers and by the inexorable human need for cropland. War in Southeast Asia pushed several of the nine gibbon species onto the endangered list. Also endangered, the orangutan is now found only in Sumatra and Borneo and numbers no more than 20,000.

In Africa 320 mountain gorillas survive, vulnerable at any time to extinction by poaching or disease. Lowland gorillas number fewer than 50,000.

The count for bonobos is 10,000 to 20,000 animals, all within Zaire, a nation plagued by civil unrest.

The chimpanzee population has been reduced to about 200,000 animals scattered in 21 nations. Only three countries—Zaire, Gabon, and Côte d'Ivoire—count populations of more than 10,000 each.

The very survival of the remaining wild apes may depend on the creation of well-patrolled reserves and a halt to the international ape trade.



in the 1960s; since then every chimp group studied has proven to use tools. And scientists have evidence that chimps and orangutans know how to use plants as medicines.

Over the past three decades, intrepid souls like Goodall, George Schaller, Toshisada Nishida, Biruté Galdikas, and Dian Fossey (some of them encouraged by anthropologist Louis Leakey) contended with disease and privation in the wild to produce the first extensive reports on the daily lives of great apes. Thanks to them, the picture of ape behavior has changed dramatically. Apes, once thought to live in a peaceable kingdom, are capable of killing one another. Infanticide has been observed among gorillas and chimps. These dark discoveries are lightened by reports of ape friendships and loving relationships between mothers and offspring.

Now a new generation of scientists is building on that earlier research and laboring, with some desperation, to protect the apes

and their environment from the advance of humans. Apes are no longer secure in any part of the wild. Their habitat continues to shrink, leaving them vulnerable to starvation, social disintegration, and poaching.

Some 17 million years ago, during the Miocene epoch, there were at least three times as many ape genera as today. Their descendants are the lesser apes, or gibbons, to which we are only distantly related; our closer kin the great apes, or orangutans, gorillas, bonobos (often called pygmy chimpanzees), and chimpanzees (sometimes known as "common" chimps); and humans. Gibbon populations have been drastically reduced; all the great apes are listed as vulnerable or endangered. We are the apes' sole modern success story.

AFTER A TEN-HOUR DRIVE from Abidjan, Côte d'Ivoire, I reach the rutted path that leads into Christophe Boesch's camp in the Taï forest. The camp reflects the Swiss biologist's lean, disciplined life—though it is pleasant and airy, there are no amenities. As I wait for Boesch's return from the field, the only sounds are the hiss of gas lamps and the ruckus of forest creatures settling in for the night.

When he appears, the gaunt scientist is preoccupied and grim. A leopard has attacked and killed Salomé, one of the female chimps in the group of 70 Boesch and his wife, Hedwige Boesch-Achermann, have been studying since 1979. This is the first successful leopard attack ever documented. Till now, chimps were thought to be generally safe from predators. If it turns out that big cats regularly eat chimps, scientists will have to rethink their earlier assumption that chimps organize themselves primarily around food, rather than defense.

The next morning, after hastily gulping a spoonful of cold porridge, I hurry to keep up with Boesch as he plunges into the dank equatorial forest. Boesch radiates intensity. He insists that those accompanying him dress in drab, dark green garments that blend with the surroundings. And although Boesch has walked these forests for 13 years, like the chimps he has never cleared trails, preferring to orient himself chimp fashion by learning the big trees and the contours of the 27-square-kilometer study area.

Boesch heads for the base of a buttress-rooted tree to show me what looks like a

primitive food-processing center. A hunting and gathering people might have just been here. Dozens of nutshells are strewn about, along with pieces of wood that turn out to be worn "hammers" chimps use for cracking nuts. There are also some stones, for harder nuts. In March the forest resounds with the sound of hammering. "Once I was leading someone here who wondered what carpenters were doing in the forest," Boesch recalls. "I told him the 'carpenters' were chimps."

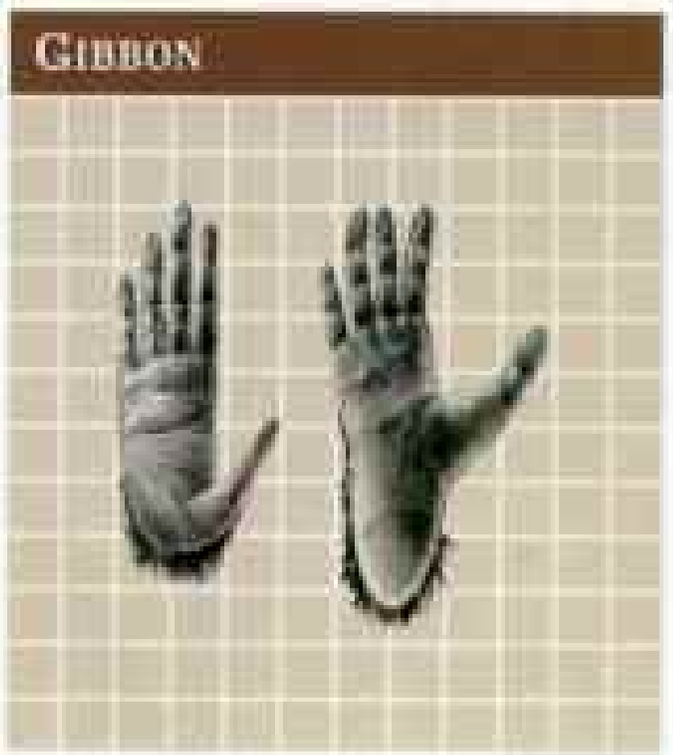
Cracking these nuts is no elementary operation, as I *(Continued on page 22)*

Fearful of humans, who hunt them for food, a band of lowland gorillas in the Central African Republic fled, leaving this female temporarily stranded. J. Michael Fay finds his long-range study here impeded by dense forest, but he is already overturning old beliefs, such as the notion that gorillas fear water. He caught glimpses of them wading in swamps to feed on hearts of palm.

How apes compare

While apes and humans share similar body structure, each species has developed different adaptations in response to its environment. Genetically, chimpanzees and bonobos are closest to humans. In fact, their DNA is so similar to that of *Homo sapiens* that some scientists look at those two species for clues to the origin, evolution, and behavior of early humans.

GIBBON



Hylobates

Arboreal acrobats, small-bodied gibbons comprise nine species ranging in weight from 8 to 25 pounds; *Hylobates lar*, shown here, is midsize. Called lesser apes because of their size, gibbons use their long forelimbs to swing pendulum fashion through the treetops of their Southeast Asia forest home. Long curved fingers and toes, including an opposable big toe, give gibbons a good grip on branches and trunks. Carrying food along tree limbs, gibbons walk upright more than any other ape. Males and females are nearly indistinguishable in size. They are thought to bond for life.

GIBBON

ORANGUTAN

CHIMPANZEE

GORILLA

IN ALL APE PAIRS ILLUSTRATED, THE FEMALE IS ON THE LEFT.

Orangutan

Pongo pygmaeus

Despite its bulk, the great red ape hoists itself high in the rain forests of Borneo and Sumatra and rarely descends to the ground. Its powerful upper limbs, almost twice as long as its legs, are made for climbing and swinging. With hooklike hands and feet it holds its place in the branches even when asleep. Males and females are noticeably different, a phenomenon called sexual dimorphism. The larger males weigh as much as 200 pounds and boast an arm span of seven feet; females weigh about half as much. With maturity males acquire bulging cheek pads and throat sacs.

Bonobo

Pan paniscus

Also known as the pygmy chimpanzee, the bonobo has been recognized as a species separate from the chimpanzee since the 1930s (pages 46-53). It has a small head, black face, and pink lips. Its frame is narrower and more gracile than its cousin's, and the face does not protrude as much; webbing between the second and third toes also distinguishes the bonobo. Males weigh about 100 pounds, females about 70; height for both sexes averages 3.8 feet. Found only in the rain forest of central Zaire, bonobos forage mostly in trees but sometimes on the ground, where they travel long distances on all fours. They are bipedal about 5 percent of the time, usually when carrying food or other objects.

Chimpanzee

Pan troglodytes

Versatile and opportunistic, the chimpanzee has adapted to forest and savanna environments in Africa. Long muscular arms reflect a life spent climbing in trees. When the chimpanzee and other African apes travel on the ground, they are quadrupedal knuckle-walkers. In knuckle-walking, long fingers, so useful in the trees, are folded under out of the way, helping to turn the hands into feet. The male chimp, slightly larger than the female, weighs about 110 pounds and stands four feet tall. Close genetic similarity to humans makes chimps and bonobos preferred laboratory subjects for research in human psychology and medicine.

Gorilla

Gorilla gorilla

The largest primate, the gorilla spends most of its time on the ground, yet its long powerful arms make it an adept climber. When knuckle-walking, stout fingers and broad, well-padded feet support its weight, which in males averages 400 pounds. Females are about half that size. At maturity males develop a silver back and a large bony crest on the skull; both sexes have heavy brow ridges.

Like all ape species, gorilla females ovulate about once a month and usually bear one infant at a time. Their young develop slowly, requiring years of maternal care and training.

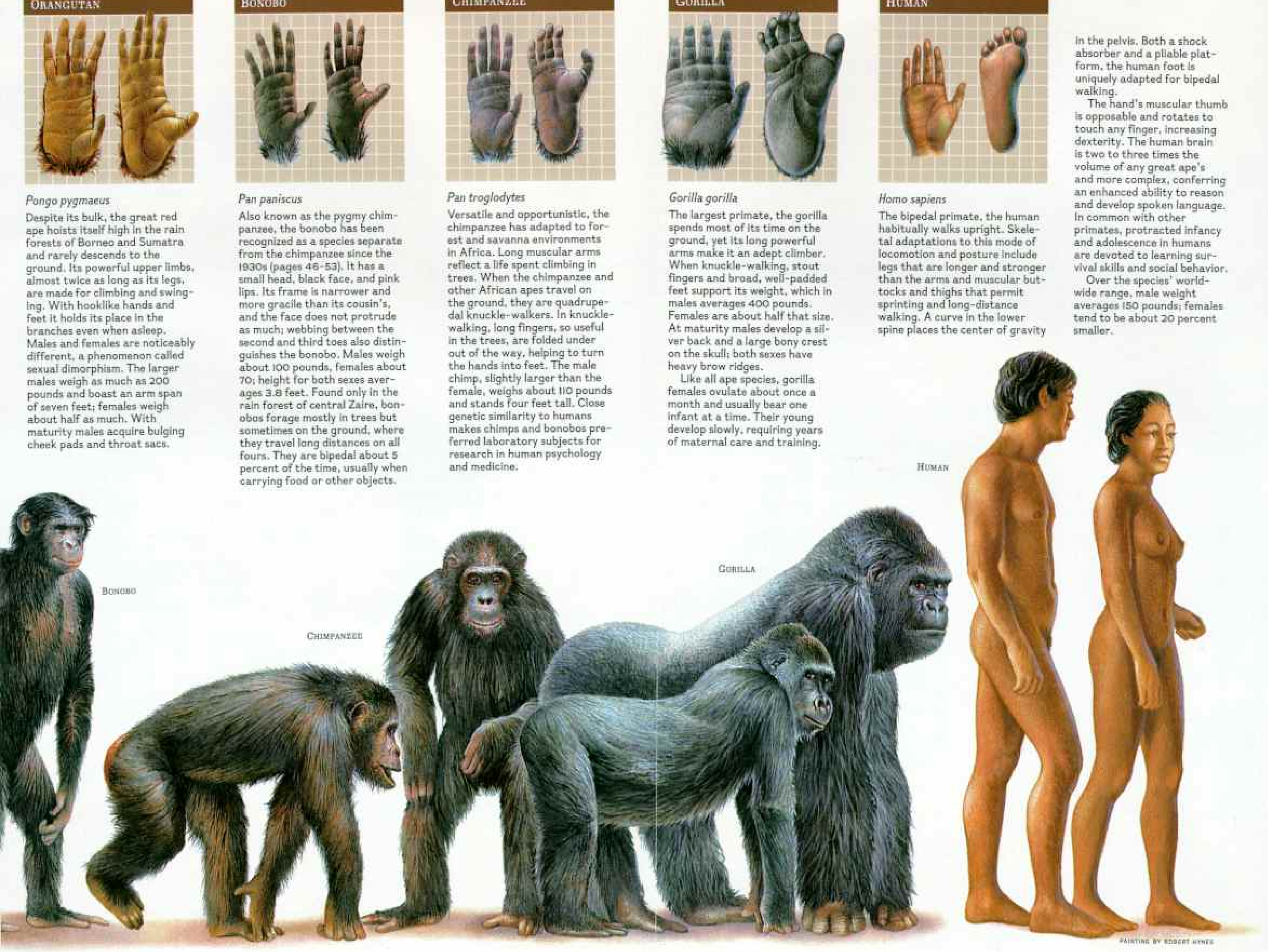
Human

Homo sapiens

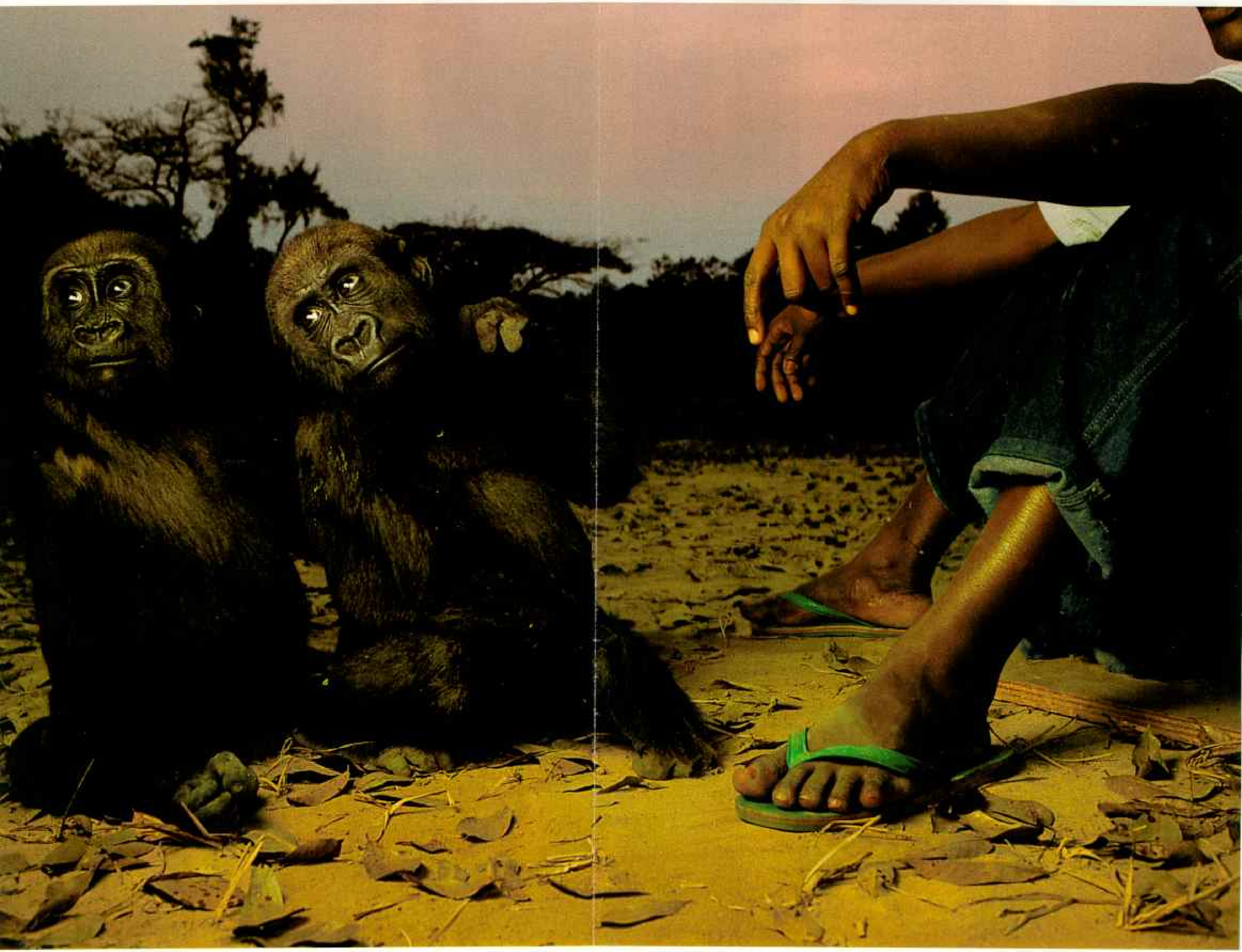
The bipedal primate, the human habitually walks upright. Skeletal adaptations to this mode of locomotion and posture include legs that are longer and stronger than the arms and muscular buttocks and thighs that permit sprinting and long-distance walking. A curve in the lower spine places the center of gravity in the pelvis. Both a shock absorber and a pliable platform, the human foot is uniquely adapted for bipedal walking.

The hand's muscular thumb is opposable and rotates to touch any finger, increasing dexterity. The human brain is two to three times the volume of any great ape's and more complex, conferring an enhanced ability to reason and develop spoken language. In common with other primates, protracted infancy and adolescence in humans are devoted to learning survival skills and social behavior.

Over the species' worldwide range, male weight averages 150 pounds; females tend to be about 20 percent smaller.



Painting by Robert Hynes



Forlorn foundlings, two-year-old lowland gorillas from the Congo, confiscated from pet sellers, get a chance at life in the Brazzaville Gorilla Orphanage (left). Young apes often arrive undernourished, mentally depressed, and bearing rope burns and bullet wounds; their mothers were likely killed for meat.

Caretakers help them learn gorilla ways on daily walks in the adjacent forest, where the apes soon climb and forage on their own.

Three-year-old Yambo (below) treats keeper Stephen Blake like another ape in a gorilla gymnasium modeled after one at Howletts Zoo Park in Kent, England. Howletts founder John Aspinall sponsors the Brazzaville facility in an effort to halt poaching and reintroduce orphans into protected reserves.

The orphanage also educates young Africans raised to believe that gorillas are fierce beasts whose meat is appropriate food. Each year in the Congo an estimated 400 to 600 gorillas are killed and consumed. Gorilla hands (left) are sold—illegally—at fetish stands in city markets; a buyer may purchase a finger to boil in water for bathing a newborn human infant, thereby conferring a gorilla's strength.

(Continued from page 14) discovered when Boesch suggested I give it a try. My first mistake was to place a panda nut in a knothole that had been worn too deep. Boesch assured me a chimp would have known to use the newer "anvil" farther along the tree root. I quickly adopted the two-handed approach favored by chimps, but I mashed the first kernel. If only I had had a chimp to instruct me.

Boesch once saw Salomé precisely position a panda nut on an anvil and leave the hammer beside it for her son to use. "Once, just before he was about to bring the hammer down on an improperly positioned nut," says Boesch, "Salomé picked the nut out of its knothole, cleaned the anvil, then replaced the nut in the correct position."

Of course, this is the kind of cultural instruction humans give their children. And, like human cultures, chimp cultures vary. Across the continent at Gombe National Park in Tanzania, chimps do not crack nuts at all but fish for termites with implements they fashion from stalks. The closer scientists look at the great apes, the more they discern individual personalities, as well as cultural differences between groups. Says Frans de Waal of the Yerkes Regional Primate Research Center

Skills once thought unique to humans have been discovered among chimpanzees in the wild. In the Taï forest of Côte d'Ivoire, Christophe Boesch (below) and Hedwige Boesch-Achermann observed chimps carefully selecting an appropriate stone to hammer open hard-shelled nuts (left). Mothers share their harvest and teach their young the fine points of tool use. The apes collect the scarce stones and remember where they have left them.

The Taï forest chimps also hunt cooperatively. A dominant male (bottom) often leads a group of males and females to surround and kill red colobus monkeys. The hunters then share the meat with the larger group.

near Atlanta, Georgia, "Humans have more developed culture and language, but we are seeing that our social system is an ape social system."

WHAT HAD HAPPENED by roughly five million years ago to cause Africa's tree-living apes to descend to the ground, then develop into divergent lines—modern apes and humans? And what did the progenitors look like? A century of paleontology has failed to turn up fossil bones from the critical period, but new insights are coming from such disparate sources as fossil pollens, the intriguing anatomy of bonobos, and the behavior of the Taï chimps.

Climate may have played a role in two key events: the shift from the trees to the ground and our increasing reliance on brain power for survival. Yale geologist Elisabeth Vrba notes that from seven to five million years ago, when hominids split from the other apes, and about two and a half million years ago, when the first truly humanlike creatures emerged, other African mammals were also vigorously evolving. Driving these changes in the latter period was a marked cooling and drying that may have forced humans to scrabble for new, hard-to-find foods.

Bonobos help show how this process may have begun. These graceful apes from central Zaire were first identified as a species in the 1930s; between 10,000 and 20,000 still live in the dense equatorial forests where they may have been isolated for upwards of a million and a half years. Although bonobos have been studied extensively only since the 1970s, they have changed the way scientists view aggression, sexual behavior, language, and human evolution (see following article).

Bonobos live in trees, but they sometimes walk upright. This contradicts the conventional wisdom that upright posture began when hominids abandoned the forest and moved to the savanna. Their anatomy may provide insight into the ancestral form apes and humans shared. "Once we can figure out how humans became bipedal, the rest is easy," says Randall Susman, an anatomist from the State University of New York at Stony Brook. He argues that distributing the weight over the feet is an efficient way of walking along tree branches; thus, our ancestors already had the rudiments of bipedalism when they began venturing out of the forests.

We tend to romanticize human evolution in heroic terms, but a prosaic event such as a change in diet may have driven the apes to develop large brains. The earliest hominids had no more brain power than their ape cousins, but all these creatures still had more gray matter than other primates. Brains are an expensive item in nature; they require a long period to mature and acquire knowledge, and they demand blood that might otherwise go to muscles. If we could understand why apes have bigger brains than other primates, we might discover why humans have larger brains than the apes.

Back in the Taï forest with Christophe Boesch, I began to see evidence of why chimps need extra brain power. On the trail one morning we nearly ran into a small group of chimps led by Kendo, the group's dominant, or alpha, male. Although we were standing right by them, they passed us in utter silence. I wondered if we seemed like ghosts to them, pale observers separate from the life of the forest. Then we followed them.

Coming upon a cluster of small, egg-shaped fruit, Kendo gave a brief, high-pitched *whoo*-ing call to announce food, and the chimps settled down to eat. Food gathering is serious business and, I learned, hardly a random exercise. The chimps move directly from one stopping place to the next; Boesch whispered, "They seem to know every tree and vine, and when it is fruiting." This efficiency may partly explain why apes have bigger brains than other primates. In general fruit-eating primates tend to have larger brains than leaf-eaters, perhaps because finding fruits requires knowledge of a larger territory and more complicated patterns than does finding leaves. Fruit-eating spider monkeys inhabit the same terrain and are roughly the same size as howler monkeys, yet the howlers' brains are only half as large. This may be because the howlers have to learn only a limited number of foods in a range a fraction the size of the spider monkeys'.

Nuts are rich in calories, and with a hammer and anvil a chimp can consume 3,500 calories in just two hours. To get these calories, however, the chimps again have to use their heads.

It is easier to crack the panda nut with stone tools than with wood, but this part of the Taï forest has virtually no rocks and few,

Man mimics ape—the swaggering gait and pant-grunt—and Jane Goodall responds with a chimp hoot. The dance at Pointe Noire, Congo, celebrates the creation of a sanctuary for orphaned chimps by Conoco Inc. and the Jane Goodall Institute.

In the Canary Islands Goodall documented the exploitation of young chimps being posed by beach photographers to earn tourist dollars. "The animals are so lethargic, they are clearly drugged. Still, when I made pant-grunts of greeting, this little fellow didn't want to let me go."

Each infant in captivity represents ten chimps killed, Goodall estimates—one mother and several relatives killed protecting the infant and other infants that die in transport. Illegal trade continues and contraband apes have become increasingly valuable. Some beach chimps may be sold to East European medical labs.

widely dispersed panda trees. According to Boesch, the chimps maintain a mental map of places where they have left stones from previous sessions. When a panda tree is fruiting, they seem to know the direct route to the nearest stone hammer, often retrieving rocks out of sight more than 200 meters away. Boesch believes that this feat is based on an "evolved mental map," a sense of Euclidian space that does not usually occur in a human child before the age of nine. "I find it astonishing that chimps can make a mental comparison of the relative position of things they cannot see," he says.

Meat is another significant part of the Taï chimps' diet. They hunt primarily red colobus monkeys, which are bigger and slower than other monkeys. Too heavy to pursue a colobus by jumping from tree to tree, the chimps resort to strategy and surprise: While one chimp gives chase, the others position themselves ahead to block escape. They first disembowel the monkey to get at the intestines, but feeding may begin before the animal is dead. Boesch shrugs off any suggestion of cruelty. "Animals do not hunt to kill," he says bluntly. "They hunt to eat." Chimps kill only because it makes feeding more manageable.

In the years he has been observing them, Boesch has seen chimps hunt, make tools, and teach, activities that were supposed to separate the early hominids from the other apes. Perhaps these adaptations began before our ancestors split from the others.

IF CHIMPS DEMONSTRATE behaviors of early hominids, why did hominids need still more gray matter? Perhaps because they had to obtain foods that were even harder to find. About two million years ago, the first hominids appeared with larger brains relative to body weight than the apes. These were the robust

australopithecines, who, as the forests retreated, were forced to adapt to arid, open land. With fewer fruits available to sustain them, they had to discover other foods.

These creatures were ultimately supplanted by *Homo habilis* and *Homo erectus*, who had dramatically larger brains. Robert Foley, a biological anthropologist at the University of Cambridge, argues that the incentive for this jump was the savanna environment, where foods are seasonal and patchy in distribution. In the wet season, when plant foods are least available, meat is abundant. And this meat is richer and even harder to procure than the monkeys and small forest game pursued by chimps. The larger savanna animals required even greater cooperation and longer hunts.

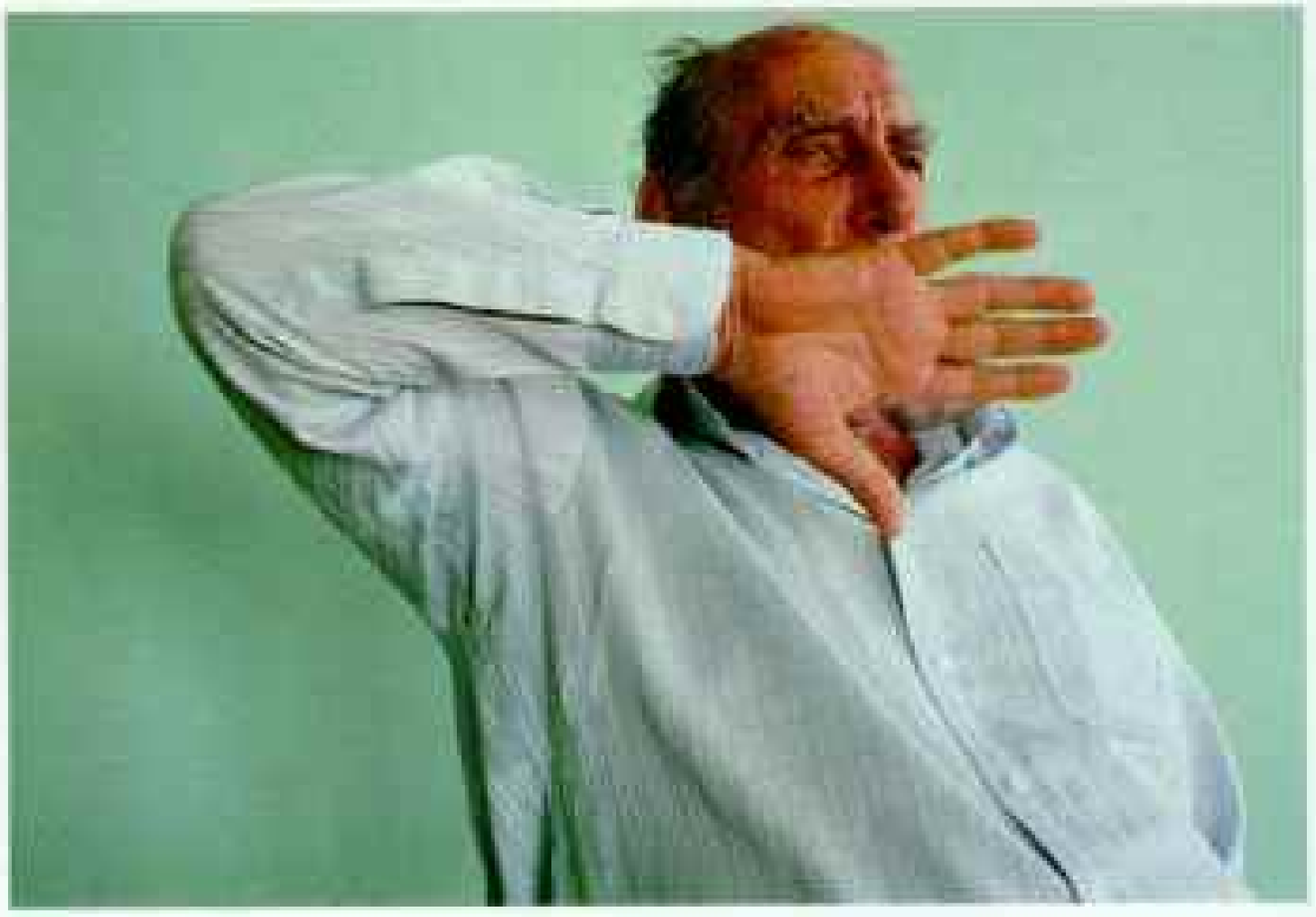
Humans thus needed to learn about living in ever larger groups covering ever larger ranges, and these hunters also had to communicate with one another more efficiently. It is an argument that appeals to Christophe Boesch. "When I watch chimps hunting," he says, "there are situations where I would try to force others to participate for a more effective hunt. This element of social coercion may be lacking in the chimp."

The holy grail of many paleontologists is some yet undiscovered fossil that provides the missing link between apes and humans, but Boesch and Foley, among others, wonder whether these bones are really missing. They argue that because the earliest australopithecine, "Lucy," was in most respects a bipedal ape and presumably close to the supposed common ancestor in appearance and behavior, it may not matter whether earlier fossil remains are ever found.

Chimps display an array of humanlike abilities in the wild, but gorillas, orangutans, and bonobos seem to use tools only in captivity, which poses vexing problems for scientists trying to make sense of human evolution. Those apes have the brains to make tools, but in the wild they live without them. William McGrew, a psychologist at the University of Stirling in Scotland, believes that the great apes use tools only when it is worthwhile.

A chimpanzee is just bush meat to a hunter in Liberia, who demonstrates how he supplies food to miners in the Nimba Range. If the chimpanzee prey is a mother, her infant is sold alive, often to an animal exporter. Franz Sitter (shown gesturing below), a longtime citizen of Sierra Leone, admits to buying and exporting chimps in the past. Otherwise, he says, "They were going to end up in someone's pepper soup."

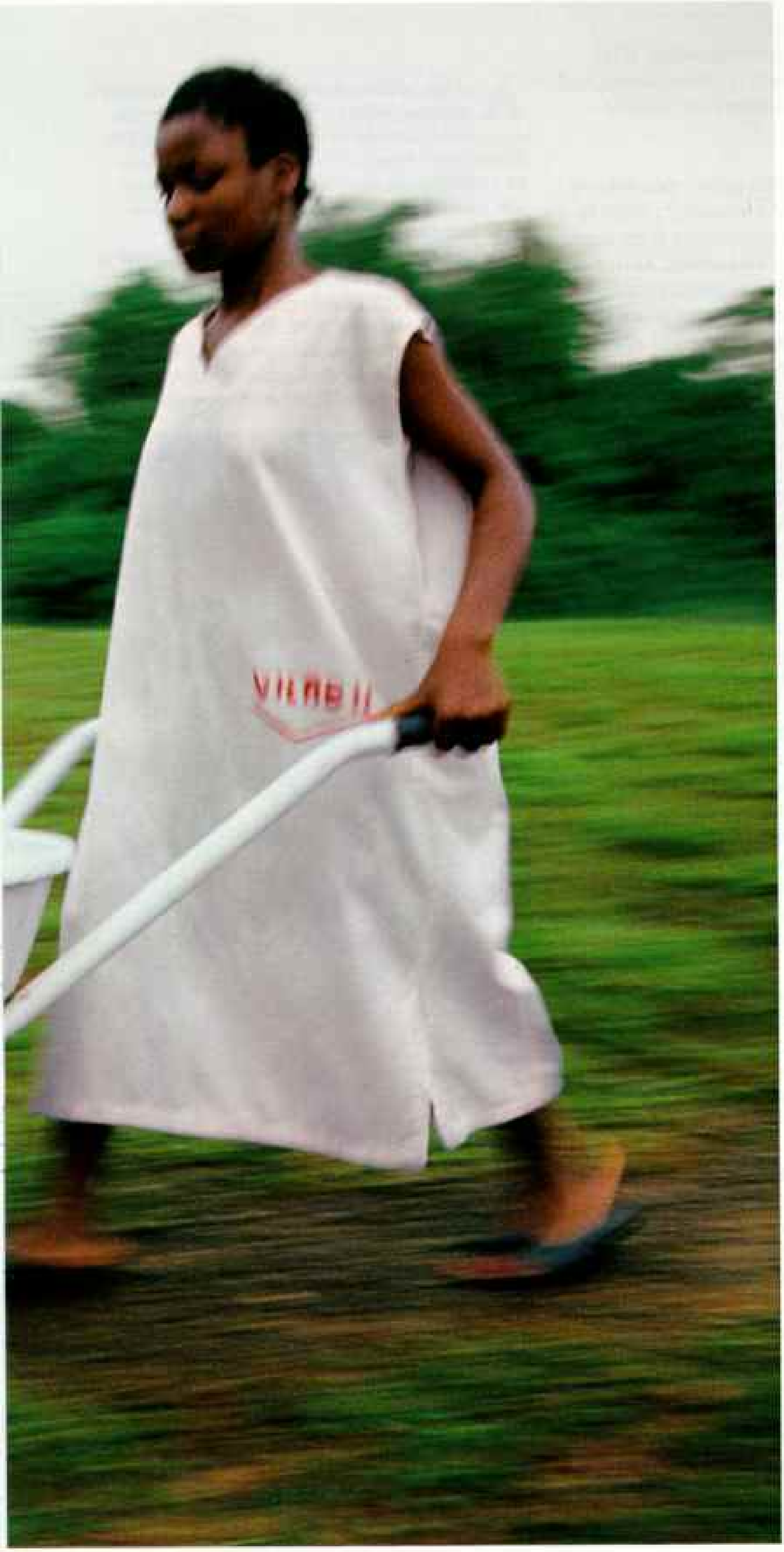
Primate dealers are more closely watched as nations honoring the Convention on International Trade in Endangered Species limit trade in apes. Recently four chimps were returned to Uganda after being shuttled through six European countries as part of a circus act.



Orangutans found an arboreal, fruit-eating niche where tools are not particularly useful, McGrew points out. Mountain gorillas opted for life in a salad bowl of vegetation and traded off tools for a belly big enough to process vast amounts of foliage. When lowland gorillas want to supplement their salads with termites, they don't use sticks like chimps; they simply knock the tops off termite mounds.

In the end it may be that diet accounts for the different paths taken by humans and the apes. Gorillas became vegetarians and grew into big chimps, while human ancestors pursued harder-to-find, high-calorie foods and became, in effect, brainy chimps.

At some point humans also became talkative chimps. We need to talk, and we spend an inordinate amount of time defining what we mean. But for all the ways in which language suffuses human life and has allowed our species to remake the world, neither linguistics nor psychology has definitively



The best of care is lavished on captive-bred two-year-old chimps by Jennah Dolley at Vilab II, a medical research laboratory in Liberia. They are being raised to test vaccines for river blindness and blood-borne viruses such as hepatitis. While chimps can carry such viruses, including HIV, the pathogenic cause of AIDS, they have not developed any symptoms.

"I would prefer not to work with chimps," says Dr. Alfred M. Prince, of the New York Blood Center, which in 1975 set up the Liberian facility. "But they are essential for this vaccine research. There is no way that the original hepatitis B vaccines could have been developed without chimpanzees. I want to treat them humanely and provide them a future."

Vilab II animals are kept in social groups during experiments and, later, on a "retirement" island.

answered the basic questions: What is language, how does it relate to other mental abilities, and how does it differ from animal communication?

FOR CENTURIES philosophers have argued that humanity's right to exploit nature derives from superior human awareness, as demonstrated by language. But scientists cannot agree on whether other creatures share these abilities. Just as studies of the great apes have given insights into the origins of tool use and hunting, it would seem natural to expect that studies of our closest relatives could help answer questions about language. It has not turned out that way.

"So far, any comparison between apes and humans is based on close to zero information about what apes say to each other in the wild," says the University of Michigan's John Mitani, who has been studying the calls of the various great apes. Chimps may exchange complex messages, but no one can do more than guess at the content of the information they pass.

A number of scientists have explored ape language capacities. In the mid-sixties psychologists R. Allen Gardner and Beatrix T. Gardner suspected that chimps might have physical rather than mental difficulties in forming spoken words. They made a major breakthrough when they taught American Sign Language to an infant chimpanzee named Washoe. In 1967 Washoe signed "gimme sweet."

Since then the history of the language experiments reads like a biblical genealogy, with some apes learning sign language while others studied invented token languages. Whether they used gestures or tokens, the apes took to language with style, not simply to identify objects but in what seemed to be all manner of provocative ways. The gorilla Koko referred to her nose by signing "fake mouth." The first time Washoe saw her own species, she signed "black bug."

But what did it all mean? Was Washoe drawing on her vocabulary of more than a hundred signs to creatively describe something for which she had no sign, or was she merely summoning vague associations in the hope of a reward? Was Koko using language to be playful, or was researcher Francine Patterson overinterpreting gestures? Were all the

A wedge of liver from an anesthetized chimpanzee (right) will be used in hepatitis experiments at the Southwest Foundation for Biomedical Research in San Antonio, Texas. In 1990 chimps here were protected against the AIDS virus by an experimental vaccine, now being tested on humans.

Dressed in protective gear, Dennis Helmling hands out treats to relieve the boredom of 20 chimps in the AIDS unit at LEMSIP, a lab at Sterling Forest, New York. He says: "They depend on us for communication and love. People should know that some of the drugs they take were tested first on chimpanzees."


Aid

apes responding to subtle cues and simply performing tricks? In the face of this debate, funding for ape language studies was drastically reduced by the mid-1980s.

Then a young bonobo named Kanzi came along and revived interest in ape language studies. In experiments at the Georgia State University/Yerkes Language Research Center near Atlanta, Kanzi has provided impressive evidence that apes can understand the different meanings signaled by varying word order in sentences.

It is hard to resist the appeal of this beguiling animal. As I stand outside Kanzi's cage, he stares at me intently. Then he points to one of 256 geometric symbols on a board he uses to make his wishes known. It is the symbol meaning "chase," so I start dashing around the outside of his cage with Kanzi in pursuit. Taking a board, I point to "chase Kanzi," and he bolts away. Several chase games later, Kanzi, unlike me, shows no sign of flagging.

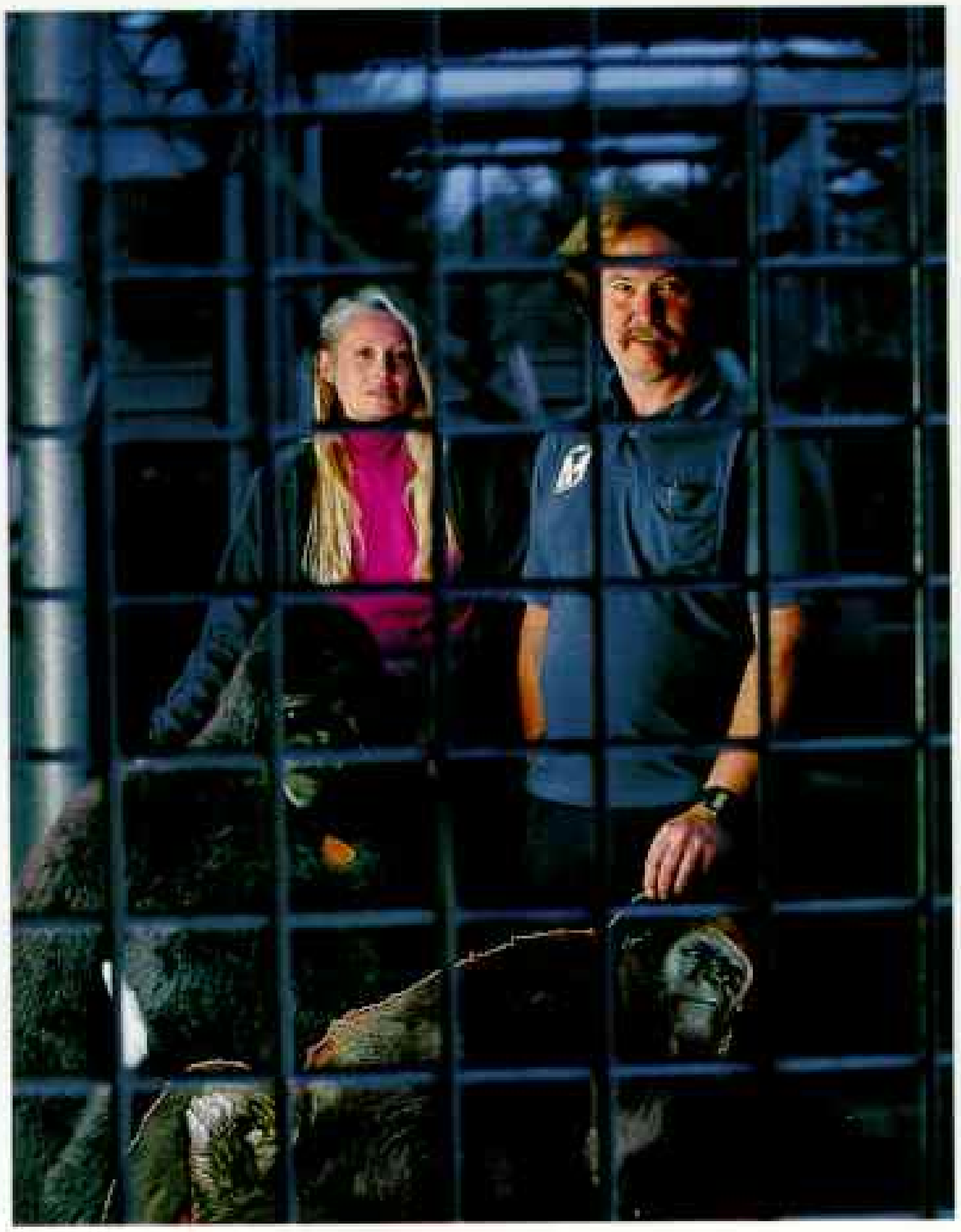
Kanzi got into language work by accident. Sue Savage-Rumbaugh was working with Kanzi's mother, Matata, when she noticed that he had learned six of the eight lexigrams. From then on, Kanzi spent his days playing, eating, wandering the 55-acre woods, and resting while people commented on these activities to him and to one another in English and by pointing to the appropriate lexigrams on portable boards.

"We would talk about what we were going to do," says Savage-Rumbaugh. She would say, for instance, "We are going to go to the A-frame," in situations where Kanzi knew this was the only destination. Kanzi would thus make the association between the spoken word "A-frame," the lexigram, and the place. Soon Kanzi was using the boards to indicate his own preferences, such as whether he wanted to eat a burrito or taco or had a thirst for Perrier.

Kanzi has the grammatical skills of a child of two and a half; this may not sound like

A worst-case scenario for chimpanzees used in medical research came to light when animal rightists—masked like the reenactor at left—broke into a lab in Rockville, Maryland, in 1986. They removed four apes and photographed tiny dark cages, each confining two young chimps. The laboratory, funded by the National Institutes of Health, has since installed individual room-size enclosures complete with climbing equipment.

CONFINED by commitment, Francine Patterson and Ron Cohn rarely leave Koko and Michael, lowland gorillas in a 19-year language study. The apes have learned hundreds of gestures of American Sign Language. The sale of Koko dolls helps raise funds to move the apes from California to Maui, closer in climate to their native habitat.



much, but it implies a more sophisticated ability to order the world than has yet been acknowledged. Even some hard-core critics admit that Kanzi and his lexigram-using colleagues bolster the case of those who argue that there is continuity linking ape and human language, just as there is continuity linking other aspects of ape and human behavior.

IF LANGUAGE IS A SKILL humans would prefer to think of as uniquely theirs, there are ape attributes humans wish they'd left behind during the course of evolution. One of these is aggression.

In 1986 a group of 20 scholars met in Spain at the Sixth International Colloquium on Brain and Aggression. They issued a statement asserting that it is scientifically incorrect to say that war is inevitable. Further, they said, "Warfare is a peculiarly human phenomenon and does not occur in other animals. . . . Violence is neither in our evolutionary legacy nor in our genes." The statement was adopted by the American Psychological Association and UNESCO, but it dismayed a number of primate researchers.

"There are roots to aggression," insists biologist Peter Marler of the University of California at Davis. "If we understand those roots, perhaps we can ameliorate its effects." Richard Wrangham, an anthropologist at Harvard's Peabody Museum, agrees: "We don't know of any other species beyond chimps and humans in which males use alliances to systematically kill males in neighboring groups." For Wrangham, the discovery of such aggression among chimpanzees makes its persistent human expression less aberrant.

"Observations of 'warfare' and cannibalism were pretty shocking," Jane Goodall told me. "In 1974 the chimp war started at Gombe, and by 1977 the smaller community was annihilated." These events gave new meaning to the daily perambulations of groups of males: They were, at least partly,

Crossing the language barrier, a bonobo called Kanzi says "chase Kanzi" to a six-year-old boy by pointing to symbols on a keyboard held by researcher Sue Savage-Rumbaugh. The boy and his two-year-old sister, regular visitors to the Language Research Center near Atlanta, have also mastered the board, which has recently been adapted for children with learning disabilities.

Savage-Rumbaugh has shown that apes can comprehend and use language spontaneously, as young children do—by listening and by relating the spoken words, the symbols, and the objects they represent.

In a test employing 660 first-time requests, such as "put the apple in the hat," Kanzi scored higher than a two-year-old child.

Before embarking on her afternoon walk, Panzee, a five-year-old chimp, points to the keyboard, her map of symbols, to choose one of 17 destinations in the woods.

PHOTOGRAPHED AT GEORGIA STATE UNIVERSITY/YERKES LANGUAGE RESEARCH CENTER

defensive and aggressive "border patrols."

To a certain extent chimps control or channel their aggression through a dominance hierarchy, expressed by greeting rituals. As in many human situations, however, this formal system may not truly reflect who has influence. In Tanzania's Mahale Mountains, researcher Toshisada Nishida grew to admire one Machiavellian old male. By allying himself first with the alpha male, then with a challenger, the elderly chimp won the power to determine which would be superior. His reward was access to estrous females without interference from either of his less astute superiors.

Challenges to dominance are often first signaled with a snub. A subordinate male, often one that has mustered support among the other chimps, will refuse to bow. As tensions rise, other members of the community take sides. Frans de Waal studied politics and peacemaking among chimps at the Arnhem Zoo in the Netherlands, where males vying for support would groom females and play with their infants, much like presidential candidates who hold babies, he observes.

A coup might take several months to complete and involve tremendous charging displays and occasional fights, but most combatants survive in relatively good shape. Moreover, de Waal has noticed that dominance struggles are often followed by periods of reconciliation in which the opponents kiss, embrace, and groom one another.

While such stylized role playing may help chimps get through the business of day-to-day life, with its jockeying for status, their occasional intergroup raids are often horrifying. Richard Wrangham and his colleague Joseph Manson of the University of Michigan, analyzing incidents at Gombe, have noted that raiding chimps will often hold the victim down while others assault the hapless animal, even ripping strips of flesh with their teeth.

According to Manson and Wrangham, the chimps go on raids because the reward of obtaining potential mates justifies the low risks of attacking smaller groups. They note that human aggressors often launch attacks because of the same imbalance of power.

For chimpanzees, which live in large promiscuous groups, competition for females inspires much of the aggression. Gorillas face less competition for females, once the dominant male has secured his position. Indeed, nothing looks quite so regally self-satisfied as a silverback gorilla in the midst of his harem.

Male bonobos fight even more rarely for access to females. Through prolonged and frequent estrus, female bonobos are eight times more available for mating than chimpanzee females. This reduces pressures on males; while they still compete with one another, they do not have the strict hierarchy or greeting ceremonies of chimps.

Aggression among the great apes is not restricted to males against males. In all species, males are able to physically dominate females (a lowland gorilla male is twice the size of a female). On the other hand, male apes may give way to females when they need their cooperation. For instance, subordinate male chimps cannot arrange clandestine sexual encounters out of sight of the dominant male without a female's active participation. They sometimes win these attentions by giving way to females during feeding.

The social differences between the sexes are sufficiently profound and long-standing that de Waal believes they are genetic, based on different goals for males and females. "In chimpanzee communities, the male strategy is to be competitive within a hierarchy, with changing alliances, frequent compromise, and reconciliation. The female strategy is to emphasize cohesion and commitment in a few relationships, while letting competition run its course in others. Females have no compelling reason to reconcile with their rivals, so they simply stay away from them."

WHERE DO HUMANS FIT in this brew of sex and aggression? It is a question that inevitably arouses passions.

Beginning in the 1970s a number of parents made serious attempts to raise their children without male and female "stereotypes," only to discover that boys still tended toward war toys, while girls usually preferred dolls. Anthropologist Lionel Tiger was vilified by feminists when his book *Men in Groups* argued that men had an inherited need to spend time with one another, yet this notion is now the stuff of an emerging "men's movement," not to mention beer commercials, clothing ads, and buddy movies. The experience of the past two decades has thus weakened the proposition

Celebrity chimp, 56-year-old Cheeta starred with Johnny Weissmuller in Tarzan movies (right). His trainer Tony Gentry shared a daily beer and cigar with his charge (below) until his own failing health made him turn Cheeta over to trainer Dan Westfall.

In his Palm Springs, California, home Westfall also keeps 43-year-old Susie (opposite). As a member of the Marquis Chimps, Susie rode a unicycle to fame on the Ed Sullivan Show in the 1950s and '60s. Westfall still promotes the act, dressing the partly blind Susie in a tutu.

"People think chimps are like humans," he says, "but they are wild animals. You have to keep a lead on them."

Adult chimps are so strong they can rip a man's arm off at the shoulder. Adorable as infants, many captives become so burdensome for their keepers that they are sold to medical labs.

COURTESY TONY GENTRY

that humans are purely artifacts of culture with no legacies from our ape ancestry.

Humans still display ape behaviors such as bowing, begging, and aggressive staring. Moreover, the size advantage men have over women implies that male-male aggression is part of our makeup. "Sexual dimorphism suggests that males compete and threaten one another," says zoologist Charles Goodhart of the University of Cambridge, who also believes this legacy of male-male competition bespeaks a polygynous past in which males mated with as many females as possible.

"But we don't need to deduce that," he says, "because it is documented that polygyny is very much a part of mankind's past and present."

On the other hand, advocates of monogamy can point to the power of culture to affect behavior. They note that male proclivities toward polygyny are often overruled by men's concern for the well-being of their children. But ultimately, says University of New Mexico anthropologist Jane Lancaster, it is a woman's need to provide for her children that determines family structure—that is, whether a particular arrangement will help or hinder the rearing of her offspring.

The study of wild apes has also underscored some common-sense intuitions about

human society. Jane Goodall says that the most important insight she has gained in her entire career is the evidence of the effects of early infant care.

"Over 30 years, I have had the opportunity to watch infants grow up," says Goodall. "Those with supportive, affectionate mothers grew up to be confident, high ranking, and assertive. Those mothers that were rejecting and nervous tended to produce offspring that were jumpy and that had difficulty entering into calm, relaxed relationships. Humans can hide the effects of the small traumas of early life, but you can see them clearly in a chimp."

SUCH INSIGHTS ARE THE PAYOFF for a lifetime's work. Apes yield their secrets slowly, and few researchers have the stamina or funding to observe the full life span of an ape in the wild. I discovered the challenge and frustration of studying animals not yet habituated to human presence when I visited Bai Hokou, a research camp in the southwestern corner of the Central African Republic.

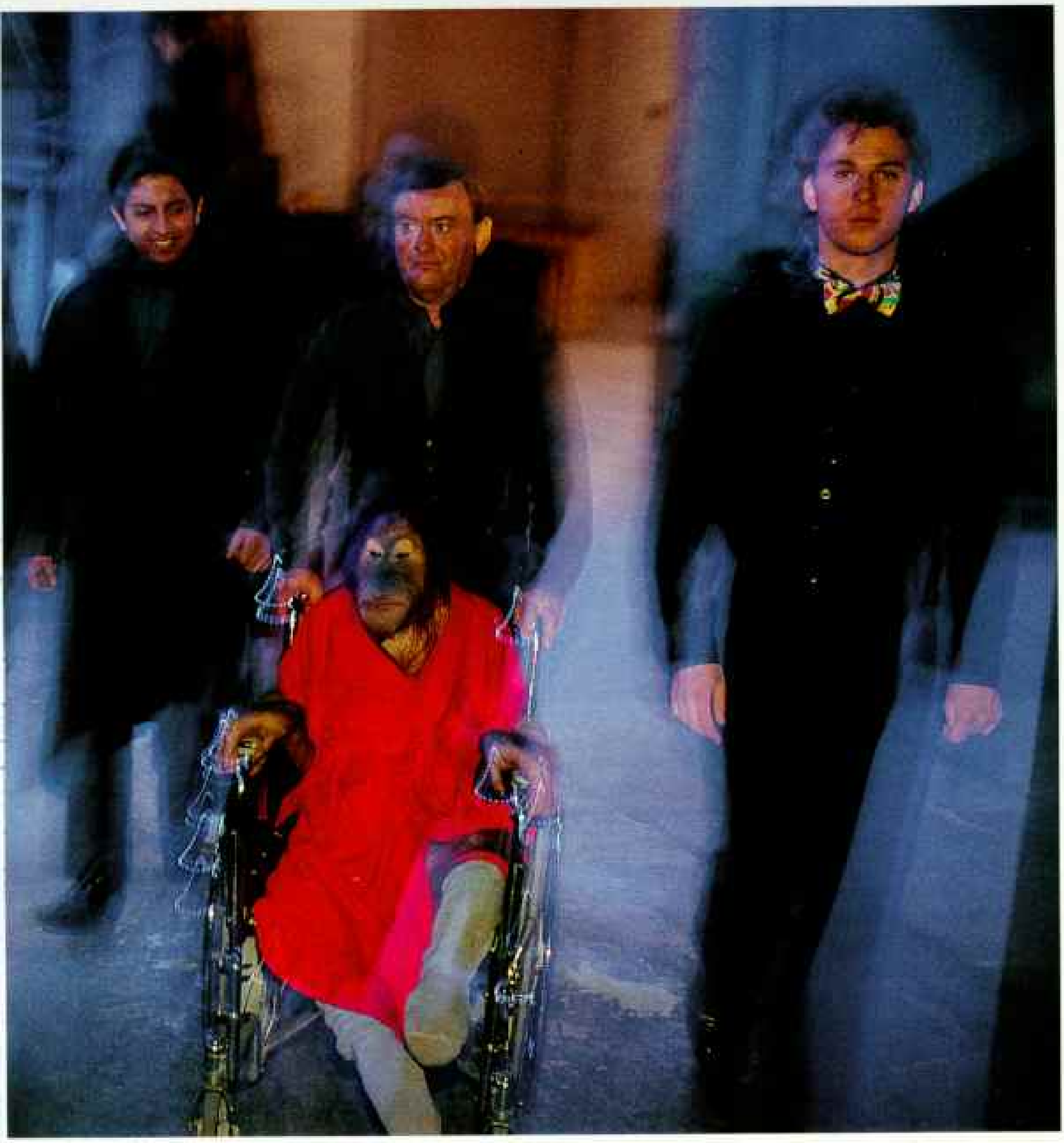
The simple base camp is run by Melissa Remis, a Yale doctoral candidate who is trying to study lowland gorillas and habituate them. Oddly, most of what is known about gorillas in the wild comes from studies of mountain gorillas, a subspecies confined to the volcanic slopes of Rwanda, Uganda, and Zaire. Yet the lowland gorillas, which constitute 99 percent of total gorilla numbers and which are exclusively the gorillas seen in zoos, have been much less studied in the wild.

Remis's first words were, "I've got to tell you, I'm not having much luck." Despite the fact that the open forests surrounding Bai Hokou contain some of the densest concentrations of lowland gorillas in the world, being hunted has made them wary. After months of daily ventures into the forests, Remis had gathered data only on intermittent and fleeting encounters. Day after day we returned with nothing to show except skin smeared with squashed sweat bees.

In at least one respect, Remis is lucky. Partial logging of the forests surrounding Bai Hokou has created an optimum environment for gorillas. Historically elephants opened the forests, allowing monocots and other plants favored by gorillas to take root. Humans do that too through selective logging, asserts J. Michael Fay, an ecologist with Wildlife Conservation International: "In this sense, man is nothing but a mechanized elephant." In many cases the danger of logging is that it opens up previously inaccessible areas for farming and hunting.

Yukimaru Sugiyama of Kyoto University has been studying a small, isolated group of chimpanzees at Bossou near Mont Nimba in Guinea since 1976. He has watched fields encroach on the apes from all sides. Isolated on a hilltop, female chimps can neither enter the group nor leave, an essential component of

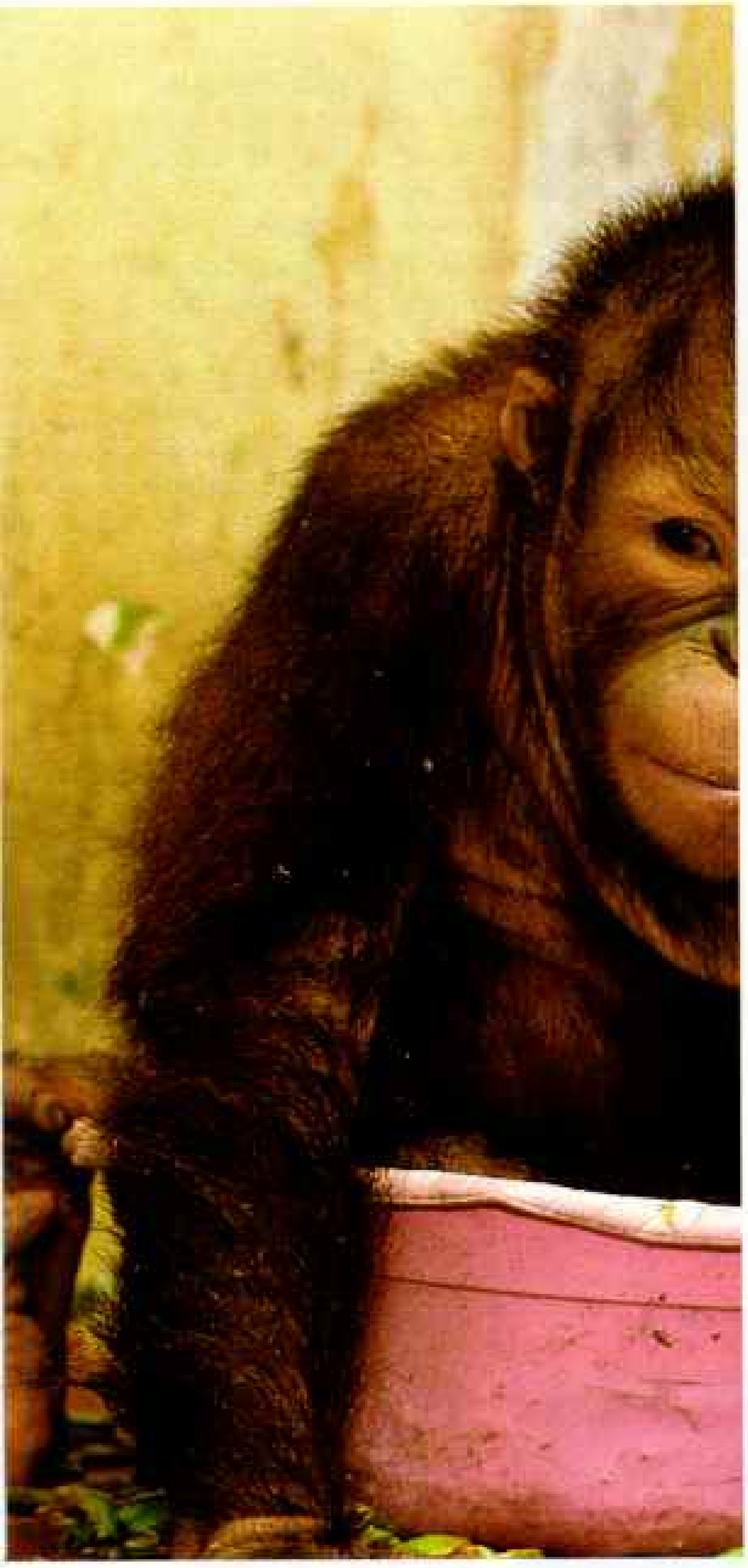
Dressed like a rock star, a female orangutan called Bo has been taught to make lewd gestures to get laughs during Bobby Berosini's Las Vegas act. The veteran animal trainer (below, at left) transports his star like a celebrity. Such acts have come under increasing scrutiny from federal regulators and animal welfare groups, but no law prohibits the use of great apes in entertainment.



chimp social structure that helps maintain healthy genetic diversity. With insufficient forage, the chimps must raid crops to survive. Sugiyama worries about how much longer the villagers will allow them to take their mangoes, bananas, and oranges. In the late 1970s these chimps gained scientific fame as the first apes observed using stone tools. Should they disappear, so will their culture.

Throughout equatorial Africa, political upheaval threatens ape research, and some scientists worry about the future of their field. Nancy Thompson-Handler, who last year was forced to flee a bonobo study site in the Lomako forest of Zaire, notes dejectedly, "Many countries harboring the great apes are in turmoil."

A NEW CLASS OF REFUGEE APES is appearing as habitat is destroyed. Some scientists now devote part or all of their time to protecting or returning to the wild the apes they study. For example, 20 years ago Biruté Galdikas established Camp Leakey, on the Sikunir River in Borneo, to study orangutans, but



now she places more emphasis on finding ways to protect the species.

A visit to her camp is an eerie experience. The dock is crowded with orangs that have come to get pineapples laid out by camp workers. The next morning a Dayak girl named Ijun tries to teach little Ciko to climb trees. Like many others, Ciko had been recovered after being captured for the pet trade. Galdikas later tells me that with 30 rehabilitants and their offspring, she is running out of space, but she can't turn the orphans away.

After a hair-raising journey, orangutan orphans come home to Indonesia. They had been smuggled to Taiwan, where pet orangs became the rage after one appeared in a popular talk show. Confiscated and dubbed the Taiwan Ten, the apes were returned with help from the Orangutan Foundation International, which hoped they would be sent to a rehabilitation camp in Borneo run by Birutė Galdikas. The Indonesian government instead sent seven to a wildlife preserve and three to a primate research center.

Orangutans seem to take well to reintroduction to the wild, but as the forests disappear there are fewer places to put them. At an orangutan rehabilitation site in Sepilok in the Malaysian part of Borneo, a huge male orangutan makes an incongruous sight among the infants being reacquainted with the wild. The male had been successfully reintroduced years before but now has begun to return more frequently to the feeding site. Veterinarian Kenji Kitaura suspects that the animal's return is one more sign that the isolated forest can no longer support the orangutans already there, much less the orphans and confiscated animals brought in every month. The burgeoning numbers of Sepilok orangs will likely become ever more dependent on food supplements, defeating the notion of rehabilitation to the wild. No one has come up with an answer.

British entrepreneur John Aspinall maintains Howletts, a private zoo outside Canterbury, England, and he has an unabashed love for gorillas. "Being English, I admire people who are not too emotional," he says, "and gorillas have dignity, equanimity, and aloofness." Aspinall has taken some chances in zookeeping that have paid off. He pioneered the idea of keeping gorilla groups together to mate and raise their young; the reward is one of the highest birthrates of any gorilla group in captivity. Now Aspinall is gambling that lowland gorillas can be reintroduced to the wild.

Under an agreement with the Congolese government he has constructed a modern, airy complex of cages to house gorilla orphans at the Brazzaville Zoo. There trained zookeepers take them into the surrounding scrub forests, where the gorillas get to forage and clamber through trees. These are probably the happiest captive apes in Africa. But whether they are ever reintroduced to the

wild will have as much to do with politics and funding as it does with habitat training.

Of all the great apes, chimps are the least promising candidates for rehabilitation. They live in complex social groups that are as important to their survival as knowledge of food-gathering techniques. Young females might have a chance to be taken up by an existing group, but constructing a successful group using only chimps that are strangers to one another would be difficult.

Jane Goodall now devotes much of her energy to finding land and facilities in Africa so that refugee chimps might enjoy partial freedom. She has found a site for Conoco Inc. and the Jane Goodall Institute to build an indoor-outdoor facility near Pointe Noire in the Congo. Goodall tells villagers that if they care for the chimps, tourists will come. A village chief says he is happy there will be a home for chimps near his village, because his people think of them as helpful ancestors. Female chimps, he said, will gather nuts together as a present when they see a pregnant woman in the fields.

In parts of Africa and Asia, tourist dollars have provided more effective protection for apes than parks and game laws. A recent conflict in Rwanda shows just how effective such economic incentives can be. Both sides have taken pains not to hurt mountain gorillas in Parc National des Volcans. Nobody wants the international opprobrium that would come from killing these gorillas, and both sides are mindful that before the conflict erupted in October 1990, tourists drawn by Rwanda's gorillas provided the nation with ten million dollars annually, its third largest source of foreign exchange.

This change of attitude is a distinct improvement. The late Dian Fossey, based at Karisoke in Rwanda, was the first to bring the plight of the mountain gorillas to the world's attention. But she opposed tourism as bothersome and even unhealthy for the gorillas. Having watched tourists hover and click over Ninja and his harem in Zaire's Kahuzi-Biega National Park, I understand her concern, but eco-tourism does create incentives for local people and governments to protect animals. It won't be enough.

CAPTIVE APES often must justify their existence as well. It is ironic that while there are too few chimps in the wild, sometimes there are too many in captivity. Apes have been used for years in breeding and other research experiments; when the AIDS epidemic surfaced in the early 1980s, it was discovered that chimps could be infected with the virus that causes it. Nearly a decade later, chimps infected with HIV have failed to develop any AIDS symptoms. It would seem that chimps can carry the virus, as they can with hepatitis, without becoming sick. They appear to be perfect human surrogates for the testing of vaccines.

Dr. James Mahoney, chief veterinarian at LEMSIP, a center for chimp AIDS testing in

The solitary ape, the orangutan has been studied at the Ketambe Research Station, Sumatra, since 1971, but the exact nature of family groups and the role of a dominant male (right) are still unclear. The apes feed high in widely scattered fruit trees. Indonesian researcher Tatang Mitra Setia (left) sends several students out to track individuals in what appears to be a community of 10 to 20 apes to learn how they adjust their location and behavior in relation to one another.

High in orang territory a male is surprised by photographer Nichols, who rope-climbed 150 feet to get a clear view of the apes feeding in the trees below. With like ingenuity and persistence researchers continue to record and analyze the behavior of the great apes.

Sterling Forest, New York, wryly notes the sad fact that AIDS has "saved" many captive chimps. Yet what is to be done with the preponderance of the more than 2,000 chimps available for research in the United States?

Among the grim possibilities is the use of chimpanzees as donors of organs for human recipients. Dr. Jan Moor-Jankowski, the director of LEMSIP, spent his early career proving in laboratories that such transplants are possible, but he has had a change of heart. "I have let my colleagues know that I could not become involved in providing chimps as organ donors for humans," he says. "It was a hard decision, since a transplant could save a young person with a heart

ailment, but AIDS or hepatitis research helps large numbers of people and does not cause death or disease for the chimp."

The apes' dilemma has been to look and act enough like humans to be useful in medicine, in scientific research, in the movies. We anthropomorphize them as personalities, yet we have difficulty accepting that they occupy their own world and live by their own rules. The great apes have endured and adapted to the same climatic changes that forged humans. Though they have gone their own way, apes share with us the affinities and bonds that come from a common ancestor. For our sake and theirs, we have to acknowledge that they didn't fail to become human; they succeeded in becoming modern apes. □

National Geographic EXPLORER will air "Secret World of the Chimpanzee" and other films on the great apes in a special show broadcast on Sunday, March 15, at 9 p.m. ET on cable network TBS.

Chimpanzees With a Difference

BONOBOS

By EUGENE LINDEN

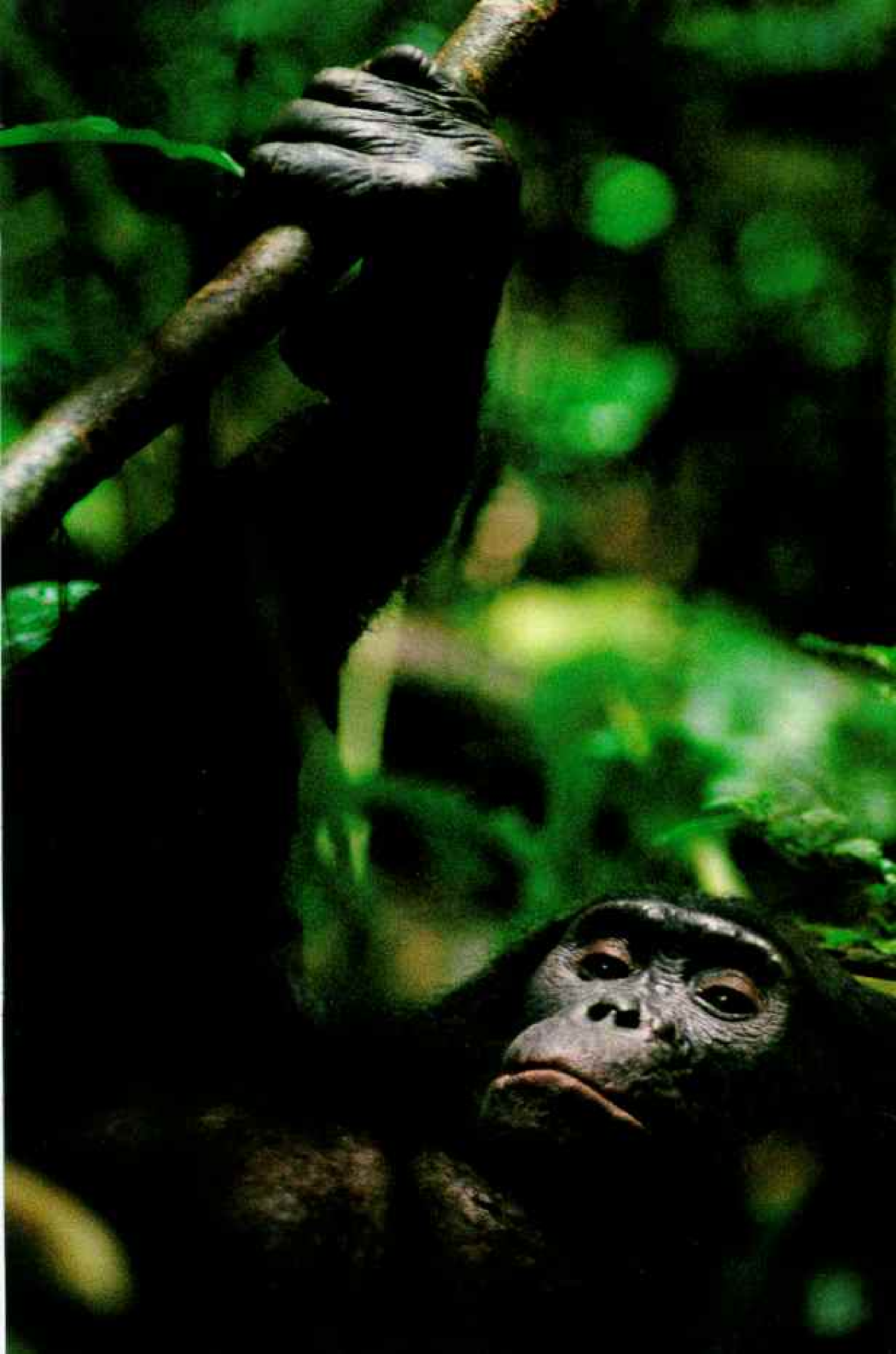
Photographs by FRANS LANTING

IN A BLUR, an agile bonobo scrambles toward invisible heights where his group feeds on fruiting trees. I sit waiting on this steaming African morning in a clearing of Zaire's Wamba forest for a better look at his kind. Fresh sugarcane lies scattered about, provided by Japanese primatologist Takayoshi Kano to bring the tree-dwelling apes to earth. Zaire's tropical forest is the only home of the bonobo *(Pan paniscus)*, also called the pygmy chimpanzee. Kano has observed this cousin of the more common chimpanzee *(Pan troglodytes)* for nearly 20 years and can recognize 150 individuals, including the male Fuchi (right).

Suddenly several young males enter the clearing and hastily grab some stalks. "They want to get some before the senior females show up," says Kano. Soon an influential female appears, and the males back off. With relaxed confidence she collects sugarcane and walks to the edge of the forest. The males reappear to resume feeding, joined by other bonobos. Males rub rumps or engage in what looks like mating. Females embrace, rubbing genitals.

Males mingling with no obvious hierarchy, females holding sway over males. What's going on here? That is what many primatologists are asking.

The bonobo is the "newest" ape, classified as a species in 1933. Even its name stirs controversy. "Pygmy chimpanzee" is a misnomer for an animal no smaller than many chimps; "bonobo" apparently derives from Bolobo, a town where specimens were collected in the 1920s for museums more interested in bones than in behavior.



EXCITED by the presence of food, a group of bonobos gathers at the Wamba site. Chimpanzees in this situation usually dispute possession, but bonobos feed with little friction.

Females with their young form the core of the group, and they get along well with one another and with males. By contrast, chimpanzee females often retreat with their infants to forage alone rather than be bullied by larger males or other females.

Individuals communicate constantly with body language and vocalizations. At least 20 gestures and calls indicate a willingness to copulate. An adolescent female will approach a male, making it clear that she wants to mate. Afterward, she takes some of his stash of cane. Such sexual bartering is commonplace. Sex, Kano suggests, is used for appeasement to reduce tensions within a group when it comes upon food or encounters another band. By peacefully coexisting, bonobos can live in large groups, sometimes with as many as a hundred members.

Kano's team has observed no infanticide or killing of males by males, as is found among chimpanzees. Males survive in equal number with females. Bonobos have rarely been seen hunting for meat in the wild, as chimps do (page 23).

Friendly feelings among bonobos may be linked to the sexual receptivity of the female. For almost half of her 46-day menstrual cycle, the female is in estrus or false estrus—signaled by a pink swelling. Like chimpanzees, female bonobos give birth at five-year intervals. Unlike them, bonobo females usually resume copulation within a year after bearing offspring. With females readily available, males do not need to compete for their favors.

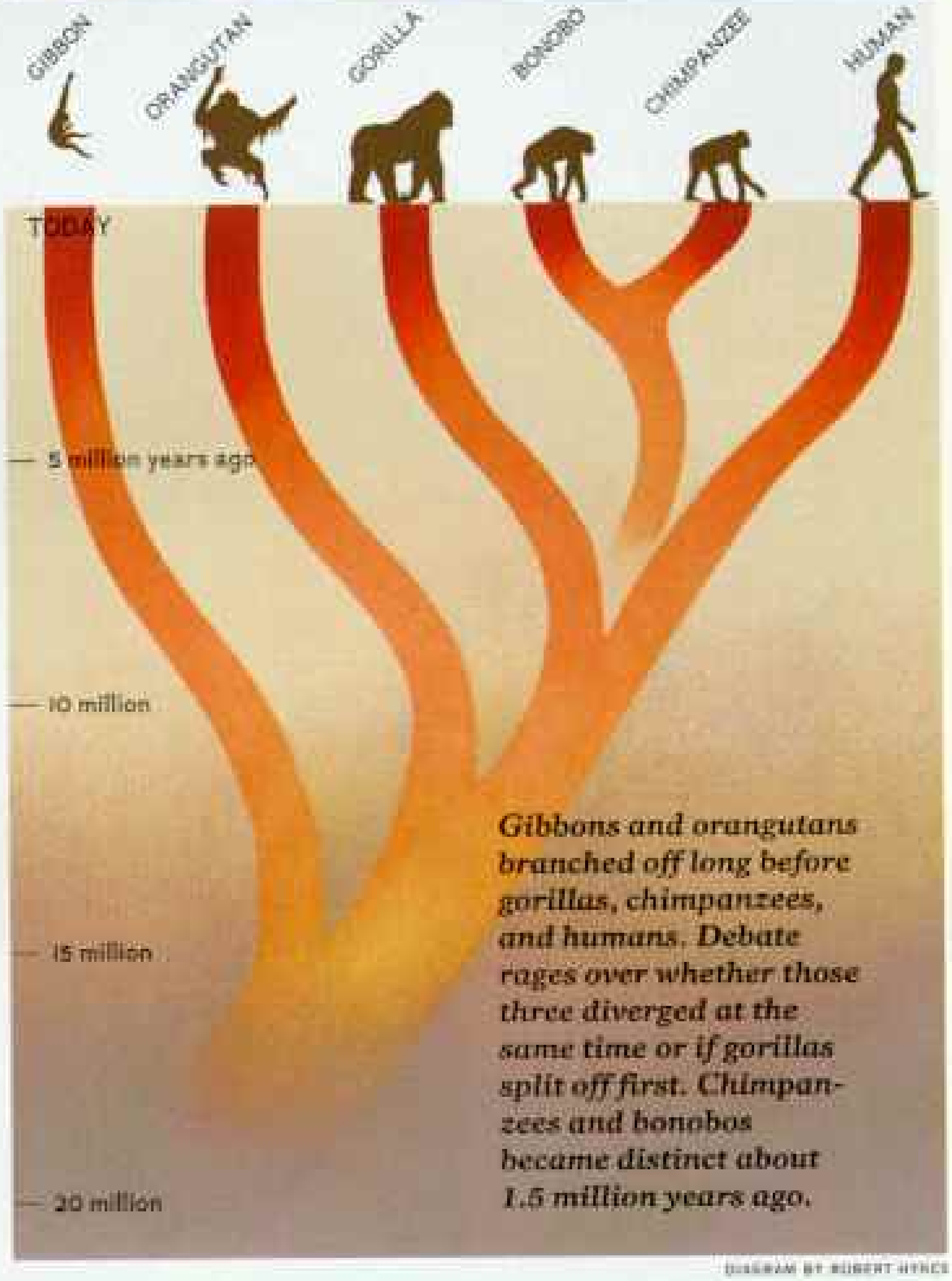
MOTHER-SON bonds last a lifetime among bonobos. Here Kiku, about 18 years old, cradles her three-year-old firstborn, Kikuo. She will nurse him until he is four. He will stay with her group for life. Daughters, however, leave their maternal group at maturity for another band, where they must establish new alliances.

Sons benefit from the web of relationships established by their mothers. In disputes a mother will intervene on her son's behalf. When an influential mother died recently, her two sons promptly fell in status.

A juvenile female and infant male (lower right) imitate copulation at a Kinshasa research facility that cares for orphaned apes. Frequently seen in bonobos, the face-to-face position is sometimes assumed by orangutans and gorillas, rarely by chimpanzees. Female bonobos often initiate mating and may change position mid-course.

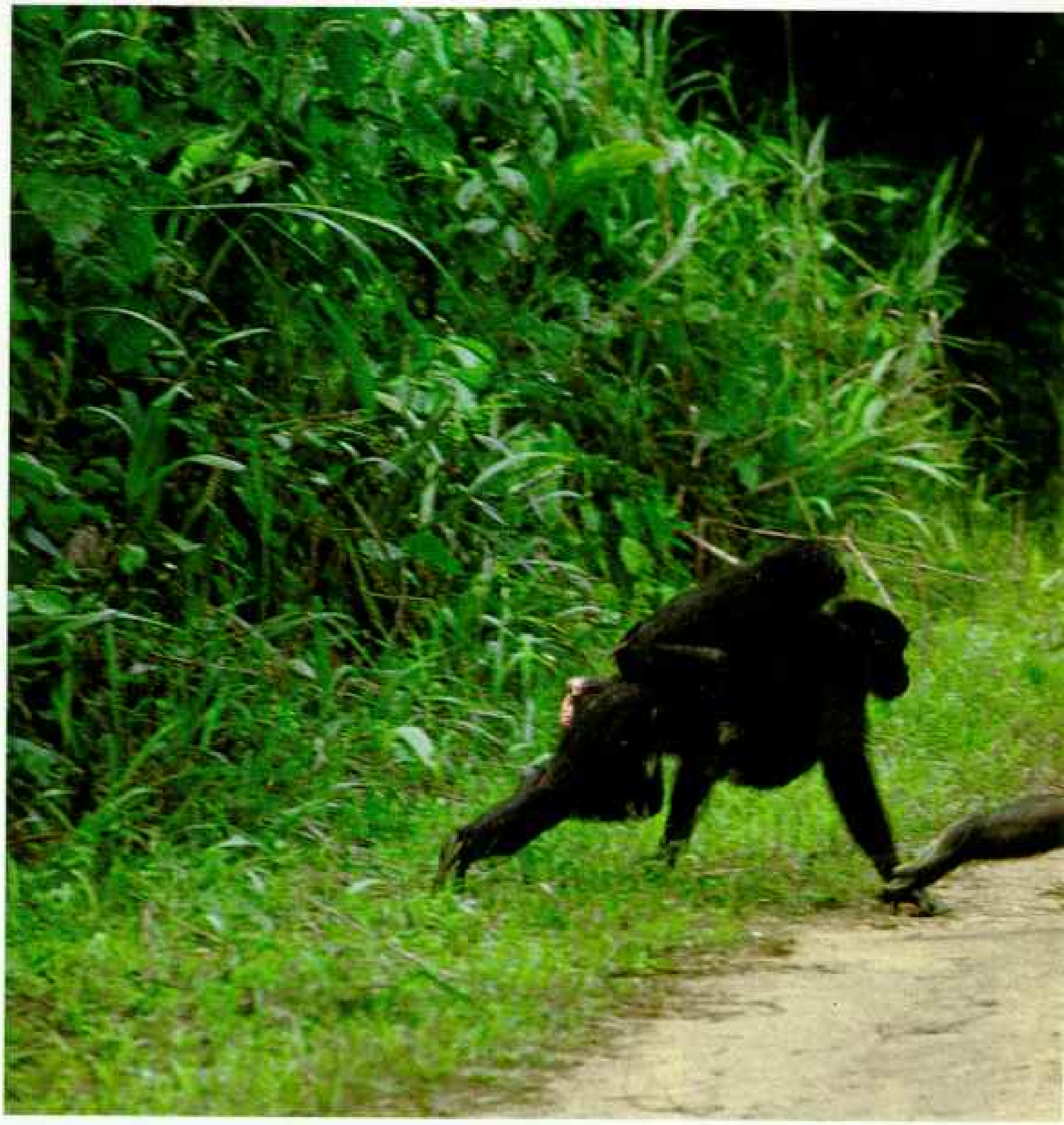
Takayoshi Kano (below) calls bonobo society "female-centric, in which the males do not dominate or lead; they just follow."

A puzzling family tree



Gibbons and orangutans branched off long before gorillas, chimpanzees, and humans. Debate rages over whether those three diverged at the same time or if gorillas split off first. Chimpanzees and bonobos became distinct about 1.5 million years ago.

DIAGRAM BY ROBERT HYNES



SCHOOLCHILDREN stand transfixed by the sight of bonobos crossing a road, the female carrying two offspring. Though here they display the normal knuckle-walking stance, bonobos occasionally walk upright.

In 1973 Takayoshi Kano bicycled along such dirt roads through Equateur, the northwest province of Zaire, searching for a place to study and protect bonobos. In most areas he was discouraged to find they were hunted for food. Finally, at Wamba he found that a local taboo had spared the apes.

Over the years Kano and his associates have earned the respect of the local Mongandu people, learning their language and hiring about 30 for his staff each season of fieldwork. Most evenings after trackers make reports, Kano breaks out a bottle of *lotoko*, a pungent drink brewed from corn. Then the stories flow.

In one myth a man frees captured bonobos because "they are like our ancestors." He is later rescued from a treetop mishap by bonobos that carry him to earth on their backs.

A real drama occurred in 1987. During Kano's absence, soldiers appeared at Wamba to capture bonobos to give to

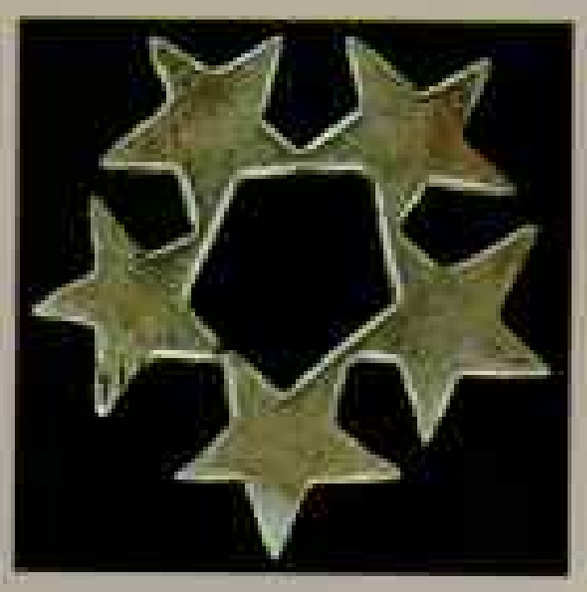
foreign dignitaries. The trackers refused to lead the soldiers to the apes and were beaten. After the soldiers killed a cluster of bonobos to collect an infant, Kano's chief tracker put himself between soldiers and another group. He said they would have to kill him before they could kill any more bonobos, and the apes were saved.

Bonobos have also been studied for more than a decade northwest of Wamba in the Lomako forest. There researchers have chosen not to provide food for the animals, so observing them has been difficult.

Both study areas are within the bonobos' primary forest range, and loggers, poachers, and farmers are pressing in. Patrolled reserves are essential to prevent the extinction of the surviving population, estimated at fewer than 20,000 apes.

Recent political instability has dimmed hopes of working with the Zaire government to establish additional protected areas. Foreign researchers have not been able to return, and the future of bonobo studies—and of the bonobos themselves—is in jeopardy. □

Takayoshi Kano's study on bonobos, *The Last Ape: Pygmy Chimpanzee Behavior and Ecology*, is being published by Stanford University Press.



PROUD MIXTURE OF VANITY AND valor, a figure of legend and controversy, Douglas MacArthur was a military prodigy unlike any other in U. S. history. A veteran of three major American wars, his honors and influence grew with each new command. In the end his pride exceeded his authority, and like a figure of Greek tragedy he fell precipitously from power. Yet a strong MacArthur heritage remains. No American had more influence over the destiny of modern Japan, and consequently the resurgence of democracy in the Pacific, than this all-too-human five-star hero.

DOUGLAS MACARTHUR

AN AMERICAN SOLDIER

By GEOFFREY C. WARD

Photographs by CARY WOLINSKY STOCK, BOSTON

"I shall return." That famous pledge to the Philippines was redeemed on October 20, 1944, with MacArthur's amphibious landing at Leyte. Amid the statuary

marking the event, a youngster splashes by the figure of MacArthur, who on that day strode ashore to undertake the liberation of the islands from the Japanese.

THE SUNSETS ACROSS MANILA BAY are among the gaudiest on earth, and there is no better place to view them than from the top floor of the old Manila Hotel, where Gen. Douglas MacArthur lived in colonial splendor during the years before America entered World War II. The great semicircular harbor is crowded with anchored ships, just as it was then, and the island of Corregidor and the mountainous silhouette of the Bataan Peninsula still rise above the horizon; as the minutes tick by and a gentle breeze stirs the palm trees along the waterfront, the blue sky slowly loses its brilliance, the scattered clouds shift from white to pink and violet and rose, and the sun turns blood-red, then flashes gold before falling into the South China Sea.

The general is said to have enjoyed the sunset from his penthouse terrace here nearly every evening. But by the time the sun disappeared on December 8, 1941, it seemed as if his once bright career had plummeted too and might never rise again. Yet, somehow, he recovered from a disaster that was at least partly of his own making to transform the scene of his most humiliating setback into the backdrop for his most spectacular success.

No soldier in our history has been more extravagantly admired—or more savagely reviled—than Gen. Douglas MacArthur. And no man embodied more genuine contradictions. He was at once magnanimous and petty, devoted to his men and unwilling to share glory with them, fearless in battle but so fearful of his own mother that he was forced for a time to lead two lives, and unable ever to think himself fully worthy of the soldier father whose deeds his own had long since dwarfed. He achieved some of his greatest triumphs—as well as his worst defeat—by ignoring or defying the civilian superiors whose orders he had sworn to carry out.

He lived almost half his professional life overseas, and it is astonishing how few physical traces he left behind in that peripatetic career; we remember best the carefully cultivated symbols of his public personality—his battered cap with the gold braid reporters called "scrambled eggs," the corncob pipe he rarely smoked except when photographers were likely to be present, his ornate, old-fashioned prose and the throbbing baritone in which he delivered it. The private man behind the ever present sunglasses largely remains a mystery.

"My first recollection," Douglas MacArthur liked to say, "is that of a bugle call." Since he sometimes offered alternative first recollections, that may not literally have been true, but he was surrounded by soldiery from birth. He was born January 26, 1880, at Fort Dodge, Arkansas, the third son of Capt. Arthur MacArthur, Jr., and his wife, Mary, known as Pinky, a Virginia cotton merchant's strong-minded daughter. Arthur MacArthur, Jr., had been an authentic Union hero; he won the Medal of Honor for helping lead his men in the headlong charge that took the Rebel guns at Missionary Ridge—and never got over the

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Historian, journalist, and screenwriter GEOFFREY C. WARD's most recent book is *American Originals: The Private Worlds of Some Singular Men and Women*. This is his first article for NATIONAL GEOGRAPHIC. With this story Boston-based photographer CARY WOLINSKY marks his 20th year of contributing to the magazine.

BORN TO LEAD

With his father as example and his mother as teacher, Douglas MacArthur, like his older brother Arthur III, was girded for battle straight from the cradle. Seen with his family (right) about 1886, the becurled

young Douglas was thrilled by the war stories told by his father, Capt. Arthur MacArthur, Jr., who earned the Medal of Honor for valor in the Civil War.

Daughter of the Confederacy, Mary Pinckney "Pinky" Hardy (right) taught her sons the virtue of courage, exhorting Douglas to "grow up to be a great man, like your father." In 1899 when Douglas became a West Point cadet (above), Pinky took up residence off campus to watch over her favorite son.

From each parent MacArthur inherited a kind of flamboyance: from his father an overbearing

THE BETTMANN ARCHIVE (BELOW RIGHT); ALL OTHERS MACARTHUR MEMORIAL

attitude and from his mother a flair for style.

Home from Europe at the end of World War I, the 39-year-old brigadier general sported a raccoon coat and knee-length scarf.

fact that his moment of glory had come because he had attacked without waiting for orders. Sometimes, he told his youngest son, a truly gifted soldier had no choice but to act on his own.

THE BOY WAS RAISED in a series of dusty frontier Army outposts, where everything around him contributed to his sense that his father was a very great man. Everyone saluted Arthur MacArthur as he passed. Everyone treated Douglas MacArthur as special too. From earliest childhood he was made to feel that the natural order of things was to be in command.

Douglas had two older brothers: Arthur III died of appendicitis in 1923, and Malcolm, just 15 months older than Douglas, died at four in 1883. "His loss was a terrible blow to my mother," MacArthur recalled, "but it seemed only to increase her devotion to Arthur and myself. This tie was to become one of the dominant factors of my life." That was an understatement. Until her death in 1935 Pinky MacArthur was rarely far from her son's side and never far from his thoughts.

"My mother put too much pressure on me," MacArthur told an aide when he was himself a parent. "Being number one is the loneliest job in the world, and I wouldn't wish it on any son of mine." He owed it to his father to excel, Pinky MacArthur told him, and he owed it to her.

Douglas did his best to live up to her exalted expectations, though the effort sometimes made him physically ill. At West Texas Military Academy he led his class in every subject and earned 100 in "deportment." He was pleased, he later wrote, but "I also learned how little such honors mean after one wins them." He was never satisfied for long. Neither was his mother.

She stayed at his side through all four years at West Point, living in Craney's Hotel on the edge of the Plain so she could make certain that her son's study light was on, strolling with him each evening along Flirtation Walk, firmly turning away any young woman in whom he showed more than casual interest, and ceaselessly urging upon him his duty to outdo his classmates. She needn't have worried. A fellow cadet recalled that MacArthur "was arrogant from the age of eight," but his overall scholastic record for four years was 98.14, a record said to have been surpassed by only two cadets, one of whom was Robert E. Lee.

In 1903 he emerged from the academy as a 23-year-old second lieutenant. He began in the Army Engineers, surveying installations in the Philippines, which had become a United States possession as a result of the Spanish-American War. The U. S. was already anxiously fortifying against the Japanese. Tall, slender, courtly, as energetic and intelligent as he was cocksure and well connected, MacArthur moved up fast, often aided by shameless, string-pulling letters from his mother.

He accompanied his parents on a tour of the Far East, which infused him with the lifelong conviction "that the future and, indeed, the very existence of America were irrevocably entwined with Asia and its island outposts," and he served as an aide-de-camp to President Theodore Roosevelt. While MacArthur worshiped his father, others did not. No one questioned his skill as a soldier, but an officer who served with both said,

"Beast Barracks," MacArthur's first test of military fortitude, remains an ordeal for West Point plebes. When MacArthur came here in 1899 as the son of a famous general, he was forced to endure far more than his share of hazing before going on to graduate first in his class. In 1919 MacArthur returned from World War I to serve as the second youngest superintendent of the academy, where duties included a review ceremony with visiting Portuguese officers (right). Though he curbed hazing, MacArthur was frustrated in his attempts to liberalize the curriculum.

MACARTHUR MEMORIAL

"Arthur MacArthur was the most flamboyantly egotistical man I had ever seen, until I met his son." When his father died in 1912, Douglas MacArthur recalled, "My whole world changed. . . . Never have I been able to heal the wound in my heart."

MacArthur inherited his father's courage, patriotism, and martial skill—along with Arthur MacArthur's hauteur, his unshakable conviction that he was insufficiently appreciated, and his belief that he must always be on his guard against the plotting of men less gifted than he and envious of his success.

MACARTHUR MEMORIAL

"Whenever I perform a mission and think I have done it well," MacArthur said in his 60s, "I feel that I can stand up squarely to my dad, and say, 'Governor, how about it?' "

HIS FIRST CHANCE to be worthy of his father's memory came in 1914 near Veracruz, where he was sent on a daring spy mission deep inside Mexican territory. On his return he said he had shot seven gunmen in combat, and he was enraged when the Awards Board refused to award him the Medal of Honor on the grounds that he could offer no "incontestable proof" of his gallantry and that the local commander had not been informed of his mission.

World War I provided him with the bigger stage he needed. As a colonel in the 42nd Rainbow Division, he proved perhaps the most courageous American officer on the western front—and certainly the most conspicuous. From the first he resolved to set himself apart. He refused to wear a helmet or gas mask, carried a riding crop rather than a weapon, and wore into battle riding britches, polished cavalry boots, a letter sweater from West Point, and a four-foot woolen muffler knitted by his mother. A wary sentry once placed him under arrest, sure that anyone so eccentrically turned out in the midst of battle must be a spy.

Some officers at American headquarters dismissed him as the "show-off," but his men called him the "fighting dude" and loved him for his willingness to lead them into battle—he clambered up the sides of trenches under machine-gun fire, crawled through mud, and returned from one overnight mission prodding along with his riding crop a captured German colonel.

When a shell exploded in the courtyard of a farmhouse in which he and his staff were dining, his fellow officers hit the floor. He is said to have gone right on eating: "All of Germany cannot fabricate a shell that will kill MacArthur," he said. "Sit down again, gentlemen, with me." Such exploits impressed his men and provided colorful copy for the newspapers.

At 38 he became the Army's youngest divisional commander. The secretary of war declared him "the greatest front-line general of the war," and he emerged from it a brigadier general with 31 honors, including the French Croix de Guerre, the Distinguished Service Cross, and seven Silver Stars for "extraordinary heroism and gallantry in action."

But no amount of praise ever seemed to satisfy MacArthur, no position was ever lofty enough to allow him to enjoy it for long: He was certain that only the personal "enmity" of officers at Gen. John J. Pershing's headquarters—where young George Marshall served—had denied him the Medal of Honor. A "Pershing faction" was out to get him, a delusion that would persist for more than three decades.

After the war he was made superintendent of West Point. Against stubborn resistance from older officers opposed to change of any kind, he streamlined courses, ended the more extreme forms of hazing, and brought in civilian teachers.

Then, in 1922, he was unexpectedly posted to the Philippines as commander of the Manila district. He blamed General Pershing, now Army chief of staff, for the change, for MacArthur, at 42, had proposed marriage to Louise Brooks, a vivacious divorcée of whom his mother emphatically did not approve and who had once been linked romantically with Pershing. MacArthur was certain Pershing was exiling him out of jealousy.

"My leaving West Point is a matter of complete indifference to me," MacArthur assured his bride-to-be, in the overwrought style with which he always sought to hide his disappointments. "On the ashes of old West Point I have built a new West Point—strong, virile, and enduring. . . . Long after I am dead and moulding the Corps will call me Father of New West Point."

MacArthur enjoyed his years in the Philippines; his new wife did not, and the marriage foundered. Much later, the first Mrs. MacArthur blamed the divorce on hostile interference by her mother-in-law.

In 1930 MacArthur returned to Washington and accepted the post that had been denied his father: Army chief of staff. At 50 he was living with his mother again, hurrying home from the War Department to lunch with her each day. But he also led a separate life about which she knew nothing. He installed a Filipina mistress, Isabel Rosario Cooper, known as "Dimples," in a Washington hotel suite. She soon wearied of the secret life she

On the blood-soaked fields of northern France, where 30,000 American soldiers of World War I lie buried in cemeteries like Oise-Aisne (above), MacArthur came of age as a leader of men. For his bravery on the front lines the young general won a chestful of medals—including two Purple Hearts after being gassed—and the devotion of his troops. In 1918, two months before the war's end, he set up headquarters in a stately château at St. Benoit, where he found furniture to match his manner (opposite).

ADM. JOHN BULKELEY

"It was a stroke of genius," says retired Adm. John Bulkeley of MacArthur's decision to use PT 41 (then under Bulkeley's command) for his escape from the Philippine island of Corregidor in March 1942. In his home near Washington, D. C., the Medal of Honor winner recalls how the Japanese had instead expected a submarine to rescue the general.

After the war MacArthur embraced his colleague, recently released POW Gen. Jonathan Wainwright, forced to surrender the troops MacArthur left behind.

MacARTHUR MEMORIAL

was forced to lead, grew bored, and took other lovers. Finally, MacArthur paid her passage back to Manila, but she refused to go, eventually settling in California.

IT WAS NOT A GOOD TIME for a professional soldier who craved headlines. The U. S. Army was the 17th largest in the world; even the Greek and Portuguese armies were larger, and MacArthur had to fight hard to keep it from shrinking further. Then, in the depths of the Great Depression, he thought he saw an opportunity to seize the popular imagination again. A ragtag army of about 22,000 desperate, jobless veterans of World War I, some of whom had fought under his command, filed into Washington in 1932, clamoring for the early payment of a bonus Congress had promised for 1945. The veterans built themselves a shantytown of tents and packing crates and cardboard boxes in Anacostia, just across the Anacostia River from the Capitol, and vowed to stay there until the government changed its mind.

President Herbert Hoover persuaded himself that this ragged band—which now included hundreds of women and children, along with a handful of communists—was a threat to national security, and when there was a scuffle with the police and two demonstrators were shot, he ordered that the rest be driven from the capital. It was bound to be a painful business, and MacArthur's aide, Maj. Dwight D. Eisenhower, urged MacArthur himself to stay out of it. The chief of staff overruled him: "MacArthur has decided to go into active command in the field," he declared. "There is incipient revolution in the air."

Things went well at first, the bonus marchers backing away peacefully in the face of tanks and cavalry. But MacArthur was not satisfied. Twice, Hoover sent word that he was not to pursue the marchers across the Anacostia. MacArthur ignored the orders and stood by as his men crossed the bridge and drove the veterans and their families from their makeshift homes, which they then set ablaze. At least 40 veterans were injured, one had his ear clipped from his head by a cavalry saber, and a sickly infant died after inhaling tear gas.

MacArthur refused to concede that he might have been overzealous. In fact, at a midnight press conference he stoutly maintained that he had saved the Republic from revolution and that no one had been hurt. An officer who had served MacArthur as an aide during the twenties and thirties saw the fear beneath his outward self-confidence: "The goal instilled into him was to be Superman. He felt inadequate to the part but did not know how to get out of it . . . [he] was never free of an imposed destiny or from fear of failing it."

Following the Bonus Army incident, some admired MacArthur's toughness and his willingness to share a distasteful assignment with the men who had to carry it out. Others never forgave him for the enthusiasm he had shown in cleansing Washington of his old comrades-in-arms or for the exaggerated claims he later made to justify it. When two newspaper columnists charged him with having been brutal, insubordinate, and publicity happy, MacArthur sued them for libel, then learned that among the witnesses his opponents planned to call was his

estranged mistress. He dropped the case, but not before he was forced to come up with $15,000 to buy her silence.

MacArthur's unhappy term as chief of staff ended in 1935. He was 55 years old and did not relish stepping down to a lesser position. When Manuel Quezon—soon to become the first president of the Philippine Commonwealth, which was to be granted full independence from the United States in ten years—offered him the post of military adviser, MacArthur eagerly accepted.

His mother sailed with him for Manila, fell ill en route, and was confined to her cabin. When Pinky MacArthur died five weeks after they arrived, MacArthur was desolate: "I find myself groping desperately but futilely," he confessed to a friend. "For the first time in my life I need all the help I can get."

His help would come from Jean Faircloth, a southern woman 20 years younger than he whom he had met aboard ship. They were married in 1937 and had a son, Arthur MacArthur IV, a year later. MacArthur made many enemies over the course of his career; his wife seems to have made none, selflessly serving the husband she called "General" and "Sir Boss" with all of his late mother's devotion and none of her urge to dominate.

MACARTHUR MEMORIAL

Short of walking on water, the "great liberator" could scarcely have picked a better way to electrify the world than his surf landing in the Philippines in 1944. In fact, it was accidental; his landing craft ran aground short of the beach. Recognizing the impact of the image, MacArthur conducted future landings in a like manner, making them a kind of military sacrament.

MacArthur's memory is still cherished by American Legion members in Manila (opposite), who discuss the controversial proposal to close U. S. bases in their islands. During the Japanese occupation, many Filipinos joined a guerrilla resistance, as did Victorina Cabral. Mother of two American-fathered children, she displays the flag given her by her GI lover.

FOR THREE DECADES American military planners had worried that they could not realistically fulfill their pledge to defend the Philippines against Japan. Seven thousand miles of open ocean separated the islands from the United States; the nearest large American base was Pearl Harbor, just 2,000 miles closer. There was simply no way to reach the islands before a determined Japanese force seized control. The best that defense planners could come up with was War Plan Orange: In case of attack, U. S. troops were to withdraw to the Bataan Peninsula and Corregidor, a heavily fortified island at the entrance to Manila Bay. There they would hold out until American warships could steam to their rescue, a process likely to take months.

Douglas MacArthur was full of scorn for War Plan Orange; the islands need not be sacrificed, he assured Quezon: "I don't *think* that the Philippines can defend themselves, I *know* they can." He drew up plans for a 400,000-man army guaranteed to hurl the invader from the beaches; he even persuaded some in Washington that under his dynamic leadership the Philippines stood a good chance of standing off an invasion.

As always, he cut an imposing figure. At his frequent press conferences, the general paced as he talked, wearing a field marshal's uniform of his own design, slapping at a wall map with his riding crop, often leaving the room before any questions could be asked. "He *lectured* us," Ernesto Rodriguez, Jr., a veteran Filipino newspaperman remembers. "We got the real answers to our questions from Eisenhower."

Only the Japanese seemed unimpressed, and when in 1941 they moved into Indochina within easy striking distance, President Franklin D. Roosevelt recalled MacArthur to active duty as commander of all U. S. forces in the Far East, including the Philippine Army and all American forces based in the islands. "Destiny," MacArthur said, had placed him in command.

But the Philippine Army in which MacArthur expressed such confidence existed mostly on paper. The men were inadequately supplied and poorly trained; when war finally came, many had never held a rifle, let alone fired one. And the U. S. was slow to provide the matériel it had promised.

MacArthur remained certain, nonetheless, that his leadership would make all the difference, that his mere presence in the islands would make the Japanese think twice about adventuring. In late November 1941 he assured his colleagues that Japan could not possibly attack before the spring.

He was sound asleep in his penthouse suite during the early morning hours of December 8, 1941—December 7 in Hawaii—when the telephone rang: Japan had destroyed most of the

Relic of the battle for New Guinea, an American B-17 lies in a waist-deep swamp north of the Owen Stanley Range. In 1942 MacArthur deployed these bombers from Australia to airlift troops new to jungle warfare into this fiercely contested "green hell." The Japanese directed their campaign from the island of New Britain, where miles of tunnels were dug as havens from Allied bombs.

Pacific Fleet at Pearl Harbor. At Clark and Iba airfields, B-17 bombers and P-40 fighters stood, wingtip to wingtip, on the runways. When MacArthur's Air Corps chief asked permission to order them into the air to strike back at Formosa, the nearest Japanese base, MacArthur's chief of staff ordered him to wait for orders from the commander himself. They came too late. The planes sat on the ground for nine hours. Then, a flight of Japanese warplanes roared in to destroy them.

Two weeks later, 43,000 Japanese began landing at Lingayen Gulf, northwest of Manila. Units of MacArthur's ill-prepared Philippine Army collapsed; his overambitious plans collapsed with them, and he fell back on the old War Plan Orange. In a massive strategic retreat that General Pershing, then retired at 82, pronounced "one of the greatest moves in all military history," MacArthur successfully directed his U. S. and Philippine troops onto the mountainous, jungle-choked Bataan Peninsula to fight a holding action. But he had neglected to provide the food and medicines and supplies they desperately needed. In the weeks of fighting to come, thousands would be weakened needlessly by dysentery, malaria, and constant, gnawing hunger.

Abandoning Manila, MacArthur, his wife, his three-year-old son, and the boy's Chinese nursemaid—along with President Quezon and U. S. High Commissioner Francis B. Sayre—slipped across the bay to the besieged garrison on the island of Corregidor, to await reinforcements that never came.

MacArthur again proved unflinching under fire, often leaving the safety of the Malinta Tunnel as bombs fell and shrapnel ripped through the air around him. By exposing himself to danger, he explained, he intended to inspire the "man at the bottom" to say, "I guess if that old man can take it, I can, too." But during his 77 days on the island he only once ventured over to Bataan—just a five-minute ride away by PT boat—for which many of those struggling to survive there never forgave him.

The officers in command at Pearl Harbor were cashiered for failing to be ready for a Japanese attack. MacArthur, who had had nine hours to strike back, blamed his subordinates for the disaster; he was never even chastised for failing to get his planes off the ground, and he received no official criticism for having failed to feed or supply the men he sent into the mountains. Instead, he became the war's first great hero.

IT IS ALMOST IMPOSSIBLE NOW to recall the sense of shock and desperation Americans felt early in 1942. The Axis appeared already to have won the war. Hitler's columns were advancing on Cairo and Stalingrad. Japan had smashed America's Pacific Fleet, conquered Thailand, Burma, Sumatra, Borneo, the Celebes, Timor, the Bismarcks, the Gilberts, Wake Island, Guam, most of the Solomons, and half of New Guinea, and their bombers were attacking Australia.

Only the men on Corregidor and Bataan still held out. And in the public mind Douglas MacArthur had become the living symbol of their defiance, the "Lion of Luzon." This was not entirely an accident. In 109 out of 142 communiqués churned out by his headquarters on Corregidor, his was the sole name to appear: It was "MacArthur's men" who were under siege; the names of the officers leading them in battle were carefully omitted.

Although Washington repeatedly praised the courage of MacArthur and his embattled army and promised that relief would soon be on its way, it was all talk. Neither the men nor the supplies nor the ships needed to convoy them were ready to fight their way through the Japanese fleet. Corregidor and Bataan were doomed. "There are times," Secretary of War Henry L. Stimson said privately, "when men have to die."

MacArthur's men, but not MacArthur. Dwight Eisenhower, for one, argued that MacArthur should share their fate. Resisting the invaders was a job "made to order" for MacArthur, he noted in his diary. It had "all the essentials of drama" for which MacArthur always yearned, but his taking on a task more complex than mere resistance could put him in a position where "his love of the limelight might ruin him." FDR disagreed: MacArthur was too experienced a soldier, too important a public figure, too much admired by his administration's opponents for Roosevelt to let him fall into enemy hands. George Marshall, now chief of staff, conveyed FDR's order for him to leave Corregidor (MacArthur insisted that the word come directly from the President so that no one could ever accuse him of cowardice). He was to slip past the enemy and make a run for Australia.

He did so on March 11, taking with him his wife and son and the nurse—and half a million dollars from President Quezon. A similar offer was later made to Dwight Eisenhower, who gently deflected it, explaining tactfully that it was against Army regulations to accept gratuities from foreign governments. MacArthur banked his gift. No one ever looked into this unorthodox transaction; heroes were not subject to audit.

Axis spokesmen gleefully denounced MacArthur as a "fleeing general," a "coward," a "deserter." To offset the impact of such attacks, George Marshall saw to it that MacArthur was awarded the Medal of Honor. *(Continued on page 74)*

GEORGE SILK

Member of the "Fuzzy Wuzzy Angels"—Papuan volunteers in the Allied battle for New Guinea—Raphael Oimbari (above) displays a much published picture of himself (left) aiding an Australian soldier on Christmas Day 1942. Shot by a Japanese sniper, the soldier, George Whittington, died shortly after reaching a field hospital. Thirty years later Whittington's wife located Oimbari and presented him with a copy of the photograph.

MacArthur perceived New Guinea as critical to the defense of Australia. With limited support from the U. S. Navy and only two divisions of American soldiers, MacArthur relied heavily on Australian troops (right) in the campaign.

MACARTHUR MEMORIAL

THE SUPREME COMMANDER

"It's been a long road from Melbourne to Tokyo," MacArthur said on arriving in Japan (left), August 30, 1945. Though he had been preparing for a ground invasion, the nuclear attacks on Hiroshima and Nagasaki sped capitulation, causing MacArthur to predict that technology would put an end to war. After accepting Japan's

MAINICHI NEWSPAPERS/TOKYO

UPI/BETTMANN

NATIONAL ARCHIVES

formal surrender aboard the battleship Missouri on September 2 (left), he stayed on to supervise the most sweeping reforms Japanese society has ever known. Helping ease the way for MacArthur's new democratic constitution, Emperor Hirohito (below) renounced his own divine status. For some Japanese, MacArthur himself took on a near godlike air. During the general's 1948 bid for the U. S. presidency, some Tokyoites displayed their affection (bottom left).

MACARTHUR MEMORIAL

From Australia, MacArthur issued a fateful promise: "I have come through," he said, "and I shall return."

FOR THE NEXT 31 MONTHS Douglas MacArthur's every waking hour was devoted to making good that pledge. The liberation of the Philippines, he believed, was the only way to redeem America's honor—and his own.

It was a long, frustrating struggle, and it took its toll on MacArthur. His hands shook, aides noticed, and to hide that fact he took to holding them behind his back as he paced up and down in his headquarters office, sometimes covering five fretful miles a day. He found a host of others to blame for what seemed to him criminal delay. Like his father, he could never concede that those who differed with him acted from any but the basest motives.

MacArthur was certain that traitors and spies were behind the policy of defeating Hitler in Europe before taking back the Pacific. (After all, Japan, not Germany, was "our main enemy," he told one reporter. Life under the Nazis would be "tolerable" since they, unlike the Japanese, were "a civilized people.") Enemies were everywhere. Throughout the war, one officer recalled, MacArthur fulminated "about his dislike for FDR, and his statements about General Marshall and General Eisenhower were rich, rare, and racy."

RAD SMITH

Told to disarm, Japan turned in its swords, thousands upon thousands, many of them heirlooms that ended up as souvenirs in the hands of American GIs. MacArthur's constitution, which forbade a new arms buildup, was supported by most Japanese. Today Japan spends only one percent of its GNP on defense.

He was certain that Marshall deliberately withheld men and matériel from the Pacific theater out of personal dislike for him; that many in Washington would rather see him defeated than win the war; that Roosevelt, whom he publicly flattered but privately scorned as "a man who would never tell the truth when a lie would serve him just as well," was motivated by fear that MacArthur might replace him in the White House in 1944. And he was encouraged in all these resentments by the little circle of aides he gathered around him, whose loyalty bordered on sycophancy. Once when MacArthur began a sentence with "my staff," George Marshall cut him off. "You don't have a staff, General. You have a court."

Victories were few at first, and MacArthur was concerned that all of them be seen as his alone. When Gen. Robert Eichelberger fought so well in the seesaw battle for Buna in New Guinea that several magazines wrote him up, an angry MacArthur told him that if it ever happened again, he could "reduce you to the grade of colonel tomorrow and send you home."

Yet for all MacArthur's vanity, for all his seething resentments and secret fears, no one ever questioned his energy, organizational skill, or determination to get on with the job. Nor

could anyone deny his extraordinary record of success. Fifty-six amphibious landings were undertaken under his command; every one of them succeeded.

Then, in early 1944, it suddenly seemed that his goal of freeing the Philippines might be snatched away at the last moment. The Navy proposed to bypass the islands, drive the Japanese from Formosa, and attack Japan directly. MacArthur was adamantly opposed. To do so, he declared, "would admit the truth that we had abandoned the Filipinos and would not shed American blood to redeem them; we would probably suffer such a loss of prestige among all the peoples of the Far East that it would adversely affect the United States for many years."

Roosevelt finally sided with MacArthur, and on October 20, 1944, the general at last found himself aboard a landing barge rumbling toward Leyte beach. He wore a crisply starched uniform and the sunglasses and soft cap that had become his trademark, and he was eager to step ashore and proclaim his return. Then, 50 yards out, the barge ran aground. Landing craft burned around him, bodies were rolling in the surf, sniper bullets still whined overhead, and when the harried harbormaster heard about the general's potential embarrassment, he was unmoved. "Let 'em walk!" he said.

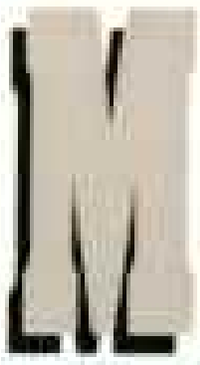
Cursing under his breath while photographers clicked, MacArthur and his companions stepped knee-deep into the surf and grimly waded ashore. MacArthur was afraid his return to the Philippines had been insufficiently dignified; then he saw a photographer's print and realized what a dramatic impression it would make in newspapers around the world. Thereafter, he made sure he waded ashore for the cameras when landing on other islands.

"People of the Philippines, I have returned," he said over a mobile-radio hookup. "The hour of your redemption is here. . . . Rally to me. Let the indomitable spirit of Bataan and Corregidor lead on. . . . Let every arm be steeled. The guidance of Divine God points the way. Follow in His name to the Holy Grail of righteous victory."

They did rally to MacArthur, strewing his path with flowers, rushing up to embrace him and shake his hand. His armies first took Leyte, restoring civilian power to the Philippines, moved on to Luzon, and fought street by street to recapture Manila. They then raised the American flag back to the top of its staff on Corregidor. Afterward—without waiting for permission from Washington—they went on to liberate the central and southern Philippines in a series of costly campaigns that some critics believed unnecessary.

To demilitarize the Japanese spirit, MacArthur outlawed some martial arts, such as the ancient practice of Kendo with its bamboo swords. Today the Japanese celebrate their martial heritage. Combining meditation with swordsmanship, Kendo is taught in thousands of schools as a means of instilling spiritual discipline in the young.

"Give me bread or give me bullets," MacArthur warned Congress, citing potential unrest among Japan's hungry postwar masses. With generous U. S. aid MacArthur—who served as Japan's virtual dictator for six years—launched school lunch programs across the nation (below). Now, as then, students serve themselves (above).



MACARTHUR WAS MADE general of the army, the highest rank in the U. S. Army, and when the signal was to be given for the final attack on Japan itself, all ground troops were to be under his command. In the end the atom bombs dropped on Hiroshima and Nagasaki rendered that assault unnecessary; instead MacArthur found himself presiding over the Japanese surrender aboard the U.S.S. *Missouri* on September 2, 1945.

His words, broadcast across Tokyo Bay by loudspeaker, were uniformly generous and conciliatory. "It is for us, both victors and vanquished," he said, "to rise to that higher dignity which alone befits the sacred purposes we are about to serve, committing all our people unreservedly to faithful compliance with the understanding they are here formally to assume. It is my earnest hope, and indeed the hope of all mankind, that from this solemn occasion a better world shall emerge out of the blood and carnage of the past—a world dedicated to the dignity of man and the fulfillment of his most cherished wish for freedom, tolerance, and justice."

MAINICHI NEWSPAPERS

Douglas MacArthur was 65 years old when the war ended, but he enthusiastically took on a new task, one which even he might have seen as worthy of his talents. As supreme commander in charge of the occupation of Japan, he was responsible for the well-being and uplift of 70 million Japanese, and the very same qualities that put off many of MacArthur's American contemporaries—his aloofness, his regal sense of himself, even his melodramatic prose—perfectly suited a

Lifted from feudalism overnight, thousands of tenant farmers like Heitaro Nagase (above) bought deeds to their small plots after MacArthur pushed a revolutionary land-reform bill through the Japanese Diet. On July 19, 1947, 74-year-old S. Otsuka acquired from his landlord the first deed in the historic land transfer.

defeated people already accustomed to venerating their emperor.

MacArthur resisted pressure to punish the emperor for his acquiescence in the war. Instead, while careful to strip him of his temporal powers, he paid him formal respect as the living symbol of Japan. He asked the Japanese cabinet to produce a revised constitution, and deeming it insufficiently different from the old one, MacArthur gave his staff just six days to come up with a wholly new document. It transformed Japanese society, guaranteeing civil liberties and the equality of the sexes, reforming the Diet, and renouncing war for all time. MacArthur supported labor's right to organize and strike and urged the Diet to pass a law aimed at breaking the power of the old feudal class by forcing big landowners to sell most of their holdings to their tenants, a reform his father had advocated for the Philippines half a century earlier. When word reached him that his land-reform bill had indeed passed, an aide recalled, MacArthur looked up at the portrait of Arthur MacArthur he always kept near him and asked aloud, "How am I doing, Dad?"

ASHVINE WORLD PHOTOS

He did well enough that most of his biographers believe the role he played in starting Japan on the path from feudal militarism toward modern democracy represented a greater triumph than any the old warrior had won on the battlefield. MacArthur himself agreed: "Historians a thousand years from now," he told one visitor, "may give the last war only a line, saying: 'And then the whole world was swept by a conflagration.' But I believe there may be a page, maybe a chapter, telling how freedom and democracy were

MACARTHUR MEMORIAL

"Senior to everyone but God," as one subordinate put it, MacArthur served in Korea as the first commander of a UN force. Aboard the U.S.S. Mount McKinley on September 13, 1950 (left), he directed the landing of 70,000 troops at Inchon harbor (above), where the tidal variations make such ventures risky but allow for good clamming. After the UN triumph at Inchon, the massive entry of communist Chinese into the war marked a shattering reversal of fortunes.

Ed Reeves, one of the 12,000 Allied casualties at Chosin Reservoir in December 1950, lost his feet and all his fingers. Though many GIs died from cold, the bitter temperatures, says Reeves, "kept many of us from bleeding to death, since the blood froze in our wounds."

MACARTHUR MEMORIAL

brought to the Far East by the United States—one of the greatest and perhaps the noblest single achievement of our country."

But even his role as the man most responsible for that achievement did not fulfill MacArthur's unslakable ambition. As the 1948 elections approached and the new President, Harry S. Truman, looked beatable, he attempted to orchestrate a long-distance campaign for the Republican presidential nomination. It was a disaster: MacArthur did not even carry the primary in his father's home state of Wisconsin. "The general," an aide reported the next day, "is as low as a rug and very disappointed." After a second primary loss, in Nebraska, MacArthur ordered his name withdrawn. Truman won the election. MacArthur returned to his duties as proconsul of Japan.

ON JUNE 25, 1950, North Korean troops poured across the 38th parallel to attack South Korea, in open defiance of the United Nations. MacArthur, now 70, flew to Korea in his old C-54, *Bataan*, and after watching the bombs fall and the frightened refugees streaming back from the front, he wired Washington: "The only assurance for holding the present line and the ability to regain later the lost ground is through the introduction of United States ground combat forces. . . ."

President Truman agreed. It was "Mars' last gift to an old warrior," MacArthur said. He drew up a characteristically daring plan. Against all military convention he would divide his

MACARTHUR MEMORIAL

AFTER THE FALL

"It's the orders you disobey that make you famous," MacArthur once said. Always defiant of authority, he met his match in President Harry S. Truman (far left, at Wake Island), who fired him on April 11, 1951, for his opposition to a limited war. Back home with his wife and son (left), MacArthur was both lionized and reviled by a nation bitterly divided over his sacking. His farewell address to Congress (below) was interrupted by 30 ovations.

LOC/LIBRARY OF CONGRESS

force, holding on to his position south of occupied Seoul while sending a second, amphibious group to land behind enemy lines at the port of Inchon. The operation was a spectacular success. Within days the stunned North Koreans were on the run.

But intelligence suggested the Chinese were massing in Manchuria, and Chinese spokesmen privately warned that China would intervene if U. S. forces crossed into North Korea. MacArthur assured Truman the Chinese were bluffing. Promising that the enemy will "evaporate very shortly," he sent his columns north on the day after Thanksgiving; the boys would be home by Christmas, he said.

The next day, 33 Chinese divisions—300,000 men—smashed the UN drive. *Time* magazine said it was the worst defeat "the United States has ever suffered."

MacArthur refused to accept any responsibility. Instead, he blamed American intelligence for misleading him, declared that "we face an entirely new war," and urged that he now be allowed to attack Manchuria with the help of Nationalist Chinese forces. His superiors in Washington refused to grant permission; they wished no wider war. The enemies ended up roughly where they had started—and where they remain today—glaring balefully at each other across the 38th parallel.

When MacArthur's recommendations were not accepted, he began a drumfire of public criticism of official policy, arguing, "There is no substitute for victory."

Whether or not MacArthur was right about what to do in

Korea, it was clear he had taken his unwillingness to follow the orders of his civilian superiors too far. "Rank insubordination," Truman wrote in his diary. "Our big general in the Far East must be recalled." The joint chiefs of staff agreed. On April 11, 1951, the President relieved MacArthur of all his commands.

He landed in San Francisco on April 17, aboard *Bataan*. It was his first return home in 14 years. "I do not intend to run for any political office. . . . The only politics I have," he declared, "is contained in the simple phrase known well by all of you, 'God bless America.' " Two days later he addressed a joint meeting of Congress. After calling yet again for an assault on mainland China, he ended with a peroration that neither his admirers nor his detractors ever forgot:

"I am closing my 52 years of military service. When I joined the Army even before the turn of the century, it was the fulfillment of all my boyish hopes and dreams. The world has turned over many times since I took the oath on the Plain at West Point, and the hopes and dreams have long since vanished. But I still remember the refrain of one of the most popular barracks ballads of that day, which proclaimed most proudly that 'Old Soldiers never die, they just fade away.'

"And like the old soldier of that ballad, I now close my military career and just fade away—an old soldier who tried to do his duty as God gave him the light to see that duty.

"Good-bye."

Tributes to an old soldier who once presumed to "just fade away," a file of bronze busts of MacArthur in his cap are held by the honorees of annual awards at the MacArthur Memorial in Norfolk, Virginia.

Visiting from her home in New York City, MacArthur's widow, Jean (opposite), meets the Army's "outstanding junior officers" chosen for the coveted prize. Twenty-eight years after her husband's death in 1964, she still refers to MacArthur as "my general."

IN THE END Douglas MacArthur did just fade away. His dismissal continued to be a sensation for a time. Eighty-four thousand letters and telegrams descended on the White House, more than half of them protesting his dismissal. From coast to coast throngs turned out to greet him. There were demands for Truman's impeachment, and there was talk once again of MacArthur's running for the presidency. But the Republican delegates were already committed to another old soldier, Dwight Eisenhower.

MacArthur lived on with his wife and son in a suite at the Waldorf Towers in Manhattan; his old admirer Herbert Hoover lived just downstairs. He served as chairman of the board of Remington Rand, greeted old comrades, revisited West Point whenever Army played Navy, and worked on his highly selective *Reminiscences*.

He did get one more glimpse of his beloved Philippines. In 1961, three years before his death at 84, MacArthur was invited back to the islands to join the celebrations marking the 15th anniversary of national independence.

More than two million people filled the streets of Manila to cheer the frail old man whom they remembered as their liberator—their greeting, he said, was "overwhelming." But when, on the way back from the scene of his 1944 landing at Leyte, the ship carrying his party neared Corregidor, the old soldier asked that the decks be cleared. As the ship slowed, gliding past the big, silent rock, he wanted to be alone. □

SACRED PEAKS OF THE ANDES

Article and photographs by
JOHAN REINHARD

In the path of his ancestors, a pilgrim braves the 16,000-foot slopes of Colquepunku near Cuzco, Peru, to honor ancient deities that still reign over daily life. Since before the time of the Inca, Andeans have worshiped the mountains themselves as gods.

THEY LIVED AT THE MERCY of the soaring peaks, and they knew it. The magnificent Inca acknowledged a power surpassing their own—the mountains themselves. And on pinnacles piercing the skies of Bolivia, Argentina, Chile, and Peru, they made obeisance and even living sacrifices. For the mountains were not merely the home of the gods: They literally were the gods and could kill with avalanche, rockfall, lightning, blizzard, and wind or bless with rain-filled clouds pouring life into rivers and lakes. Some Andean people still regard the mountains as their actual ancestors. Many call them "father."

It didn't take me long to understand why. As a cultural anthropologist, I have spent the greater part of the past 12 years studying high-altitude ceremonial sites in the Andes. During that time I have made more than a hundred ascents above 17,000 feet, and the more time you spend with a mountain, the more it seems alive. You begin to personalize it. "I'm not going to let it beat me," I would sometimes think as I forced myself to push on toward the looming summit. I could feel the mountain resist me; after hours of climbing rocky, desolate slopes alone with the buffeting, whistling wind, I could sense its changes of mood. Many times, climbing at these altitudes, I would have the uncanny sensation that someone was with me.

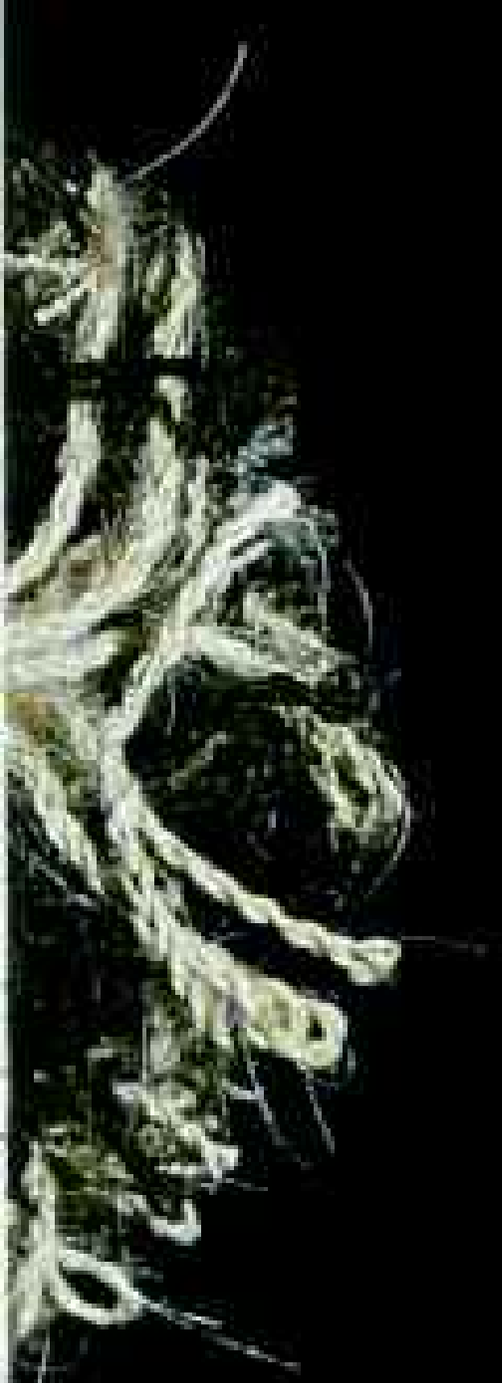
A RESEARCH PROJECT SUPPORTED IN PART BY YOUR SOCIETY

As I climbed, I couldn't help marveling at the Inca genius for mountaineering. Every time I discover a ruin atop some pinnacle, I'm filled with admiration. Not only did the ancients climb peaks more than 22,000 feet high—heights that wouldn't be scaled again for another 400 years—but they also managed, with extraordinary logistic skill, to build ceremonial centers there.

It is apparent that they built base camps and additional camps ascending the mountain,

At 22,000 feet an Inca ceremonial platform near the summit of Llullaillaco is the world's highest ritual site. By investigating scores of such Andean peaks, the author has helped pioneer the field of high-altitude archaeology and gained new insight into Andean religion and folkways that have persisted for centuries.

CHILEAN MUSEUM OF PRE-COLUMBIAN ART, SANTIAGO



The deep freeze of high altitude perfectly preserved the ceremonial garb of a silver goddess created 500 years ago. Buried as an offering on Copiapó, the statuette is one of several discovered throughout the Inca Empire. Even rarer is the tightly woven clothing brightened with vegetable and mineral dyes, a fine example of Inca weaving.

Except for the plumed headdress, the clothing is the same as an Inca woman's everyday wear. The bordered dress is wrapped around the body, with the upper edges pinned over the shoulders. A patterned sash is then wound around the waist and tucked. Finally, the brilliantly edged shawl is pinned in front.

A male icon carved from a spiny oyster shell 500 years ago was excavated on Copiapó. Shell was believed to invoke the ocean, source of all water, to bring rain.

ANDEAN PEOPLE, MOUNTAIN GODS

The Spanish called them cordillera, or knotted rope. The Andes stretch 4,700 miles along the western edge of South America, the world's longest mountain chain above sea level. Second only to the Himalaya in average height, Andean peaks reach more than 22,000 feet. By 3000 B.C. early inhabitants were farming tubers and grains at nearly 13,000 feet. The influence of the Chavín culture, dominant from 900 to 200 B.C., spread throughout the central Andes. The Chavín was followed by the Nazca and Moche cultures, from 200 B.C. to A.D. 600, and the Huari and Tiahuanaco, from A.D. 100 to 1000. About 1200 the Inca people set up their capital at Cuzco and became dominant by the mid-15th century. They defeated the Chimu, their last rival, in the 1470s. The mountain-worshiping Inca controlled a vast but short-lived empire—Spaniards conquered them in 1532—and left offerings on peaks along the Andes. Today's Andeans continue to worship mountains, awaiting the gods' blessings.

A llama figure of shell found on Copiapó was likely offered to entreat water from the mountain deities and to increase the size of herds.

normally within sight of each other. Deep deposits of ash indicate that they transported vast quantities of wood for burning. The trails connecting the ruins demonstrate that the Inca ferried loads of building materials on repeated trips—at one 20,700-foot site, some experts estimate that men would have had to make more than 4,500 carries from 300 feet below. The highest archaeological site in the world sits at 22,000 feet, near the summit of Llullaillaco between Argentina and Chile.

The Inca established an empire spanning nearly 3,000 miles that flourished for a mere century before the Spanish conquest of 1532. The ritual sites they built in such arduous terrain remain an epic feat of civilization, as awesome in its way as the building of the Pyramids.

Yet as powerful as they were, the Inca also feared the mountain gods. Why did they brave their wrath to build on their very crowns?

Wresting offerings from the mountain that held them for five centuries, an excavation team on Copiapó discovers simple gifts such as bits of wood, bones, and nuts that the Inca buried during stages of the ritual platform's construction. These findings, along with more precious items including two shell icons (map, opposite), suggest that the Inca offered objects important to them as well as icons of the gods they beseeched to fulfill their wishes.

DURING my years of exploring these windswept sites, that question lingered in my mind. I have found rare and precious objects whose meaning we cannot yet fully comprehend: figurines still fully and elaborately clothed in superbly woven miniature garments, statuettes of intricately worked gold and silver, and the remains of human sacrifices. And I have learned that past and present in the Andes are inextricably interwoven. Fabled sites emblematic of Andean cultural development over 3,000 years—Chavín de Huántar, the Nazca Lines, Tiahuanaco, and Machu Picchu—have long intrigued Western observers. But my experiences both at excavations and in the villages and cities of today vividly demonstrate that much of modern Andean life is based on fundamental beliefs also held by the Inca and even their predecessors. More important, those beliefs were the principal reasons for building these crucial sites.

I saw this connection between past and present one day when I was trekking to the Chilean village of Socaire. I passed a man leading his donkeys to a nearby lake. When I mentioned I had scaled mountains in the area and found ceremonial ruins on their summits, he looked at me strangely. "In a few days we too will be worshiping the mountains," he said. "We have to clean the irrigation canals, and before beginning the work, we make offerings to the mountains, asking them to send water for our crops and livestock."

This was the clue I was looking for. Archaeologists had assumed the Inca had built their high-altitude sites primarily to worship the sun, but it also made sense that the ritual structures were intended for venerating the mountains themselves. The mountains control the weather, which provides water, which induces fertility. But they can be capricious. In 1983 one 15-minute hailstorm near Cuzco, Peru, destroyed 90 percent of the maize crop, 75 percent of the fruits, and 100 percent of the beans and gourds.

The mountains still demand respect. "Illimani controls the weather," an Aymara

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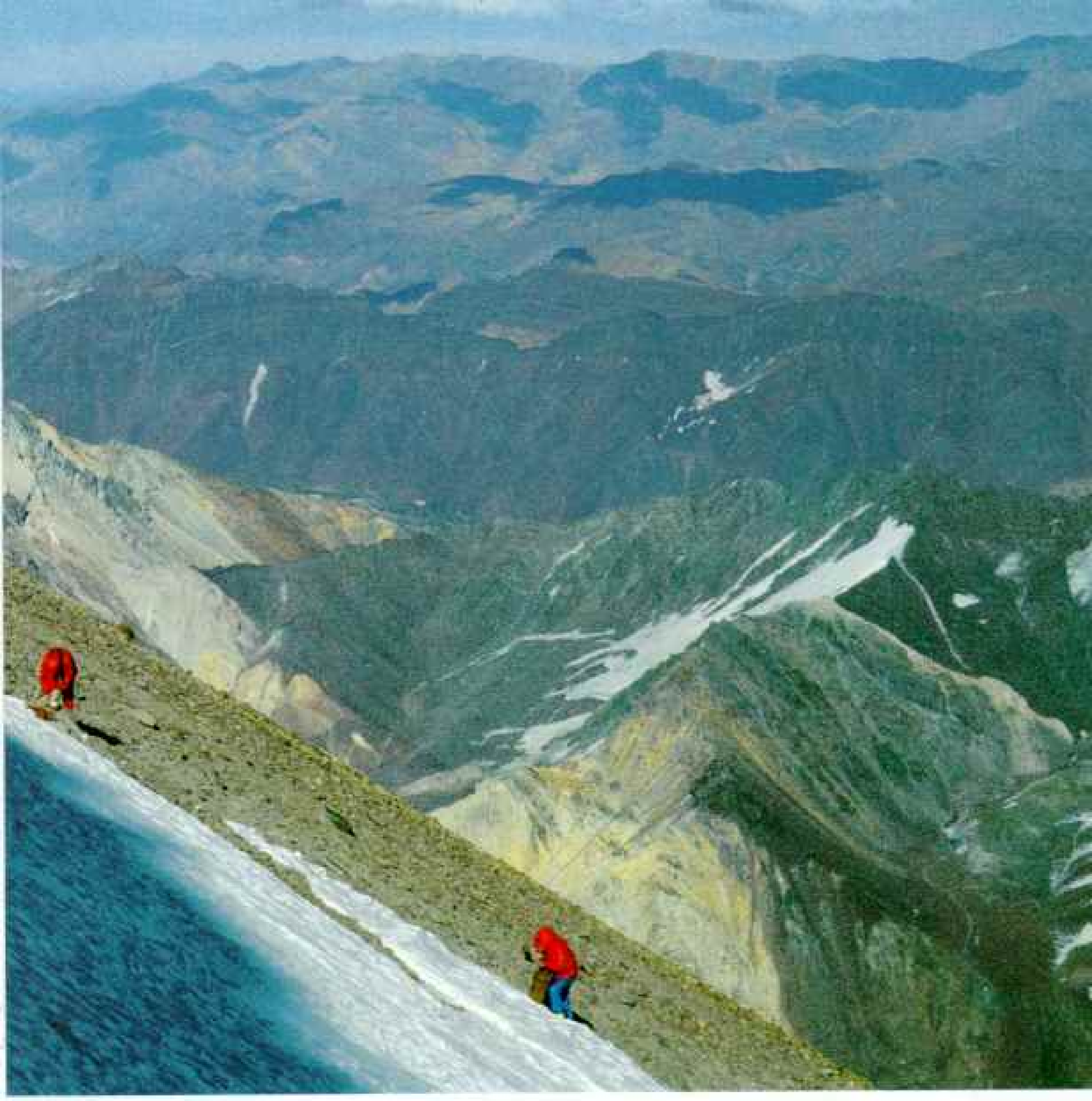
A research associate with Chicago's Field Museum of Natural History, American anthropologist JOHAN REINHARD is based in La Paz, Bolivia. This is his first article for NATIONAL GEOGRAPHIC.

Sport climbers labor up a ridge of Aconcagua—highest peak in the Western Hemisphere—to enter heights where the author has set up camp for archaeology. Frigid streams (inset), sudden storms, and altitude sickness threaten those who aspire to reach the high Andes offering sites.

villager told me in Bolivia. "He is the chief, the one to ask for favors." The villager was referring to a mountain noted by the Spaniards as being one of the region's most important deities and still called the "king of the mountains." So in the middle of a rainy September night I went with some *yatiris*, or ritual specialists, to the foot of two 300-foot waterfalls spilling from the melting glacier on Illimani. The yatiris were carrying offerings of beer, a llama fetus, cigarettes, incense, bread, candy, coca leaves. "We are making these offerings to Illimani," they told me, "so that he will supply water for our fields."

Documents left by Catholic priests in the

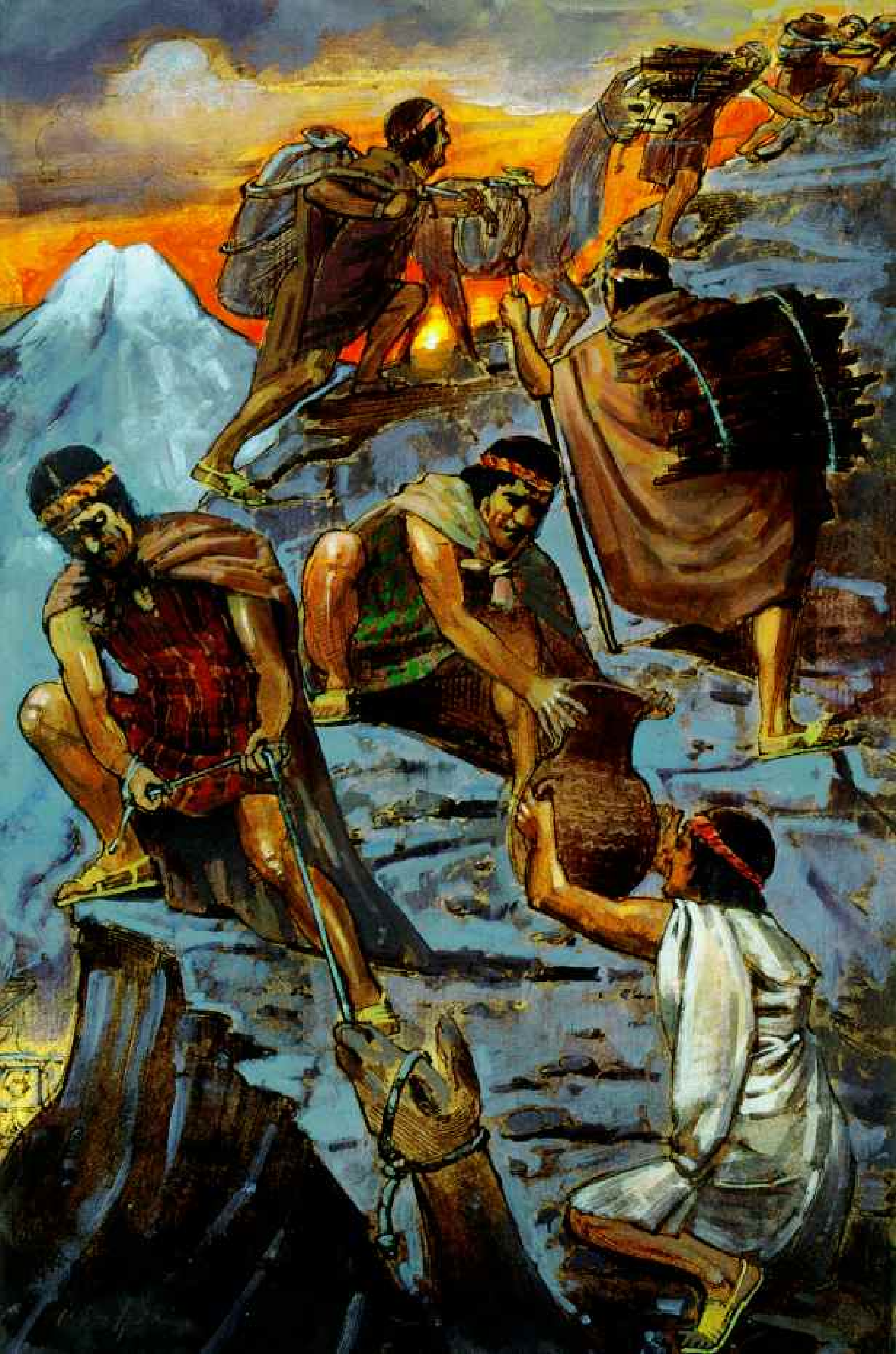


16th and 17th centuries list the major Inca deities and sacred sites; they also indicate that mountains were consistently important objects of worship. And as the Spaniards took their idols, the Indians laughed. "Don't you get tired of seizing them?" one man asked a priest. "Well then, take this mountain if you can, for it is the god that I worship."

I BEGAN TO APPRECIATE that the landscape was not merely a region of challenging topography but actually a complex religious map. Mountains were spiritual landmarks fraught with magical significance. Mountain worship was evident not simply when I was digging ancient sites but also when I looked at daily life.

There are the ever growing trailside cairns, to which people routinely add a stone to invoke safe passage.

Anthropologists estimate that more than a thousand *curanderos*, or healers guided by the mountain deities—many times the number of modern health workers—practice their art in Cuzco, once the Inca capital. The Cuzco market sells plenty of the small sacrificial bundles, called *despachos*, like the ones the yatiris had taken to Illimani. These may contain such items as starfish, cookies, minerals, miniature metal figurines, seashells, incense, llama fat,



and coca leaves and are remarkably like the offerings I have dug up from centuries-old Inca ceremonial platforms on the peaks.

In Bolivia schoolchildren have painted their names on a boulder just below the 17,667-foot peak of Tata Sabaya. "Yes, I know why they wrote them," a villager told me. "They were asking Tata Sabaya for good grades."

At a Bolivian rock quarry I watched the workers sacrifice a bull to a stone covered by a poncho, which represented the mountain, "so that it will continue to provide us with stones and not cause accidents."

One year I trekked with thousands of pilgrims to the base of the glacier north of the peak called Ausangate for the festival of Qoyllur Rit'i (Star Snow, for the glacier's snow and the rise of the Pleiades). "We are making these offerings to the great Ausangate and other *apus* [mountain deities], so that they will give us more potatoes and livestock," one villager explained. Men also hacked glacier ice to melt for use in rituals and to cure illness, for the mountain's water contains its sacred power.

And in isolated areas the *tinku* persists, the ritual battle once widespread in the Andes. In the Bolivian town of Toracari, I watched people form bands and fight one another with fists, feet, and sometimes stones. "The blood that is shed and the lives lost are offerings to Pachamama [Earth Mother] and the mountain gods," one villager explained. "The more of it, the better for the harvest."

THE FIRST REMAINS of human sacrifices I found were near the summit of Pichu Pichu in southern Peru. Blood, of course, has always been the most powerful offering; the remains of llamas have been recovered at some Inca ceremonial sites, and I have heard that even today human sacrifices are occasionally made. Writer Patrick Tierney, who investigated these practices in the 1980s, believes that "human sacrifices are a regular seasonal occurrence in the Lake Titicaca area."

Still, I wasn't actually looking for human remains. I was working with a team of Peruvians from the Universidad Católica Santa María in Arequipa, which included archaeologist José Antonio Chávez. We were excavating a six-foot-deep ceremonial platform frozen so hard that days of work with picks had barely scratched the surface. Suddenly I heard someone shout: "A burial! There is a body here!"

Inca priests and porters leading provision-laden llamas faced death from falls and exposure as they forged up mountain trails to the summits. Having to make repeated ascents with all the logistic problems of staged resupply, they built rock shelters along the way. They also packed in great quantities of firewood, some of it still in place although blasted by centuries of wind (below).

PAINTING BY DANIEL MAFFIA (OPPOSITE)

During the next two days we carefully freed the remains of a young woman, about 18 years old, along with wooden vases, copper shawl pins, beads, a wooden spoon, a ball of thread, and the remains of a comb. As I brushed away the sand beneath her ribs, a strong, rank odor of decomposed flesh compellingly reminded me that she had been a real person.

The woman had clearly been brought here to be sacrificed. From what we know of Inca customs, we can suppose she belonged to a middle- or high-status family, she had no physical blemish, and she climbed to the summit for the ceremony. Nothing remained of what she was wearing, but Inca women had fairly standard attire: a dress, belt, mantle or shawl clasped by a pin, and sandals.

A medical examination indicated that she may have been killed by a blow to the head, though the Inca often strangled or smothered their victims.

She had been buried just below the surface—perhaps they had found the platform as frozen as we did—so her remains were not as well preserved as the deeply buried, frozen bodies exhumed by Argentine archaeologist Juan Schobinger on the mountains of Aconcagua and El Toro (pages 102-103). It is common to refer to the frozen bodies of sacrificial victims as "mummies," though the bodies had been preserved by the intensely cold and dry air, rather than by embalming.

Pipes trill and drums echo across the Sinakara Valley as Indians from the Cuzco region gather at the Qoyllur Rit'i, or Star Snow, festival—a ritual of purification and transition.

Nimble fingers of young weavers (top) construct tiny looms to entreat the mountain deities to bless their craft. A costumed dancer, or qolla (above), represents a llama herder, caretaker of the Andean beast of burden.

United beneath the cross, pilgrims at Qoyllur Rit'i—held just before the Catholic feast of Corpus Christi—pray to many gods. Ancient beliefs have blended with Christian ones, and the cross has come to symbolize mountain deities as protectors of crops and communities.

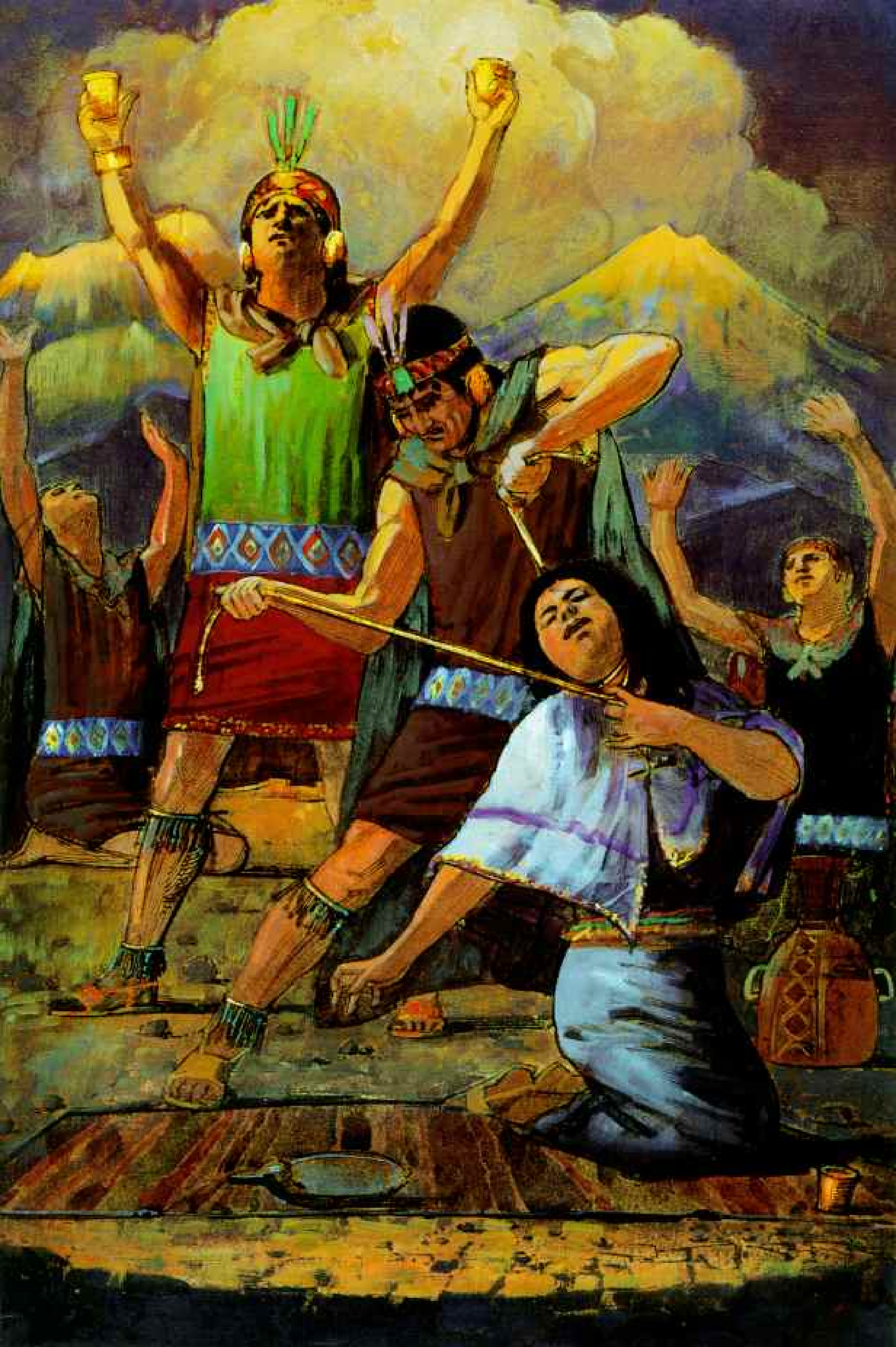
An ukuku, or bear man, secures ice from a glacial cave. As part of the mountain's benevolence, the ice and its water promise healing powers for his village.

On the other hand, the girl from Pichu Pichu was mostly intact. A few years earlier I had joined a team led by a pioneer of high-altitude archaeology, Argentine Antonio Beorchia Nigris. He wanted to recover the body of an Inca child he had seen some years before frozen in the ice near the 20,112-foot summit of Quehuar in Argentina. I was working in a circular stone structure when I uncovered pieces of cranium plastered against the wall and felt something soften with the warmth of my hand. It was an ear; impatient treasure hunters had blown up the site with dynamite. It was ironic as well as tragic, for they had destroyed something more valuable than anything they could have dreamed of finding.

We're still discovering their value, but these mummies have been a bonanza for paleopathologists, who have been able to establish blood types, examine diseases, and identify what food was eaten before death.

"I'd never seen anything so exciting," Canadian paleopathologist Patrick Horne told me. Gold? No, he was discussing a virus, the first one found in an ancient mummy. He had discovered the virus that caused warts on a mummy found on El Plomo, proving for the first time that viruses existed in the New World prior to the arrival of Europeans.

The Inca made human sacrifices on



summits on special occasions, which included the worship of the mountain deities. Children, ideally without physical imperfections, were offered, sometimes with the blessing of their parents. Inca believed this sacrifice brought honor to the parents and an afterlife of bliss for the child. According to Hernández Príncipe, who wrote in the early 1600s, a girl of ten sacrificed north of Lima, Peru, told the Inca priests, "Finish with me now, because the feasts they held for me in Cuzco were enough."

THE MORE I CLIMBED, the more I began to realize that the sacred mountains are literally related to one another. Though they are considered male or female, they often have both aspects. Many Aymara villagers believe Bolivia's highest peak, Sajama, to be the brother of the Illampu-Ancohuma massif. Legends of the mountains' exploits are common. A villager in Isluga told me why Tata Sabaya has a notch between its two summits: "His tooth was knocked out during a battle with the mountain Sajama."

Because of the role mountains play in making weather, especially by affecting the circulation of water, lakes are often regarded as the consorts of the mountains. Lake Titicaca, at 12,500 feet the highest navigable body of water in the world, is viewed by some Aymara *campesinos* as the wife of Illampu-Ancohuma. The Inca also regarded Titicaca as sacred, for several reasons: They believed that both man and the sun originated in the lake, which was a highland manifestation of the ocean, mother of all water.

The Island of the Sun in Lake Titicaca was one of the greatest Inca ceremonial centers, and it would be natural to expect to find more offerings there than elsewhere. I had heard stories of underwater ruins, and Japanese divers in 1977 and 1988 recovered some artifacts from an underwater ridge in the lake near the island: unusual carved stone boxes, some containing Inca statues. Even more interesting, they also found parts of incense burners from nearby Tiahuanaco, the center of an important civilization that had dominated the central Andes for nearly a millennium before the Inca. But the divers left no records, and we had to start over.

Our finds at first were unremarkable—more stone boxes and pieces of Tiahuanaco incense burners. But early in 1991 I was working some 30 feet underwater, brushing silt from the bottom to uncover the head of a puma on a ceramic incense burner. The sand shifted beneath it. I felt something metallic, round and smooth. Even in the dim underwater light it gleamed as if new. At first I thought a tourist had tossed a can overboard. Then I realized that I was holding a Tiahuanaco beaker made of gold. Only a few of its kind exist. The next day my teammate, conservation specialist Eduardo Pareja, topped that when he discovered a gold medallion with an exceptionally fine engraving of the "gateway god" (page 108), a deity depicted on the famous monolithic gateway at Tiahuanaco.

PAINTING BY DANIEL MAFFIA (OPPOSITE)

Passion fired by religious devotion, Inca priests offer the ultimate sacrifice—human life (opposite). Physically perfect children and youths were selected—sometimes with parental blessings—as offerings to the gods during times of crisis such as drought. After 500 years the remains of a young woman were found buried beneath Pichu Pichu's summit in southern Peru (above).

Sacrificial victims, typically buried in a sitting position, are often mummified by the antiseptic altitudes. Only the top of a youth's skull (left) protruded from the site where his frozen body was excavated on El Toro.

Argentine archaeologist Juan Schobinger unearthed a young boy whose skull was partly exposed on Aconcagua (right). The child (below) may have been strangled. Victims were sometimes drugged and buried asleep.

JUAN SCHOBINGER

Over the next weeks we recovered our first unopened stone boxes. One contained two gold and two silver Inca male statues; the other a gold male figurine with diadem and a silver llama statue. More than 25 boxes have been found at the site, but most of their contents had been looted. Each box must have held at least a couple of statues.

The real find, however, was the tangible link between the Tiahuanaco culture (A.D. 100-1000) and the Inca, who followed soon after. It seems clear that the ridge was a place to worship a deity, or deities, associated with Lake Titicaca during both the Tiahuanaco and Inca periods, demonstrating a continuity of basic beliefs lasting more than a millennium.

Even today villagers lower offerings onto the lake bottom to implore the lake and mountain deities for success in fishing and fertility for crops and livestock. "We call the underwater ridge the Altar of Viracocha," a villager told me on the Island of the Sun. "That is why we do not cross over it with our boats." Viracocha was the Inca creator deity associated with Lake Titicaca and water and mountain cults. He was worshiped on the Island of the Sun.

TRADITIONAL BELIEFS and Christianity seem to coexist quite happily in most regions. Andean people see no contradiction in worshiping mountains and Jesus Christ. "God is distant," one villager declared, "and we must deal with his intermediaries, the mountains."

In some areas the cross has lost its link to Christianity and is thought instead to represent the spirits of the land and to act as a protector for the crops. But for the perfect joining of Christian and pagan beliefs, it's hard to beat what one villager in southern Peru told me: "Saint Peter holds the key," he said, not to the Christian heaven but rather "to enter the world of the dead in Nevado Coropuna."

Mountain gods can appear to people during journeys, but more often they do so in dreams. Though they often take the form of animals, especially birds such as the condor, they can also appear as people, and that includes

Blow by thunderous blow, a condor tries to bat itself free of a frenzied bull's back. Onlookers cheer it on in Cotabambas, Peru. Tethered by thongs sewn through the bull's hide, the bird, symbol of the mountain gods, seems to dominate the bull, symbol of the Spanish conquerors.

Honored with a banner and maize beer, or chicha (top), the exhausted condor is freed (above) by Andeans proud of its trial by ordeal.

While ice-bound mountains (opposite) were honored as the most sacred of Andean geography, Lake Titicaca and its Island of the Sun (left) ranked high among holy places in the Inca Empire.

The Tiahuanacans also made offerings to the deities there. Conservation specialist Eduardo Pareja (below, left) raises a golden Tiahuanaco beaker discovered by the author on an underwater reef off Koa near the Island of the Sun.

EDSAT CORPORATION (OPPOSITE)

anyone from young children to old men, and not infrequently Westerners. One day, when I mentioned that I had just come down from a mountain, a young man looked at me closely and remarked, "The apus [mountain gods] can sometimes look just like you."

The locals rarely climb. In some areas it is difficult for the villagers to believe that mere humans could reach the summits, even if they were fool enough to try. I was having something to eat in a simple restaurant in the village of Socaire in northern Chile and fell into conversation with an elderly gentleman. When I mentioned my recent ascent of Chiliques—18,957 feet high—he gave me a highly skeptical glance. "*Dios mio,*" he replied, "I am most pleased to meet you. Allow me to introduce myself; my name is Jesus Christ."

The risks are certainly real. Storms can come up out of a virtually clear sky; lightning will strike, and several times it nearly got me. Once I was climbing to the summit of Tata Sabaya with a local man. He had just explained how the mountain would eat people for a meal when I heard what I thought was the self-timer on my camera make its zinging sound. It wasn't. Suddenly I realized that static electricity in the air was making the camera play an off-key tune. The electricity had to be building to a dangerous intensity.

I yelled "Down!" and we began to run down the mountain. We had scarcely descended a hundred feet when there was a massive thunderclap, and we were knocked momentarily unconscious. I came to, turned and asked, "Do you think it is time to go down?" He gave me an incredulous look that plainly said, "Of course, you gringo fool!"

The wind on the summits can also become ferocious; I've seen a teammate's tent fly away, which could be funny except that a night spent in the open tempts death from exposure. I carefully monitor the weather, particularly the clouds and the wind, but it is easy to become overconfident. You begin to think you're in control, and suddenly you're not.

And there is the mental discipline that's crucial as the air thins and the brain is starved for oxygen. Thoughts become disjointed. I set goals for myself: counting steps in groups of a

hundred to measure my progress, because often the summit is invisible. Or I try to maintain a rate of a thousand feet an hour. It is important to get up the mountain quickly to allow myself extra time to pause if I discover something on the way or when I reach the summit; I may even find I need to go to the other side of the peak, which could be miles away.

And although it is mentally taxing at 20,000 feet, I force myself to pause and look back at least once an hour to memorize the terrain below me, so I can picture it accurately for a safe trip down. I make a mental note of likely places to take refuge if a storm should suddenly come up. I notice swaths of scree, which is hard to climb but perfect for a fast descent. And with my dread of spraining an ankle on unknown terrain, I also watch the clock. I don't want to get caught in the dark.

Strenuous as the climbing itself always is, excavation work is even more demanding at these altitudes. A Swiss-Chilean team I led spent a total of 12 days on the 19,855-foot summit of Mount Copiapó in Chile and devoted at least 200 man-hours of work to excavating a platform that was only six feet deep and roughly 26 feet by 13 feet. The ground was as hard as rock, making progress maddeningly slow. The cold was often intense, and the altitude exacerbated our physical fatigue. Everybody seemed to find a reason to work with a trowel rather than a shovel.

Before some climbs, I have invoked the name of the mountain and made simple offerings, usually sweets, and poured out a small libation of liquor onto the ground. It is a form of meditation for me, and in the process I've gained a sense of respect for the mountains and even, to a degree, a personal relationship with them not unlike the Andean tradition. This isn't especially odd; most climbers have experienced at times a special closeness with the mountains, and some have had what might be called religious experiences on them. Like most Western climbers, I am prone to approach the mountain as if it is something to be attacked and conquered. Performing a simple Andean ritual, I have found, makes me feel more at ease when looking for ancient sacred sites.

Hammered pinpoints release the golden stare of the "gateway god" (far left), a primary Tiahuanaco deity. The 1,500-year-old pectoral disk, one of the finest pieces of Tiahuanaco goldwork known, may have been worn by a priest who offered it in that drier era when the Koa reef was still an island.

A rare gold beaker (right), delicately crafted from sheets of hammered gold to hold ritual libations, was retrieved from the same reef.

Even after the reef was submerged, the Inca continued Tiahuanaco religious practices by making offerings at the site.

Such ritual was described in 17th-century Spanish chronicles. They also recounted the orders of one Inca ruler that his minions carve boxes of stone, fill them with offerings, and lower them onto the reef.

Many of the andesite boxes were later found and looted, but the author and his team discovered two intact. Inside one (left), whose corner and lid barely protruded from the sand, they found two inch-high gold male figurines (above left). Their elongated earlobes were a signature of the Inca elite who offered the icons five centuries ago.

I SUPPOSE IT WAS INEVITABLE that my research would lead to one of the most famous sites of the Inca Empire: Machu Picchu. It ranks as one of the great mysteries of South American archaeology. "We do not know why it was built where it was or what the site meant, and we probably never will," said archaeologist Manuel Chávez Ballón in Cuzco.

In any ultimate sense he is probably correct, for no historical accounts have been found to explain it, and little insight can be gained from the people who now populate the area. But when set against the background of Inca concepts, there are other kinds of information in the ruins and surrounding terrain.

In 1983 I hiked to Machu Picchu along a portion of the famous Inca Trail. At Phuyupatamarka—a ceremonial stopping point on the way—I could see that the ruins provided a perfect setting for mountain worship.

As I descended the trail to Machu Picchu, I looked down on its spectacular setting. I was surprised to notice that the site is surrounded on three sides—east, south, and west—by snowcapped mountains, all of which were sacred during the Inca period. Salcantay, one of the most sacred, is still revered today. Machu Picchu lies at the end of a ridge that extends down from Salcantay (following pages).

Then, in 1988, I located Inca ruins and a road section that connected Machu Picchu with a road found by Hiram Bingham (who came upon Machu Picchu in 1911), leading out from Vitcos, one of the last Inca strongholds. Clearly Machu Picchu was not the isolated site that scholars once thought.

The location of Machu Picchu allows for a combination of sacred geography and astronomical alignments that is perhaps unequaled in the Andes. For years the first reaction of visitors to this overwhelming site has been, "Why here?" But a careful study demonstrates that the setting was suffused with significance, drawn from the juxtaposition of powerful mountains and constellations, giving Machu Picchu special ceremonial power. For example, at its highest point during the rainy season, the Southern Cross is exactly above Salcantay. The Southern Cross and

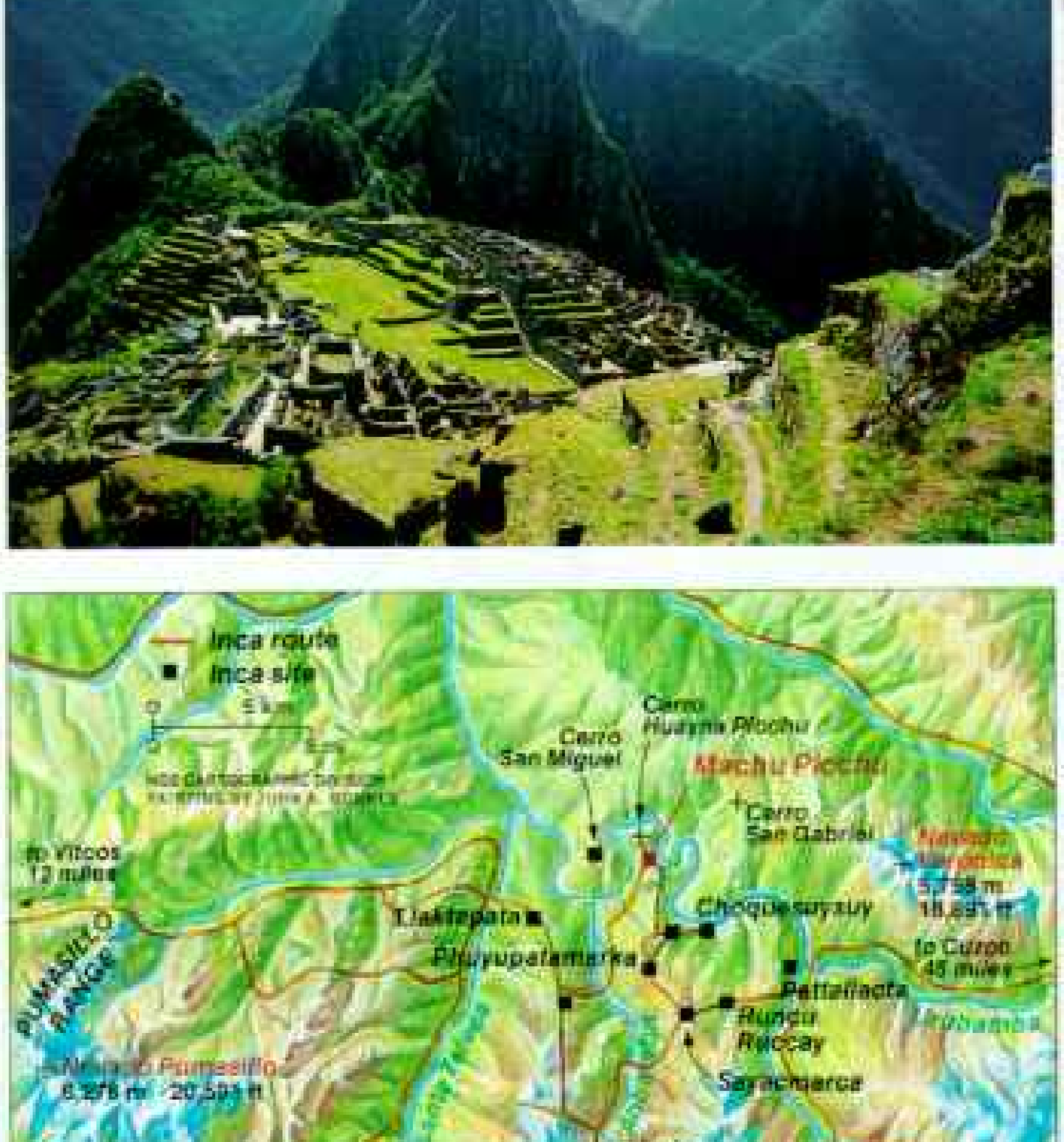
constellations near it are all linked with concepts of rain and fertility, of utmost importance to the Inca.

Looking in every direction from the large, carved Intihuatana stone in the midst of the ruins, one sees mountains that connect with vital forces on earth and in the sky: The highest summit of the sacred Pumasillo Range coincides with the place of the setting sun at the December solstice. This was a particularly important astronomical event for the sun-worshiping Inca, who performed major ceremonies at that time (the onset of the rainy season) for rain and fertility. The summit of San Miguel, at the equinox setting point, has a ceremonial platform containing a sacred rock set upright in its center. The sun rises at both equinoxes from behind the sacred mountain Verónica. Huayna Picchu, the hill that dominates Machu Picchu, has rock carvings that indicate it too had religious significance.

Machu Picchu's setting combines sacred mountains, water flow, and celestial phenomena, especially sun passage, with an economically and politically strategic position between Cuzco and the forested lowlands. Whatever other roles it played, Machu Picchu was certainly a sacred geographic center.

IN BUILDING THEIR EMPIRE, the Inca not only reached far more mountains, at greater heights, and constructed more complex ritual sites than any previous Andean culture, but they also performed regular ceremonies on the summits. And they did not do this to supplant local practices but to expand on them, adding worship of their principal deities, such as the sun, in the process. In doing so, they gained greater political, economic, and religious control over the people and land they conquered.

No center would have existed in a sacred geographic vacuum. "You must understand," said a villager in northern Chile, "for us, the mountains are alive." This belief was shared throughout the Andes and appears to have crossed cultural boundaries throughout three millennia. And, without doubt, the mountains will continue to live for the people of the Andes. □



Holy Inca sanctuary, Machu Picchu (left) sits in what seems to be puzzling isolation. The author, however, finds it central to the region's sacred geography (map.) As seen from Machu Picchu during the rainy season, the snowy summit of Salcantay (above, at right) points to the constellation of the Southern Cross, symbol of water and fertility.

On the December solstice, marking the height of the growing season, the sun sets directly behind western Pumasillo. On the planting and harvesting equinoxes, the sun rises behind Nevado Verónica, east of Machu Picchu. On the June solstice, it rises behind San Gabriel.

Machu Picchu thus stands as a holy hub and compass marking divine influence in the seasons of the Inca.


WaveRunner
CF 1979
YAMAHA

Lake Tahoe

Playing for High Stakes

Business is buzzing at Lake Tahoe. California's sports and Nevada's gambling compete for tourist dollars, but development to support them threatens the famous purity of the lake.

By ERNEST B. FURGURSON

Photographs by GEORGE F. MOBLEY
NATIONAL GEOGRAPHIC PHOTOGRAPHER

BESIDE A SNOWMELT waterfall cascading from a lake set between unnamed 9,200-foot peaks, I stopped, turned, and looked back. That day in early summer the Sierra air seemed as pristine as the cloudless sky. On the granite plateau below, where our horses waited, clumps of columbine, lupine, and the pinkish flowers of dwarf manzanita speckled the jumbled boulders. Far beyond, past stairsteps of other lakes and ridges, stretched Lake Tahoe, a mountain-locked jewel that has defied every effort to describe the pureness of its blue.

Framed by the slopes and slants of California's Desolation Wilderness, Tahoe appeared tilted just off horizontal. It struck me the way it has those who have written about it ever since John C. Frémont spotted it from near Carson Pass on February 14, 1844.

When I saw the lake up close, I had to grope like so many first timers for the right words to tell others about it. I was in a powerboat, cutting through a breeze-blown chop toward the deep center of Tahoe. Beneath the bright mountain sky, it was as blue as the Scripto ink we used as school kids long ago. When I looked north away from the sun, the water changed subtly to cobalt—or was it ultramarine? When we skimmed close to shore in a boat a few days later, I tried turquoise and aquamarine. Then, sitting against a boulder on the Nevada shore as the setting sun cast its benediction on a lakeside wedding, I considered azure and cerulean. The sun dropped, and in the shadow of the Sierra the lake's color

PAUL KURODA

"A fine place this to forget weariness and wrongs and bad business," John Muir wrote of Lake Tahoe. Overlooking the lake's southern shore, packer Jim Hawksworth rests near the summit of Mount Tallac.

deepened, perhaps to indigo or sapphire. I can tell Air Force from Navy blue, and artists know the difference between French, Persian, and Prussian, but no word has come close to capturing and holding still the blue of Tahoe.

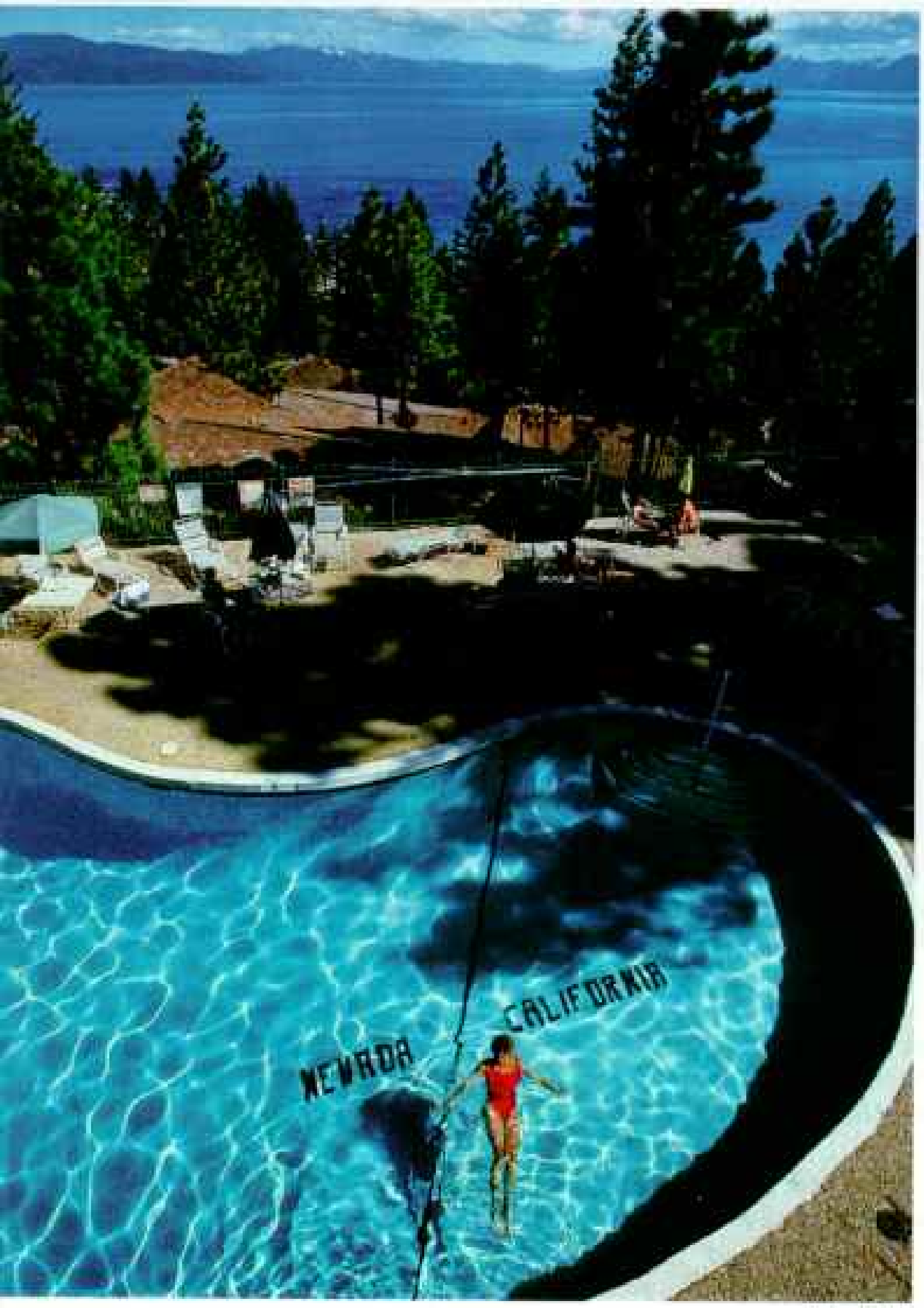
The idea of Tahoe as a Shangri-la high and virginal, a place of escape to the mountains as God made them, survives after almost a century and a half of exploitation. The lake is still breathtaking despite intensive timbering and real estate development. Today bureaucratic machinery has been devised to slow the bulldozers. But no one yet has found a way to make the lake safe from millions who come with nothing greedier than admiration in mind. As the 21st century approaches, Tahoe has become a test case of whether government and private interests, even with avowed goodwill on both sides, can work together to protect a national treasure from a mobile and swelling population.

Soldier-explorer Frémont first saw Tahoe after fighting through snowdrifts up what was probably Red Lake Peak, later writing in his journal that, "We had a beautiful view of a mountain lake at our feet, about fifteen miles in length, and so entirely surrounded by mountains that we could not discover an outlet."

Samuel Clemens, not yet Mark Twain, came later, in 1861. "The lake burst upon

us," he wrote—"a noble sheet of blue water lifted six thousand three hundred feet above the level of the sea, and walled in by a rim of snow-clad mountain peaks. . . . I thought it must surely be the fairest picture the whole earth affords."

I thought so too, seeing it from far up beside Fontanillis Falls. From there, on that quiet day, nothing suggested that the 98 square miles of Desolation had become one of the busiest terrains in the national wilderness system or that, despite the ban on vehicles, some 100,000 hikers and campers would use it before the season was out. And from Fontanillis, I could not see around Mount Tallac to a garishly different world, to the commercial strip that lines the south side of Tahoe barely ten miles away, to the vacation-home development dredged out of the lakeshore, to the wall of high-rise casinos and hotels at the Nevada state line.



RICK RICKMAN

An interstate swim awaits guests at the Cal-Neva Lodge on the lake's north shore. Seventy-two miles of mountain road circumscribe Lake Tahoe, passing through two states and five counties and by countless warnings of "Caution—Falling Rocks."

At the casinos there billboards advertise "Passion: Hot Adult Revue." Inside, amid acres of slot machines and gaming tables, a visitor named Roberta slips a pocketless smock over her clothes and steps into a transparent cubicle. At a signal an electric fan blows greenbacks into the air around her—the Blizzard of Money—and she gets to keep all she can grab in a minute. She squeals as she emerges with $117.

Around her a few curious tourists stop to watch, but the hundreds of serious players do not even raise their eyes. They don't bother to look up through the haze of cigarette smoke to see whether it is night or day; they are oblivious of the beauty outside. At Tuesday daybreak, the games are as brightly lit and optimistic music beats as steadily as at Saturday dusk.

Both John Frémont and Sam Clemens were a bit off in their estimates of Tahoe's size and elevation. It is 22 by 12 miles, the largest mountain lake in North America. Its natural rim is 6,223 feet above sea level, and the peaks around it reach up toward 11,000 feet. The lake has 63 tributaries including the Upper Truckee River, but the lower portion of the Truckee is its only major outlet. Tahoe's maximum depth is 1,645 feet, making it the

Lake Tahoe

FRESHWATER SEA *embraced by mountains, Lake Tahoe fills a basin that formed two million years ago when a valley between two faults sank and was dammed by lava. Tahoe's great depth —1,645 feet—keeps it cold; even along the shore the surface temperature reaches only 68°F. In recent decades nutrient pollution, from such sources as fertilizer runoff and clearing of natural vegetation, has fed growth of algae, clouding the once crystalline lake near highly populated areas.*

ALGAL GROWTH RATE

Low — High

Despite a gradual loss in clarity, Tahoe is still exceptionally transparent relative to other lakes, with visibility ranging from 26 feet to 130 feet down.

Built-up area

National forest land

State park or other state land

Private or other land

Ski area

Recreation site

0 5 km 0 3 mi

NGS CARTOGRAPHIC DIVISION
ALGAL GROWTH RATE SOURCE:
CHARLES R. GOLDMAN, UNIVERSITY OF CALIFORNIA AT DAVIS

continent's third deepest lake. If the basin were emptied, it would take hundreds of years for nature to refill it.

Tahoe was considered sacred for centuries before Frémont passed by. Its waters inspired folktales of the Washoe Indians, who gathered each year at the "edge of the lake," *da ow a ga* in their language; the white man's mispronunciation of it provides one version of how Tahoe got its name. Since Frémont, the same beauty that meant magic to the Indians has meant good times to millions of other Americans.

Because the state line angles right down the lake, two-thirds of Tahoe is in California, the rest in Nevada. That puts it within a four-hour drive for about nine million potential visitors. Droves of tourists came in the decades after World War II; construction of housing developments, casinos, ski resorts, marinas, and roadside businesses boomed. Each project sent more runoff pollution into the lake. By the 1960s this had roused environmentalists, and by the 1980s there were strict limits on construction.

Yet, despite tight building codes, each new groundbreaking still threatens the fragile lake. Though sewage is piped out of the basin, there are inevitable leaks in that system. Timber cutting, although tightly controlled, nevertheless causes erosion. And no matter how strictly building and cutting are regulated, people keep coming. Today their sheer numbers, the crowding, the air pollution from their cars have become the main concern of planners, the reason defenders of the lake think it is still in danger of being loved to death.

THREE HUNDRED THIRTY YARDS off the western shore of Lake Tahoe, near the mouth of Blackwood Canyon, Bob Richards throttled back the custom-made 37-foot *John Le Conte*, named for the Berkeley professor who did the first detailed research on the lake more than a century ago. Richards is field scientist for the Tahoe Research Group, headed by Professor Charles R. Goldman of the University of California at Davis. Assisted by Debbie Hunter, Bob ran a series of tests they have done so often that they proceed like a finely executed drill.

Running bottles and nets into the depths, the scientists check and record the lake temperature and light down to 500 feet and collect algae, zooplankton, chlorophyll, particulate organic carbon, dissolved inorganic carbon, nitrogen, and phosphorus. In each, they look for clues to the future of Tahoe.

For them, it was not a coldly scientific enterprise. Both are so involved in life at the lake that they chose to be baptized there. So did Bob's wife and two daughters. Bob has spent more than 23 years on the lake and at the Tahoe City laboratory, an old cedar-bark-sided fish hatchery where apprentice novelist John Steinbeck put up a business sign saying "Piscatorial Obstetrician" when he was caretaker in the late 1920s.

Debbie Hunter's first memory is of falling into Lake Tahoe and dog-paddling out at the age of three. At nine she had her own little rowboat. Her parents, Ray and Marjorie Fellows, ran a lakeside grocery store, along with six cottages and a pier, at Carnelian Bay for 35 years. She grew up exploring the shore and rowing from settlement to settlement.

To Debbie, defending the lake means restricting how it and the land around it are used. Her father remembers when regulation seemed unnecessary, and he looks at today's red tape as a frustrating hassle and expense. Yet both generations agree that the beauty of the lake that brought them there is still what matters most.

Bob idled the research boat around so its starboard gunwale shaded the lake surface beside one of the winches. Leaning overboard, he fed what looked like a white Frisbee weighted by a lead ball into the water and watched as it dropped into the depths. This was a Secchi disk, devised by the Italian scientist Pietro Angelo Secchi in the mid-19th century for research by the papal navy. John Le Conte had used an ordinary dinner plate in his study of the lake. Checking how far down the disk can be seen is a simple way of gauging the clarity of a lake or an ocean.

Bob and Debbie each held up a clipboard to cut the surface glare as the ten-inch disk descended. When it disappeared, Bob moved it up and down to mark where it reappeared: 26.5 meters, or 86.9 feet. To avoid influencing Debbie's reading, Bob did not disclose his own until she had recorded hers, at 26.25 meters, less than 10 inches of variation.

Le Conte had marveled that he could see his dinner plate 108 feet down. Sam Clemens was

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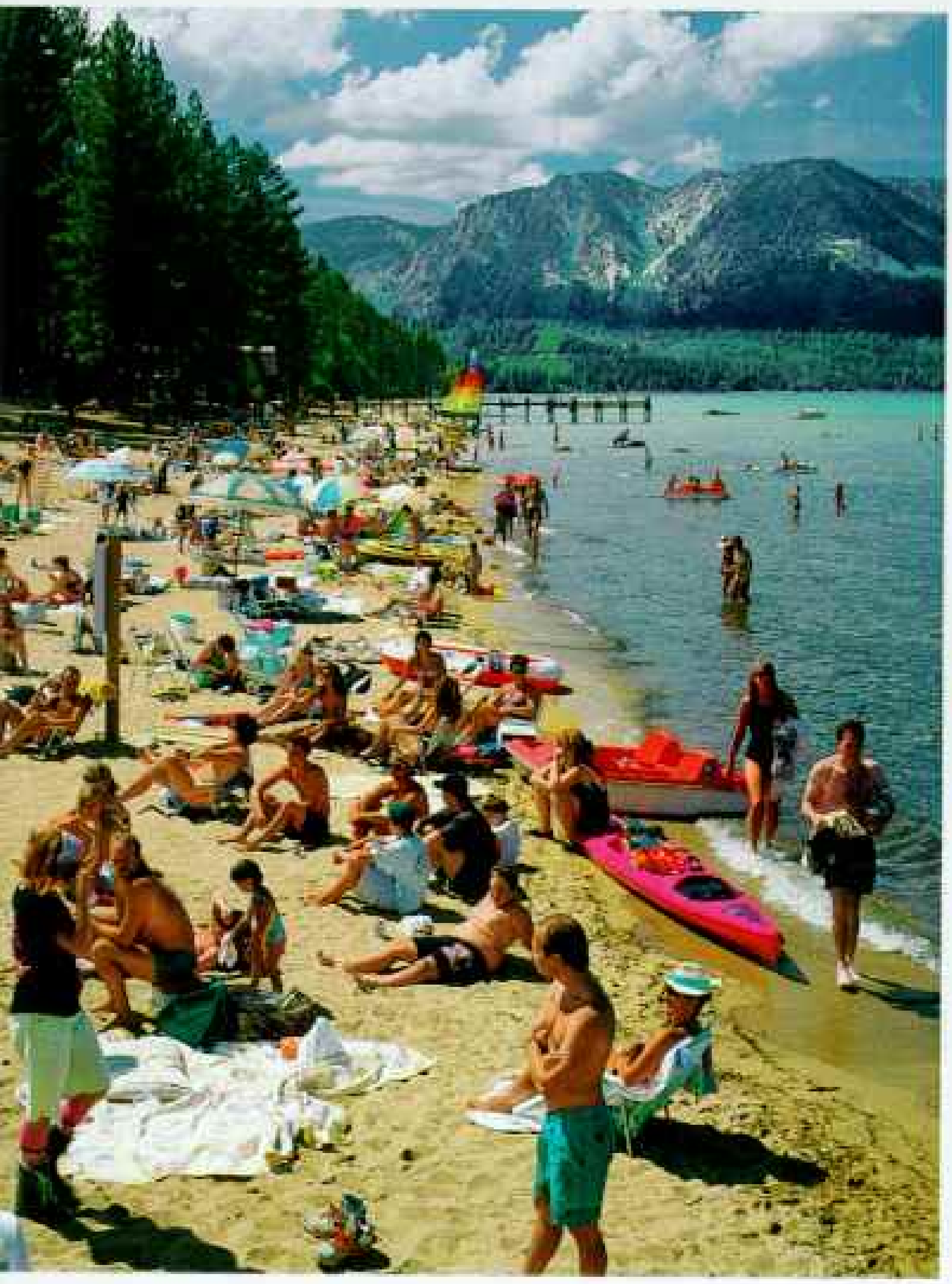
ERNEST B. "PAT" FURGURSON, a Washington, D. C., journalist, has just completed *The Souls of the Brave*, a book on the Civil War battle of Chancellorsville.

High-rise casino hotels loom at Stateline, Nevada (above), where gambling and entertainment help lure two million visitors a year. "Tiger Pete" Renzo (below) hopes to start his own club there, featuring wild animals and disco music. Renzo's family shares its home with Sabre, a "thousand-pound house cat" who has his own bedroom but sleeps anywhere he wants to.

Easing its way through an ancient pine forest, a remotely operated vehicle prowls the lake bottom off Baldwin Beach. Scientists believe that stands of 6,000-year-old tree stumps chronicle a time when drought in the region lowered Tahoe's water level.

EMORY KRISTOF, CHRIS NICHOLSON, JEFF LEDDA, DEEP SEA SYSTEMS, INC.



Man and nature both have changed Tahoe; drought has dropped lake levels seven feet in five years, widening the beach at Camp Richardson (above). In the early 1960s the area's largest wetland was dredged to build Tahoe Keys (above right). Now silt has drifted into lake shallows, and marsh wildlife no longer returns. "It's an ecological disaster area," says a resident, "but with good restaurants."

more rhapsodic: "Every little pebble was distinct, every speckled trout. . . . So empty and airy did all spaces seem below us, and so strong was the sense of floating high aloft in midnothingness, that we called these boat excursions 'balloon voyages.' "

Arguments drag on over the effect on Lake Tahoe of storm and drought, road and home construction, marina dredging and motorboating, air pollution from traffic inside and outside the basin. These activities feed nutrients into the lake, cutting its clarity, slowly turning it from blue to green as algae grow in the waters.

To the casual eye, the day-to-day change is imperceptible. As Bob says, "If you drop a frog in a pot of boiling water, he hops right out. But if you drop him in cold water and turn up the heat gradually, he doesn't realize that he's cooking to death." To the meticulous scientist the long-range trend at Tahoe is clear from the three decades of studies conducted by Charles Goldman and his research group. And the one indicator that everyone understands is Bob Richards's white disk, disappearing into the blue lake.

ALTHOUGH volcanic activity and glaciation brought Lake Tahoe to roughly today's form, geologic and archaeological evidence shows that the lake level never has been constant.

Snorkeling, archaeologist Susan Lindstrom has located about 25 ancient tree stumps preserved beneath the cold, clear water off the south shore. "Carbon-14 dating shows the trees lived between 4,800 and 6,300 years ago," she says. Their presence nearly 13 feet below the lake's natural rim suggests that there was an extended period of drought; perhaps for centuries there was no outflow at all.

Susan says studies of lake-bottom sediment demonstrate that "human impact through all the centuries, including decades of clear-cut logging, was trivial compared with what recreational development alone has done over the past generation."

The current drought conditions have exposed indentations in bedrock along the western shore—mortars in which the Indians ground food. But so far no one has found more than traces of human activity before Frémont's visit. As late as mid-century, Tahoe still did not appear on most maps of California. What finally put it there was the 1859 discovery of one of the world's richest silver deposits, in the Comstock Lode in the Nevada hills. Soon mine operators had used up all the available timber in the area and demanded more from around Tahoe.

In little more than a quarter century, enough Tahoe forest was cut for mine timbers in the Comstock Lode to have built a city of

A burn boss fights fire by firing dry brush left after a government timber sale. No commercial logging is permitted in the Tahoe basin, but insect-damaged trees, plentiful since the drought began, are often felled by the U. S. Forest Service for salvage. This sale netted 1.4 million dollars.

200,000 people. By the 1890s the basin had been nearly denuded. As the Comstock was mined out, business grew around the lake, with portents for the future: Rich visitors came to rusticate in high style, and thirsty Westerners tried to tap the lake for their own use.

Almost 30 miles from where the Truckee River leaves Lake Tahoe, federal watermaster Garry Stone sits in his Reno office and touches a series of buttons on his telephone. Moments later a computer voice tells him the current level of the lake: precisely 6,222.71 feet, almost 3½ inches below the natural rim. That was its high point last year, when for the first time on record Lake Tahoe failed to reach the natural rim even at the peak of snow runoff in late June. Had the lake exceeded 6,223 feet, Stone could have released some of that water downstream.

In 1915 a federal court placed Tahoe Dam under U. S. government control. Up to the level of the natural rim, Tahoe water is unavailable for downstream use by the cities of Reno and Sparks or nearby Nevada farmers; the six feet between that level and the top of the dam can be released by the watermaster as needed to maintain court-decreed rates of flow on the Truckee. In dry periods the state still looks at the lake as a great untapped reservoir in the sky—its capacity of 122 million acre-feet is more than four times that of Lake Mead, the world's largest man-made lake.

Within the basin itself, a compact forged some 20 years ago by California and Nevada has settled, or at least found a way to manage, competing claims on Tahoe water. The struggle in the basin now is mainly over the quality of that water.

Environmentalists have actively opposed logging and building, and some landholders

complain about controls and regulations. Mike Fluty, a Placer County, California, supervisor, asserts, "If you want to sneeze, you need a permit in this basin." Norman Woods, former mayor of South Lake Tahoe, says, "In essence, what we've got is a no-growth policy." But Laurel Ames, who heads the League to Save Lake Tahoe, maintains that the "frontier mentality" of earlier days has faded, and even pro-growth advocates have learned to live with planning, glad to have clear though strict rules.

UP TAYLOR CREEK, half a mile from the south shore of Tahoe, a female merganser paddled calmly, barely moving as she held her place against the current. She seemed to ignore the life swarming beneath the riffles. In the shade of overhanging willow and alder, I made out a dozen bright red fish skimming the pebbly bottom. They were among thousands of kokanee salmon, come to spawn and die.

Kokanee are not native to Tahoe. They entered the lake in 1944 when holding ponds at the old hatchery at Tahoe City overflowed, then were planted regularly in later years. Lake trout, locally called mackinaw, plus brown, brook, and rainbow trout also have been introduced into Tahoe and its tributaries. They have thrived at the expense of native Lahontan cutthroat trout, which survive only by frequent restocking. Once man intrudes, the delicate balance of centuries is shaken.

Julie Perrochet, a U. S. Forest Service fisheries biologist, and I bounced down the lake aboard a speedboat confiscated by the government from drug runners in Florida. Biologist Jeff Reiner was at the wheel, scoffing at how some sportsmen call native nongame fish "trash." "Logging, overfishing, road construction, and urban development are the worst problems for the Tahoe fishery," Jeff said, slowing the boat and heading into a narrow channel.

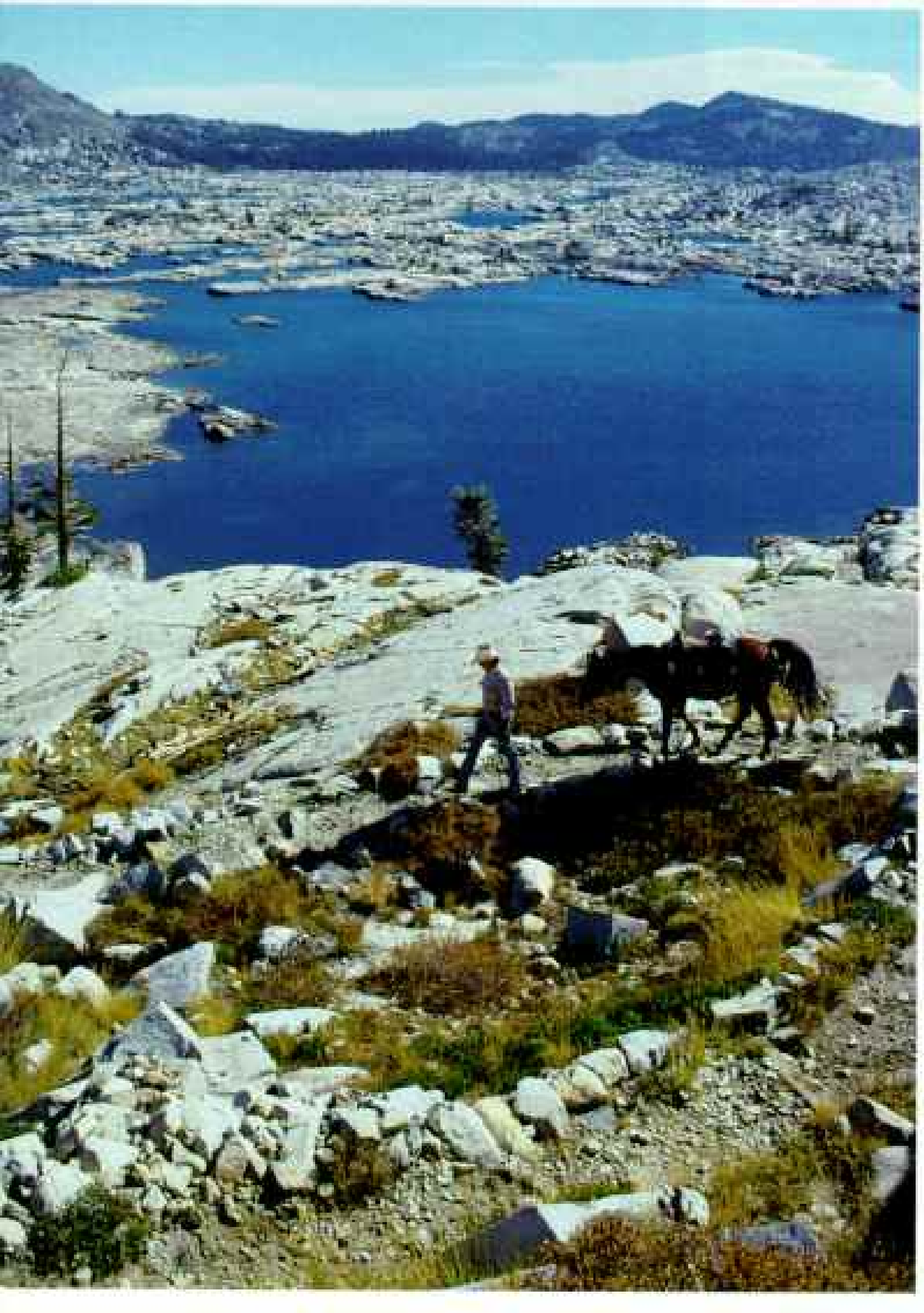
In seconds we were in a maze of canals dredged in the early 1960s, the most damaging of man's intrusions into the lakeshore. The canals wind past more than 1,500 homes in the development called Tahoe Keys. As much as any other event, its coming rang the alarm for those who loved the lake the way it was. The project destroyed 50 percent of Upper Truckee Marsh, the primary filter for river water entering the lake, and tore loose uncounted tons of

Descendants of fugitives, nonnative kokanee salmon (above) still thrive in Tahoe 48 years after a north-shore hatchery overflowed into the lake. Each October thousands of the fish surge to mate at Taylor Creek (top), where California Conservation Corps workers set willows into the steep banks. The trees protect the spawning stream by controlling erosion.

sediment that clouded the shallows along the south shore. As we eased along the canals, I saw sailboats that need six feet of water high and dry in the long drought.

That subdivision was an environmental turning point, fully a century after shoreline resorts began. Even the former mayor, Norman Woods, an outspoken pro-development contractor who lives in Tahoe Keys, admits now that such projects "kind of raped the land. There's no question it never should have been built. With today's rules, it would be unthinkable."

"Shrimp" Ebright remembers the old days. At a trailhead, unloading and saddling horses, he has the tight-jeaned, slightly bowlegged walk of a 72-year-old cowboy, and he speaks the language of the corral. At his lakeside cabin at Cascade Stables he is as gracious a host as his grandfather, a San Francisco physician, must have been. But at his most polite, Shrimp cannot think of a kind word for all that has happened to Tahoe since his grandfather bought his land more than a hundred years ago.



Once the domain of glaciers, Desolation Wilderness in the western Tahoe basin hosts more than 100,000 tourists a year. Only hooves and hiking boots may enter this granite-rubble outback; no paving mars the 63,000-acre protected area, and no off-road vehicles are allowed.

When Shrimp began coming up in the 1920s, "You couldn't see a single light across the lake," but now there are too many for him. "The way to enjoy the lake now is get away from it, back into the mountains." Gesturing toward the Nevada casinos that dominate the south shore, he growls, "They could do that in the middle of the desert."

Indeed they could. But in 1944 a Sacramento meat distributor by the name of Harvey Gross opened his Wagon Wheel Saloon at Tahoe, smack against the state line on U. S. 50, as close as possible to populous California. It had a six-stool counter, three slot machines, two blackjack tables, and a gasoline pump. Today Harvey's is a 22-story, 740-room hotel-casino, one of four massive gambling complexes jammed together at Stateline.

Harvey's was not the first, and the south-shore district is not the only place with gambling action at the lake. There are casinos on the north shore too, including the lake's oldest, the scenic Prohibition-era speakeasy called the

Cal-Neva Lodge. Its gangster clientele is long gone; renovated and past its 65th anniversary, today it caters to honeymooners. But the hotel-casinos rearing back from the southern shoreline are the only architectural presence easily visible from one end of the lake to the other. And their aggressive promotion, with package deals including free bus service from northern California cities seven days a week, feeds the basin's most dense urban pocket. Many visit Tahoe just to gamble. For them the gaming tables might as well be, as Shrimp maintains, in the middle of the desert.

SNOW, BLESSED SNOW, finally came in abundance in March 1991. The long-term annual average at Tahoe City is 15 feet 9 inches, but since 1987 the drought had held snowfall to a small fraction of normal. Beginning each fall, hopeful skiers and worried resort operators watch clouds ease over the Sierra from the Pacific. When last year's serious snow finally arrived, grownups rejoiced like children.

Photographer George Mobley and I, on cross-country skis, toured the open woods around Kiva Beach, toward the mouth of Taylor Creek. There were no tracks, and there was no sound, except for the wind through the Jeffrey pines. When we came out of the woods, the wind roared down from the north and numbed our faces, kicking up whitecaps on the lake and driving breakers hard onto the sandy shore. The fast-moving clouds constantly shifted their shadow patterns on the Taylor Creek meadow, posted as a bald eagle sanctuary. Looking northward up the lake, I could see the white streaks of ski slopes more than 20 miles away behind Incline Village. And from a fire lookout at that far end, on another day, I could see south to the downhill runs at Heavenly Ski Resort, one of the largest in the country.

Sierra snow is essential to the water supply of California and Nevada, and Tahoe snow is a promoter's dream. The Winter Olympics in 1960 at Squaw Valley stimulated so much publicity that ski-lodge and second-home business boomed. There are now some 200 lifts at 20 resorts in and close around the basin. Rodeos, golf, moonlight paddleboat excursions, floor shows, hiking, biking, sailing, and fishing give visitors something to do year-round. High-season traffic jams are common in South Lake Tahoe and Tahoe City.

Emerald Bay, on the lake's southwest shore, is the spectacular essence of Tahoe scenery. In the late 1950s local politicians and casino operators tried to push through a four-lane westside highway with a bridge across the mouth of the bay.

The fight to defeat that proposal was a catalyst for all that has happened since; the development of upscale Incline Village on the north shore and especially Tahoe Keys on the south further alarmed environmentalists. In 1965 they formed the League to Save Lake Tahoe. With its slogan, "Keep Tahoe Blue," and with lawsuits, research, and publicity, it has been in the thick of the struggle.

In the early going there were death threats against environmentalists, says Laurel Ames. "Car windows were broken. People would

"The county calls this a non-maintained road," declares one driver, as another (above) spins his wheels during the Annual Jeeper's Jamboree. Several backcountry trails near Lake Tahoe are now banned to vehicle traffic, worrying Mark Smith, Jamboree organizer. Says Smith, "Public lands are for us too."

"I'm the trailblazer," boasts Black Bart the Mountain Man (above), though his trail is car-clogged Highway 50. For a week every June costumed participants slow traffic as their horses and wagons retrace the route of forty-niners through the Tahoe basin. A young rider (right) rinses off the dust of the road.

join the league but say, 'Don't send me the newsletter. I don't want to take a chance on being seen with it.' "

The league supported efforts by California and Nevada legislators to create a bistate Tahoe Regional Planning Agency, with power to control growth on both sides of the lake. The resulting TRPA works closely with the Forest Service, which manages more than two-thirds of all the basin's land. But well into the 1970s, before TRPA had teeth to enforce the law, construction accelerated, and the lake further deteriorated.

Since then, though often challenged in court, TRPA has set strict standards for water quality, air pollution, soil disturbance, wildlife habitat, even noise—most of the things that determine the quality of life at Tahoe. Every foot of land that is cleared or paved must first be approved by TRPA. Thus the agency earns enemies on all sides.

One environmentalist says it has "all the guts of a chocolate eclair." But a gentle lady, devoted to Tahoe history, flares when TRPA is mentioned. "It's like a Gestapo agency!" she says. "It lets big projects go ahead while people who've owned a little lot for 20 years can't build." She has a point: Carefully planned redevelopment is not only permitted but encouraged; would-be individual homebuilders, however, vie for a limited number of permits each year, and building is banned on sensitive lots. To bring as much as possible of that sensitive land under public control, a new force called the California Tahoe Conservancy has been at work since 1985.

SNATCHES OF DENNIS MACHIDA'S conversation sound fanciful if you don't hear the hardheaded legal approach that supports his idealism. He concedes as much: "It's our Don Quixote vision. Here at Tahoe we're actually trying to reclaim past conditions. Before the 1970s nobody could conceive of that. Everything was already subdivided. We're going at it like a jigsaw puzzle, to create an equilibrium that has been lost. If we're successful, eventually you won't know we've ever been here. But if we don't do it now, the struggle will be much more difficult."

In law school Dennis did not study erosion control, wildlife management, or stream ecology. He has had to learn them on the job as executive officer of the Tahoe Conservancy, a position that seldom requires a coat and tie. The conservancy uses state funds, as the Forest Service uses federal funds, to buy and restore thousands of parcels of critical land. It negotiates the swap of development rights from more sensitive to less sensitive areas.

Dennis drove along U. S. 50 through South Lake Tahoe, where ticky-tacky blocks have been demolished to be replaced by a resort complex surrounded by green space—redevelopment that will actually reduce the number of hotel rooms at the lake. Then we turned again toward Tahoe Keys, every environmentalist's showpiece of what should never have happened. Beside it, the conservancy has bought up land that would have been the second phase of the Keys development. Dennis is considering ways to make the area nearly natural again; one possibility is trucking out all 30 acres of fill dirt dumped there. I wonder aloud how many thousand truckloads that would

Ice jewels the tiaras of Snowfest princesses Shannon Colhoun (right, at left) and Tracy Ann Harder, as they smile through the season's biggest snowfall during Tahoe City's annual winter celebration. Nearly two and a half million vacationers visit the area each year to enjoy winter sports.

The view alone leaves skiers breathless on Skyline Trail at Heavenly Ski Resort (above). Heavenly, recently bought by a Japanese family, is working with the Forest Service to fight erosion by replanting vegetation long ago cleared from its slopes.

be, and what it would do to air pollution.

Everyone concerned about the lake learns to react that way, because every introduced element, solid, liquid, or gas, affects Tahoe. Air pollution from traffic within the basin is thickened by that blowing over the Sierra from the heavily farmed and populated Central Valley of California, dropping nutrients into the water. Those nutrients feed algae, gradually making the lake greener. Air pollution, combined with the severe drought, may also have weakened millions of Sierra trees now being killed by bark beetles. The Forest Service at Tahoe is more committed to recreation and conservation than logging and cuts only dead timber on its land in the basin. But that has run into thousands of acres, causing erosion and stirring controversy.

Larry Hoffman is attorney for the Tahoe-Sierra Preservation Council, which defends property rights. Yet he agrees with Laurel Ames of the League to Save Lake Tahoe that contending interests have begun working together more often. It's a long time since environmentalists have had to check under their car hoods before starting up for the day, as one fellow says he did a few years back.

"All problems are linked to polarization," Larry believes. "We need to trust each other. Everybody realizes he has to give up a little to protect what's valuable."

Such talk offends Jim Hildinger, a retired music teacher whose photography does for Tahoe what Ansel Adams's pictures did for Yosemite. Jim thinks too much has already been given up.

A lone boat waits out winter snug beneath its tarp, but Tahoe cannot be protected as easily. Those who love the lake fear for its future; like its cold blue waters, Tahoe's problems run deep.

"The environment can't compromise," he says. "Each compromise loses a little." Jim is a pessimist about Tahoe's future, but like most of those who love the lake, he refuses to give up the struggle to defend it.

Riding into the mountains again on my last day at Lake Tahoe, I thought about what those lawyers, rangers, writers, scientists, lobbyists, hikers, bureaucrats, and wranglers have in common.

Our grizzled packer, Jim Hawksworth, led the way with his mule, Smoky. We climbed toward the southernmost edge of the basin, up Big Meadow, past patches of bright red paintbrush, fields of corn lilies, yellow mule's ears, and occasional alpine shooting stars. Our horses wound through groves of great orange-trunked pines, past house-size boulders fallen from volcanic palisades above Round Lake. The cliffs seemed a perfect habitat for peregrine falcons like those released at Tahoe, and I kept an eye upward, hoping but not expecting to spot one—or at least a Clark's nutcracker like the one that sassed us from a pinetop as we hiked along the Nevada shore of the big lake in the fall.

We skirted Round Lake and pushed on into the Dardanelles Roadless Area, then picked up the Pacific Crest Trail to Showers Lake, one of the highest in the Tahoe basin at 8,647 feet. Above it a point of rocks juts like a sentry post overlooking the wilderness. We climbed onto the topmost boulder. There on the highest square centimeter, a marmot had deposited its scat as if to stake a claim to all it could see.

I realized that what ties together those devoted to Tahoe, newcomers and old-timers, tough and tender, is love of what the place once was—and a probably naive vision that with enough striving, it can be that way again. Their dream is contagious.

On the marmot's lookout, I stood and faced north. The course of the Upper Truckee was just a wrinkle in the trees far below. Fourteen miles away, Lake Tahoe stretched blue to the mountains beyond. No road or house was in focus. I imagined that out on the lake a glint of light was the research boat *John Le Conte*. Bob Richards and Debbie Hunter were leaning over its side, peering down, following the Secchi disk as it dropped and dropped, smiling as they watched it, all the way to infinity. □

THE PRESIDENT'S REPORT ON THE

Education Foundation

ERIK LARS BARRE

A Million Ways to Boost Geography Education

"There is great freedom in the study of geography," says sixth-grade teacher Santo Nicotera of Denver, Colorado. "Kids enjoy its open-endedness. You can go as deeply into people, their cultures, and locations as you want. And in the end, you see yourself through the eyes of others."

In his Lake Middle School classroom (above), Nicotera shows his students how to use population tables, square mileage charts, and hand-held calculators to determine population density of nations in the Western Hemisphere.

Now Nicotera and other geography teachers in his state can look forward to new resources to draw on, thanks to visionary foundations and companies that have, along with your Society, pledged one million dollars to establish the Colorado Geography Education Fund.

Our goal is to see similar funds created in every state of the union.

In 1990 the Society, as part of its mission to improve geography awareness among U. S. students, committed up to $500,000 to create an education endowment in Colorado. Only one string was attached: An equal amount was to be contributed by local foundations, corporations, and governments. The money would be invested and the proceeds used to pay for Colorado geography programs in perpetuity.

Colorado's response to the challenge was astounding. The full sum in matching funds was raised, with a lead gift from the Gates Foundation and major contributions from the El Pomar Foundation, the Helen K. and Arthur E. Johnson Foundation, the state of Colorado, the Bonfils-Stanton Foundation, and Total Petroleum, Inc. The endowment will initially generate an estimated $50,000 a year, with larger yields in the future.

"The study of geography is essential for every student in the United States," says F. Charles Froelicher, executive director of the Gates Foundation. "There is no choice."

The Colorado fund is the second to be established, the first being Mississippi's, which was endowed in 1989 with a lead gift from the Phil Hardin Foundation.

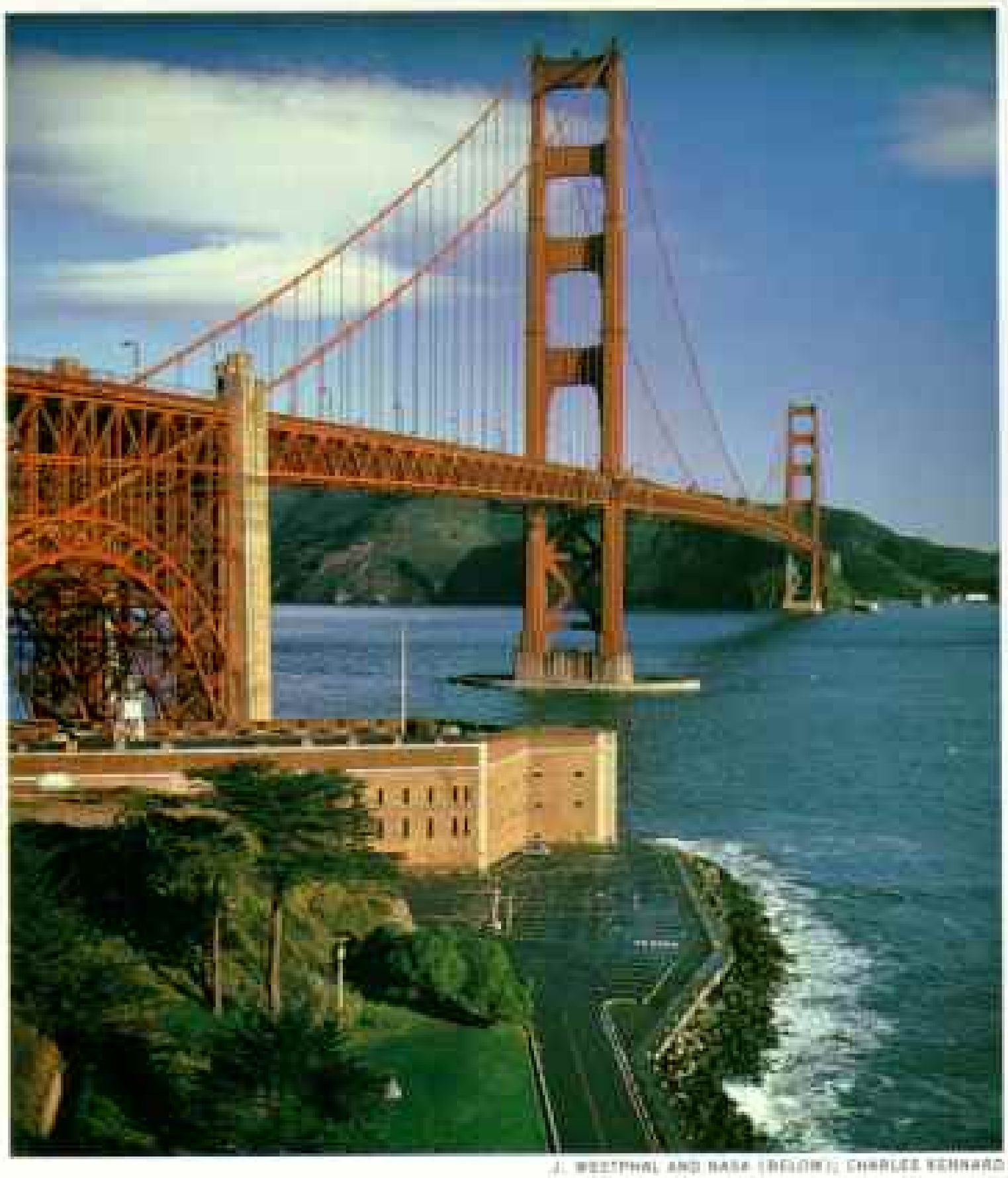
With funding in place, it's now up to Mississippi educators to spend it. Proposals are being considered by the National Geographic Society Education Foundation's Board of Trustees, working closely with an advisory committee of individuals from across the state. Proposals for the Colorado fund will be sought later this year.

Momentum for other geography education funds is snowballing. Texas and Oklahoma have begun raising money, and more states may soon follow. The Society is prepared to match up to $500,000 in every state that has an exemplary geography program.

When one in seven adult Americans cannot find the United States on a map, it is time to reverse the shameful slide of geography education. Of course, money can't buy people like Santo Nicotera. But with our financial and moral support, we can help them make a difference.

Gilbert M. Grosvenor

Geographica



J. WESTPHAL AND NASA (BELOW); CHARLES KENNARD

The Presidio Awaits a Changing of the Guard

It is a military post like no other: a registered national historic landmark in the shadow of the Golden Gate Bridge with 216 years of service under three flags. The Presidio of San Francisco covers 1,500 acres, holds 876 buildings—half of them historic—two hospitals, a military cemetery, a pet cemetery, a forest of eucalyptus, cypress, and pine, and the city's last free-flowing stream, which spills into the Pacific.

Spanish soldiers founded the Presidio in 1776. Mexico occupied it in 1822; the U. S. in 1846. By mid-decade the Army will leave—one of a nationwide series of military base closings—and the post will become part of Golden Gate National Recreation Area (GGNRA).

But what role will it play, and where will its funding come from? The National Park Service is seeking answers with the help of a 37-member advisory council.

Proposals for the site include conference facilities, training centers, and research institutions with public programs on topics such as pollution, education, and health. Nan Stockholm, the council's director, notes, "Local people cherish and use the Presidio as a park now. The challenge is to make the most of this unique city space."

Brian O'Neill, GGNRA superintendent, agrees: "This is a once-in-a-lifetime opportunity to create an exceptional urban park. We have one chance to do it right."

Doing it right means that the Presidio cannot rely on federal funds alone to meet its estimated operating costs of 40 million dollars a year—more than half the entire GGNRA budget. The council is helping the Park Service to find partners to make up some of the shortfall.

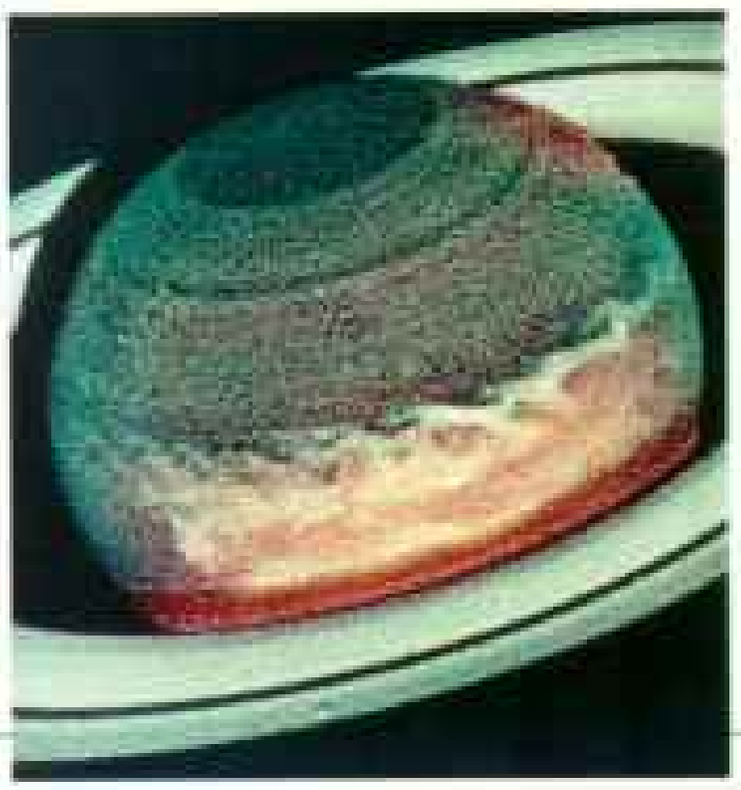
Saturn's Stormy Weather: the Great White Spot

Weather is a wild affair on Saturn, even during the best of times. Thousand-mile-an-hour equatorial winds smear clouds into a featureless band, and a layer of haze further reduces chances for astronomers to see weather patterns on the second largest planet (NATIONAL GEOGRAPHIC, August 1990).

But during the Saturnian summer of 1990, an intense storm caused ammonia ice clouds to form in the upper atmosphere—visible from earth even with a low-power telescope. Astronomers call the storm the Great White Spot.

Such storms tend to occur in the northern hemisphere summer, which begins every 30 earth years and lasts more than seven. Agustin Sanchez-Lavega, the Spanish astronomer who identified the seasonal pattern, predicted in 1989 that Saturn was due for a violent storm.

He believes that a large temperature difference between the upper and lower atmospheres could have caused warm gases to shoot upward and condense. Within a month fierce winds had dispersed the clouds around the planet.



National Geographic, March 1992

Geographica

Science Supports Ancient Legends

To the Gitksan people of British Columbia (right) the tales were part of their oral history: how a supernatural giant resembling a grizzly bear roared down a mountain valley scattering trees into the air and how women picking berries alongside a lake had to scramble for their lives when its waters suddenly began to rise.

GITKSAN ELDER FRED JOHNSON, BY STEPHEN ROSCH

The tales took on new significance, however, when two Canadian scientists found supporting evidence for them. The scientists, hired by the Gitksan and the neighboring Wet'suwet'en, testified in a land-claims case in which the native peoples argued that they, not the provincial government, should have title to 22,000 square miles of forested land.

Allen Gottesfeld of the University of Alberta found that soil samples from around Seeley Lake near Hazelton indicated a major landslide about 3,500 years ago. Rolf Mathewes, a biologist at Simon Fraser University, said his study of fossil pollen from the lake showed that large numbers of plants had been swept into it about the same time. They concluded that the landslide dammed an outlet stream, causing the lake to rise.

The two peoples may have won the battle to show how long they have lived on the land, but so far they have lost the war. The British Columbia Supreme Court denied their claim; the decision is being appealed.

Wild Asian Horse to Return Home

Przewalski's horse, the last true wild horse species, freely roamed the Mongolian steppes (GEOGRAPHIC, February 1985) for millennia. But the population shrank as nomads settled on the steppes and their domesticated stock won out in the competition for water and pasture. The last Przewalski's horse to be captured, in 1947, was taken to Askanya-Nova, a reserve in Ukraine.

Today there are about a thousand around the world born in captivity. Most are in zoos and wildlife parks that coordinate breeding efforts through the Przewalski's horse Global Management Plan Working Group, says Oliver Ryder of the Zoological Society of San Diego. Next year the group aims to reintroduce horses into the wild on their Mongolian native ranges.

TONI ANGERMAYER, PHOTO RESEARCHERS

Named for the Russian colonel who reported their existence in the 1870s, Przewalski's horses have a short mane with stiff hair and no forelock. They are also genetically distinct: They have 66 chromosomes instead of the 64 found in domestic horses and feral horses such as mustangs.

Apelike Jaw—Clue to Human Origins?

Scientists trying to solve the mysteries of human evolution have been stymied by the lack of fossil evidence in Africa from a key period, 15 to 5 million years ago, when the lines leading to today's humans and apes diverged (chart, page 51).

Now a piece of the puzzle may be in hand, not from the usual East African sites but, surprisingly, far to the south, in Namibia. It consists of half of the lower jaw with several teeth from an

GLENN C. CONROY

apelike creature found last summer by a joint French and American team led by Glenn Conroy of Washington University, St. Louis, and supported in part by the National Geographic Society. The team named the 25- to 40-pound hominoid that roamed the Otavi Mountains about 13 million years ago *Otavipithecus namibiensis*.

The animal's little-worn teeth indicate that it ate a "soft diet: berries, seeds, leaves, flowers," Conroy says. The region is now semiarid but must then have been forested and much more humid.

The discovery of *Otavipithecus* suggests that African hominoids ranged widely over the continent and that they did not evolve only in equatorial East Africa.

National Geographic, March 1992

Geographica

FRANS LANTING, MINDEN PICTURES

Aye-aye, Sir: There's Food in These Timbers

The aye-aye, a Madagascar lemur, doesn't sing for its supper—it taps.

Carl Erickson, an animal behaviorist working with aye-ayes at the Duke University Primate Center, has discovered that they tap on trees to locate cavities that may contain insect larvae. The aye-aye is the only primate known to use this method to find food.

By tapping with its narrow middle finger, Erickson believes, the animal detects changes in vibration, indicating cavities. He speculates that the lemur uses its large ears to listen for larvae. It then gnaws through the wood and manipulates its middle finger to pull out the grubs.

"These animals are very curious and often eager for humans to approach," he says. "They love to participate in experiments."

Like other Madagascar lemurs (GEOGRAPHIC, August 1988), the aye-aye is endangered. Erickson hopes to help those bred in captivity to return safely to the wild.

Ancient Wine: Piecing Together the Evidence

Even 5,500 years ago, apparently, man could not live by bread alone. It took wine to make a meal a feast.

Ceramic remains unearthed at Godin Tepe in the Zagros Mountains of Iran suggest that wine was produced there about 3500 B.C., pushing back the earliest documented evidence of wine making about 500 years.

While piecing together a pear-shaped jar brought to the Royal Ontario Museum, University of Toronto graduate student Virginia Badler noticed a red stain on the bottom and one side—a sign that the vessel may have been used to store liquid. A hole near the base of the jar could have served to decant wine, leaving the dregs behind.

BRIAN BOYLE, ROYAL ONTARIO MUSEUM

Chemical analysis of the stain revealed that it contained tartaric acid, a substance found abundantly in grapes. Badler and her colleagues concluded that wine was being made about the same time that writing was developing.

According to Solomon Katz, an anthropologist at the University of Pennsylvania, "Wine making probably goes back as long as grapes have been picked. This helps prove it."

Badler says that researchers in the past may have washed away red stains on sherds they uncovered, destroying the evidence. She hopes her discovery will make others aware of the importance of preserving and analyzing such stains.

Volunteer Countdown to Cleaner Beaches

In 1986 a Washington-based environmental group, the Center for Marine Conservation, organized a "sweep" of Texas beaches to clean up litter. Part of the center's method of calling attention to the seriousness of the problem was to document, in exhaustive detail, every last item collected by its crews of volunteer sweepers. The cleanups were so popular that they were copied on coastlines throughout the United States (GEOGRAPHIC, November 1989).

The sweeps have crossed the border into Canada. Last summer the Clean Nova Scotia Foundation attacked the province's beaches, enlisting nearly 7,000 volunteers who collected 167,793 pieces of trash. Plastic articles made up 54.4 percent of the haul; 24,655 items were glass.

The collectors found 1,708 shotgun shells, 718 tires, 186 light bulbs, 123 condoms, 56 clay pigeons, and 317 lobster traps. Also a Christmas stocking, a Christmas wreath, a boomerang, an anchor, two hockey sticks, a portable television set, a car bumper with license plate, a Newfoundland penny dated before 1900, and a newspaper vending machine.

All that, and four lottery tickets—presumably losers.

—BORIS WEINTRAUB

National Geographic, March 1992

Forum

Zaire River

We were the other two American passengers on the boat described in "Lifeline for a Nation—Zaire River" (November 1991). Bob Caputo's photographs document our initial immersion in Zairian culture; we spent the following year as International Partners with Habitat for Humanity and were struck by the camaraderie among the people and by their friendliness to us as we attempted to learn the Lingala language.

TRUDY AND ANDY ANDERSON
Springfield, Oregon

At the October Commonwealth conference in Harare, Zimbabwe, Canadian Prime Minister Brian Mulroney called for a link between aid to Third World countries and human rights abuses. He was criticized by many who are aid recipients. After reading about life on the Zaire River, I think his suggestions may be justified.

Donors must question the advisability of providing billions of aid dollars that do not reach people in need. How many examples of dollars diverted into the pockets of leaders do we need before the leaders are held accountable?

LINDA HESLEGRAVE
Toronto, Ontario

Caputo's story of madness and mayhem on board the Zaire River boat makes me shudder all over again. I'll never forget the charred monkeys, squealing pigs, fat white grubs squirming in bowls of dirt, and the loud rhythms of electric African rock blaring day and night. Last year I endured the trip for only four days and stepped off in Kisangani feeling like a survivor.

RICHARD FOOT
Halifax, Nova Scotia

Your article describes central Africa's great river as "once called the Congo." This will come as a surprise to the two million citizens of the Republic of the Congo. The river forms the border between our country and Zaire for some 700 miles. We have always called it the Congo and do to this day.

ROGER ISSOMBO
CONGOLESE AMBASSADOR
Washington, D. C.

Because the article was written from the perspective of one traveling through Zaire, reference to the river followed Zairian usage.

Did Africa move from colonialism to self-government so rapidly that its people were totally unprepared to govern themselves? We cannot reverse history and provide for a more orderly transition from colonialism to statehood. But there may be another answer—world government (a greatly strengthened UN?) in which the central government would not permit local tyrants to impose inhuman conditions on their subjects while accumulating enormous wealth for themselves.

JESSE E. AIKEN
Hickory, North Carolina

Japan in the Pacific

The contradiction between the great national prosperity and the not so great standard of living in Japan is hard to explain unless one assumes that the Japanese economy is rigged to favor export trade at the expense of the common man—that is, low-priced exports and high-priced domestic goods and services.

ROBERT B. JACOBS
Tallahassee, Florida

As a child during World War II, I saw maps depicting the advances of the Japanese empire after Pearl Harbor similar to the one on pages 42-3. Does history repeat itself? You bet it does. This time it's an economic war. While the American public has slept, a second Pearl Harbor has happened with the destruction of our television and related electronics industry. Next will be the auto industry. Can we win? Only if the American public demands that our government halt further erosion of our economic system. We must insist on an equal and fair trade agreement with the Japanese.

MARIO A. CROCIATI
Plymouth, Massachusetts

Regarding references to Australia's economy in the article on Japan's influence in the Pacific region: Recent data show definite improvement. True, our external deficit remains large, but it is falling, not rising. The deficit was 12 billion dollars U. S. in 1990-91, below the 17 billion dollars for 1989-90 cited. The problems of excessive imports, high inflation, and high labor costs appear in large part behind us thanks to application of longer term policy measures. Inflation is now running at an annual rate of 3.3 percent, the lowest in 20 years.

I. J. WATT
ECONOMIC MINISTER, EMBASSY OF AUSTRALIA
Washington, D. C.

Surely Japan is a mid-life crisis waiting to explode. The elimination of a play-filled childhood combined with extreme pressures to succeed academically—only to be rewarded by long hours in the office, a long commute, and a ride on a mechanical horse—must make the populace ask: Is this life well spent? Yet it is not far removed from the existence of many middle-class Americans. I take

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heart from the people described in the Alcan Highway article who are willing to battle nature's challenges and reject this Japanese-American way.

JULIE SCANDORA
Seattle, Washington

Alaska Highway

Richard Olsenius's article on the Alaska Highway admirably captures the spirit of that odyssey. I was 26 years old, a woman driving the Alcan alone during a snowy April in 1980 (without cassette tapes). The experience was nothing short of profound.

RITA HARMON GILETTA
North Aurora, Illinois

The article makes only passing references to the highway's construction during 1942. Much of it was hacked through harsh wilderness by African-American troops of the U. S. Army. I served on the highway from 1943 until 1945 as a member of a 3,600-man truck regiment ordered to transport supplies to airports. Our 12 companies were literally dumped at intervals of 120 miles along the highway. The tale of establishing camps for these companies is another saga of life on the Alcan.

ROBERT MARTIN DAVIS
Marietta, Georgia

Communities along the highway deserve more respect. Fort Nelson has more to offer than gas stations and bars. We have a heritage museum, the northernmost grass golf course [in British Columbia], the Phoenix Theater, and Trappers Rendezvous Days. These may seem dull to a city slicker, but to a small close-knit community they are important. For industries we have Tackama Forest Products, one of the largest natural-gas processing plants in North America, and the largest chopstick factory in the world.

NORMA CHMELYK
Fort Nelson, British Columbia

None of the people in the photographs were from Alaska. And, contrary to your map, Delta Junction is not "just a stopover" but for many travelers the destination. It has great fishing and one of the largest free-ranging bison herds in North America, and it is a bird-watcher's mecca.

SHARON HANEY WRIGHT
Delta Junction, Alaska

We who are fortunate enough to live on the Alaska Highway want to extend an invitation to visit us during our year-long celebrations of the highway's 50th anniversary this year. There will be international air shows; float-plane, snowmobile, and car rallies; a mule trek; and vintage army motor convoys. For information contact: Alaska Highway Rendezvous '92, 9223 100th Street, No. 14, Fort St. John, B.C. V1J 3X3. Phone: (604) 787-1992.

STEVE THORLAKSON, MAYOR
Fort St. John, British Columbia

Satellite Rescue

The Long Duration Exposure Facility was the first mission I worked on as a NASA engineer. The Kennedy Space Center work force is constantly reminded by the news media of each and every setback. It is refreshing to read a positive article about the knowledge that we have gained from a success.

ROGER SARKOVICS
Orlando, Florida

I appreciated the well-balanced article and the inclusion of my work. It is not often that an individual scientist has such a large forum. My 11-year-old daughter brings home copies from classmates and teachers for autographs. The latter is not important; the significant fact is that young kids read NATIONAL GEOGRAPHIC and about space sciences.

FRIEDRICH HÖRZ
Houston, Texas

Geographica

Within the 3,400 square kilometers of phase two of the James Bay hydroelectric project—the Great Whale complex—the Cree number about 500. They prefer to have the territory only for fishing and hunting. However, there are nearly seven million Quebecers, and the northeastern U. S. is in need of clean, renewable, and cheap energy.

JACQUES GENEST
Montreal, Quebec

Forum

I am sorry to disappoint the letter writer in the November Forum regarding his identification of the photograph in the Blitz article (July 1991). It is not Sir William Stephenson but Brendan Bracken [Winston Churchill's friend and Minister of Information]. The photograph did not come from British Security Coordination files because no such files existed.

Intrepid was the registered cable address of BSC at Rockefeller Center in New York City. Stephenson never had a team called the "Baker Street Irregulars," nor did he break the German Enigma code machine; this was done by Polish cryptographers prior to 1939.

While it is perfectly true that Stephenson did much good work for the allied cause while at BSC, the book *A Man Called Intrepid* contains inaccurate accounts of wartime operations.

JAMES RUSBRIDGER
Bodmin, Cornwall

Verifiable records are scant in the shadowy world of espionage, and there apparently are a number of discrepancies in the book.

Letters should be addressed to FORUM, National Geographic Magazine, Box 37448, Washington, D. C. 20013, and should include sender's address and telephone number. Not all letters can be used. Those that are will often be edited and excerpted.

THIS MEETS ALL FEDERAL CAR SAFETY STANDARDS AND IT ISN'T EVEN A CAR.

You probably didn't even know it, but the federal government has some pretty tough safety standards when it comes to cars. Over fifty of them, in fact. That range all the way from side-door and roof strength, to accelerator control systems. All designed to better protect your family.

For some reason vans don't have to meet all the same standards that cars do. However, one of them does.

It's the 1992 Toyota Previa. The only van that meets the demanding safety standards set forth by the federal government.* And not because we have to. But because we want to. With standard features like driver-side air bag** and rear center high-mounted stoplamp. You can even get optional anti-lock brakes.

You see, when it comes to your family's safety, it's not the government's standards we're trying to live up to . . . it's yours.

"I love what you do for me."

TOYOTA

*Meets all passenger car federal motor vehicle safety standards except models with optional privacy glass due to window tinting. **The 1992 Previa features a driver-side air bag Supplemental Restraint System (SRS) which activates in a front-end accident of enough magnitude to inflate the bag. In a moderate collision, primary protection is provided by the three-point lap and shoulder belt system, and the air bag may not inflate. So, safety belts should be worn at all times by all occupants. Call 1-800-450-TOYOTA for a brochure and location of your nearest dealer. Get More From Life . . . Buckle Up!

WILDLIFE AS CANON SEES IT

Scarlet Macaw
Genus: *Ara*
Species: *macao*
Adult size: Length, 85 cm
Adult weight: Approx. 1 kg
Habitat: Various types of forests in Mexico, Central and South America
Surviving number: Unknown
Photographed by Patricio Robles Gil

Scarlet macaws glide through the forest, casting splashes of magical rainbow colors. Macaws have declined dramatically throughout their range from habitat loss, hunting and the illegal pet trade. Because macaws have few offspring, their recovery from such assault is particularly difficult. This spectacular bird remains numerous only in remote regions and wildlife reserves. To save endangered species, it is essential to protect their habitats and understand the vital role of each species within the earth's ecosystems. Color images, with their unique ability to reach people, can help promote a greater awareness and understanding of the scarlet macaw and our entire wildlife heritage.

On Television

Unique Chimp Behavior Documented on Film

"Because it was so wet, because it was so dark, and because I was so physically exhausted all the time," cinematographer Michael W. Richards wondered if he'd have any success filming chimpanzees in the rain forest of Africa's Côte d'Ivoire.

During six months of 12-hour days Richards followed literally in the footsteps of zoologists Christophe Boesch and his wife, Hedwige Boesch-Achermann, who spent five years observing before the chimps would tolerate their close approach.

All the patience and sweat produced remarkable footage of chimpanzee behavior that no one could have imagined a few years ago.

These chimps not only gather stones to use as nutcrackers, they also appear to remember where they left the stones on previous excursions, and mothers teach fine points of nut cracking to their young.

The chimps hunt in groups. In the film they dart like flying shadows through the dense foliage, fanning out to trap colobus monkeys. One chimp named Ulysse, Richards recalls, "was the main catcher. Others were drivers or ambushers." With their prey in sight, chimpanzees attack like swift commandos. An isolated monkey has no chance; it is caught, killed, dismembered, and shared by the hunter-chimps and the larger group.

Such behavior tied to food gathering and sharing leads the Boesches to question whether the distant forebears of humans lived, as is often assumed, on open savannas. Perhaps deep forests were a more stimulating and likely environment.

MICHAEL NICHOLS, MAGNUM

That idea is provocative; this rare film is the same.

"Secret World of the Chimpanzee," Explorer, March 15, cable network TBS, 9 P.M. ET

PAULA N. KEYSER

A Curiosity of "Cats" Highlights Video Club Season

What do cats and VCRs have in common? Both are popular in millions of U. S. homes—and both resist owners' attempts to program them. And they come happily together in the new National Geographic Video Club series for 1992. "Cats: Caressing the Tiger," among the Society's most popular Specials shown on PBS, is just one of the hour-long videos available to club members. From tabbies purring by the fire to tigers flowing toward the kill, felines share the grace and instincts that drive a matchless predator. The essential character of cats and their interaction with humans are explored in this intriguing home video. (No programming is required, and it won't scratch the furniture.)

For information on National Geographic Video Club call 1-800-447-0647

Earth Almanac

CHRIS NOLWES, PLANET EARTH PICTURES (BELOW); ART WOLFE, ALLSTOCK

Bear of an Issue Surfaces Over Arctic Drilling

The polar bear has joined the caribou as a national symbol for preserving a pristine Arctic. Amid congressional debate about opening Alaska's Arctic National Wildlife Refuge to oil and gas development, environmentalists and scientists have raised new concerns about the impact on 2,000 or more polar bears in the area.

"If the bears' habitat is adversely affected, the U. S. could be in violation of an international agreement on polar bear conservation," says Robert J. Hofman, scientific program director of the Marine Mammal Commission. Although many breeding females den on sea ice, the refuge's coastal plain is the primary on-land denning area for the species in the U. S. Some biologists fear that exploration and drilling could force females and their cubs out of their dens before the cubs are able to survive the elements. Conservationists also worry about disruption of the 170,000-strong Porcupine caribou herd, which calves on the coastal plain.

Yucca: A Breath of Fresh Air Down on the Farm

Air pollution doesn't stop at the city limits. In the country, among the nastiest gases is ammonia from farm-animal waste. Now comes an anti-ammonia agent from the desert—the yucca plant, a natural odor-eater.

In England, high-density pig-raising facilities often have excessive ammonia levels, says Irish biochemist Denis R. Headon. When pig manure is spread on fields, ammonia disperses and contributes to acid rain.

Headon is testing a yucca extract that binds with ammonia to make it nontoxic. With yucca mixed in their feed, pigs produce this harmless ammonia. Soon, the addition of yucca to heather-and-peat-moss air filters may improve conditions for indoor workers.

LARRY LEFEVER, GRANT HEILMAN PHOTOGRAPHY

British Leap to Save Amorous Amphibians

March rains now pelting England bring a seasonal hazard: The mating urge is driving hundreds of thousands of toads pell-mell to breeding ponds. But roads often block their path, and about 20 tons of toads are run over every spring. To give toads a chance, 230 signs now caution motorists.

Earnest roadside volunteers in rain gear will scoop up gobs of live toads in plastic buckets and carry them to their ponds as they have since 1984. Last year 8,000 volunteers relocated about 200,000 toads, according to Tom Langton, who organizes the Toads on Roads campaign. "It can be a family affair, with parents dragged out on the road for the first time by their enthusiastic children. Often the parents return in wonderment, surprised by a rewarding experience," says Langton.

His group also has built six toad tunnels, 11 inches in diameter. Thus toads can safely hop under roads, underscoring how thoughtfully the British define right-of-way.

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Earth Almanac

Power to the Prairie on an Iowa Refuge

Instead of a nuclear power plant, Iowans will have electrifying springtime vistas of natural plants—blazing stars (right), big bluestem, and Indian grass. Such native species once graced the 400,000-square-mile tallgrass prairie, nearly all fallen to the plow.

Now the U. S. Fish and Wildlife Service will plow under 8,600 acres of farmland to bring back a piece of tallgrass prairie—Walnut Creek National Wildlife Refuge.

About half the land had been purchased by an Iowa power company for a nuclear facility. When that idea was scrapped, the utility's acreage was bought with four million dollars from Congress. Adjoining farms are also being acquired. Seeding will soon begin, and plans call for resident bison and elk. It will be a learning experience. "We know a lot about converting prairies into agricultural land; we know less about the reverse process," says project leader Richard Birger.

WILLIAM K. BOND, NAS STAFF (BELOW); ANNIE GRIFFITHS BELT

ESMOND BRADLEY MARTIN

Extra Exploitation—Orangutan Skulls for Sale

Poachers have added a grisly dividend to their already lucrative illegal trade in Indonesia's orangutans. On Borneo, Dayak tribesmen capture young orangutans by killing their mothers. The orphans are sold for $80 to $200 each to middlemen, who offer them as pets to wealthy Indonesians or Taiwanese. Adult orangutan carcasses were formerly abandoned as worthless.

Now the Dayaks have hit upon a bonus. According to Chryssee and Esmond Bradley Martin, environmental sleuths who monitor Asia's illegal wildlife trade, the poachers collect the skulls of the dead females. They decorate them with shoe polish and sometimes carve them with tatoo-like markings, then sell them to middlemen for tourist souvenirs. The Martins found illegal skulls priced at $70 to $80 readily available in several Borneo towns.

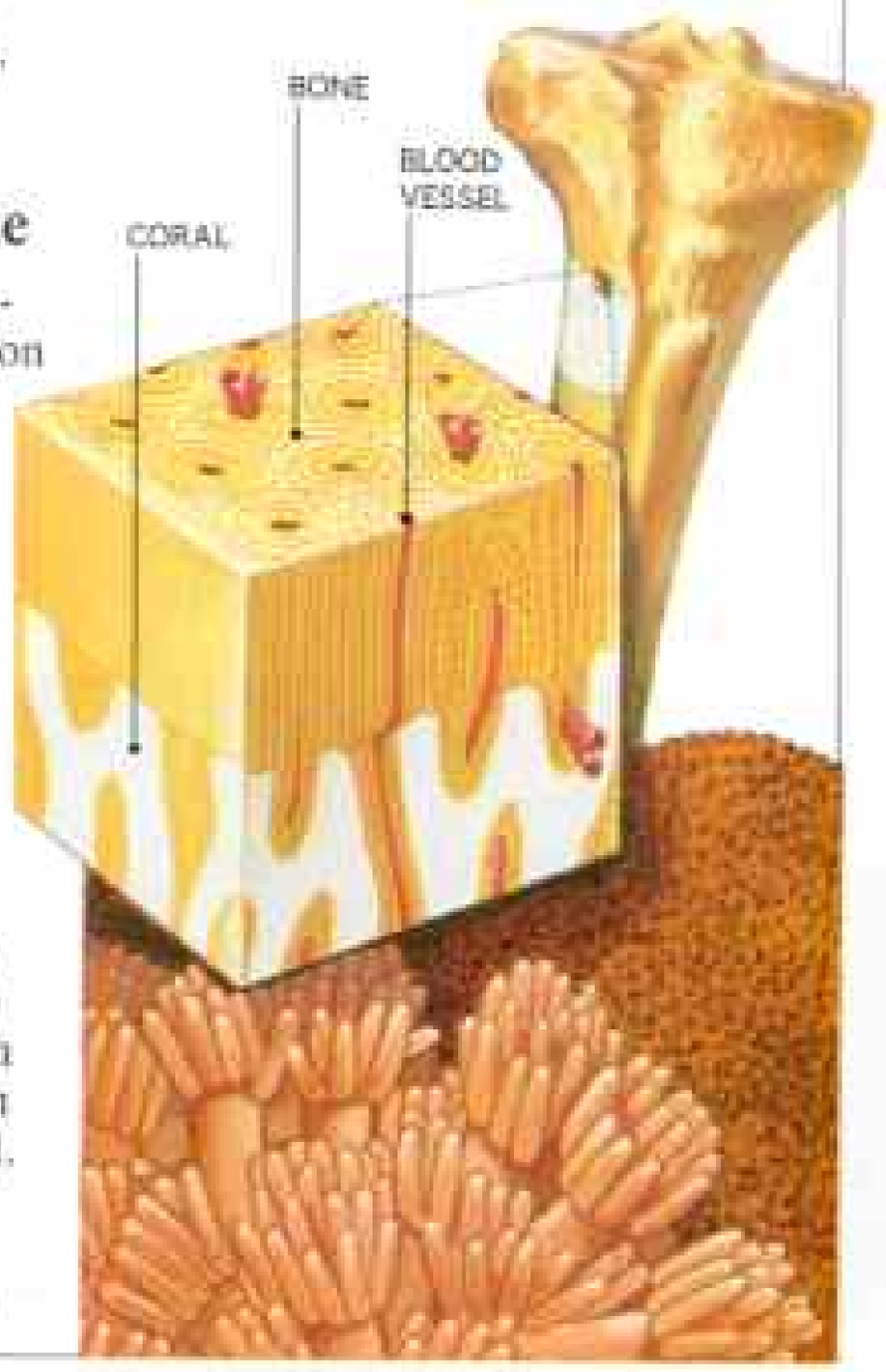
Bone of the Sea, Coral Mends the Human Frame

Coral reefs are the sea's skeleton, a living framework upon which myriad organisms grow. Fittingly, coral in death is becoming part of more and more human legs and chins. Treated coral makes an excellent substitute for bone, say doctors who perform reconstructive surgery.

When a bone injury needs to be bridged by a graft, surgeons usually use bone borrowed from a patient's hip, ribs, or skull. Pain and infection can result from those additional incisions, but such risks are eliminated when common warmwater corals are used instead. Their interconnected pores allow adjacent living bone to send new blood vessels and bone tissue into the coral maze. A strong bond of new bone is thus created (cross section, below). Because the coral is first heat-treated to convert it into the same minerals as bone, the body does not reject it.

Edwin Shors of Interpore International in Irvine, California, the world's only producer of the coral bone, says the firm obtains coral heads weighing 200 to 300 pounds from the South Pacific. One head provides material for hundreds of bone grafts.

—JOHN L. ELIOT



On Assignment

PETER WILKINS

When a 400-pound subject turned investigator, photographer MICHAEL "NICK" NICHOLS knew just what to do. He had barely snapped the photograph on pages 2-3 when the silverback came up to take a sniff (above).

Retreat would have aroused aggression and endangered Nick's backside. "I had no choice but to take this submissive fetal position," he says. "I am on my knees, belching like a gorilla. It's their hello."

Flying over Rwanda in 1979, Nick saw his bush pilot point to a forested slope below, saying, "That's where that crazy American lady lives alone with gorillas." As a lifelong GEOGRAPHIC reader, Nick realized that he meant Dian Fossey. A year later for *Geo* magazine, Nick hiked into the mountains to do a feature that led to a book—*Gorilla: Struggle for Survival in the Virungas* (Aperture Foundation, Inc., 1989)—and to an obsession with the great apes and their dilemma. "You can talk yourself blue in the face about protecting the apes," Nick says, "but people will listen to photographs."

Breaking through an icy barrier to the past, anthropologist JOHAN "JOE" REINHARD dives in one of the world's highest lakes looking for Inca artifacts. Near the summit of 19,508-foot Paniri, he encounters water reddened by phytoplankton.

It's a long way from New Lenox, Illinois, where as a boy Joe organized camping trips to search for Indian relics. When buddies bowed out, he went on alone.

An expert mountaineer, Joe participated in a U. S. Everest expedition in 1976. Climbing in Chile, he heard about mountaintop ruins, and his career took a turn. He has since identified Chavín de Huántar and Tiahuanaco as pre-Inca sites of mountain worship. He has also uncovered Inca sacrifice victims. "Coming face-to-face with the remains is like meeting the people themselves," he says. "The mummies are so lifelike I feel close to them and their culture."

ROB BLATHERWICK

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