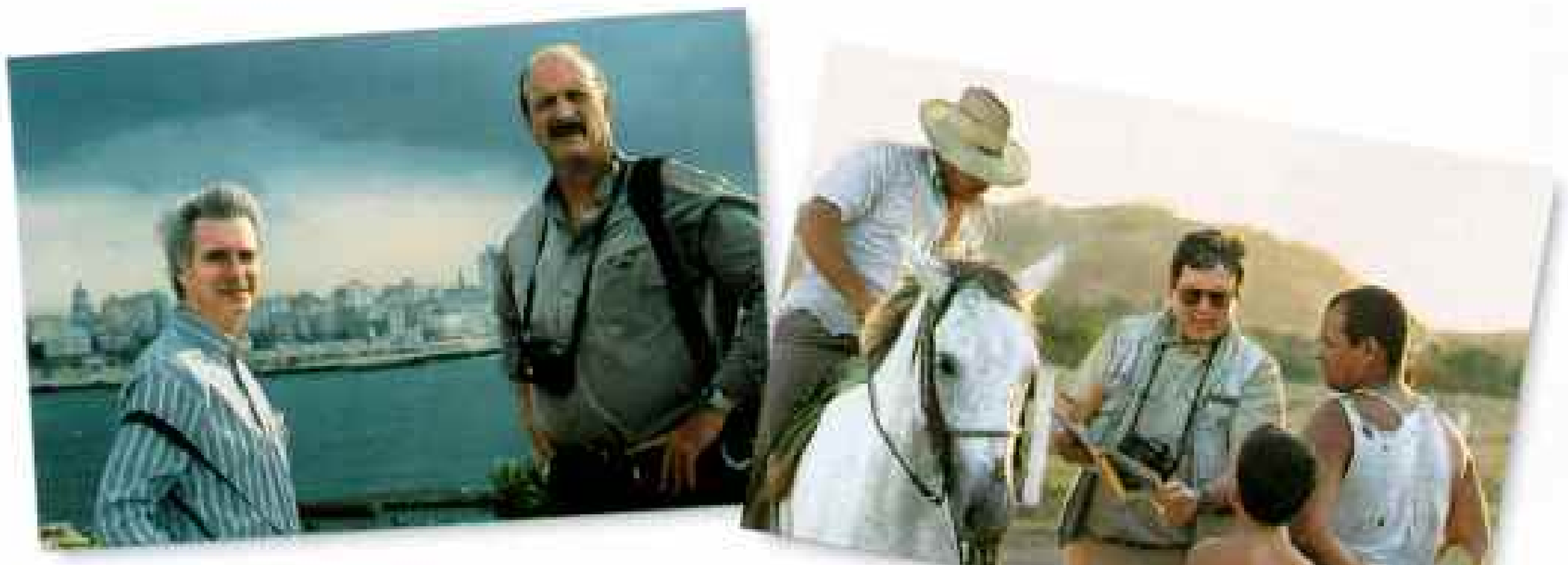
NATIONAL GEOGRAPHIC



From the Editor

JOURNALISTIC COUPS almost always result from being in the right place at the right time. But that seldom happens by chance; only through years of cultivating contacts, making friends, and establishing credibility can a writer or photographer get more than a mere foot in the door and fully explore an elusive subject.

This month's coverage of Cuba and Old Havana is a case in point. Cuban-born John Echave (top right, at center), a NATIONAL GEOGRAPHIC illustrations editor, has for decades navigated the often rocky political seas between Cuba and the United States. Thanks to Echave's groundwork, photographer David Alan Harvey (above, at right) was able to roam the island nation virtually unfettered and even host me, at left, for a visit to Havana. When a longtime compatriot of Cuban President Fidel Castro died, Echave and Harvey were allowed to attend his burial. They turned around at the service and were startled to see Castro himself directly behind. Echave came away with a portrait of a somber leader (bottom right) presiding over the inevitable dwindling of his revolutionary generation.

Talk about access—for three months photographer Joe McNally practically lived with John Glenn and his crewmates for our intimate coverage of Glenn's return to space. McNally and staff writer Bill Newcott found NASA's doors wide open to them in Houston and at the Kennedy Space Center—thanks to, in the words of NASA Administrator Daniel Goldin, "what the GEOGRAPHIC is, and what the GEOGRAPHIC stands for." You don't get better references than that.

Bill Allen

WILLIAM L. ALLEN (TOP RIGHT), JOHN ECHAVE

Evolution in the Revolution

CUBA

The austere times affecting her island haven't made a Havana teenager lose heart. In power for 40 years Fidel Castro is trying to keep prized social programs alive while rebuilding a collapsed economy.

By JOHN J. PUTMAN

Photographs by DAVID ALAN HARVEY

Somewhere under the rainbow five-year-old Claudia Sabina Hernández shows off new shoes to her father and grandfather, who support their family by working a 15-acre tobacco farm in Manicaragua.

Hot clothes and cool cash from abroad brighten Cubans' lives. Relatives alone send hundreds of millions of dollars a year. "If I didn't get money from my daughter in Miami, I couldn't make it," says a Havana retiree.

Optimists all, men cast nets for bait along the south coast near the port of Trinidad. If they can then hook red snapper or sawfish, they will sell it on the street for extra income or haul it home for dinner.

THE MOUNTAIN TRAIL was slick, difficult, rocks, rain, mud. It took me up into a cool, misty world far different from the sun-blasted lowlands below. The trail led to La Plata, the mountain camp where in 1958 Fidel Castro planned the last guerrilla attacks against the army of President Fulgencio Batista.

My companion was Rubén Araujo Torres, 60, a short, sturdy man in a peasant's straw hat. He had joined Castro's cause back then, picking up medicine and soap from secret caches, trading these for food from peasants, then bringing the food up to the guerrillas in their aerie. "It was dangerous. The army was everywhere." Why did he go with Castro? "I was a peasant, illiterate, didn't know anything. But friends said, 'Come on, come with us.' I knew the other guys were burning and killing, so I came with them." Rubén ended up on the winning side; from these mountains, the Sierra Maestra, Castro and his fighters broke the spirit of Batista's army.

We passed guard posts and a few outbuildings, then came to Castro's house of thatch and wood, set on a steep slope above a spring-fed stream in a sea of green.

The house had two rooms. The kitchen held a kerosene fridge with a bullet hole in it. The small bedroom had wooden windows on three sides; you propped them open with sticks. "Fidel built the bookcase, those chairs," Rubén said. "He built this chair for himself, that one for Celia." Celia Sánchez was his aide-de-camp. I went outside, sat on a pole bench. "Fidel would sit there sometimes to write," Rubén said. "It's the original wood, hard; it lasts."

I asked about Celia. "She was very nice," Rubén said, "the mother of the troop." She was constantly by Castro's side taking notes, keeping watch, running errands. She stayed by his side until she died in 1980.

"Celia planted these," Rubén said, "hibiscus, *mar pacifico*." I had noticed the bright red petals on the trail coming in. They seemed to me now souvenirs of a time when everyone here was young and all the world was green.

Forty years after the mountain, Fidel Castro, *el comandante en jefe*, the commander in chief, still dominates Cuba, his hand everywhere. Yet Cuba is changing, its future uncertain. The end of economic and military aid from the old Soviet Union has led to a search for new money, new friends, new ways of doing things. And the comandante is aging; people wonder who will replace him and when. I wanted to look into these questions and also into the questions of how life is in Cuba today and what the people think about their lives, their problems, their future.

I knew that to gain answers, I would have to range the island, talk to people at every level, let them shape their stories, be an honest and patient listener. I discovered to my surprise that almost everyone wanted to talk, and at length. It was as if, controls having been eased, there were thousands of pent-up conversations and experiences to be shared. Only an ear was needed.

I decided to start in Havana, that magnificent and crumbling city of 2.2 million souls. It is said Havana is two cities: One represents the old socialist ways, one the new ways.

I drew a circle around one block on a map of Old Havana, the historic heart of the city. I would dig in there, see what life was like. On one side of the block was Calle Obispo, the tourist street that runs from Hemingway's old hangout, El Floridita, down to the 16th-century Plaza de Armas. The block's other streets were not touristic but narrow, filled with people, potholes, carts, voices, music, dogs, laundry fluttering from balconies, a mattress being lowered by rope from an upper floor. I went to Obrapía No. 508 to meet the block's family doctor, a state employee in a system that offers free medical care to all Cubans.

Dr. Henry Luis Brito, 29, was at work in a small, hot, humid room. As patients came in from a dark passage outside, he would listen attentively, take blood pressure. A woman suffered from depression, another from pain in her knees. A child had asthma. A young man,

WHERE SIDEWALKS ARE PORCHES **in central Havana, the street becomes both playground and footpath. Families often share cold-water row houses in such crumbling neighborhoods, which get less government attention than programs for education, medical care, and rural development.**

Living icon **and tireless voice of the revolution, Castro commands attention in Santiago de Cuba, where he made his first speech as the island's new leader on January 2, 1959. His dictates include neighborhood surveillance by a Committee for the Defense of the Revolution. Meeting outdoors (facing page), a Havana CDR discusses a burned-out streetlight and a dog that barks into the night.**

the doctor determined, was afflicted with *blenorragia*, gonorrhea. By 11:30 a.m. Dr. Luis Brito had seen 20 patients, and he took a break.

"In theory I am responsible for 120 families," he said, "but actually almost 130. More than 500 people in three blocks." The doctor's examining room was spare, dimly lit, missing lightbulbs; it held little medicine. I asked about reports that Cuban doctors are well trained but lack equipment and medicines, that because of shortages hospitals some days can perform only emergency operations, and that many Cubans receive needed medicines from relatives in the United States, sent by way of commercial agencies.

"You must understand," Dr. Luis Brito said, "that I am a son of the revolution. I grew up with the revolution, and I believe there is always a solution here." If one medicine was lacking, he prescribed another. "And there is the possibility of alternative medicines, acupuncture, homeopathy."

For his efforts the doctor received a furnished apartment and 400 pesos ($20) a month. It wasn't enough. So the doctor helped his wife, Yumila, "in a kind of private thing," making ceramic earrings and necklaces to sell in the market to tourists.

The block's rationed-food stores stood at the corner of Obrapía and Villegas; one for meat (sausages of uncertain content) and one for vegetables ("No potatoes today," a smiling young woman said. "Maybe tomorrow, maybe the next day"). Everyone had a little ration book, well thumbed, heavily marked, listing how many grams of what each person could

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JOHN PUTMAN, a former senior assistant editor at NATIONAL GEOGRAPHIC, reported on the early days of Castro's regime in the *Nashville Tennessean*. DAVID ALAN HARVEY photographed the National Geographic Society book *Cuba*, which will be available in October.

buy at cheap prices at the government stores. It allowed one roll of bread per person per day; if you had a few centavos extra, a man would bring your allotment to your house in a pushcart. "You get chicken maybe four times a year," a man said, "but certainly twice." You could buy more food in the private markets but at a much higher price.

AT VILLEGAS NO. 212 was the house of Lourdes González, a positive woman with a big smile and silver bracelets, president of the block Committee for the Defense of the Revolution (CDR). She saw to fulfillment of socialist tasks: recycling, night patrol of the street, health campaigns such as polio vaccinations for all children.

She had a ledger listing everyone on the block. "Nobody can live here, even temporarily, without control." The CDR was on the watch for antisocials—"those who don't work or study, who hustle or rob, who do nothing for anyone, not even themselves."

What if an antisocial is noticed? "We must tell the police. They meet with that person, give warnings. They watch him. He can face sanctions of up to four years."

Rules lie heavy on daily life. You cannot legally buy or sell a house or an apartment; if you want a change, you go down and join the crowd in the median strip of Paseo del Prado to read the swap notices tacked on trees there.

And if you are a young woman, recently married, and want your new husband to move into the house you share with your brother and stepfather, the first step is to obtain a temporary change-of-residence permit. It's good for three months. It takes that long to do all the paperwork for a permanent permit. You must visit the housing authority and a notary and apply to the architecture office for an inspector to come measure your house. He must verify that with an additional occupant the house still meets the rules—ten square meters per person.

"There is more," the young woman told me. Permit in hand, "you must register with the CDR, go to the identity card office, ration book office, driver's license office to get new documents." But she still had no permit; papers had been lost or found wanting, while the days had ticked by. "If we don't get it all done in three months, we could be fined 1,300 pesos." She laughed. "It's crazy," she said.

Jorge, 28, who drives a *triciclo*, or pedicab, and calls himself a *cochero*, or coachman, was

trying to pedal his way into the future. The work was hard. "At the end of the day I am very tired, and some mornings I get up with pain in the legs and back." But with foreign tourists he might on a good day earn $15 (U.S.). He was making payments to buy the tricíclo. He had one worry, that the state, which allowed this small piece of private enterprise, might change its mind, change the rules. It had done so before. Jorge kept on pedaling.

JORGE'S JOURNEYS took him past the new Cuba as well as the old, for the new is everywhere in Havana: shiny new hotels, new Korean-built taxis with radio telephones and drivers in crisp shirts and ties, swarms of foreign tourists and businessmen. The U.S. dollar is everywhere, the currency used by all foreign visitors, and flowing in by the millions to Cubans as remittances from relatives living in the U.S. The dollar is helping create two societies in Cuba: one with dollars, the other without.

A Cuban grumbled. "All the nice new shops are for dollars only, not pesos." The better hotels, with CNN on the TV and plenty of food, were for dollars only, and mainly for foreigners. Most Cubans were stopped at the door unless they worked with, or were guests

A *SEA CHANGE* in finance erodes hard-line socialism. Enterprising Cubans run their own shops and restaurants, while across the country resources beckon to foreign investors. They come to the high-rises of Havana to get in on projects like hotels, textile plants, and mines. "You have to be here if you want to do business," says a German railroad consultant. "Things can happen overnight." U.S. dollars, legal since 1993, divide a once egalitarian society into those who have access to them and those who do not.

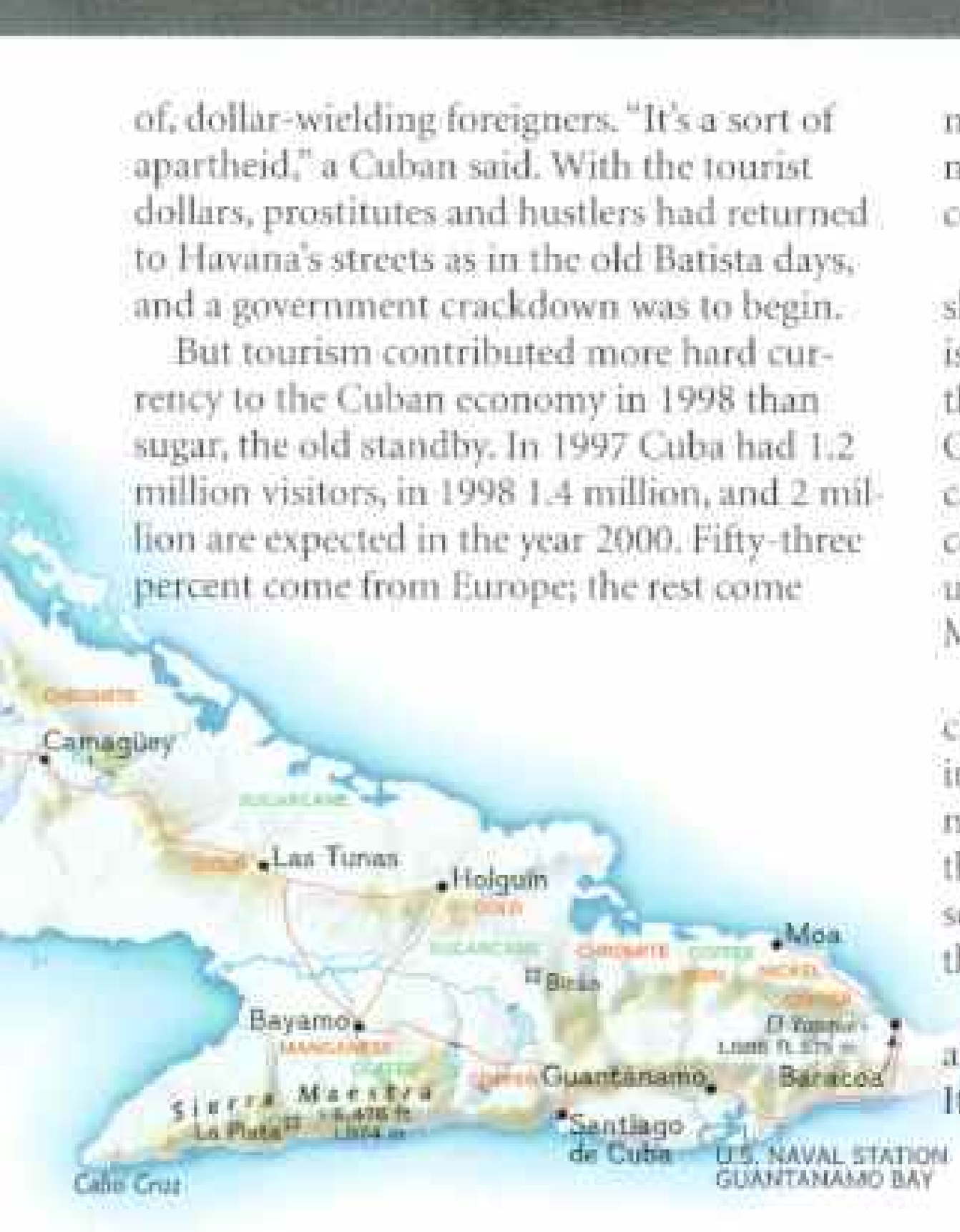
of, dollar-wielding foreigners. "It's a sort of apartheid," a Cuban said. With the tourist dollars, prostitutes and hustlers had returned to Havana's streets as in the old Batista days, and a government crackdown was to begin.

But tourism contributed more hard currency to the Cuban economy in 1998 than sugar, the old standby. In 1997 Cuba had 1.2 million visitors, in 1998 1.4 million, and 2 million are expected in the year 2000. Fifty-three percent come from Europe; the rest come mostly from Canada and Latin America. The new hotels represent investments by foreign copartners, mainly European and Canadian.

A new terminal in Havana awaits cruise ships that will bring more multitudes of tourists. "We're talking with all the big cruise lines, the American too," said Minister of Tourism Osmany Cienfuegos. Cuba welcomes Americans. The U.S. embargo, which prohibits commerce with Cuba, says that U.S. citizens, unless exempted, may not spend money there. Many thousands visit anyway.

Everyone expects the regulations to be changed, but nobody knows when. So the impending arrival of the Americans, with their numbers, their money, their demands, lies on the horizon like a great storm cloud over the sea. One day the storm will break, wash over the old city, change it for better or worse.

The ministry has begun using the Internet, another official said. "A million hits a month. It's the future." Meanwhile ordinary Cubans



A passion for baseball overcomes the lack of a bat in a pickup game in Havana. "We love U.S. culture," says one city resident. "We play your sports, study your language, and know all your Hollywood stars."

"*No es fácil*—It's not easy" applies to almost everything now. With public transport scarce, some commuters squeeze into private vehicles like this truck in Santiago de Cuba. Others bike, walk, or hitchhike. A weekly blackout, relieved briefly by headlights in Baracoa (facing page), has also become common since subsidized Soviet oil that once fueled power plants dried up in the early 1990s.

are denied its use. Life in Cuba today is rich in contradictions, if nothing else.

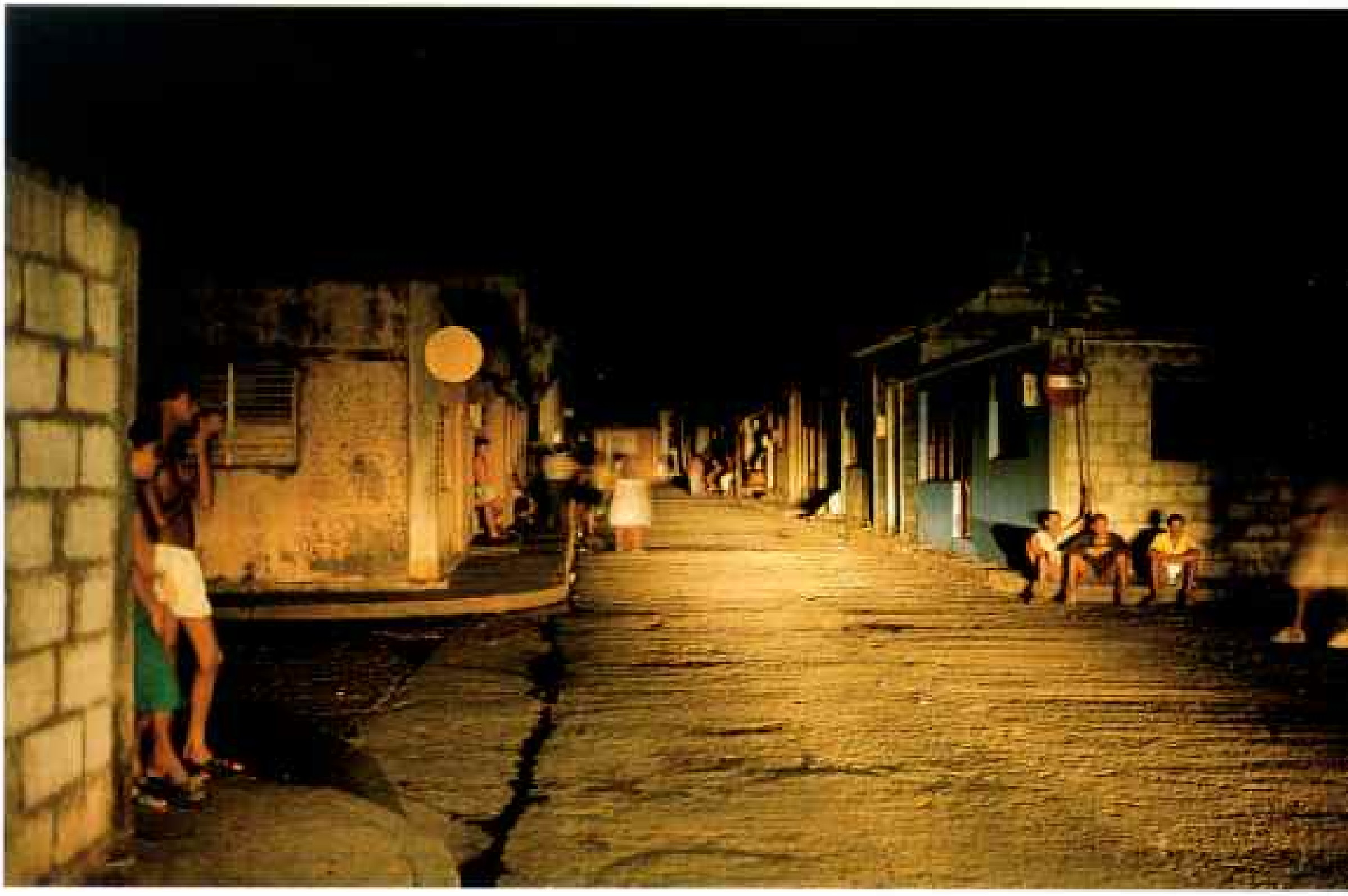
When I visited Habanos, S.A., the state company that controls the marketing and sale of Cuba's famous cigars, I found business booming. Exports had jumped from 72 million cigars in 1996 to 126 million in 1998. More production was wanted, said Francisco Linares, the company president. "We're searching for more suitable land"—with just the right amount of sand in the soil and a microclimate that promises moist nights, cool mornings.

And the government is getting out of tobacco growing, turning land over to farm families to work as their own. Already 90 percent of Cuba's tobacco is grown by 30,000 private farmers working small pieces of land. When experience as well as hard work was needed, perhaps it seemed best to let the farmer make the decisions, enjoy the profits.

I was pleased to see that in the push to produce, traditions endured. The factory I visited in Havana was 150 years old, built by a man with a name famous in cigars, Partagás. In a great room suffused with the dark colors of tobacco, rows of men and women bent to their work. Each had a pile of filler tobacco and wrapper leaves; a *chaveta*, or knife; a *tabla de bonche*, the cigar mold to go in the little wooden press; and a *tabla de rolar*, the darkened wooden block on which they cut and rolled. They worked swiftly, their target about a hundred cigars a day each—Cohibas, Montecristos, Bolivars, as well as Partagases.

As they worked, a *lector*, reader, on a platform with a speaker system read newspapers to them, played the radio for them, made announcements, a custom as old as cigarmaking.

Cuba's prestigious Center for Genetic Engineering and Biotechnology, on the outskirts



of Havana, competes in a more high-tech market. Dr. Manuel Limonta, its director general, described breakthroughs achieved or sought by his scientists: vaccines against AIDS and dengue fever; medicines to dissolve blood clots; genetic modifications of plants, fish, and animals to promote better yields, resistance to pests and disease, and faster growth.

He said the institute's commercial arm was already exporting medicines and clinical supplies to 47 countries: China, India, nations in Latin America and Eastern Europe. "We are now looking to the European community. We would welcome partnerships there. Those companies have big marketing networks, much experience. We can offer lower costs in development and production."

Cuba's low pay, it seemed, was a card that could be played on the global market.

I wondered how the state could maintain its communist ideology as it attempted to edge into the capitalist world market. I went to see Raúl Valdés Vivó, rector of the Cuban Communist Party's Nico López school for advanced studies outside Havana. It stands close to the state's Marina Hemingway, which welcomes foreign yachts, including those of Americans.

Valdés Vivó, 69, was quiet-spoken, wore glasses. He had been a communist before Fidel organized his revolutionary movement. When Fidel declared communism the guiding ideology of Cuba, Valdés Vivó became a leading ideologue.

"The problem today," Valdés Vivó said, "is to maintain socialist principles when we have to use not only socialist but capitalist means." It wasn't easy. It had led to a change in the school's curriculum. Before, he said, students had studied basic texts: the works of Marx, Engels, Lenin, Che Guevara. Students had been expected to give answers in class that coincided with what was written in those books.

"Now we have a more creative education, one that focuses on the problems of today. The student must talk as much as the professor." If there is a basic text at the school today, he said, it is the "ideas of Fidel, even the example of Fidel."

Valdés Vivó mused a moment. "Cuba is no longer an island," he said. "There are no islands anymore. There is only one world."

Maybe, I thought. But I remembered the young woman who told me of her feelings of isolation living on the island of Cuba. "It's like we live on Mars: We are Martians."

I TOOK THE *AUTOPISTA* WESTWARD, into a countryside of banana groves, lime trees, distant hills, tobacco barns, rice spread to dry along the roadside. A fine superhighway, but cars were few, buses fewer. Big trucks carried people packed rump-to-rump, chest-to-chest. I turned right at Pinar del Río, capital of the province of the same name, and climbed little hills to the town of Viñales.

"*¡Lo cubano—está aquí!* The real Cuba—it's here!" a billboard promised.

The area is indeed beautiful. Early morning mist covered the valley of Viñales, and dark limestone masses rose through it like ancient gods. Birds circled, a rooster crowed, the first workers entered the fields of manioc and beans. It reminded me of Eden.

The town, long a regional agricultural center, seemed little touched by the years. Houses with porches, tall pine trees, a gentle atmosphere. But a new emphasis on tourism had brought change. Here too were two Cubas, the old and the new, and sometimes envy.

Each month workers in tourism could buy at low cost from their employers a bag of soap, shampoo, detergents, cooking oil—scarce and costly items all. Other workers didn't have that benefit and sometimes expressed resentment. A party member defended the system. "Some people, because of human nature, think a bar of soap is a big thing, a higher level of life. But they forget that tourist workers share all the other limitations of life in Cuba today."

The Catholic church stands on the main square in Viñales. The priest, Padre Vicente Cabrera Delgado, was 34. He served eleven churches, said Mass in five every Sunday.

"I start about 5 a.m. and end about 10 p.m. I have a car but not a very good one. Often I have to use a bike." He had been born in the province, his father a mason. He wore no clerical collar but a tan shirt, dark trousers. He thought the church was growing, if slowly. One reason was "younger priests, a change of style. A presentation of God not as a rewards and punishment man but as a God that establishes a relationship of friendship with men."

The pope's visit to Cuba had been very

SPORTING HER SOCIALIST PIONEER BANDANNA, a girl in Baracoa picks up the day's bread for her mother and herself—one roll apiece. "Rationing is the worst thing about Cuba these days," says one of the many women with no hard currency to buy extra groceries at the well-stocked dollars-only stores. Lush, like the rest of the country, Baracoa (facing page) is a producer of cacao and coconuts.

NATURAL RICHES **still support much of Cuba's economy. Some of the world's finest cigar tobacco grows in San Juan y Martínez, where farmer Juan Gómez checks drying leaves that he will sell to the state monopoly. Cuba mines nickel ore near Moa (facing page) and offers other tempting prospects—reserves of gold, iron, copper, and zinc—for investment by foreign companies.**

important. "Six busloads of people went from here to Havana to see and hear him." The pope had reached out to join believer and nonbeliever in reconciliation, to urge Cubans to look at the future with hope, to commit to changing things so all might live in harmony. "He spoke," another priest had told me, "like a friend who says things you don't want to hear but you should listen to."

"For four decades the church has faced problems with the state," Father Cabrera Delgado said. At the beginning the revolution seized church property, banned public devotions, drove priests from the country. Even Christmas was abolished.

Now problems were more subtle. "There's a disco next door; they do not respect our services." And sometimes the city blocked off the plaza for an event, barring access to the church, giving no warning. "But there has been an opening, and we cannot ignore that."

VIÑALES'S LINK to the world in the old days—shipping out agricultural products, receiving manufactured goods—was La Esperanza, Hope, on the north coast. It's a small fisherman's town now, quiet, its houses drawn up along the main street. I turned down a side road, took a path past goats and fiddler crabs to the beach, and found the local branch of the Cuban Federation of Sport Fishing. There was a shack, a rickety wharf, some 30 skiffs dancing on the blue sea.

The club manager pulled chairs from the shack, and we sat in the sun. He said the club had 400 members. Dues were one peso (five cents) a month. "A good deal," he said. And not only for sport. "You can catch and keep for your family 15 kilos [33 pounds] of fish a day. Over that you must give to the state." The boats were privately owned. A pretty one, *La Gaviota—The Seagull,* was for sale. It had

an Italian engine. The price was 7,000 pesos.

It was pleasant there. On the horizon cays lay like dark shadows. I could understand why Hemingway so loved the seas around Cuba, the fishing, and why he wrote so much about these things. Close by was the dock of a state fishing cooperative and the tower of a coast guard station. Atop the tower a man bent over a powerful telescope, scanning the horizon, looking perhaps for invaders, spies, or fellow countrymen setting out for Key West 175 miles to the northeast. From small fishing ports like this, I remembered, thousands of Cuban *balseros*, rafters, had set out in 1994 for the Florida shore, risking all against the sea for a better life.

I noticed the Cyclopean eye of the scope swing to focus on me and the fishermen. The manager was called away, returned to say I must leave. "Why?" I asked. He nodded toward the tower. The fishermen expressed regrets. "I don't know why they do this," one said. "The people who come here are nice."

The next day in Viñales, officer Ira of the immigration police, prim, polite, came looking for me. He took me into his tiny office in the police station, closed the door, unlocked his filing cabinet, removed four pages of blank paper, took pen in hand. Had I been down to the fishermen's club by the coast guard station at La Esperanza? Why had I gone to talk with the priest? Who else had I talked to? Well, I mused, even Eden had interrogations.

Back in Havana an official of the ministry of foreign relations said that the actions by the coast guardsman and officer Ira did not conform to new regulations. Perhaps, he said, the new rules had not yet been absorbed by every officer in every town.

EAST OF HAVANA lies the great bulk of the island: green seas of sugarcane, mountains, vaqueros on their little horses, farmers with oxen. I drove east, then south, and ended up in the town of Trinidad. It had once flourished as a sugar port, but time had passed it by. Its center held 1,200 buildings from the 18th and 19th centuries; these were to be restored, a treasure from the past, a lure for tourists. Sometimes I thought the history of Cuba was written in houses.

Leopoldina Fonseca y Valdés-Busto de Iznaga was 90, ill, abed, white hair on a white pillow. There was a rosary above the bed, an old family servant, Benito, by her side. Leopoldina recalled when the revolution had come to

Though they rarely have new wire to mend a fence,
tobacco farmers in Manicaragua live better than
many city dwellers. A horse takes them on errands,
and a kitchen garden helps keep them well fed.

Cuban to the core: **Centuries-old customs, both secular and sacred, flourish unfazed by decades of Soviet presence. Fighting cocks fascinate a boy in Baracoa. Cigar smoke and prayers cleanse the spirit of 13-year-old Nayade Garcia (facing page). Her mother performs a ritual of spiritism in their Havana apartment, where she also practices Santeria, another religion with African roots.**

Trinidad. She and her husband had been at their country house when the rebels arrived. "They said we had to leave the house in 24 hours. They said they would help, bring trucks. But much was left behind."

It had been the end of a dynasty with thousands of acres of cane, fine houses, a great bell tower. Leopoldina and her husband moved to their city palace, and in time, after her husband died, she had to leave that. She lived now in a modest house the government had given her. "Everything was taken from us," she said, "and they give me a pension of only 120 pesos a month, not enough even for medicine."

Buena Vista, the country house from which she had been expelled, sat on a little hill in a valley of cane, a copy of a Roman villa, of stone, square, strong. It was now a shambles, its occupants a retired cane cutter and his family. But he too might soon be asked to leave. Officials were considering adding Buena Vista to the list of houses to be restored for "social uses" such as tourism.

Down the coast to the east lies Santiago de Cuba, the island's second largest city. Images crowd the visitor's mind: a rim of mountains, undulating streets, houses of pink and green, black faces recalling a slave port past, a dwarf on crutches, begging, horse coaches carrying arrivals from the train station, down by the docks, up into the neighborhoods.

It was Carnival, the festival the city has long held to celebrate the feast day of its patron, Santiago—St. James the Apostle. Night after night teams competed for prizes with dancers, musicians, marchers, towering floats. In the dark city, Carnival streets glowed with light and shook with music—a mix of congas, rumbas, salsas. One young dancer, tall, black, elegant, had her eye on the future. She had

joined the team of a well-known dancing school, La Placita. "After its training," she said, "I will get a contract at a tourist cabaret. Then I will make money."

African spirits hung in the air. Santiago is a stronghold of Santería, a faith based on African gods and traditions that incorporates Catholic saints and imagery. I went to see a *santera*, a practitioner, Vicenta Tejeda, from a family of santeros. She performed her ceremonies in a small room at the back of her house. She was a friendly woman wearing a yellow-patterned shirt and navy skirt with rings and a gold bracelet. She was surrounded by paraphernalia: African-looking drums of many sizes, iron pots, dolls, dishes, stones, cowries.

"People come because they have problems," she said. "They are sick or have a sick child or have a problem with the law." She performed rituals, would counsel a sick person to give food to the gods or take special baths. If needed, "I will sacrifice a goat."

Vicenta said that in her parlor she practiced spiritism, another religion popular in Santiago. "It's based on the spirits of different protectors. We work with a table, many glasses of water, candles, perfume, petals of flowers."

During that busy Carnival week there was also a political celebration, one marking the anniversary of the revolution. Fidel himself was to speak. The venue was the Moncada barracks, a handsome yellow-and-white art deco building. Castro had attacked it as a young man in 1953; the battle had been fierce, a number of men killed, Castro captured, later released. It was a milestone in the revolution.

I went to the barracks early, saw rows of blue chairs on the parade ground awaiting guests. I decided to spend the evening in the neighborhoods. As I moved through the dark, crowded streets, I noticed loudspeakers had been set to carry the comandante's message to everyone. Block to block, I heard his voice, reciting the achievements of the revolution: "Cuba counts one teacher for every 42 inhabitants . . . 98.8 percent of infants up to age two are immunized against ten diseases . . . 7.3 hospital beds per 1,000 inhabitants . . . total of doctors: 63,384 . . . electricity production capacity multiplied by ten. . . ."

"He always cites statistics," a young man later remarked. "I should know them by heart." Before I went to bed that night, I looked out my hotel room window and saw the floodlights at the Moncada barracks still blazing. The comandante was still speaking.

Carnival lights up Santiago de Cuba on a sultry July night as troupes of costumed dancers pulse through the streets to the syncopated beat of music played on trumpets, conga drums, and cowbells.

Cuba's biggest business, **tourism grosses almost two billion dollars a year, partly with resorts like Varadero. State-of-the-art medical technology attracts many visitors. Quadriplegic after a car crash in Colombia, Maria Claudia Raigosa (facing page) swims, with help, at Havana's International Center for Neurological Restoration. "When I go home, I'll wheel myself off the airplane," she says.**

Among his concluding words: "We will never surrender. . . . Socialism or death!"

Fidel seemed everywhere. I wondered what had shaped this man. His boyhood home lay north of Santiago in the village of Birán. I drove there through fields of cane rimmed by mountains. At the gate to the family *finca,* or farm, I was stopped by a guard. To visit, I would have to get special permission from the secretary general of the Communist Party in nearby Holguín. It was given, and the next day I entered.

The finca was in truth a hamlet. There was a small wooden hotel, a store, a post office, a one-room school, an arena for cockfights, thatched huts for Haitian workers. On a rise was the family house, handsome, rimmed by a porch and topped with a lookout room. The house stood on posts so that animals and supplies could be sheltered underneath. All the buildings were beautifully restored, empty of people.

Inside, the house was light, airy, had an interior gallery. The parlor held two photographs. One depicted Fidel's father, Ángel, on horseback. He had come from Galicia in Spain as a penniless boy, worked his way up. He sat erect in jodhpurs, leggings, a tightly buttoned jacket, his face as stern as a conquistador's.

The other photograph showed Fidel's mother, Lina, willowy in a white dress, holding flowers. She was from a peasant family, had been a maid in Don Ángel's household.

Another room held Fidel's baby bed, simple but snug, the crib of the revolution, you might say. The lookout room was the parents' bedroom, windows on all sides. Here Ángel could survey his domain in every direction. The room reminded me of another: the one in the little house that Ángel's son built on the mountain when he was the guerrilla chief.

Graciano Gómez, 78, a peasant's son who grew up with Fidel and now lives nearby, recalled the family. Ángel demanded hard work but was fair. Lina was nice, could talk easily with any peasant. As for Fidel, "he was always the leader. We would be playing one game, and he would say, 'Let's do another.'"

The finca, in a way, brought to mind Washington's Mount Vernon: a handsome setting preserving a glimpse of life in a bygone time and linked to a historical figure. There was indeed a plan to open the finca to tourists, I was told. "But not yet."

BACK IN HAVANA, I visited one of the 50 or so dissident organizations that protest the rule of the Castro government or charge violations of human rights. I found the headquarters of the Pro Human Rights Party of Cuba in the basement of a house in southeast Havana. The basement was also home to Odilia Collazo Valdés, president of the party. She was 48.

To argue with Fidel had its risks. The founders of the party, she said, had been jailed in Cuba and were now in the United States. "Our program is to defend the 30 points of the United Nations Declaration on Human Rights." Because the government controlled the media in Cuba, she said, the party denounced violations through international organizations such as Human Rights Watch. It was in constant touch with those organizations by phone. It was also in touch with Cuban Americans in Miami and with Radio Marti, the U.S. government-sponsored radio station in Miami. Once the phone rang. Another party member answered, talked, hung up. "Radio Marti," he said.

Odilia said there were between 350 and 400 political prisoners in Cuba. Her father had been a political prisoner, held six years in La Cabaña, a sprawling Spanish fortress overlooking Havana's ship channel. "They let him out when he was very ill; they always do that. He died shortly thereafter."

She said the party had links in every province. Members exchanged visits and information, sometimes demonstrated. "Earlier this month we planned to demonstrate at a religious procession at a church and gathered at a house nearby. But security forces came, and we were not allowed to leave the house."

She had taken along her *ropa de calaboza*, cell clothes—soap, spare underwear—just in case. She had been to jail before, she said,

Children of the revolution—born since 1959, as are almost two-thirds of Cuba's 11 million people—ride to Guanabo, a beach just east of Havana, in an American relic from pre-Castro days.

sometimes for hours, sometimes for days. Unlike her father, not for years. Still, rules governing public dissent can change.

A SMALL NOTICE APPEARED in *Granma*, the newspaper of the Communist Party, early last June. "*Información a la población*—Information to the people," the headline said. It announced that the U.S. Interests Section, the de facto U.S. embassy in Havana, was holding another lottery to give Cubans a chance at immigration visas. The lottery would open June 15, close July 15. Entries had to be postmarked within those dates.

The lottery is part of an agreement between the U.S. and Cuba designed to discourage the chaotic flight of boat people to U.S. shores. The U.S. allows 20,000 Cubans to immigrate to the U.S. each year, of which the lottery provides about 15,000. The Cuban government, for its part, tries to control illegal departures.

When I visited the Interests Section, the lottery had just closed. I asked a diplomat how many letters had been received from applicants. The answer was 541,100. That is about 5 percent of Cuba's population.

I wondered what the youth of Cuba thought about the future; it would belong to them. I ascended the great stairway leading to the University of Havana. The university had been one of young Fidel's favorite venues. As a student there he had carried a gun, demonstrated, agitated, speechified.

I would find today's students more circumspect. I walked through the gate into a pleasant quadrangle: trees, paths, benches, law students taking a break. They gave varied answers to my question about the future. "About the same . . . more privatization . . . the government will take the private things back . . . much different . . . the same . . . we have to see who is coming after."

One graduate student, slim, swarthy, had

HAVANA SIZZLES, **especially at Carnival time, when kiosks are set up to sell beer and soda along the Malecón, or seawall drive. Revelers who can't afford to buy? They simply celebrate as they live—laughing at what they lack and sharing what they can. Though some Cubans still dream of an easier life elsewhere, most defend their land, problems and all. "I always come back to Cuba," says an artist who travels abroad. "My roots are here. My heart is here and will be until the day I die."**

been mulling the question. "We are living in an age of reorganization," he said. "We see it every day in class and in daily life. The Cuban economy is going to be restructured, decentralized, become more spontaneous, and Cuba will be inserted into the global economy. I hope we can survive." Would economic changes lead to political change? "This is not the current tendency," he said.

Who might follow Fidel? People I spoke with mentioned three or four leading government officials. They often cited 61-year-old Ricardo Alarcón, president of the 601-member National Assembly, the "Congress" of Cuba. Considered Cuba's top expert on the U.S., he had spent years as Cuba's ambassador to the United Nations in New York.

Alarcón assured me there was no jockeying to succeed Fidel. "If Fidel is not president or is not working for any reason, his successor is the vice president of the Council of State, Raúl, automatically. Raúl was elected to that post by the National Assembly. If somebody else wants that position, it would be illegal. It's in the constitution."

Raúl, Fidel's brother, is also chief of the army—an army that has gone into business with hotels, car and aircraft rental agencies, the growing and marketing of food. But Raúl is 68, reported to be frail. So the question of who will lead Cuba in the years ahead remains unanswered, as does the question of what direction a new government might take. Future possibilities, a U.S. official said, include a gradual, peaceful transition to democracy, or chaos, or something else. No one knows.

Fidel was the one subject Cubans seemed reluctant to discuss. I asked one man if it was perhaps time for the comandante to step down. He bristled. "To retire would be cowardly." Later he added an old Spanish proverb: "*No hay mal que dure 100 años ni cuerpo que lo resista*—There is no illness that lasts 100 years and no body that could endure it."

ON MY LAST NIGHT IN HAVANA I walked in the garden of the old Hotel Nacional de Cuba. The garden overlooks the sea. By day peacocks stroll and caged birds sing. By night you watch the beam of the El Morro fortress lighthouse flash from across the ship channel. I thought of my first visit to Cuba, just days after Castro's army seized the capital in 1959. He was then 32, fresh faced. I was a young journalist, curious to see a revolution.

I had stayed at the Nacional, walked the streets, looked at everything. But I remembered little except the *guerrilleros* in their fatigues, weapons hung from belts, shoulders, chests—young, exultant, shouting, smiling, swaggering. You don't see much exultation in faces today, I thought. Rather, you see struggle, uncertainty, maybe hope.

In my room I switched on the television. The face of el comandante filled the screen.

He looked old, tired; he is 72. At times, making a point, he would lift a finger, raise his eyebrows, and an expression of satisfaction would pass over his face. Forty years takes a toll on all of us. I switched off the TV. Tomorrow is another day. □

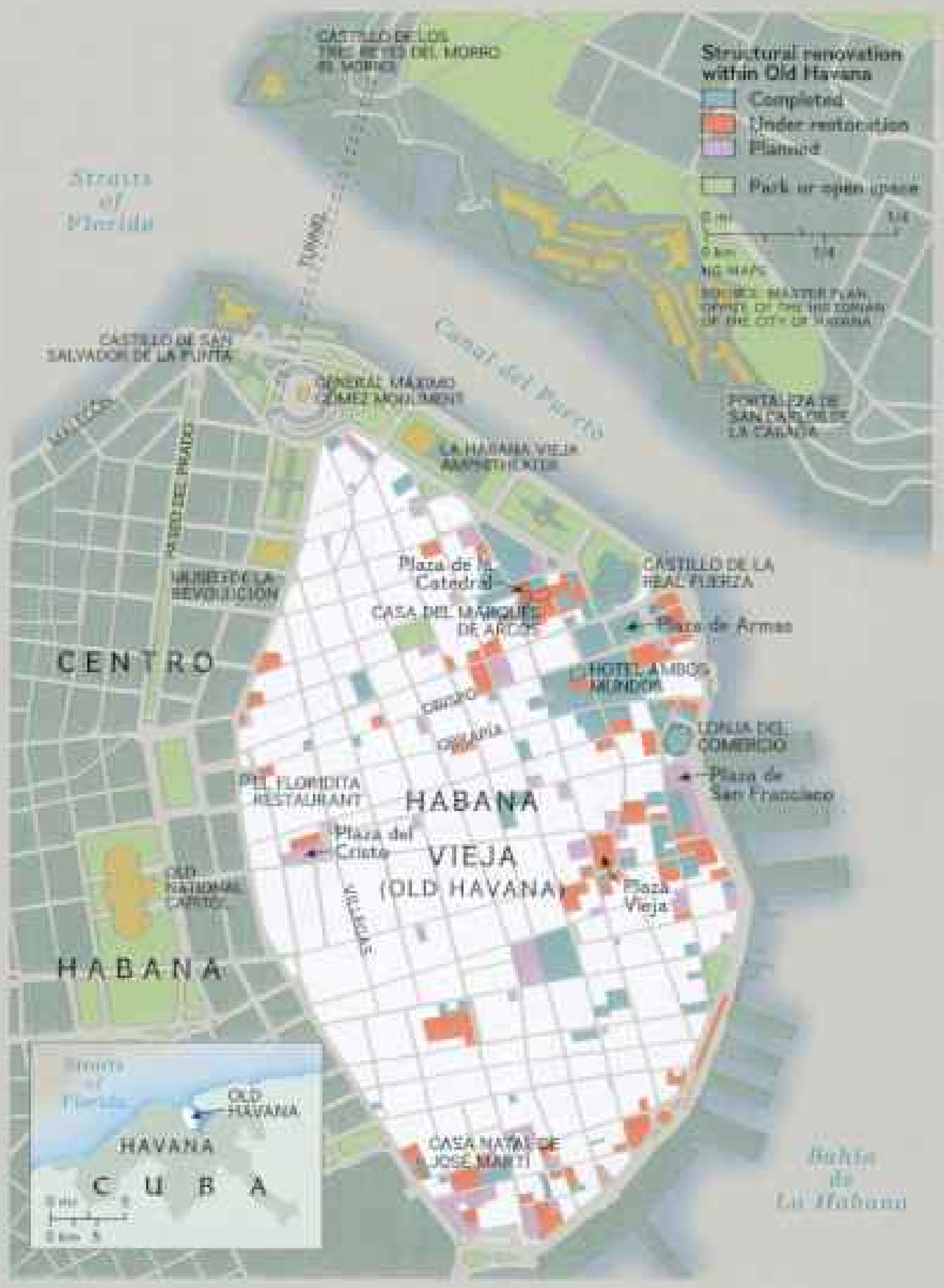
Discuss Cuba's prospects at *www.nationalgeographic.com/ngm/9906*. See more David Alan Harvey photographs at *www.nationalgeographic.com/photography*.

The Rebirth of Old Havana

Life rolls along with new energy on the Plaza Vieja, a centerpiece in the ongoing rehabilitation of the Cuban capital's historic quarter. Paving stones and a fountain of Italian marble replace a parking lot.

Photographs by DAVID ALAN HARVEY

In a race against time the city is trying to restore Old Havana—named a UNESCO World Heritage site in 1982—before long-neglected walls and roofs come crashing down. "We have treasures here, everything from the 1500s to the present century," says City Historian Eusebio Leal Spengler, who heads the effort. Work on the 18th-century Casa del Marqués de Arcos (below) began with structural stabilization. As renovation progresses, eight-year-old Adel Acea does a painting for his art class. "We encourage such field trips for local students," says historian Azalia Arias González. "It gives them an appreciation for their culture that they wouldn't get any other way." The house, former residence of a noble family, will become an art museum and boutiques. An office building from the early 1900s (right) is being converted into offices, shops, and apartments.


Straits of Florida
CASTILLO DE LOS TRES REYES DEL MORRO EL MORRO
CASTILLO DE SAN SALVADOR DE LA PUNTA
GENERAL MÁXIMO GÓMEZ MONUMENT
LA HABANA VIEJA AMPLIACIÓN
Canal del Puerto
PUNTALIZA DE SAN CARLOS DE LA CABAÑA
Paseo del Prado
PARQUE DE LA REVOLUCIÓN
Plaza de la Catedral
CASA DEL MARQUÉS DE ARCOS
CASTILLO DE LA REAL FUERZA
Plaza de Armas
HOTEL AMBOS MUNDOS
Calle Obispo
Calle Oficios
LONJA DEL COMERCIO
Plaza de San Francisco
DEL FLORIDITA RESTAURANT
HABANA VIEJA (OLD HAVANA)
Plaza del Cristo
Plaza Vieja
Calle Mercaderes
OLD NATIONAL CAPITOL
CENTRO HABANA
CASA NATAL DE JOSÉ MARTÍ
Bahía de La Habana
Structural renovation within Old Havana
Completed
Under restoration
Planned
Park or open space
OLD HAVANA
HAVANA
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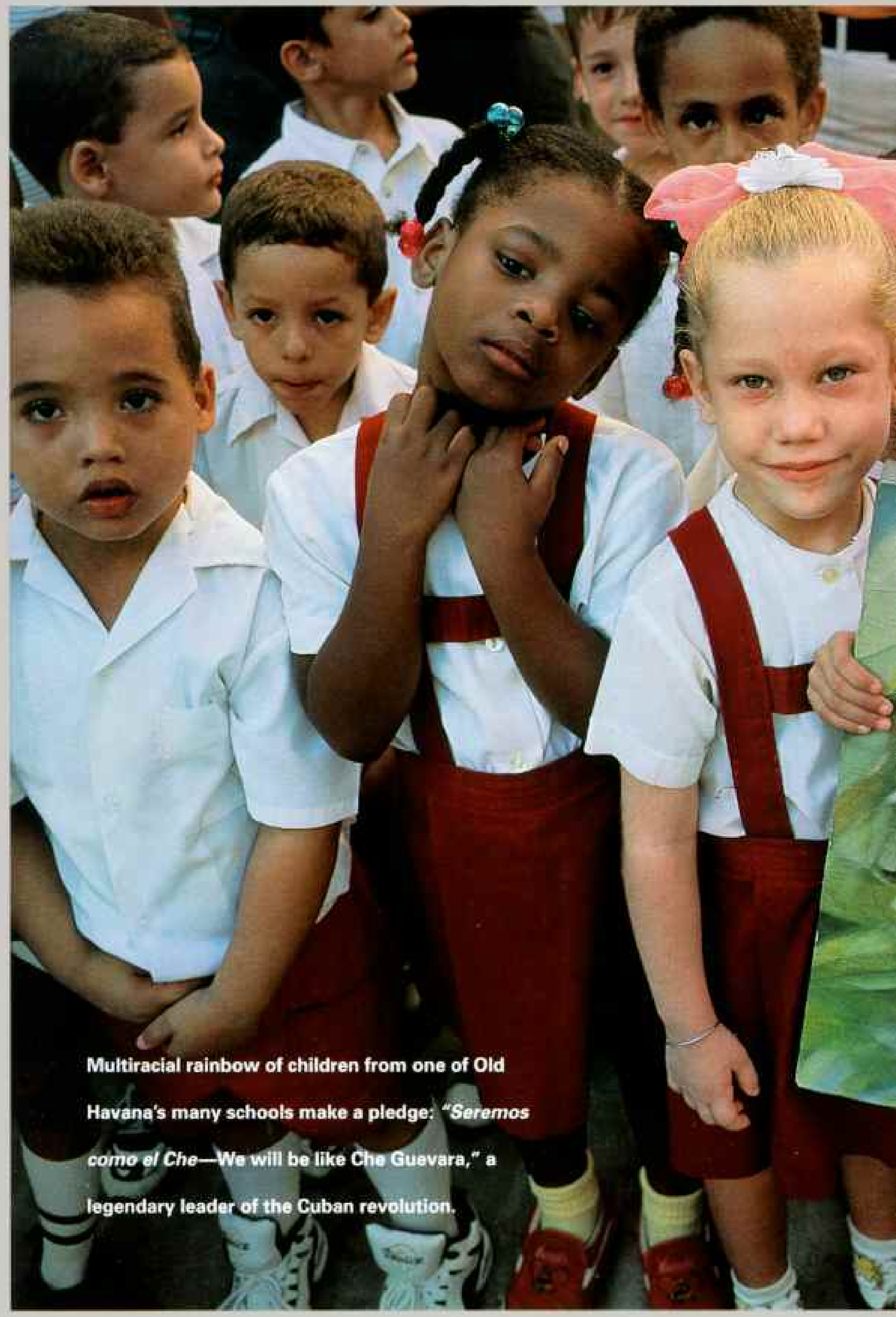


Multiracial rainbow of children from one of Old Havana's many schools make a pledge: *"Seremos como el Che*—We will be like Che Guevara," a legendary leader of the Cuban revolution.

"We want this to remain a living part of the city, with homes and shops as well as the colonial forts and palaces that tourists come to see," says Leal Spengler. True to that goal, a number of restored structures retain their original function. A shelter for expectant mothers built in 1859 reopened two years ago as the Doña Leonor Pérez de Martí center, named for the mother of José Martí, the hero of Cuban independence, who was born in Old Havana. As part of the free national health care system, it houses women with high-risk pregnancies. In addition to gathering regularly in the lounge for lectures on prenatal health, patients often attend public concerts and plays in newly renovated grand old houses that have become cultural centers.

Since its establishment in early 1994 the restoration effort's umbrella company,

Habaguanex, S.A., has supported such centers as well as museums, libraries, and art galleries with profits from its real estate ventures—a practical marriage of capitalism and social conscience. Radiating from the 16th-century Castillo de la Real Fuerza (above), renovation has advanced along blocks of cobbled streets in all directions. After refurbishing a building, the company may rent it to a commercial tenant or run a business itself, as is the case with the Hotel Ambos Mundos, where author Ernest Hemingway once lived. "The money those properties earn also pays for work on apartments and offices that would be difficult to finance otherwise," says Raimundo Gómez Cervantes, a museum curator. "In the past ten years we've reinvested tens of millions of dollars, and we're now seeing the benefits."

A palace turned tenement on the Plaza Vieja is next in line for renovation. "As people see their surroundings improve," says historian Arias González, "we hope they will be more optimistic about the future."

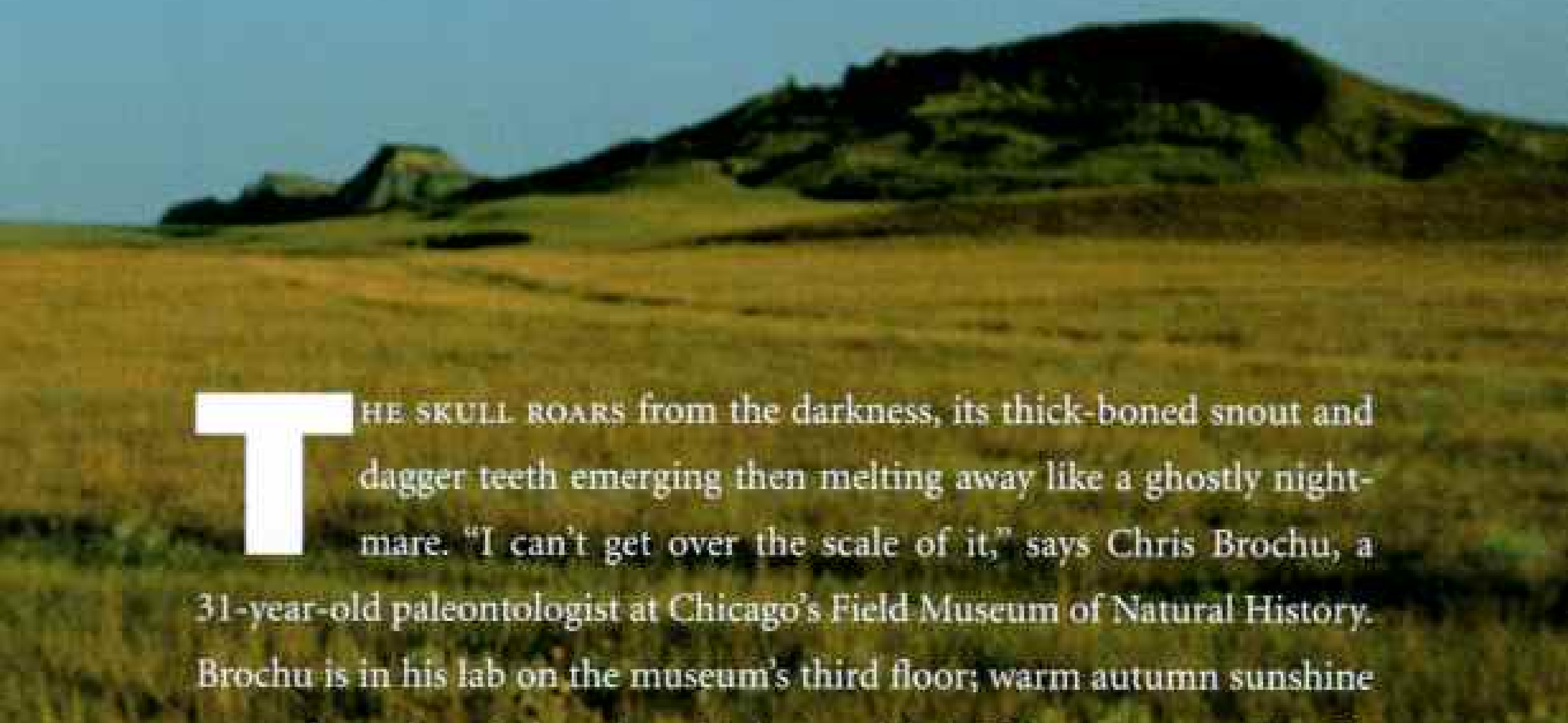
TEXT BY A. R. WILLIAMS
SENIOR STAFF


BEWARE
TYRANNOSAURUS
AHEAD

A DINOSAUR NAMED

SUE

BY DONOVAN WEBSTER
PHOTOGRAPHS BY IRA BLOCK



THE SKULL ROARS from the darkness, its thick-boned snout and dagger teeth emerging then melting away like a ghostly nightmare. "I can't get over the scale of it," says Chris Brochu, a 31-year-old paleontologist at Chicago's Field Museum of Natural History. Brochu is in his lab on the museum's third floor; warm autumn sunshine pours through a window above his battered desk. He's staring at a digitally generated image of the museum's newest celebrity fossil unfolding across his computer screen. It's an animated computed tomography (or CT) picture of the enormous 67-million-year-old skull of a *Tyrannosaurus rex*, now known to most of the world as "Sue"—after Sue Hendrickson, the fossil's discoverer. Technology has collided with prehistory, and it's helping to unlock long-standing mysteries of Sue's world.

"We call it 'where the rexes roamed,'" says field paleontologist Sue Hendrickson (right), describing South Dakota's badlands, an area so rich in *Tyrannosaurus rex* fossils that friends posted a playful sign (preceding pages). In sediments dating back some 67 million years, Hendrickson found her namesake, "Sue." Dug up in 1990 (below), Sue's skeleton is about 90 percent complete—a Rosetta stone for the species.

PETER LARSON, BLACK HILLS INSTITUTE OF GEOLOGICAL RESEARCH

"Let's go again, this time slower," Brochu says. He taps his computer keyboard, and across the black screen comes the five-foot-one-inch-long skull, moving from the snout, past the eye sockets toward the braincase. I can see teeth and nostrils and bony structures, inside and out. The image was created at Boeing's Rocketdyne lab in Ventura County, California, where Sue's skull was sectioned into electronic slices by industrial-strength x-rays instead of dissection saws. When the scans were complete, Brochu put the pictures together in animated form, creating this moving x-ray.

Brochu freezes a frame halfway up Sue's snout. "See here?" he asks, pointing at a bone-encased tube the circumference of a child's fist. "This is the olfactory passage, where nerves for smell passed between the nose and brain. They were huge."

He points to another, smaller hole at the skull's rear. "This is where the spinal cord emerged from the skull to enter the spinal column. This animal's bundle of spinal nerves was smaller than the nerves running to its nose."

Hitting one last key, he backs up the animation and points out a small, slightly rounded cavity. "There," he says, "is the braincase."

Brochu turns from the screen. An ironic smile crosses his face as he scrubs a hand through his thatch of brown hair. The narrow, lumpy, nearly foot-long brain that once sat inside this skull, directing the age of dinosaurs' most fearsome creature, was not much larger than a quart of milk. "By using the CT scan to cut the skull in half without destroying it," he says, "we've gotten the clearest view yet of *T. rex*'s skull anatomy and learned that

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DONOVAN WEBSTER wrote about the dinosaurs of the Gobi desert in the July 1996 issue. Born and raised in Chicago, he knows the Field Museum well. Photographer IRA BLOCK has contributed to the magazine and other Society publications since 1977.

the olfactory nerves were even larger than we had thought." He flashes another grin. "Literally, this thing must have smelled its way through life."

As fossils go, none these days casts a larger shadow than Sue. Whether people first heard of it thanks to the 8.36 million dollars paid at a high-profile auction, the lawsuit that landed it at Sotheby's in New York City to begin with, or the Field Museum's commitment to preparing it for display in public view, Sue is likely the world's most famous dinosaur fossil.

At more than 40 feet long, standing some 13 feet tall at the hip, and with an estimated live weight of 6 to 8 tons, Sue is the largest of the 22 *T. rex* specimens ever discovered. (The indefatigable Barnum Brown—who may have excavated more dinosaurs than anyone else this century—unearthed the first in Wyoming in 1900.) And with about 90 percent of its bones accounted for, Sue is also the most complete specimen ever found in western North America, *T. rex*'s range.

Because of its size and completeness, Sue may help solve mysteries about dinosaur life 73 to 65 million years ago in the late Cretaceous period. It was a time when plants and animals were rapidly diversifying, just prior to a mass extinction that ended the age of dinosaurs.

Parts of Sue's skull and other bones can already be seen at various times in the museum's public preparation lab. It will likely be May 2000 before the world gets its first view of the full skeleton of the colossal fossil in the soaring, white-marble showcase of Stanley Field Hall.

But Sue's saga doesn't begin on the shores of Lake Michigan. It starts on the eroded, fossil-rich badlands of the Cheyenne River Indian Reservation north *(Continued on page 54)*

If bones could talk

Sue has quite a tale to tell. After years in storage because of an ownership dispute, Sue's bones arrived at Chicago's Field Museum of Natural History in 1997. The partly cleaned skull captivated Chris Brochu (below left), lead researcher on the fossil.

Last year Brochu accompanied the five-foot-one-inch skull to a Boeing lab in California, where it was scanned using computed tomography. "We can see every internal detail without taking a saw to the bone," says Brochu, who created a three-dimensional portrait from the scans (below). Neither the skull nor Sue's other bones have yet conclusively revealed the fossil's sex. But this 3-D view does show an extensive network of sinuses and details like a tiny opening for a narrow brain (A), space for huge olfactory bulbs (B), even a tooth broken loose from the jaw (C). Used as road maps, the scans also helped preparators strip away Sue's stony matrix to expose chocolate-colored bones of the intact skull, seen here in all its frightful glory.

FIELD MUSEUM

Lethal force

Tyrannosaurus rex—"tyrant lizard king"—was aptly named. With resin, rubber, and careful scrutiny of Sue's well-preserved skull, sculptor Brian Cooley was able to reconstruct the musculature of *T. rex* (right), believed to have had the most formidable teeth and powerful jaws of any dinosaur ever known. "The size of the muscle complex that produces the bite is enormous," says Cooley, who saw clear muscle-attachment markings on Sue's massive jaws.

Those jaws still contain the roots of almost all 60 teeth, deadly scythes up to a foot long from root to crown. Lined with serrations that aided in tearing flesh, each tooth was more bludgeon than blade, thick enough to resist snapping on impact with bone. Replacing themselves every two to three years, teeth surfaced from the jaw like ominous fins (below).

Despite imposing strength, Sue shows signs of vulnerability. Some of the holes in the lower right jaw may have resulted from infection.

Such riveting details emerged after meticulous cleaning. In Chicago, Paul Brinkman (below right) used an air-abrasion machine that shot out special baking soda to scour away rock without scratching the underlying bone.

Because Sue's soft tissues are long gone, Brian Cooley used educated speculation to place air sacs in the large windows in front of the eyes (above). Pebbly skin completes this plausible portrait of a tyrant king.

(Continued from page 49) of Faith, South Dakota. One August morning nine years ago, Sue Hendrickson, a field paleontologist for the Black Hills Institute of Geological Research, spotted some bone fragments at the base of a 57-foot cliff. "Because the fragments appeared to have fallen from above, I looked up," Hendrickson says. "And there, about seven feet up the cliff face, three vertebrae were sticking out of the wall. By their shape, I knew the specimen had been a meat-eater. And by their size, I knew it could only be a *T. rex*."

Hendrickson found the fossil on land ranched by Maurice Williams, who is a member of the Cheyenne River Sioux. So Peter Larson, president of the institute—a commercial supplier of fossils to collectors and museums worldwide—paid $5,000 to Williams for what he believed were the rights to Sue's bones. The institute began to quickly excavate the fossil, in 17 days stripping away 29 vertical feet of rocky cliff face over an area 30 feet wide and 25 feet deep.

But while Sue lived in the age of dinosaurs, its fossilized remains were unearthed during the epoch of lawyers. On May 14, 1992, as the institute used glacial patience and tiny tools to strip away the rock, or matrix, encasing the bones, federal agents arrived with a warrant and seized Sue. At issue: Like many Native Americans Williams has his land in trust with the U.S. government. This exempts him from taxes but requires that he have government permission to sell or lease his land. Such permission had not been sought for Larson's excavation of Sue. But were Sue's buried bones part of the land? Or were they personal property found on the land?

Convoluted custody battles involving Larson, Williams, the Cheyenne River Sioux, and the U.S. government finally ended in April 1993. A U.S. district court ruled that Sue had been an integral part of Williams's land and declared that the fossil belonged to the rancher and the Bureau of Indian Affairs, which allowed Williams to sell it. Two years later Sotheby's offered to broker the sale, and in 1996 Williams accepted. During the next year—as the fossil was shipped to New York, inventoried, photographed, and catalogued—a gaggle of potential Sue buyers came forward, including everyone from a rumored H. Ross Perot to the Field Museum.

Tools of the future unmask the past at Boeing's Rocketdyne lab in Ventura County, California. Engineers Jeff Anders, left, and Tom Koehnlein spent more than 500 hours bombarding Sue's skull with high-powered x-rays to generate hundreds of dime-thin computed tomography scans—the most detailed look yet at a large fossil. Study of these electronic slices of bone will shed new light on how *T. rex* experienced its world.

John Flynn, chairman of the museum's department of geology—which oversees paleontology—flew to New York and inspected the fossil. "It was impressive, to say the least," says Flynn. "The skull alone was more than five feet long—and in amazing condition. It was like seeing the Hope Diamond."

John McCarter, the museum's president, called on the McDonald's Corporation, a longtime museum supporter, to help fill a war chest to buy the specimen. McDonald's then enlisted the Walt Disney Company in the effort. Even as a Field Museum team boarded a flight for the auction, McCarter was dialing for extra cash donations from friends of the museum.

"That's how unsure we were if we could prevail," he says.

When the sale began—with Sue's partly prepared skull placed near the auctioneer's podium for inspiration—bidding opened at $500,000, then climbed to 1.2 million dollars in seconds. At 5.3 million dollars the museum finally joined the chase. At 7.6 million dollars (8.36 million with Sotheby's commission), Sue's future in Chicago was sealed.

"It was one of those nice endings," McCarter says. "I think people were relieved to know Sue was going to a public museum instead of a private collection." He smiles. "We, of course, were pleased the museum was ours."

WHILE FOR MANY SUE-WATCHERS the fossil's story ended with the auction, for the Field Museum Sue's epic was just beginning. Half of Sue's bones still remained encased in rock. And the public had been promised a full view of the skeleton's preparation at a lab sponsored by McDonald's at the Field Museum and at another inside Disney's new DinoLand U.S.A. at its Animal Kingdom near Orlando, Florida.

By June, only seven months after Sue arrived in Chicago, the labs were staffed, equipped, and bringing Sue's story to anyone interested. Thousands of visitors were.

Inside the lab on the museum's mezzanine

Cretaceous Bigfoot: Not one to tread lightly, Sue had feet that measured some 50 inches from ankle to claw tip. Each of *T. rex*'s birdlike feet had three primary toes, which supported the multi-ton bulk of one of the world's largest bipeds.

Size didn't necessarily denote sluggishness. Relatively slender hind limbs suggest that *T. rex* could outrun most dinosaurs of its day.

overlooking bustling Stanley Field Hall, a team of fossil preparators employ tools the size of pencils to strip the matrix from Sue's bones. For less subtle work they use an impact tool that looks like a miniature jackhammer, then they abrade away the remaining rock by firing a special baking soda through a sandblaster the size of a dentist's drill.

As the bones have been cleaned, Chris Brochu has been uncovering Sue's secrets. Because of the way the specimen's leg bones were split and scarred, for instance, initial reports were of battle damage, bite marks, and deep flesh wounds—evidence that Brochu is still reviewing. "You'd expect a mature animal like this to have pathologies," he says. "Clearly its left fibula suffered an injury of some kind."

There was also talk of deep bite marks and scars in the skull and jaws. Brochu talked to forensic pathologists and examined scars on human bones for clues to Sue's life. "Ninety-nine times out of a hundred," he explains, "bone heals the same way in all animals. So I don't think it would have healed differently in Sue." He shows off a human bone from the lower leg with a small, circular depression in it. "That's a scar similar to what we've seen on Sue's jaws."

Brochu leads me into the McDonald's lab, over to where Sue's lower left jawbone sits on a shelf like a four-foot capital letter "L," cleaned and fully prepared. The bone has the richness of finely oiled hardwood. Along its jawline, beneath the teeth, is a series of large holes that look as if they were smashed through by a ball peen hammer. "Look at these perforations," Brochu says. "They were described as bite marks, but I don't think so."

He slides a finger inside one, to where the hole has smoothed over and scarred, reminiscent of the human bone in his lab. "See?" he says. "It's healed the same way that human fibula healed. Also, I can't find a bite line. I've tried to match these holes with most every jaw and skull I can find, and I can't get the teeth on any skull to line up with the perforations on this jaw. So what do I think? I think it could have been some sort of infection, some periodic wounds that healed."

Brochu stops and grins. "I'd love to be able to tell you a lot of things about this specimen, but I can't yet," he says. "Sure, it most likely had a great ability to smell—a killer nose—but that

"We've become an exhibit ourselves," says Bruce Schumacher (above, at right) at Disney's DinoLand U.S.A. in Florida, where he helped display Sue's 54-inch femur. Preparators there have cleaned Sue's fibulae (below), vertebrae, and other bones. Abnormal bone growth on the left fibula, at right, was likely caused by infection after a bite or other trauma.

doesn't necessarily mean it was a scavenger instead of a hunter. Most carnivores are both. Why couldn't *T. rex* have been both too? Was it male or female? I don't know. Warm-blooded or cold-blooded? I'd love to tell you this dinosaur was purple with green spots. I'd love to be able to tell you the sound it made, but I can't."

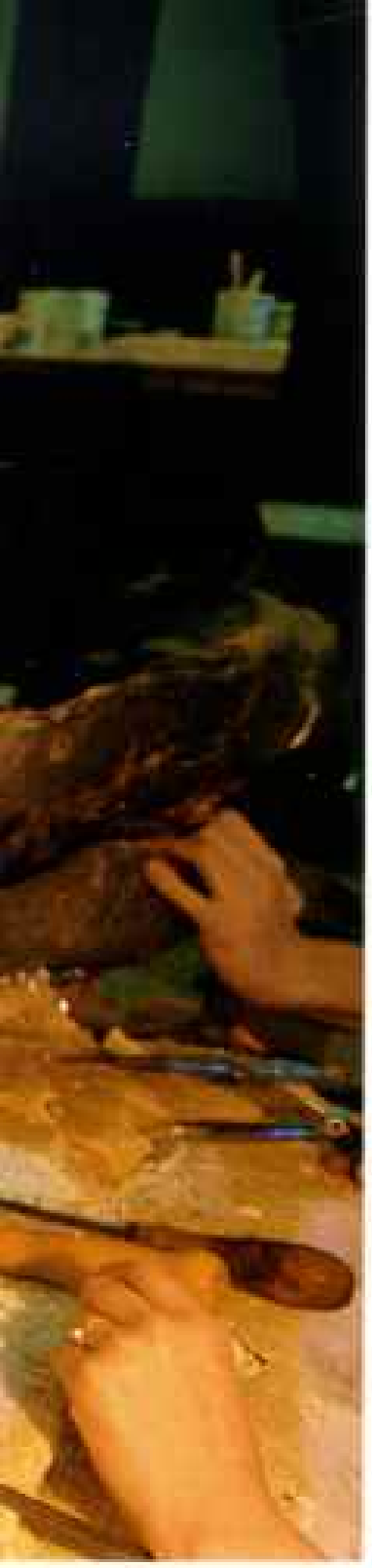
Still, Brochu has learned a great deal about Sue, with much more to come. Some of it reinforces the conclusion most scientists favor these days: that birds evolved from theropods—a group of bipedal meat-eaters including tyrannosaurs. Sue, for instance, has bones in its jaw similar in shape and arrangement to those of modern birds. Its skull bones and vertebrae, like those of birds, are air-filled.

"What I can say is that Sue most likely didn't die in some violent battle, as was originally thought. Best I can tell: This animal simply died."

DOWN A WARREN of museum hallways Jennifer Moerman, a fossil preparator, is at work with the skull in a lab. She shows me chunks of crumbly sandstone matrix. "We've been finding all this other fossilized material—leaves and bits of wood—as we've been preparing the skull," she says. "It's pretty cool."

On different layers inside the stone, fossilized foliage—mostly conifers and flowering plants—is visible. Such plants suggest that today's arid and rocky South Dakota might have looked more like North Carolina's river floodplains during Sue's time. "We've kept all these pieces, even noted the leaves' orientation and where we found them," Moerman says. "There are little clues to the world everywhere with this specimen."

Brochu grabs a CT-scan image of the skull, this one shot from beneath, and points to two elongated triangles where the animal's tongue



Like a prehistoric dentist in Sue's gaping maw, Bob Masek in Chicago works to free Sue's lower right jaw from the skull. With a chart of Sue's progress (below), colleagues in Florida good-naturedly show that they too share the pain of this full-time effort to have Sue ready for display in Chicago in the year 2000. Missing a foot, an arm, and a few ribs and vertebrae, Sue will stretch more than 40 feet from nose to tail. Because so many of its bones were articulated, or still in position, when found, Sue gives the clearest view yet of the species' impressive anatomy and is beginning to answer other questions about how *T. rex* hunted, mated, lived, and died.

once was. "These are teeth, broken off and floating around in the matrix. One's normal and one's pathological."

Moerman grabs another box, showing off the normal tooth: It's a sharply rounded cone with serrated edges, perfect for ripping meat and smashing bone. Then she lifts out the pathological tooth. Instead of being five inches long or longer, like most of Sue's teeth, it's two inches and twisted, its serrated edge squashed. The beautiful varnished brown color covering much of Sue's skeleton and teeth is absent. Instead, this tooth is a sickly, blackish gray.

"We don't know why this tooth ended up defective," Brochu says. "Maybe age, maybe damage to the jaw. But it shows that Sue was just like any other animal, the processes of life were going on, some of them working—some not."

Just as people sometimes grow deformed fingernails after a crushing blow—or sheep's horns sprout at odd angles in the wake of injury—Sue's tooth is a freakish reminder that once, 67 million years ago, what's now an 8.36-million-dollar mass of exquisite bone actually walked the Earth. And not merely as the perfect terror conjured by today's moviemakers, but as one of the planet's inhabitants—vulnerable and mortal as any other.

As Sue begins to emerge from prehistory for all to see, it's these small understandings that raise the fossil from mere bone to marquee attraction. Imagine this animal turning its massive head to sniff the breeze, smelling its way through life. The head rotates, scanning the scene—one scrawny, twisted tooth protruding strangely from an otherwise fearsome row. Sue was likely the last thing many an ancient animal saw. □

Follow Sue at *www.nationalgeographic.com/dinorama* and on National Geographic EXPLORER's *Colossal Fossil*, airing in June on TBS.

John Glenn

Man with a Mission

Standing tall in a bulky pressure suit for his return to space, John Glenn evokes memories of his 1962 Mercury flight—and visions of a future when seniors can still grow up to be astronauts.

JOHN GLENN GAZED OUT the big square window in the orbiter *Discovery* and watched the Earth slide by 345 miles below. A tear came to his eye. And stayed there.

"In zero gravity a tear doesn't roll down your cheek," he later recalled. "It just sits there on your eyeball until it evaporates."

He smiled, embarrassed a little. But he was clear-eyed on this day in December 1998, a month after his triumphant return to space and just a couple of weeks before his four terms as a United States senator would come to an end. On the walls of his corner office in the Hart Senate Office

By WILLIAM R. NEWCOTT
NATIONAL GEOGRAPHIC SENIOR STAFF

Photographs by JOE McNALLY

Making headway, Glenn pushes through the rubber seal that helps preserve air pressure in his launch and entry suit. All shuttle astronauts use teams of technicians to suit up, right down to lacing their boots, a ritual unchanged since Glenn's first space flight.

"I figured my time in space had come and gone. . . .That was it."

OFFICE OF SENATOR JOHN GLENN

In a hurry: After serving in the Korean War, Glenn became a test pilot (above) and in 1957 flew a record-setting 3 hours 23 minutes coast to coast. In Washington, D.C., brisk walks proved that even after 24 years on Capitol Hill he was no sedentary senator.

Even at age 77, John Glenn seemed to be made for an astronaut's gear, and vice versa. Back in the beginning it was that way too.

THERE IS SOMETHING about Ohio and flight. Everyone knows about the state's most famous fliers: Wilbur and Orville Wright, John Glenn, and Neil Armstrong. And the Buckeye State has churned out, so far, a total of 19 astronauts.

From the time he was born in 1921, John Glenn saw people going places. His childhood home, in New Concord, stood on a hill overlooking the National Road, the first federal highway and one of the pioneers' earliest routes west.

"When they widened the road, we had to move the house up the hill," he said. It's there still, unmarked, right near the new John Glenn High School, where on fall weekends the John Glenn Muskies football team fights for old JG.

A walk down Main Street tells the story of Glenn's life. There's the old high school building where he attended classes with Annie, his childhood sweetheart. And the long drive that leads to Muskingum College, where they both earned degrees. If you head down to the veterans' park and look at the big brass plaque that commemorates local boys who marched off to World War II, there—between Raymond M. Glass and Leonard A. Goff—you'll find John H. Glenn, Jr. (Just above, in the list of World War I vets, is John H. Glenn, Sr.)

Stop into the coffee shop, and along with your menu you can pick up vintage laminated pages from the Zanesville *Times Recorder* tracing the favorite son's career. Seems he was a local hero long before anyone dreamed of sealing him into a space capsule. He learned to fly as a civilian in 1941, then flew off to fight in the Pacific. A decade later he was hunting down enemy MiGs over Korea, every inch the cocky flyboy. How cocky? Glenn told the *Times Recorder* in 1954 that "it was very disappointing to be all keyed up for a big mission, fly the mission and make no contact."

Building in Washington, D.C., hung mementos of legislative victories, photos of presidential handshakes, tributes to him as America's first man in orbit, in 1962. And everywhere, pictures of his beloved wife, Annie.

Sitting across from Glenn, who was illuminated like a museum piece by sunlight slanting through the window, I realized that this was the first time I'd encountered the senator in a suit and tie. For months I'd followed his training at the Johnson Space Center in Houston and at the Kennedy Space Center in Florida, and virtually all he'd worn were blue zippered flight outfits, bulky orange pressure suits, polo shirts emblazoned with the mission insignia.

JOE MCNALLY photographed American astronauts and Russian cosmonauts at Moscow's Star City for *Life* magazine in 1997. His most recent assignment for NATIONAL GEOGRAPHIC was "Quiet Miracles of the Brain" in the June 1995 issue.

Launchpad: Tracking John Glenn and the Space Program

John Glenn was not the first man in orbit—Russian cosmonaut Yuri Gagarin accomplished that nearly a year before. Nor was he the first American in space—Alan Shepard and Gus Grissom went before him in 15-minute suborbital flights. After 36 years no U.S. space traveler had spent less time in orbit than Glenn. But those three orbits in 1962 imprinted him on the national consciousness forever.

1959, April: Glenn is named one of the first seven U.S. astronauts.

1961, May: After Shepard's flight President John F. Kennedy challenges America to land a man on the moon by decade's end.

1962, February 20: John Glenn is the first American to orbit the Earth.

1964: Glenn resigns from the space program; one year later he retires from the Marine Corps.

1965, June 3: Edward White makes the first U.S. space walk, a 21-minute float outside the Gemini 4 capsule.

1967, January 27: Grissom, White, and Roger Chaffee die in a flash fire during a launchpad test for the first manned Apollo flight.

1968, December: The crew of Apollo 8, first to circle the moon, marks Christmas with readings from Genesis.

1969, July 20: First moonwalker Neil Armstrong makes his "one giant leap for mankind."

1970, April: An explosion cripples Apollo 13's command module; the crew uses the lunar lander as a lifeboat to return to Earth.

THIS PAGE: SEVEN ORIGINAL ASTRONAUTS, NASA; FRIENDSHIP 7 CUPOLA, ASTRONAUT GLENN IN ORBIT, NASA; EDWARD H. WHITE, NASA.

FACING PAGE: GLENN IN 1964, GREETING ASTRONAUTS ON THE MOON, BUZZ ALDRIN, NASA; SPACE SHUTTLE DISCOVERY, SCOTT ANDREWS; SPACE STATION, NASA; SATELLITE PHOTO, JOHN AND ANNIE GLENN; JOE MCNALLY.

I put down the laminated paper and slurped my cabbage-cheese soup. Let me get this straight: He was *very* disappointed that no one tried to kill him that day? More news clips. Here's Glenn in 1957, the first man ever to average supersonic speeds in a coast-to-coast jet flight. I began to understand the mentality that led John Glenn to have himself strapped atop a rocket on February 20, 1962—and the ambition to do it again that would gnaw at him for nearly four decades afterward.

EARLY ON THE MORNING of Glenn's space shuttle flight, I drove through the Florida scrub to the Kennedy Space Center by way of the Cape Canaveral Air Station, where the original Mercury rockets were launched. It was still long before dawn as I approached the abandoned site of launch complex 14. The Mercury gantry is gone. The blockhouse is a conference center. The ghosts of a space program in its infancy whisper through the sea grapes.

Thirty-six years earlier, at this spot on a morning much like this, a man in a silver space suit trudged from a trailer carrying his briefcase-size life-support system, an alien headed for the office. Above him a nine-story-tall rocket groaned under the pressure of refined kerosene fuel and hissed billowing clouds of vented liquid oxygen.

A countdown, a roar, a pencil-shaped craft rose into the Florida sky. Five hours later it was all over: John Glenn, the first American to see three sunrises in a single day, sat bobbing in the Atlantic, awaiting pickup by the destroyer U.S.S. *Noa*.

He was a national hero. Although two other U.S. astronauts, Alan Shepard and Gus Grissom, had pierced the boundary of space before him in short suborbital flights, Glenn cast a spell on the American people that never quite wore off. There were parades, speeches, honorary degrees, and a medal from the President. But what John Glenn really wanted, and what he genuinely expected, was his next shot. America was going to the moon, and John Glenn planned to be there.

1974, November: In a landslide victory Glenn is elected U.S. senator from Ohio. He joins the Governmental Affairs Committee, the Senate Special Committee on Aging, and later the Armed Services Committee.

1975, July: In the last flight of an Apollo capsule, a U.S. crew docks with a Soviet Soyuz craft.

1981, April 12: Nearly six years after the previous U.S. manned flight, space shuttle *Columbia* is launched.

1983, June 18: On the second flight of shuttle *Challenger*, Sally Ride becomes America's first woman in space.

1984: Glenn runs for President in primaries but fails to eventual nominee Walter Mondale. He is reelected to the Senate in 1986.

1986, January 28: *Challenger* explodes 73 seconds after liftoff, killing all seven crew members, including teacher Christa McAuliffe.

1988, September 29: Redesigned for safety, shuttle *Discovery's* flight relaunches the U.S. manned space program.

1995, June: Shuttle *Atlantis* makes first U.S. docking with Russia's Mir Space Station.

1998, October 29: Glenn returns to space aboard *Discovery* as part of a scientific study on aging.

"I wasn't concerned when I wasn't put back in the astronaut rotation right away," he says. "They gave me some administrative work to do, and I kept asking about being sent up again, and they kept telling me, 'Headquarters says not yet. Not yet.'"

Some speculate that President John F. Kennedy didn't want to risk losing the space program's greatest hero in an accident.

"Unfortunately I never got to ask him," said Glenn. "And I got tired of waiting around. So I left the space program."

A year later, adrift from the Marines for the first time in his adult life, Glenn went into business. He became president of Royal Crown International and eventually achieved political legend status: Four times Ohioans sent him to the Senate.

"I figured my time in space had come and gone," he said. "I'd given the space program a good run, I thought, and that was it."

He has always remained an advocate of NASA and the space program though. Within hours of the space shuttle *Challenger* accident in 1986, Glenn was in Florida with the crew's families to offer sympathy and to lend his support to the space program. His influence has been key in keeping the International Space Station program alive.

It was while doing research in support of the space station that Glenn stumbled upon what ultimately became his ticket back.

"Over the years," Glenn said, "NASA has observed more than 50 changes that occur in the human body in space. And nine or ten of these are very similar to things that happen in the process of aging. Things like loss of muscle strength. Bone density loss. Cardiovascular changes. Changes in balance and coordination.

"My idea was to send an older person up and study the body's reaction to space flight—see if there were differences between younger and older people. For example, how long was the recovery period after returning to Earth? Shorter or longer for an older astronaut?

"I went over to NASA to talk to Dan Goldin, the administrator. I made no bones about it—I wanted to be the person to do it."

The Measure of an Astronaut

"It's really not that uncomfortable," says Glenn of the weblike head gear he wore for sleeping-brain-activity studies aboard *Discovery* (above). "You're weightless, so your head doesn't press down on the sensors." In a study of the effects of space flight on a 77-year-old's bone density, Glenn had full-body x-rays taken before and after the flight (above right). In a shuttle mock-up in Houston (right) instructor Sharon Jones gauges the distance between Glenn's seat and the locker-mounted procedure cards. The seat is secured to the floor, so Glenn's eyes have to be able to span the gap. Watching Glenn watch the wall is his wife, Annie.

MAN WITH A MISSION

Goldin recalls vividly the day Glenn strode into his office to make his pitch.

"He was well prepared," Goldin told me, heading for a bookcase and pulling a thick volume off the shelf. "He came in with this textbook. It's called *Space Physiology and Medicine*. He knew it backward and forward. I know, because I quizzed him."

Listening to Glenn lay out his plan, Goldin was both enthusiastic and skeptical. He knew that the minute a John Glenn flight was announced there would be grumblings about a NASA stunt, or worse, some sort of political payback for Glenn's long support of the space program.

"John Glenn is a hero," said Goldin. "He deserved a second flight. But I told him two things: The project would have to be real, peer-reviewed science, and he'd get no freebies on the astronaut physical."

Even in his late 70s, Glenn was confident the physical would be no problem. For scientific backup, he had gone to the National Institute on Aging in Bethesda, Maryland.

"I was absolutely prepared for the scientists at the institute to say there was not enough merit to the study," said Goldin. "But the experts said, 'Go for it.'"

IF YOU'RE JOHN GLENN reading this story, your sky blue eyes are narrowing suspiciously just about now, and your jaw is tightening a bit. That's because so far it's been all John Glenn, and John Glenn has never wanted it to be that way. "I know there was a lot of personal interest in me," Glenn says, "but the other people on this flight were more important to the overall mission than I was."

In fact the crew for STS-95, the mission's official name, was already taking shape when the media frenzy over Glenn's return to space broke in January 1998. Flight plans included the release and retrieval of a solar observation satellite and several life sciences studies.

Commander Curt Brown was a veteran of four previous shuttle flights. Pilot Steve Lindsey had flown once before and helped design the next-generation shuttle orbiter cockpit. Pedro Duque, who would become the first Spanish citizen to fly in space, was assigned as a mission specialist with responsibility for various onboard experiments. Chiaki Mukai,

"There was never a time we didn't know each other," says Annie. "I married my friend." She stayed at home through Glenn's Mercury days; in Houston this time, Annie barely left his side.

a medical doctor from Japan with one previous shuttle flight, was a payload specialist.

Shuttle veteran Scott Parazynski, nicknamed "Too Tall," was flight engineer. Also a medical doctor and an experienced spacewalker, he earned the moniker after spending five months in Russia in 1995 training for a mission aboard the Mir Space Station, only to discover he couldn't fit in the Soyuz spacecraft.

One day in Houston a TV crew from Sacramento, California, was on hand to tape a report about the seventh crew member, payload commander Steve Robinson, a Sacramento native preparing for his second flight. It was a rare day of media attention for someone other than Glenn, who busied himself with astronaut-type tasks—conferring with the commander, checking the seals on his pressure suit—clearly relishing this moment in the background.

In High Bay 9N the crew was practicing an emergency procedure, bailing out of a scale-model orbiter. But before they could bail out, they had to climb in, no mean feat in 89-pound pressure suits. One by one, they lumbered up a ten-foot stairway to a platform at the hatch. From there they seemed to tumble into the shuttle as much as board it.

The fact is, the orbiter was designed to be boarded and exited in flight suits. That's how earlier crews dressed for flight until one cold January day in 1986, when *Challenger* lifted off in one piece and came down in thousands. In the top-to-bottom safety overhaul that followed, NASA decided that a crew might have a

"Nothing is one hundred percent risk free—nothing. But the gain to be made is worth that risk."

better chance of surviving an emergency if they had pressurized suits for liftoff and landing.

For Glenn, who made one career flying into battle (in Korea he earned the nickname "Magnet Ass" because he drew so much antiaircraft fire) and then another test-piloting all sorts of unproven craft, the inherent risks of space travel barely register as a concern.

"Nothing is one hundred percent risk free—nothing. But the gain to be made is worth that risk," he says matter-of-factly. "That just goes with the occupation."

That's Glenn—matter-of-fact. An active member at National Presbyterian Church in Washington, D.C., he refuses to place undue responsibility on God to bring him back alive.

"Faith is something that is part of you, part of the way you live on the street, in the Senate, or in space," he told me. "So if I put myself in a life-threatening situation and then suddenly start praying, 'Oh, God, get me out of this alive!' well, that's foxhole faith. That's no kind of faith at all."

Most astronauts echo Glenn's sentiments. One time in Houston though, when I mentioned the upcoming blastoff, pilot Steve Lindsey corrected me. "We prefer to say 'launch.' When you're sitting on top of a great big bomb, you don't like to use the word 'blast.'"

For the better part of a year the crew practiced escapes, countdowns, and in-orbit experiment procedures in Houston. By the time they arrived in Florida on October 26, three days before launch, they had practiced virtually every possible variation of their mission and simulated every imaginable escape. They also finished each other's sentences, shared jokes with obscure punch lines that they alone understood, and baited and teased each other as only comrades can.

On the runway they stood in front of their T-38s, and commander Brown led them in singing "Happy Birthday" to Steve Robinson. Glenn shared a quick hug with Annie. All but spouses kept their distance. Steve Lindsey could only wave to his three children. The crew was in isolation now for fear of last-minute infections.

As dusk fell over Florida, I wandered to the top of the Kennedy Space Center press mound, a small hill where the NASA public information office and network broadcast booths perch. A fleet of trucks bristling with satellite antennas pressed in on all sides. Diesel generators rattled behind dozens of trailers emblazoned with TV network logos. Across the jammed parking lot white canopies and tents rose to the clang of hammers on stakes. Scattered among them, starkly lit in impeccable suits, television reporters clutched microphones and recited: "Not since the shuttle's return to flight in 1988 have so many members of the press converged upon this place. . . ."

Two jets cut across the sky. It was Brown and Lindsey, practicing landings on the space center runway. They headed out over the ocean and vanished into a cloud.

The routine on October 29 bore more than a passing resemblance to that Mercury morning in 1962. The drive to the pad, the ride in the gantry elevator, the walk across a metal bridge to the waiting spacecraft. The strap-in, the closing of the hatch, the long wait.

A few minutes of trepidation—five private planes buzzing into, and finally out of, restricted airspace—and then *Discovery* rose into the afternoon sky on a tongue of fire. As an estimated quarter million observers crawled back home fighting ten-mile-an-hour traffic jams. *(Continued on page 80)*

A flier at heart, Glenn takes a backseat in a T-38 training jet flown by mission commander Curt Brown, as shuttle pilot Steve Lindsey holds formation behind them. "It was one of those beautiful flying days," said Glenn, who pilots his own twin-engine plane.

JOHN GLENN AND JOE NIGHLEY

"I don't recall a single cross word on the entire mission," says Glenn, flanked by his crewmates, from left, Chiaki Mukai, Steve Lindsey, Pedro Duque, Steve Robinson, Curt Brown, and Scott Parazynski. "I know a lot of attention focused on me, but in the end I really was just payload specialist number two."

Dress Rehearsals

For a man who'd waited 36 years to get back into a spacecraft, it seemed that Glenn spent an awful lot of time practicing escapes from one. Much of the crew's physical training in Houston involved egress exercises, including a postlanding exit in which Glenn climbed through the orbiter's overhead window and slid down (top left). "Once you get over the side, it's actually kinda fun," he reported. Less fun was tumbling out the orbiter's side hatch (middle left) and landing on a thick foam mattress. Seated next to Mukai after a half-hour strap-in exercise (above), Glenn practiced unstrapping himself in the windowless lower cabin. "We were down in steerage," he jokes. "It was us and a couple of toadfish." The fish were part of an experiment to study the effects of changes in gravity on balance. Also on board were a perfume industry rose and an electronic nose—for unrelated studies.

A Call From the Office

"I was up on the 195-foot level, where you walk across from the elevator to the orbiter, and I saw this phone," says Glenn, recalling a light moment with Parazynski during the crew's countdown test three weeks before the launch. "I just wanted to see if it worked, so I picked it up and dialed Annie's number. And darned if Annie didn't answer!" The scene, caught on remote TV cameras, was being viewed by reporters at the press center. "So, of course, they all demanded to know who I had called, and what was that all about. Annie and I got a terrific laugh out of that." Press frenzy reached full throttle on launch day (right), when one of the largest swarms of reporters in history descended on the Kennedy Space Center. Ever the politician—and good sport—Glenn gave them a wave.


NASA

Mission Accomplished

A pillar of fire carried *Discovery* into a cloudless Florida sky on October 29 (below). Within hours the crew was activating the Spacehab module (left), an annex in which most of the scientific experiments were conducted. Ticker tape honors awaited the crew after they landed (bottom), but for Glenn the true reward was the view from 345 miles up: "from Florida clear to Lake Erie."

NASA (left); JOSEPH C. STANCAMPIANO, NGS STAFF (top); STEVE AMSTER

"People are thinking differently," says Glenn, on a training flight. "After my flight was announced, I found a note from [96-year-old Senator] Strom Thurmond: 'I want to go too.'"

(Continued from page 71) the shuttle crew orbited the globe at five miles a second.

In space, surprises are never a good thing. Months of study and practice ensured blissful predictability for the crew. All seven were involved in many of the 83 separate scientific experiments performed on the mission. But only Glenn participated in all ten medical studies.

"In Mercury they gave me an experiment or two to do," Glenn recalled afterward. "I did some sun readings. They had me read an eye chart to see if my eyeballs changed shape."

On *Discovery* he was poked, prodded, and examined inside and out. He swallowed a bullet-size pill that measured his core temperature; a similar pill is being developed to monitor at-risk fetuses. Before, during, and after the flight he underwent tests for muscle strength, posture, blood-protein chemistry, sleep disturbance, and blood pressure.

"Scott's taken my blood so many times," Glenn reported from orbit, "that when I see him I say, 'Here comes Dracula.'"

What will be the outcome of the studies? Reports on Glenn's data will be released later this year. What does the future hold for seniors in space? "If the scientists come back and say we could benefit from sending more seniors into space, then I'm prepared to send five or ten," says Goldin.

When *Discovery* landed nine days after liftoff, Glenn had the option of being carried

"I say you should live life based on how you feel and not by the calendar."

off the spacecraft on a litter. But he eased gingerly down the stairs under his own power. "I've got to admit I was a little shaky," he said, but he completed the "walkaround" with the rest of the crew, inspecting the orbiter on the runway.

The postflight attention rivaled that after Glenn's first trip into space. Speeches, parades, television interviews. Through all of it Glenn was accompanied by his fellow crew members. "They all deserve recognition," he declared, every chance he got.

Commander Brown has a slightly different take. "The fact is, the public doesn't know shuttle crews," he says. "People will never know how much fun Scott is. They'll never know the infectious enthusiasm Chiaki brings to her work. But they know John. And if he brings people closer to the space program and generates enthusiasm for it, that's good for all of us."

His time in the Senate over and his days as an astronaut completed, Glenn will settle down with Annie in their homes in Maryland and Ohio. He plans to oversee creation of the John Glenn Institute for Public Service and Public Policy at Ohio State University and to do some lecturing. It's not the retirement Annie had in mind, but it will do.

"We drove all the way back home from Houston," she told me. "And I took that time to tell him that I'd shared him for years with everybody else, and now I wanted him for me. But he said, 'Wait a minute. I have a new job now. I need to get these young people excited about space and about public service.'"

She clutched my wrist and smiled at me. "Those are *your* children he's talking about." John was on another mission, and, as always, Annie was along for the ride.

SPACE TRAVEL used to be a young man's game, but when John Glenn went into orbit aboard *Discovery*, four generations of men and women could gaze into the sky and think, That could be me someday. At the same time Glenn was looking down and doing some thinking of his own.

"It's quite something," he said, "to look down on this blue planet, seeing that little film of air that surrounds it. You fly over the Mediterranean, over the Middle East—and it's so beautiful. You wonder why in the world humans can't solve all the problems they've created and left to fester over the centuries.

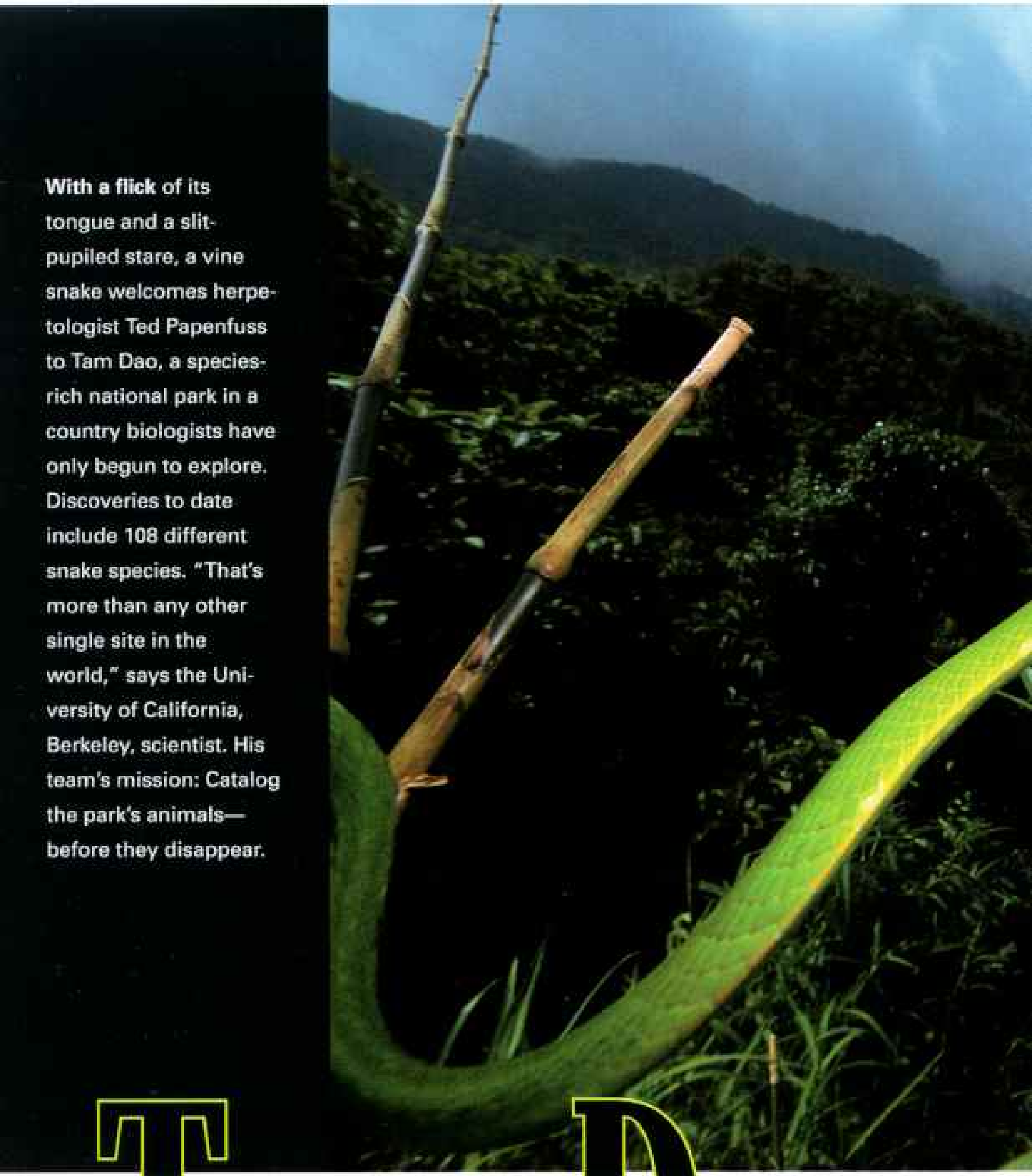
"I was at the Houston airport on my way back to Washington recently when this older guy walked up to me, all excited. He shook my hand and said, 'Boy, you're changing my life!' I said how's that? He said, 'I'm 74, and ever since I was a kid I've wanted to climb Mount Kilimanjaro. I haven't done it, and I kept putting it off. And now I'm gonna do it!' And all the time his wife is standing behind him, just shaking her head.

"So I may have killed a man on Kilimanjaro, for all I know. But I've noticed something. I've noticed that maybe because of all this, people are seeing themselves in a way they haven't before. They're realizing that older people have the same ambitions, hopes, and dreams as anybody else. I say you should live life based on how you feel and not by the calendar."

The measure of John Glenn's achievements may someday be the familiar sight of grandparents waving good-bye to grandchildren at Gate 36 of the Los Angeles Space Port. And don't be surprised by the gentleman with the sky blue eyes you see in line there.

"Annie says no more space travel," Glenn grins. "Well, I've never fully committed to that." □

Is America's space program a good investment? Comment online at *www.nationalgeographic.com/ngm/9806*.



With a flick of its tongue and a slit-pupiled stare, a vine snake welcomes herpetologist Ted Papenfuss to Tam Dao, a species-rich national park in a country biologists have only begun to explore. Discoveries to date include 108 different snake species. "That's more than any other single site in the world," says the University of California, Berkeley, scientist. His team's mission: Catalog the park's animals—before they disappear.

Tam Dao

VIETNAM'S SANCTUARY UNDER SIEGE

BY **MICHAEL McRAE** PHOTOGRAPHS BY **MARK W. MOFFETT**

WEARING THE PANTY HOSE was Ted Papenfuss's idea. A prophylactic against leeches, said the University of California herpetologist and leader of our expedition into Tam Dao, one of Vietnam's newest national parks. And so there I was, clambering about in the steep, steamy jungles of the Tam Dao Mountains in queen-size, navy blue L'eggs. After a few hours of sweating it out (and with renewed respect for working women the world over), I dispensed with the panty hose in favor of the cotton leech leggings that our Russian colleagues favored.

It seemed a sensible trade-off. The start of the rainy season was late, it was terribly dry in the forest, and there weren't many leeches about. Besides, we were stalking snakes, in particular a 14-foot king cobra that Nikolai Orlov, a Russian herpetologist, had spotted before I'd arrived with the American team for a month-long biodiversity study. If a cobra was to latch onto my leg, a layer of navy blue nylon wasn't going to be of much use—except perhaps twisted and applied as a tourniquet.

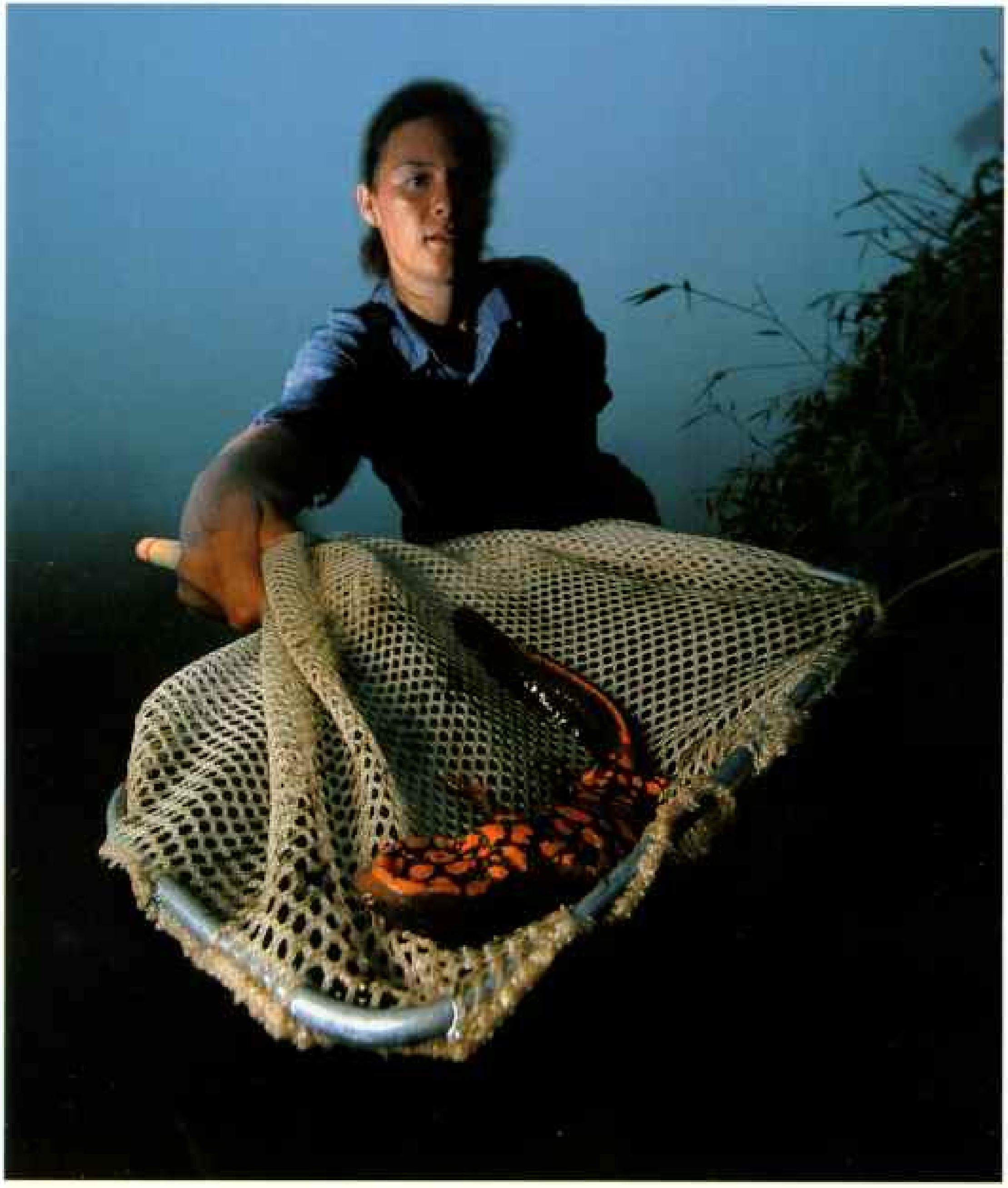
Having never seen a cobra in the wild, I'd persuaded Orlov to take an hour of his time to try to locate it. If anyone might succeed, it was he. Since 1982, when Russian researchers began conducting surveys of Vietnam's long-closed jungles, they'd discovered some 30 species of reptiles and amphibians previously unknown to science; 17 of these were discovered at Tam Dao. Orlov and his colleagues have now expanded the count of snake species at Tam Dao to 108, or 4 percent of the global total of 2,700 species. By that measure the park harbors one of the richest, most diverse ecosystems on the entire planet.

The mix of species at Tam Dao exists partly because the park sits at an ecological crossroads. Animals from the tropical forests of Southeast Asia, the temperate forests of southern China, and the alpine forests of the eastern Himalaya all are represented. Moreover, the Tam Dao range rises so abruptly from the Red River Valley that its slopes are virtually an island in the sky surrounded by the floodplain below. This isolation produces a host of indigenous species, and gullies and ridges create more isolated spots where microhabitats form.

Papenfuss and a team of 15 field biologists from the U.S., Russia, and Vietnam had assembled to collect as many species of reptiles, amphibians, and mammals as they could in a month's time. Among the rarities they had already found were a curious little frog that resembles a lump of lichen and *Polypedates dennysi*, the world's largest gliding frog.

The team planned to compile a species inventory of Tam Dao's indigenous creatures, take tissue samples to determine their genetic makeup, and describe their anatomy and natural history. Ultimately the scientists hoped their work would contribute to a conservation plan for the park.

Starting at our research station below the resort village of Tam Dao, Orlov had led us up to what the team



Its fiery belly exposed, an endangered Tam Dao newt wriggles in the net of herpetologist Kelly Zamudio. The hills of Tam Dao harbor hundreds of endemic species—and host more and more people seeking to escape the busy streets of Hanoi, just 32 miles away (map).

called the Old French Road, which circles the heavily forested upper slopes of two peaks. Our sturdy little Russian four-wheel-drive whizzed past the bombed-out ruins of extravagant villas that French colonials had built early in the century—and that bitter Vietnamese partisans destroyed in the mid-1950s after Vietminh forces overthrew French rule. Surprisingly, given the pounding that nearby Hanoi took during the later war with the U.S., Tam Dao showed no evidence of the bombing and defoliation that ravaged much of the rest of the country.

Orlov, a short, rotund, bearded dynamo from St. Petersburg's Zoological Institute, stopped our driver at a bridge spanning a stream and dismissed him for the night.

A halo of spines loaded with toxins awaits predators foolish enough to ignore a slug caterpillar's warning colors. A katydid (below, second from left) tries another tactic—blending into its grassy habitat. Innumerable animals stalk Tam Dao's insects, from bats and birds to tiger beetles (below), ants (attacking moth), and lightning-quick centipedes (far right). Beetles and butterflies face the toughest predators: villagers, who gather specimens to sell to foreign collectors.

TIGER BEETLE, *COSMODELA AURULENTA*

KATYDID, PSEUDOPHYLLINAE

SLUG CATERPILLAR, *SETORIA FLETCHERI*

TIGER MOTH, *AMERILA ASTREUS*; ANTS, *LEPTOGENYS DIMINUTA*

CENTIPEDE, *SCUTIGERA SP.*

"We saw the cobra right down there, among the roots of that tree," Orlov said, aiming the intense beam of his flashlight toward a culvert beneath the bridge. "We observed it for a while and decided that there was no need to collect it." With so many lesser known reptiles at Tam Dao, a cobra was low on Orlov's wish list. He'd approached the slumbering female with caution, prodded her with a stick, and watched her slither off. Where she was lurking now was anyone's guess.

"Let's go down to have a look," said Orlov. When we reached the stream, he asked us to stay back some 30 feet. "Nikolai needs his concentration, and having more people along will disturb him and the snakes," explained Natalia Ananjeva, Orlov's wife, who heads the Zoological Institute's terrestrial vertebrates division.

The night sounds of Tam Dao filled the heavy air as we waited in the darkness—the cheeping and croaking of frogs, the piercing metallic wail of katydids . . . and then Orlov, calling for us to join him. When we did, he was gripping a venomous, writhing, four-foot, black-and-white banded krait just behind its head. He lowered it carefully into a cotton sack, which he knotted and stuffed into his rucksack.

ON THE LIST of Earth's deadliest snakes, kraits rank right up there with cobras. Seeing this one put me in mind of Sergei Ryabov, who was searching for the cobra upstream from the bridge culvert. His right hand was missing a finger. Working late at a reptile zoo south of Moscow one night several years ago, Ryabov had reached into a terrarium containing a highly venomous Gaboon viper. He thought the viper was out of striking range. It was not.

"The snake jumped so fast," said Ryabov. "It was my fifth bite from a venomous snake, and I had an intuition that this one was serious. I was lucky that it bit only my finger. I summoned a security guard, and in 50 seconds he arrived with an ax and the finger was off."

Oregon-based writer MICHAEL MCRAE rafted a wilderness river in Uzbekistan for his last GEOGRAPHIC assignment (November 1997). Ecologist MARK W. MOFFETT began working in tropical forests at age 17. He has contributed to the GEOGRAPHIC since 1986.

Ryabov had explained that herpetologists seldom have antivenin available on short notice, especially in the wild, because each venom type requires a specific antivenin. Plus, the risk of botched administration or severe allergic reaction to the antivenin makes it, in some cases, as dangerous as the snakebite itself.

Orlov, at any rate, seemed unconcerned, and with our krait safely bagged, he was off again. Several minutes passed before he summoned us once more. "Look down," he said, aiming his flashlight at my feet. "Can you see it?"

"See what?" I asked.

He reached down and came up with another krait, as long as the first but more agitated. As the snake went into the collecting sack, I realized just how acute Orlov's vision was. He'd spotted the krait even though it had been concealed except for one tiny patch of skin. I'd heard about Orlov finding a tiny moss frog two years ago in a cistern of a ruined villa. The only way he'd distinguished it from its mossy surroundings was by its eyeshine—the reflection of his flashlight in the little frog's eyes.

Back at the bridge culvert we searched again for the cobra's lair, but all we found was candy wrappers and soda cans where the snake had been. In the distance below us, a chorus of caterwauling poured from the village's karaoke bars—weekend tourists from Hanoi. With alpine relief just two hours by bus from the sweat and pandemonium of the city, it's no surprise that the village's guesthouses and hotels are packed every weekend during the tourist season.

Orlov sat on a rock shaking his head.

"Look at this trash!" he boomed. "Two weeks ago, none was here. That house? It was not here ten years ago. All of this was primary forest. Every morning I saw monkeys here. Yes, right here! Now every month we see a new building."

But his mood was fleeting. Orlov bade us farewell and during the night collected a legless amphibian called a caecilian, a number of gliding frogs, and three snakes, including a rare species long considered a member of the genus *Boiga* but that Orlov believes represents an entirely new genus. It was as if the specimens had fallen from the trees directly into his sack.

Standing on the porch of the field station next morning at sunup, Orlov was his old irrepressible self. When I asked to see his finds, he pulled prize after prize out of his sacks.

Each morning locals offer animals to Russian herpetologist Nikolai Orlov, who pays a few dollars for desirable specimens. "If we don't buy them, they'll be eaten," he says—or, in the odd case of squirrels mounted for sale at souvenir stands, the first sight tourists see as they arrive in Tam Dao village (facing page).

With each one he took half a step back, cocked his right foot out in the manner of a Roman orator, held the specimen at arm's length, and announced its scientific name in Latin.

Researchers hope that their work will someday put Vietnam on the map as a mecca for natural history tourism and that the income can be channeled into conservation. But right now locals, who have few prospects for employment, make the most of the tourist season in other ways. They sell the insects, butterflies, and snakes they collect as souvenirs. One beetle may be worth a hundred dollars to Japanese or German collectors. The trade is illegal, but if violators are caught by police,

Twitchy menagerie: Marjorie Matocq inspects a haul of live salamanders and lizards collected by the team at their temporary headquarters, a research station set up a decade before the first postwar visit by an American scientist, in 1994.

they generally end up just paying a small fine.

Restaurants also serve the meat of the small mammals that the locals trap and don't eat themselves. Snakes and turtles are so widely eaten that some species are seriously threatened. And illegal cutting of tropical hardwoods and bamboo from the forests on the upper slopes of the Tam Dao Mountains is a constant threat.

HERPETOLOGISTS WORK in darkness, when nocturnal creatures move about in search of food or mates. Tracking them, I was learning, requires not only a powerful light but also a great deal of stamina. I found myself one night with Oleg Shumakov from the Moscow Zoo, searching for snakes and frogs near a spot where Orlov had first found a venomous, white-headed Fea's viper, so rare that fewer than a dozen exist in captivity. The temperature at 11 p.m. was 85 degrees, the humidity 80 percent. We clambered up a streambed and slithered over slick rocks. A thousand tiny lights winked back at us as the beams from our headlamps caught the eyes of frogs and spiders, dewdrops, and iridescent beetles.

The collecting did not go well for us that night, due to the dry season, we concluded. Others reported similar results. Indeed, Orlov was the only team member who was consistently successful. He had announced that his night's goal was to find a male *Boiga*, his suspected new genus, and he scored. Orlov's achievements were not unexpected though. By now I knew him to be a scientist with an impressive grasp of the natural history of the species he stalked. The 45-year-old Russian's career total of collected specimens numbers in excess of 60,000. Papenfuss, who has been collecting for many more years than Orlov, puts his count at a respectable 24,000.

And so, in spite of the unseasonable drought, our collection grew rapidly. Orlov's room resembled a cross between a biological laboratory and a Laundromat. Beneath lines of drying socks and trousers stood stacks of plastic terrariums. Opening their lids, Orlov showed off squirming masses of green tree vipers, lizards with flaps of silky orange skin on their abdomens that allow them to glide from tree to tree, snakes that eat slugs and worms, others that eat all kinds of lizards, still others that eat only skinks and geckos.

Among the other curiosities in the team's collection were little blind snakes that looked like earthworms, legless lizards, frogs that resembled lumps of tree bark, and perhaps the most perfect example of protective mimicry: a harmless rat snake with brilliant green skin and a white stripe—just like that of a venomous green tree viper.

But as fascinating as these adaptations were, few of the creatures could match the web-toed gliding frogs. The six-inch-long amphibians can spread their legs, splay out their toes, and parachute to the ground from great heights. Not only are there gliding frogs in Tam Dao, but also gliding snakes, squirrels, geckos, and other lizards.

One theory about why so many acrobatic species have evolved in Asian forests is that trees here are generally taller than those in, say, Africa, and are not as well linked by woody vines called lianas. Webbed toes and gliding flaps would afford a distinct advantage by providing a way to "fly" from tree to tree.

But can human changes to the forest environment cause species to adapt? It's a question that intrigues Kelly Zamudio, the team's DNA specialist. To hunt for answers, she was collecting *Polypedates leucomystax*, a non-gliding relative of the big tree frogs. To my untrained eye they all looked identical, but as Zamudio explained, those living in clearings around Tam Dao's reservoir had smaller toe pads than those inhabiting the undisturbed forests high in the mountains. It was her aim to discover through DNA analysis if the variation in toe shapes resulted from genetic differences or simply from different living conditions.

The taxonomy of Asian tree frogs might seem arcane to the layperson, or even irrelevant. But in applying modern genetic tools to solve issues of scientific classification, researchers like Zamudio are answering basic questions about evolutionary biology that Charles Darwin and Alfred Russel Wallace were puzzling over more than a century ago—how species arise, for example. If her tree frogs are indeed genetically distinct, Zamudio said with excitement, "it could show the beginning of the process of speciation."

Today's genetic tools also can help scientists make difficult conservation choices. If a lineage contains five species, all endangered, but resources are available to save just two, which

Skinned and gutted alive, a snake writhes in a Hanoi restaurant ("snake specialties" boasts its business card). The animal's blood, heart, and genitals, at right, are said to confer virility, a promise that fuels the annual export of millions of live snakes. Park rangers release a brush-tailed porcupine at a ceremony symbolizing Vietnam's struggle to curb the animal trade.

"**A face like** Jabba the Hutt's," says Ted Papenfuss of the moss frog. Nikolai Orlov found several of the tennis-ball-size animals in the cistern of a demolished French colonial villa. The frogs look so much like wet moss that few can spot them. Other amphibians and reptiles (below) are camouflaged to hide in bamboo, trees, or leaf litter on the rain forest floor. At least 17 new reptile and amphibian species have been discovered at Tam Dao since 1982.

BAMBOO SNAKE, *PSEUDORHABDION BAMBUSICOLA*

ASIAN PAINTED FROG, *MICROHYLA PULCHRA*

MOSS FROG, THELODERMA CORTICALE

WATER DRAGON, PHYSIGNATHUS COCINCINUS

BLACK BREASTED LEAF TURTLE, GEOEMYDA SPENGLERI

Weekenders crowd a pool at the park's edge, where income from tourism and hunting helps sustain local residents. Sharing their home with a stuffed deer, schoolgirls Vu Hong Nhung and Hang Thi Thu (below, at left) buy books with cash they earn selling beetles. Vietnam's challenge: Protect the park's animals without harming the lives of people in its shadow.

two should they be? Twenty years ago biologists might have selected the scarcest two. Now they might choose the two that are farthest apart in terms of their genetic codes. Likewise, phylogenetic studies can show which of two imperiled ecosystems contains the greater number of unique species and is more urgently in need of protection.

Reaching this level of knowledge about the forests of Southeast Asia is probably 50 years away. Meanwhile, karaoke bars and guesthouses flourish at Tam Dao, and most of the hard-pressed villagers who live nearby still try to make a living from the forest however they can. Unlike the locals, scientists are allowed to collect species samples from the park. So the purchase of specimens by scientists from locals, while considered unethical by some, is generally accepted in the name of scientific research, especially when field time is limited. As I sipped my coffee each morning in a small garden near the field station, I could hear Orlov haggling with hunters of all ages. They began arriving around 7:30 proffering bats, rats, vipers, lizards, and all manner of beetles.

"Why have you brought this to me?" Orlov would ask as if offended. "It is very common; we have many already." Some specimens he bought; those he rejected were offered to me. There was no escaping this commerce. Everywhere we went, we were accosted by children with pockets full of beetles. "Mista, you buy!" they would say.

PLAYING DEVIL'S ADVOCATE one morning, I asked Jim Patton, an evolutionary biologist from Berkeley, what good our survey was doing and why it was important to preserve biodiversity in the first place. "It's a legitimate question that we can't always answer," he said as he deftly stripped the skin off a rat and stuffed the skin with cotton. "The classic answer is that in cutting down a forest we may lose a cancer drug we never knew existed. But I don't think that's valid. We should be trying to educate people that they're part of the whole, rather than in control of the whole. It's important to show where people came from and how they fit in.

"Life is a web, and if you remove pieces of the web, it crumbles—in what ways, we can't always predict. There are certain organisms that most people agree we should preserve: pandas and tigers, for example. But they're only part of the matrix. They depend on these rats and beetles. There's a certain amount of redundancy in the pyramid of interaction. But how much? That's the crux. Preserving a place as richly diverse as Tam Dao can help us find the answers."

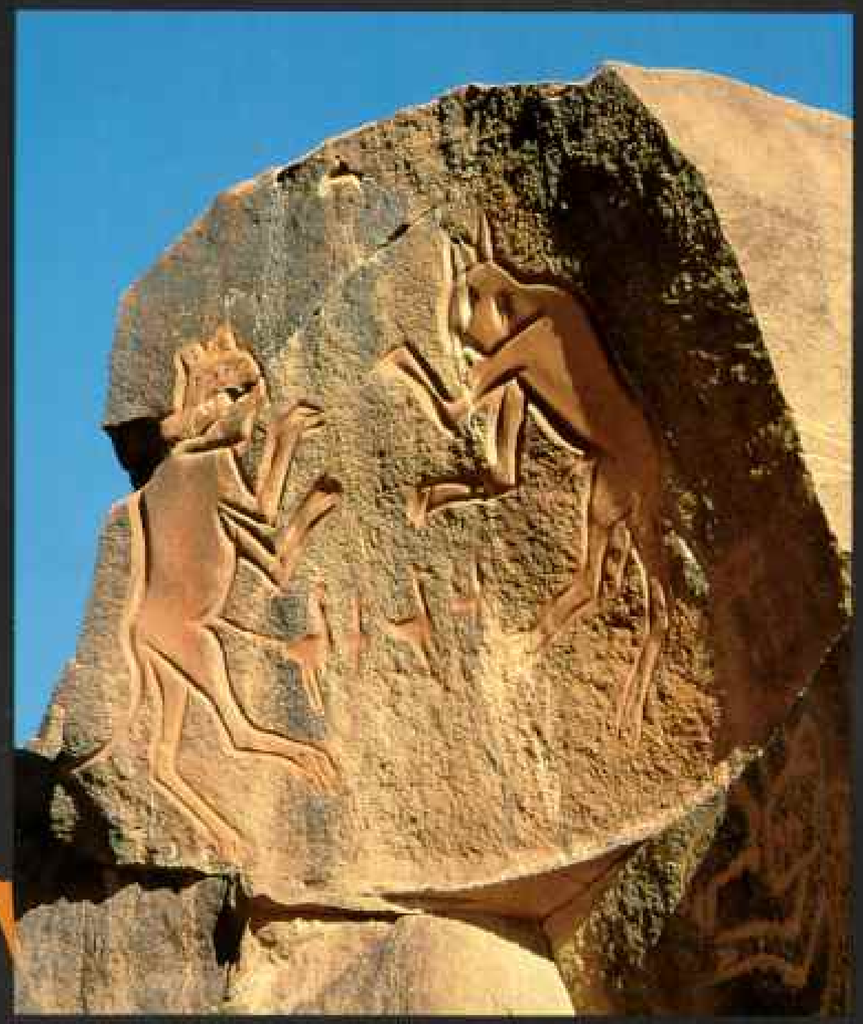
Developing a conservation plan for Tam Dao is high priority for Cao Van Sung, the energetic director of Vietnam's Institute of Ecology and Biological Resources in Hanoi. With data supplied by several different research teams about the age structure of species populations as well as their reproductive biology, diet, and growth rates, Sung already has some of the basic biological information necessary to manage the park's ecological future. But Patton thinks Sung's work has another, perhaps more important, purpose.

"What we're doing on this sort of expedition is relatively trivial," says Patton. "A month of surveying is nothing. But the value to Vietnam is in developing international relations that can sustain a dialogue. Information can be transferred, students can be brought to universities in other countries. That's what Sung is doing—he's making connections."

A guidebook I'd brought along said that the mist and clouds sometimes blow through the windows of the hotels in Tam Dao. On my final morning this proved to be true. The hot, dry weather had taken a turn. Great swirls of mist curled down from the north, pouring through the windows of our pink stucco guesthouse and cascading over Tam Dao's denuded lower slopes. The rains would soon come. The Old French Road would be squirming with creatures that had been holed up in the damp streambeds trying to stay cool and moist during the drought. There would be an orgy of mating and predation—a rearranging of the web of life of which we humans are a part.

At last the rains arrived and the team's success at collecting took a sudden turn for the better. But they would never relocate that cobra Orlov had spotted and I had hoped to glimpse. Still, it had been heartening to see 15 scientists from three nations—nations previously at odds—working together to ensure the survival of king cobras and thousands of other creatures, each one a marvel of evolution and adaptation. □

Brought to life by the afternoon sun, a procession of graceful necks and long legs sweeps across a cliff face in Libya. Although this engraving of giraffes, six to seven feet tall, is roughly 7,000 years old, it still elicits "a tremendous feeling of a herd on the move," says the author.



SAHARA

Ancient Art Of The

Caught up in battle or a ritual dance, these mythic catlike creatures have faced each other on a cliff in Libya for perhaps 8,000 years. During that time northern Africa's broad savannas became a vast desert, and most of its people moved south. Civilizations vanished, but their works of art remain.

Article and photographs by
DAVID COULSON

AFRICA'S

Scrambling after my guide, Aissa, I scale a jumble of rocks and duck into a large cleft open to the wide African sky. It's been a long day—plodding across stony plateaus, stung by the Sahara's bitter December winds—but it's all about to pay off. Quickly scanning the sandstone walls, I stop at one bright patch. It's a lone figure about nine inches long that seems to leap across the rock, its energy undiminished after millennia. The detail is astonishing: I can see the taut muscles in his legs and the string of the bow that he carries in his clenched right fist.

This ancient archer is from one of thousands, possibly hundreds of thousands, of rock art sites in northern Africa. Over the past dozen years these sites have become my passion and recording and protecting them my life's work. Each time I find one, I'm transported back thousands of years to a time when this vast desert was a grassland, veined with braided rivers and shallow lakes, and home to thriving civilizations. Like the rivers and lakes, the people have vanished, but through their art their stories have survived.

The tale begins perhaps 12,000 years ago, when elephants, rhinos, and the prehistoric wild ox Bubalus antiquus *roamed northern Africa's plains. For some 4,000 years rock art of the so-called Bubalus period was dominated by engravings of large animals that were hunted by humans. Then about 9,000 years ago representations of people ushered in what experts call the Round Head period, which overlaps the end of the Bubalus.*

By about 7,000 years ago domesticated livestock entered the scene—a momentous change immortalized in art of the Pastoral period. As the Round Head ended and the Pastoral began, art changed dramatically, says my colleague Alec Campbell, who travels with me through the Sahara, documenting the desert's art. "The paintings started to show man as above nature, rather than as a part of nature, seeking its help."

The next big change came after 1650 B.C., when the Hyksos conquered northern Egypt by chariot and introduced the domesticated horse, common in rock art of the Horse period. The camel arrived from Asia about 2,200 years ago, inspiring the Camel period.

Kenya-based DAVID COULSON is founder of the Trust for African Rock Art. His book on this ancient art, co-authored with Alec Campbell, will be published next spring by Abrams.

ART TREASURES

Engravings of boats have been found in Egypt's Nile Valley and Red Sea hills.

In well-traveled Morocco rock art is often removed by crowbar and sold in Europe.

TASSILI N'AJJER

FEZZAN

Sahara

AIR

ENNEDI

Sahel

Herdsmen migrating south from the Sahara may have spread rock art into the Horn of Africa.

AFRICA

Rock art sites featured in this article

Area where rock art has been found

Engraving

Painting

NATIONAL GEOGRAPHIC MAPS

Rock art has been discovered on every continent except Antarctica, and Africa has more sites than any other, widely distributed across the continent. The oldest known African pictographs are in the south and are estimated to be 27,000 years old, but experts believe painting in Africa may reach back more than 40,000 years.

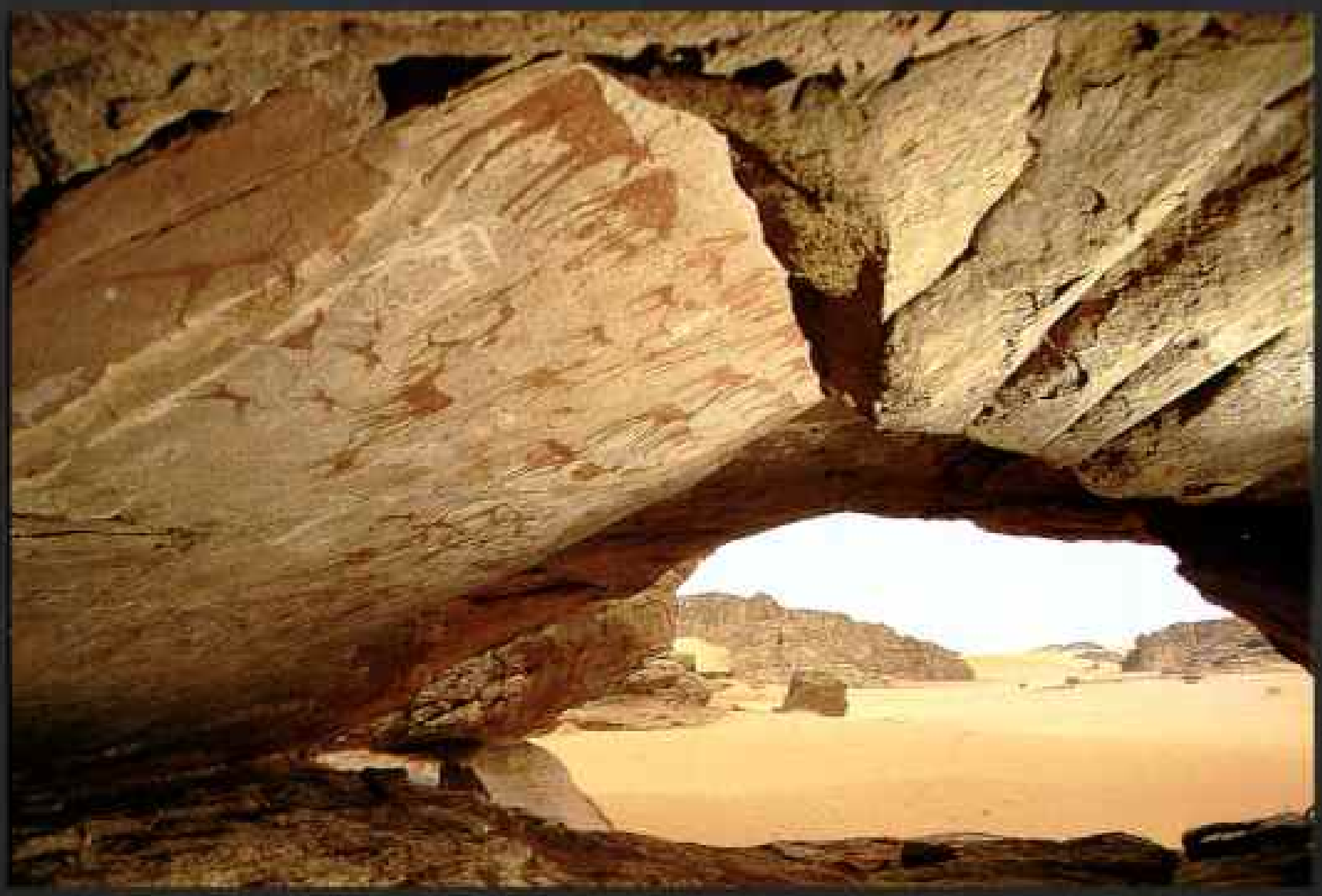
KALAHARI DESERT

Apollo 11 cave

DRAKENSBERG

Discovered in 1969 and named for the Apollo 11 moon mission, a Namibian cave yielded Africa's oldest paintings, including a cat-like creature with human legs.

South Africa's Drakensberg mountains, once home to the Bushmen, or San, constitute one of the world's richest rock art regions.



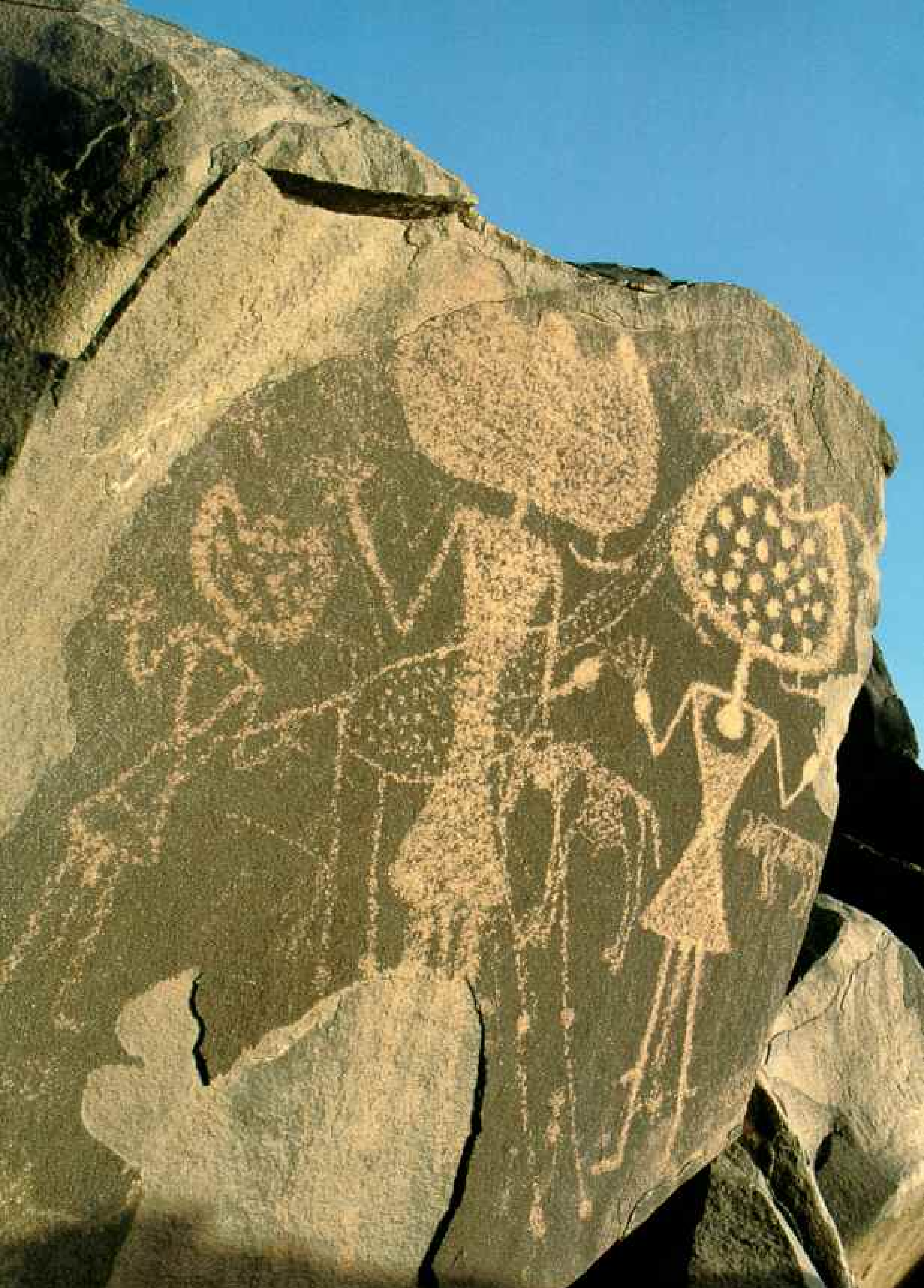
From the mouth of this cave Algeria stretches dry and desolate before me, but the paintings inside (above and detail at right) tell of a time, perhaps 7,000 years ago, when this land was wet and green enough to support cattle and a community of herders. Today our only evidence of this rich life is an ancient artist's rendering of it.

RESEARCH PROJECT

Supported in part by your Society

The first rock art site in northern Africa was reported more than 150 years ago, but pictographs such as these still largely remain a mystery. Fortunately modern science has answered some of our questions about this early art. Analysis shows that the artist's palette was mixed chiefly from minerals such as red and yellow oxide, white clay, and charcoal, and perhaps bound to the rock with blood, fat, or urine. Amazingly, even after thousands of years the colors are still vibrant.

The Bushmen of the Kalahari may offer some clues to how rock art imitated life. Though they haven't painted for about a hundred years, these southerners keep other ancient traditions that appear in Saharan rock art. A few years ago in Botswana I photographed a Dzu Bushman playing a musical bow (below), one of the world's oldest instruments and possibly the same object held by the white figure in the painting at right. Placing the end of the bow in his mouth, the Bushman tapped its sinew string with a reed and a haunting music floated across the desert, connecting us with Africa's distant past.



With tulip-shaped heads and hourglass bodies, these 2,500-year-old figures look more like they're from a different planet than another time. Working on a pile of boulders in Niger's Air mountains, the artist pecked through a dark patina to reveal the bright granite underneath.

Some 6,000 years after its work was done, a stone chisel (right) still fits easily into the groove it cut in the Libyan sandstone. Alec Campbell, who found the tool on a narrow ledge below the engraving, demonstrates the hammering technique that the artist may have used to carve a domesticated cow.

We are impressed with the skill and stamina it took to cut these evocative images. But the fact that they have lasted for millennia, even when exposed to the fierce wind and scouring sand of the Sahara, is astounding. This life-size crocodile (below), dramatic evidence of a wetter climate and the life that once

basked on the banks of northern African rivers, was cut into the rock perhaps 9,000 years ago. Some of its grooves sink more than two inches deep.

Much of the rock art in this vast region is as inspired as it is indelible. I first saw the engraving at right (known as "*Les Vaches qui Pleurent*," or "The Crying Cows") while traveling in Algeria's Tassili-n-Ajjer mountains. I was stunned by its almost Picassoan sophistication. The cattle seem to emerge, horns first, from the rock face on which they were carved some 7,500 years ago.

The artist chose his canvas carefully, looking for a surface that would catch the sun's rays and create depth and the illusion of motion through shadow. At the right time of year, as the light plays across this engraving, you can almost see the cattle move.

As if sprung from a dream, floating figures seem to swim across the Sahara toward an eight-foot-tall archer. Found in Algeria, these immense paintings, which may depict shamanistic out-of-body travel, are typical of the Round Head period, about 9,000 to 7,000 years ago.

I know these people, I thought, as I studied a series of small paintings, like snapshots of daily life, on a rock face in the Fezzan region of southwestern Libya. One in particular caught my eye—a seven-inch pictograph that we named "The Hairdresser" (below). At least 4,000 years old, it could have easily been a portrait of the Wodaabe people who now live just south of the Sahara in the semiarid region known as the Sahel.

Scenes much like this—one man leaning over a bowl while another carefully washes his long, thick hair—

are common among the Wodaabe. Though not conclusive evidence, these pictographs support the theory that the nomadic Wodaabe, known for their skill with face painting, are descendants of northern Africa's Neolithic artists.

Such pieces to this complex puzzle are rare. The sheer size of the Sahara —3.5 million square miles—and thousands of years of migration to and from the region make it difficult for us to track down the rock artists' descendants. Fortunately some of the customs they chronicled are easier to trace.

Another ritual still common today is body painting, especially among the Surma of southern Ethiopia (above). Carefully crafted to intimidate an opponent during ritual battles, these elaborate clay-and-water patterns are remarkably similar to some of the engravings I have seen in Chad—like these massive figures from the Ennedi mountains (right), the tallest of which is nine feet high.

CAROL BECKWITH AND ANGELA FISHER (TOP)

Today Algeria's Tassili-n-Ajjer region is as deserted as it is dry, but millennia ago it was home to Neolithic peoples who collected wild grains, hunted with bows and arrows, and left exquisite paintings in rock shelters scattered throughout this forest of eroded towers.

For thousands of years northern Africa's rock art has endured sun, sand, and the occasional thunderstorm. Now it faces a more potent threat—man.

The danger ranges from tourists who wet paintings to make them easier to photograph to guerrillas who take shelter in caves and use the art for target practice, like this bullet-pocked camel in Chad (right).

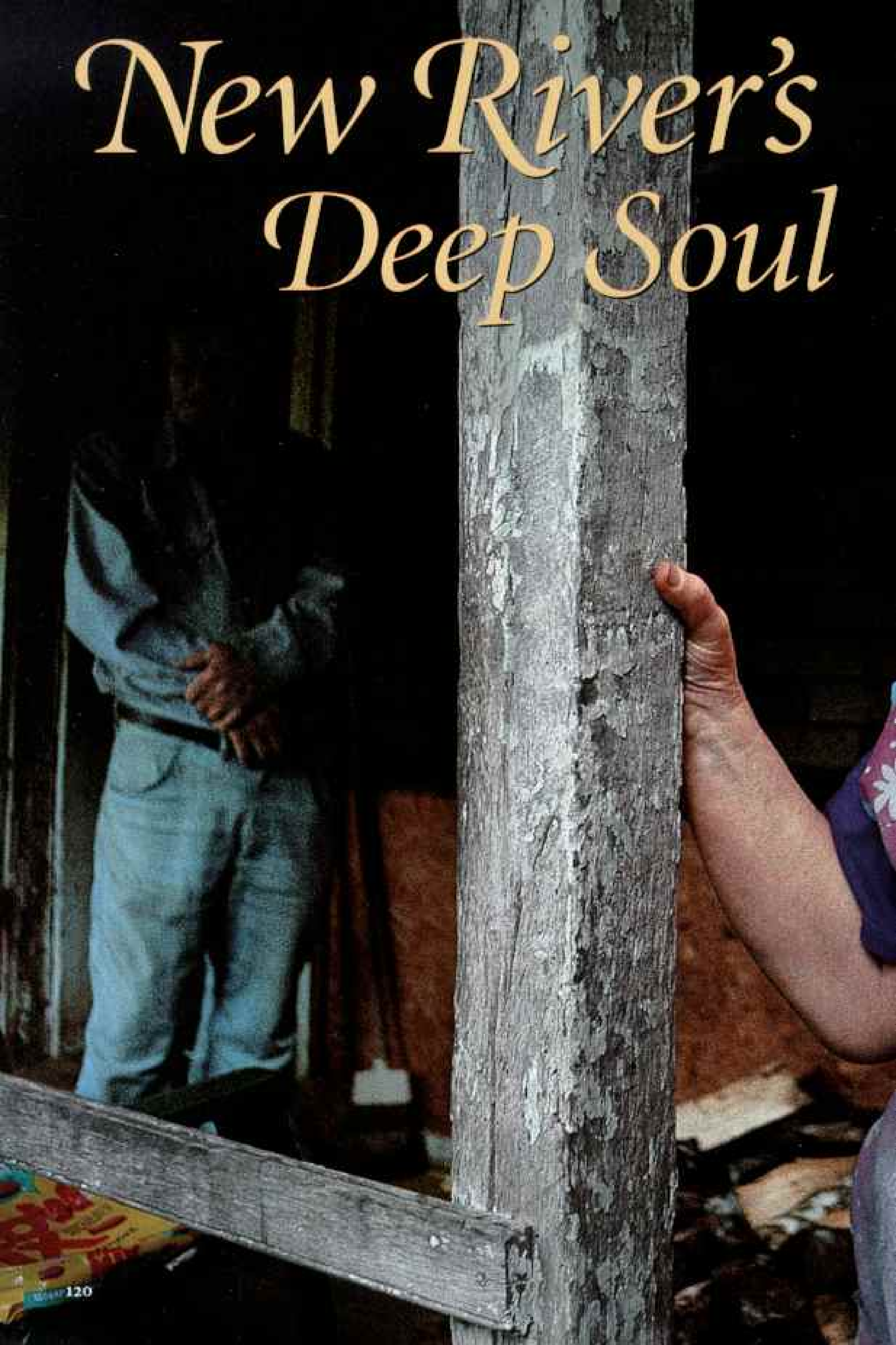
But the most alarming destruction we've seen is in Morocco, where at site after site rock art has been either completely removed or irreparably damaged in the attempt.

Abdellah Salih, who works for Morocco's Ministry of Cultural Affairs, picks up a wedge from a 6,000-year-old engraving (above) to show me where it fit before a botched effort to remove the entire piece. According to Salih, 40 percent of the engravings and 10 percent of the paintings in this region have been stolen or damaged. Most have fallen prey to thieves, who pry the art off rock faces and smuggle it into Europe to sell to private collectors.

Rock art is also retouched out of respect for the magic it's believed to contain. I was told that engravings in the Air mountains (right) were recently marked with clay and charcoal by fighters in Niger's civil war who hoped to tap into their ancestral power.

All this is why in 1996 I founded the multinational Trust for African Rock Art. Because only if we protect these sites can we learn more about this ancient art form—and the long-vanished civilizations that gave it life. □

New River's Deep Soul



Grace Ray is singing her favorite song: "Precious memories flood my soul." She has lived all her life within ten miles of the North Carolina home where she was born. Like Grace, the New River is at home from start to finish in Appalachia, its northward course running from the gentle to the wild.

Spanning a West Virginia canyon 3,000 feet wide, the New River Gorge Bridge transformed 44,000 tons of steel and concrete into structural art as graceful as the morning mists drifting below it. Opened in 1977, it replaced an 1889 trestle—and 40 white-knuckled minutes on one-lane switchbacks—with 40 seconds on cruise control.

By Roff Smith
Photographs by Susie Post

On a Labor Day weekend in Fayetteville, West Virginia, Andrew Berk found plenty of sidewalk space for coffee and a morning chat with Peanut. "It's very satisfying to wander home to the woods here," says shop owner Gene Kistler, "but we face the same issues other communities do. We've got to manage growth so we sustain the peace that makes this place special."

THUNDER RUMBLED through the narrows of West Virginia's New River Gorge, adding theatrical menace to our guide's warning. "This one's going to be rough," Jerry Drennen shouted, raising his voice above the roar of the approaching rapids. "When I give the word, everybody hold tight to their paddles, scrunch down, and lean hard into the raft." Nodding like punch-drunk boxers taking instructions, we paddled toward a midstream boulder where greenish black water foamed white. At the last second Jerry cut left, taking us down a thundering sluice. Our eight helmeted heads ducked together as the rubber raft slammed between two mountainous whitecaps. When I reopened my eyes, we were missing a stockbroker, a banker, and an aeronautical engineer. As we drifted out of danger, they bobbed up in the foam and scrambled over the side, eyes rolling with relief and exhilaration. "What do they call that one?" I asked. Jerry grinned. "Bloody Nose."

What else would you expect from a bare-knuckle stretch of water running north through the heart of Appalachia? Its whole 330-mile length, from the hickory ridges high in the mountains of North Carolina to West Virginia's coalfields where it joins the Gauley River to create the Kanawha, is a testament to raw power, contrariness, and endurance. Far from being "new," the New River is the oldest watercourse on the eastern seaboard. "I've heard dates of anything from 10 million to 360 million years," says Llyn Sharp of the Virginia Tech Museum of Natural History in Blacksburg. "I usually just say it's ancient."

Look at a relief map, and you'll see that the New even forced its way across the Appalachians: At Narrows, in wild southwestern Virginia, a notch—a water gap—transects an unbroken spine of mountains.

Millennia later the New River channeled a different energy, as thousands of workers scrambled for a living on the steep, muddy slopes of the New River Gorge, toiling in the coal mines, cutting timber, stoking the coke ovens beside railroad tracks newly laid to carry these riches to the world outside. The heroes of the New River were engineers who ran their trains on time, union organizers, moonshiners, and bluegrass banjo pickers. Men like John Henry, the legendary black steel-driving man who challenged the steam drill to a duel—and

ROFF SMITH, a New Englander who now makes his home in South Australia, wrote about Nebraska in the November 1998 issue. Covering the New River was a homecoming for photographer SUSIE POST, who spent her childhood weekends near the river's headwaters.

won—near Hinton, West Virginia, in the early 1870s. The New River has enough history and folklore that last year President Clinton declared it one of 14 American heritage rivers. Enough grandeur and devotion that in 1976 the secretary of the interior named a stretch of it a national wild and scenic river, averting an effort to dam it for hydroelectricity.

FOR A TANK TOWN BRAWLER, the river has genteel roots. Its South Fork starts as a series of springs near the fashionable resort town of Blowing Rock, North Carolina, where generations of southern well-to-do have come to take the air and escape the summer heat. This was the South of wicker chairs and seersucker suits, of golf dates at the Blowing Rock Country Club, where the fledgling creek's waters have been captured to form the course's water hazards.

"Our season traditionally ran from Memorial Day to Labor Day," said Jerry Burns, editor of the local newspaper, the *Blowing Rocket*, since 1965. "Wealthy summer folk would bring up their entire household staffs—maids, servants, and chauffeurs—and Main Street would be lined with Cadillacs and Rolls-Royces."

Blowing Rock has broader appeal these days. It is a honeypot for Florida retirees wanting a summer home in the cool mountain air, for professionals from the banking and high-tech hubs in Charlotte and Raleigh-Durham looking for a weekend retreat, and for dreamers who want to open a bed-and-breakfast.

"It's definitely a seller's market around here," said Rita Wiseman, a real estate agent on Main Street. "I've got wealthy couples ready to write

a check for $400,000 if I can find them a place, but there's so little available."

As the stained wood chalets spring up on the banks of the New River, an old Appalachian way of life has had to come to grips with a new one. Early this century Ashe, Alleghany, and Watauga Counties were known as the Lost Provinces; little places in the mountains like Glendale Springs and Todd were so remote you could barely get to them from anywhere else in the state. Most commerce was with Virginia and Tennessee via a painfully slow mixed-goods train known as the Virginia Creeper, which snaked into North Carolina's mountains along the tortuous New River Valley—unless, of course, the tracks were blocked by rockslides or floods; or the rails were broken. It was the 1920s before people could drive directly to these hamlets on paved roads from Charlotte.

Even today some of these county roads are a two-Dramamine adventure, but at least I arrived in Todd, an old logging town that was the last stop on the Virginia Creeper, the same morning I left Blowing Rock, about 20 miles away. It was Memorial Day, warm and humid, with Old Glory fluttering on the general store's porch and hazy sunshine shimmering on its pressed metal cladding. I joined a knot of regulars who were drinking coffee and swapping news around the store's wood-burning stove, always the focal point. They were mostly in their 70s and 80s, and their families had lived in these parts for more than 200 years.

"Many's the time I've walked in here carrying a chicken by the legs looking to barter it for something we needed at home," said Ruby Trivette, 84. "When we were kids, we'd raid the chicken coops and come in here to barter an egg's worth of penny candy."

She reminisced about old church revivals. "They'd last for two weeks, and just when they started to flag we kids would suddenly get real interested and try to keep them going because, you see, there was a lot of courting going on."

Todd had little contact with the outside world until the railroad arrived in 1914, allowing exploitation of rich hardwood forests. For a few heady years Todd thrived. There were hotels, nine stores, two lumberyards—even a Ford shop where Model T's were pieced together and driven down the muddy roads to showrooms in Boone and Jefferson. Then, around 1933, when the timber was all cut, the trains stopped coming. The tracks grew weedy, and Todd withered. Over the years the forests grew back, the deer and bear returned. The Lost Provinces were ripe for rediscovery.

Now Todd holds an annual New River Festival that draws a crowd of more than 5,000. The old train station has been restored as the offices for Appalachian Adventures, an outfitting business, one of half a dozen working the upper river. Fly-fishing guides from Boone and Blowing Rock bring their clientele here. Tourists ride bicycles on a beautiful rustic path where the tracks of the Virginia Creeper used to be. All along the New River, communities like Jefferson, Sparta, and Mouth of Wilson are being "found." On a busy weekend canoes and inner tubes crowd the river, and packs of Lycra-clad cyclists explore its back roads.

In Todd, so far, it has been a gentle collision of worlds. Sitting beside me at the woodstove, Homer Murdock, pastor of the South Fork Baptist Church, told me about a river baptism he had performed. "A family of tourists floated down on inner tubes during the service. They saw what we were doing, pulled over to the bank, and waited respectfully for us to finish. Afterwards, the parents asked me to baptize their three kids. I questioned them for a while to be sure they'd truly been saved, and then I baptized them. We still hear from them."

"What we need to do next is build a bigger road to make it easier for more people to get in here," said Murdock, who recently moved back to the area from Charleston, South Carolina. "It'd be so much better for business."

Ruby Trivette shook her head and replied, "Oh, no, Homer. That's the last thing we need. There's plenty of people getting back here as it is." After a few minutes of polite but earnest debate, they agreed it was something they would have to pray about.

THE NEW RIVER has had moments of higher passion. Twenty-five years ago it was the focus of a national controversy over a proposal to build two hydroelectric dams near the Virginia towns of Galax and Independence. Some local people were keen to sell and develop land on the new lakefront. Others decided to fight.

"This was about people, not endangered species or trees," says Edmund Adams, an

"We see a lot of tension before the trip," says New River outfitter Dave Arnold, "but whatever that stress is, you can't help but get away from it on the river. It's a powerful change." His attention soaked in the moment, one rafting client (above) is a droplet in a revenue stream from tourism, much of it generated by splattering whitewater thrills, which have helped offset tough times in the region's older coal, lumber, and textile industries.

On Bridge Day each October you can walk across the New River Gorge Bridge—or jump off. Hundreds of parachutists make the 876-foot leap on the one day it's legal. How much free-fall time is safe? "You'll hit the water about nine seconds after you jump," advises Bridge Day enthusiast Bill Von Novak. "It's a good idea to open your chute before that happens."

attorney who represented surrounding counties in Virginia and North Carolina that would have lost more than 42,000 acres to the dams. "This was about preserving a way of life that had gone on here for more than 200 years. A river just happened to run through it."

After years of bitter protest North Carolina declared 26 miles of the New a state scenic river. The federal government raised that designation to national status in 1976, preventing the area from being flooded. More than 1,500 acres along this stretch have been set aside to form the New River State Park.

I canoed the wild and scenic New River with Sandy Davison, a retired forestry professor from Duke University who devotes much of his time to land conservation along the river. It is a wide, handsome stream here, flanked by steep, leafy ridges and cliffs. The air was heavy with the scent of the wild roses along the overgrown banks. Nubs of billion-year-old gneiss, the oldest rocks in the Appalachian Mountains, created gentle riffles and thumped on the bottom of the canoe. "All this would have been more than 200 feet underwater if the dam had gone ahead," said Davison. "As it happens, much of the riverfront has become highly sought after real estate instead."

He was talking about a contentious boom in recreational homes overlooking the river. I went with Davison one evening to a farm on a ridge along the Virginia-North Carolina line. It was owned by the family of Tom Smith, whose ancestors settled the property in the 1790s.

"My daddy was the only one around here who didn't sell to the power company or speculators," Smith said. "He told them all to go to hell in a bucket. Let me show you what I'm trying to save for my family."

We went to a promontory, thigh deep in hay, overlooking a bend in the river hundreds of feet below. It was a warm, firefly dusk. Deer sprang into the gloom, insects whirred, and the ribbon of river shone gunmetal blue. Behind it, mountains stretched into the distance in successive shades of gray, blue, and indigo. We were silent. I had a sense Smith was waiting for something. Then, one by one, almost like the stars coming out, a line of yellow lights flickered on a ridgetop a couple of miles away.

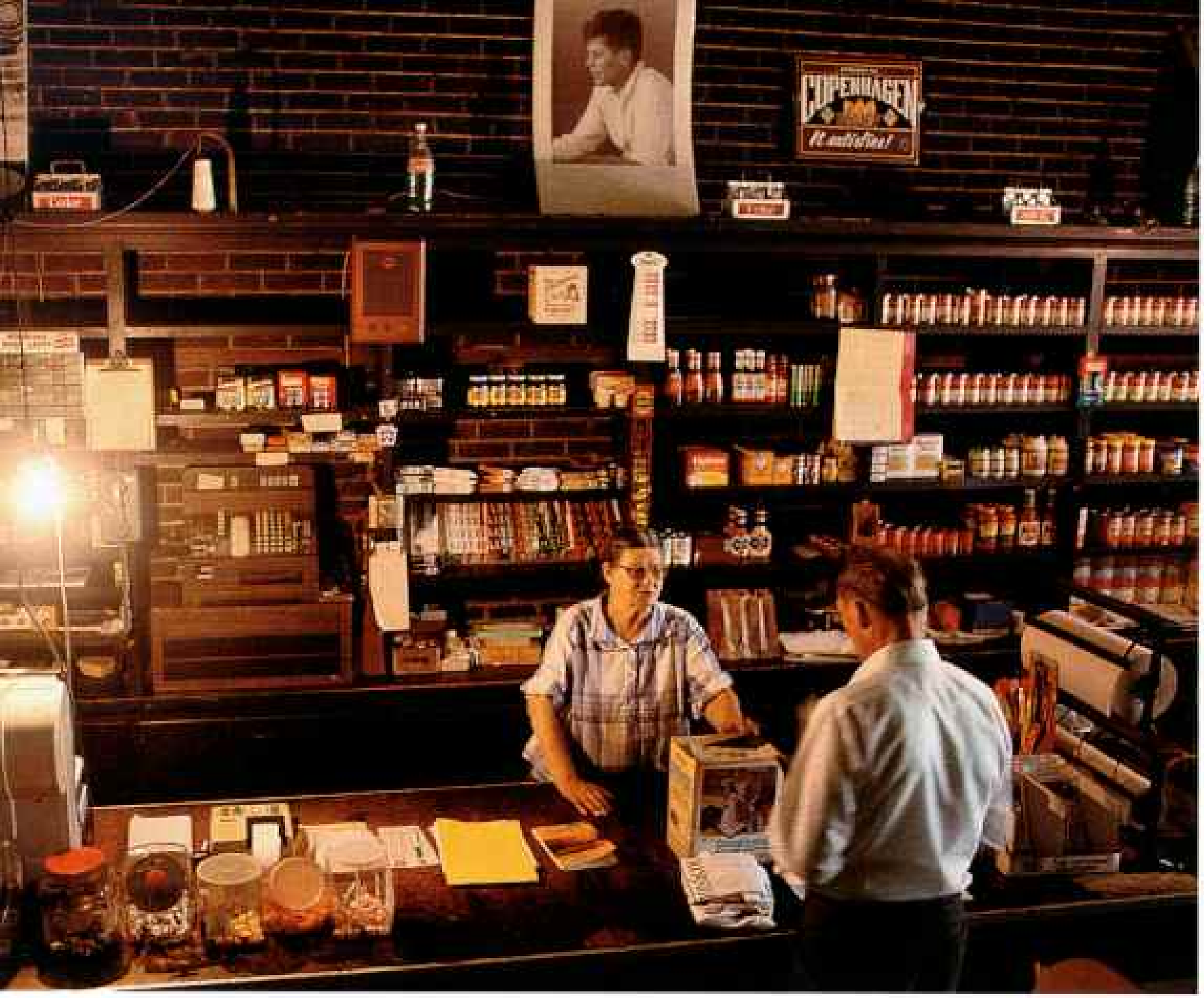
"Three years ago that ridge looked just the way it did when Daniel Boone was passing through here," Smith said. "Now it's all going to half-acre lots. Call a toll-free number in Miami, and get your brochure. They're bringing up busloads of tourists to have a look and buy. But that's never going to happen on this ridge. I've signed papers that will help us keep it in the family for many generations yet—as long as we manage the property well."

Smith had closed a deal with the National Committee for the New River, a nonprofit environmental organization, which had bought "development rights" to 196 acres of his land. This would lower the property's value, a tax advantage, while protecting the river, because the committee pledges to keep the land intact.

FORTY-SIX RIVER MILES downstream from Smith's farm sits the old textile mill town of Fries, Virginia. It was from here in 1923 that a millworker named Henry Whitter took his guitar and harmonica to New York City and recorded "The Wreck on the Southern Old 97," "Lonesome Road Blues," and later "New River

Change comes slowly to Eggleston, Virginia. Even though her father bought out Mr. Pynes in 1945, Gladys Dowdy's one-woman operation (right) is still called Pynes Store.

In Elk Creek, Virginia, they also know a good thing when they've got it. Four thousand people show up for the annual Grayson County Old-Time & Bluegrass Fiddler's Convention, sponsored by the volunteer fire department. "There's music all night long," says fire chief Jerry Testerman. "Everybody wants it to keep on happening."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Train." They brought him no great success, but his pioneering effort soon opened the ears of record companies to the commercial promise of a music they labeled "old-time country." People joked that Whitter played and sang so badly that everyone in Virginia believed they could do better.

"Music is a big part of life along the river," said Wayne Henderson, a mailman who, when he's not making deliveries to farms along the river (including Tom Smith's), builds acoustic guitars. His skill has won him a National Heritage Fellowship, recognition that meant a trip to the White House and performing tours overseas and around the country. "My daddy was a fiddle player, and my granddaddies were banjo players," he said. "Learning to play is just something everybody does around here when they're a kid."

Henderson, now in his early 50s, made his first sale when he was 17. "A local moonshiner came by our house with a man we had never seen before. We were pretty scared, particularly with that stranger being around. They'd heard that I made guitars and wanted to know how much I'd take for one. I blurted out $500, figuring that would get rid of them quick. It did, but the next night the stranger came back, had another look at my guitar and gave me five one-hundred-dollar bills. It was more money than I had ever seen or heard tell of before, and I knew right then I was going to make guitars for a living."

Henderson was working on his 208th guitar the morning I stopped by. It was to be a prize at a local country and bluegrass festival, which he organizes every year to encourage local talent.

MUSIC ENDURES, but at the textile plant in Fries where Henry Whitter got his start, the shift whistle blew for the last time ten years ago. Getting by has always been a challenge along the river, and no more so than in West Virginia, where the New becomes darker and wilder and menacing, cut off from the rest of the world by steep valleys cloaked in dense forest. When national Prohibition went into law in 1920, it was the perfect fastness for making illegal moonshine.

"The region . . . became the scene of armed clashes between 'shiners' and Prohibition officers," wrote Howard Lee, prosecuting attorney for Mercer County during that era. "Brutal murders were almost commonplace." He described the moonshiners as "a well-armed, wild, and lawless breed who zealously guarded their domain against unwanted intruders."

Willard "W. C." Parker, 70, a retired railroad man who knew Howard Lee and whose family has lived in the area since 1772, confirmed Lee's assessment but softened it. We were sitting over plates of catfish in a fishing camp on an island in the river at Hinton. "The best moonshine used to come from the Pipestem area," he said. (Men there brought in talent from Virginia to run a moonshine school.) "I might add that a lot of moonshiners were decent, hardworking people."

Nobody is making much moonshine anymore around Hinton, although the town still looks the part, with the claustrophobic ridges brooding over it. Hinton was an instant boomtown when it was founded in 1873 by the Chesapeake & Ohio Railroad to service the trains

When illness confined Ermel Hess (right, far right) to the home he shares with wife Jean in Fayetteville, West Virginia, barber Matt Scalph started making house calls. Matt and his wife left the Washington, D.C., suburbs four years ago, seeking intangible luxuries—like time to help an ailing neighbor. The couple run three businesses, but even so, smiles Matt, "Here we've got a life again."

In the baptizing waters of nearby Mill Creek, pastor and flock of the New Hope Missionary Baptist Church nourish a life of faith.

"You get filthy black," says Donnie Bunch, "but it's good work." A 28-year veteran of West Virginia's coal industry, Bunch was a roof bolter and utility man in the New River Gorge's last mine. Coal ran out there in 1996. "We got 60 days' notice, then I was laid off. I had to go into a non-union mine for a while," he recalls. "The way work is now, most folks go wherever they have to."

hauling coal and timber out of the New River Gorge. It was big business: Henry Ford and the Cunards, the British shipping family, owned mines in the gorge. By 1925 more than 6,000 people lived in Hinton; 12 passenger trains stopped every day, and a thousand men made good money in the freight yards and workshops or on train service crews.

"There were always railroad people on the streets—coming and going night and day," said Parker, who put in 47 years on the C&O. One of his first jobs was as fireman on one of the Allegheny locomotives, the biggest, most powerful steam engines ever built, weighing nearly 600 tons. "They were like our Boeing 747s. You had to have a lot of seniority to be an engineer on one of those," he said, regretful to have missed the opportunity.

The steam engines became obsolete when diesels arrived in the 1950s—a disaster for Hinton, with its sprawling steam engine workshops. "The town never really got over the change," said Parker.

It certainly looks that way. The saloons on Front Street are weedy piles of brick; a small tree grows out of the fourth-story of the McCreery Hotel, in its time one of the grandest establishments on the C&O line. Hinton's boom-time population has halved.

Coal trains still lumber through the town but not from the New River Gorge, where the last coal mine closed in 1996. Hinton is living, literally, on its past. Railway pensions are generous: A recently retired career employee receives on average $26,000 a year—better money than most full-time jobs, such as pumping gas or flipping burgers, which are scarce anyway. "When somebody dies or moves

away, it's like the unemployment rate just rose," said Parker.

THE DECLINE of places like Hinton belies the fact that, a century and a quarter after the first coal was hauled out of the New River Gorge, the area is as busy as ever, having turned to another natural resource for its livelihood: Last year more than 154,000 rafters tackled the New.

Dave Arnold was a trailblazer in this enterprise. Twenty-two years ago he borrowed $7,500 from his father to launch a white-water rafting business with three friends. "We started off with just a couple of rafts and ran our office out of a 1956 trailer on a couple of acres we rented from a coal company. It was tough. In those days rafting was a novelty. My wife, Peggy, and I lived in a tent for the first six months. But there's something about running a river that reaches deep into the human soul," he says. "It's as primitive and instinctive in us as music, and so I knew it was going to work."

Now the Arnolds live in a large hemlock-beamed home with a spectacular cliff-top view over the river. His company, Class VI River Runners, owns hundreds of acres along the river and has taken 320,000 visitors through the rapids, from girl scouts to Dan Quayle. The morning I visited, he was expecting a chartered 727 full of tourists from Indianapolis.

More than 20 other outfitters compete along the same stretch of river, and Fayetteville, a tiny community perched on the edge of the gorge, is a major stop on the globe-trotting river guide's circuit—Australia, Mexico, Chile, California, and New Zealand. I walked the streets one evening, past the mountain-bike shops, the breezy restaurants, the studio that specializes in white-water videos, the old mansions of coal barons graciously restored as B and Bs—the newest evidence of the restless energy that has shaped life along the river.

Then, on my way back to my car, I happened to meet a big, rangy man who was out exercising his dog. He introduced himself as Tunney Hunsaker. In 1960 Hunsaker went the distance with Cassius Clay. It was Clay's first professional fight, before he became Muhammad Ali, and Tunney Hunsaker lost on a points decision.

Hunsaker, who had been Fayetteville's police chief, invited me back to his house to see his trophy room. "Ali told me later that I hurt him," he said proudly, passing me a black-and-white photo of the fight, autographed by the Champ, and another photograph, taken in 1992 when Ali stopped by at Hunsaker's retirement party. "It was sure a tough fight, I know that. Ali knocked out the next five men he faced, but not me. I was there, still standing, at the end. That's the important thing we learn around here."

I drove north out of town thinking about Tunney Hunsaker's staying power—the kind that outlasts coal booms or rafting trips and seems to mirror the stubborn persistence of the New River itself. At the lookout by the New River Gorge Bridge, I pulled over and peered 900 feet down at the river, carving its bed ever deeper, its waters looking as still from up there as an old photograph. □

Where summer decorates riverbanks with joe-pye weed and yellow wingstem, New River robber barons and their industrial descendants saw profits waiting to be extracted. Today, from North Carolina's highlands (left) to West Virginia's hollows, lifelong residents and urban refugees alike see natural beauty worth preserving and take pride in their gently paced, face-to-face way of life. "Much has been lost," says Mountain Times *editor Jim Thompson, "but much remains."*

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Apollo (*Parnassius apollo*) **Size:** Wingspan, 7–8 cm **Habitat:** Mountain ranges of the Palearctic; occurs at sea level in northern areas **Surviving number:** Unknown

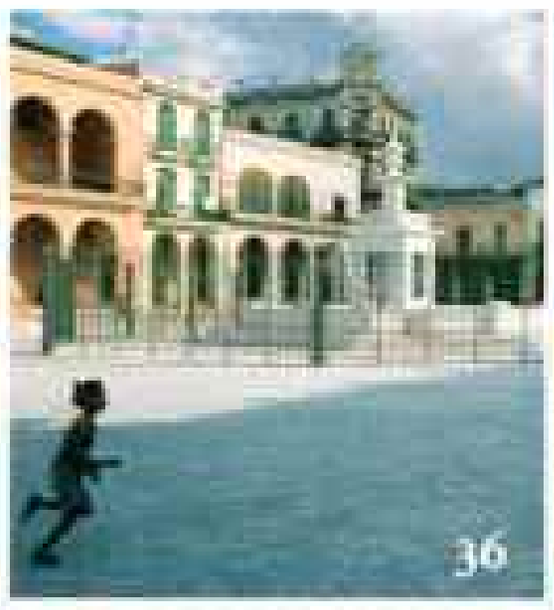
Photographed by Dick Forsman

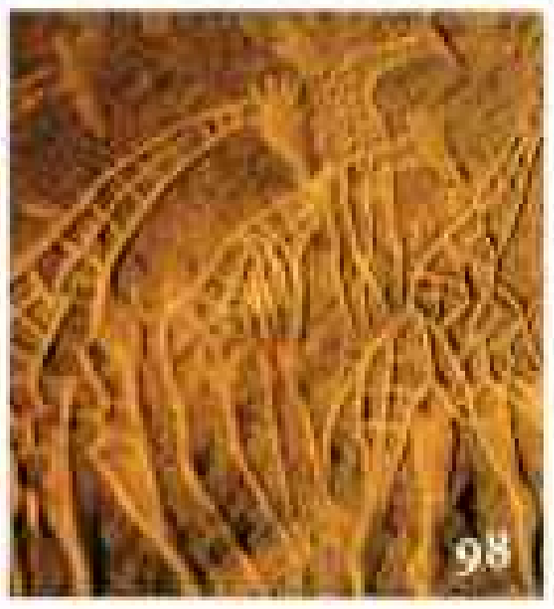
WILDLIFE AS CANON SEES IT

Vivid eyespots adorn the translucent papery wings of an Apollo. By repeatedly raising and lowering its forewings over the spots, this mountain butterfly creates an illusion of blinking eyes to frighten predators. After winter, velvet black Apollo caterpillars with red spots emerge to feed on stonecrop, a plant of alpine meadows, screes, and rocky coasts. As a relict of the glacial epoch, the Apollo ranges widely in Eurasia; but populations have declined, especially at lower altitudes, due to habitat loss and fragmentation. Prized by collectors, the Apollo is protected by law in many countries. As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.

NATIONAL GEOGRAPHIC

JUNE 1999





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BY JOHN J. PUTMAN PHOTOGRAPHS BY DAVID ALAN HARVEY

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PHOTOGRAPHS BY DAVID ALAN HARVEY

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ARTICLE AND PHOTOGRAPHS BY DAVID COULSON

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The Cover

Cruising in a 1953 Chevrolet, a boy rides home after his birthday party at a hotel swimming pool in Havana. Photograph by David Alan Harvey

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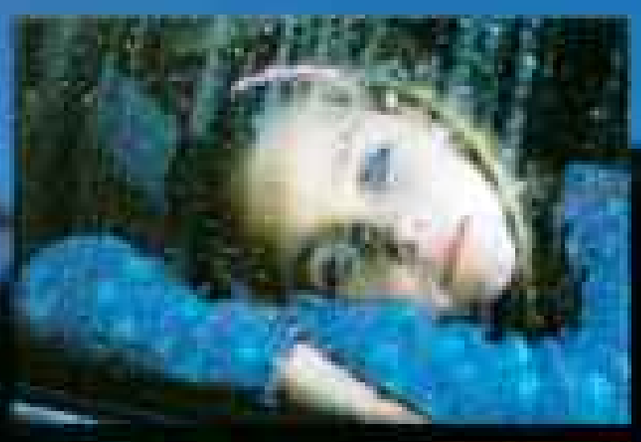

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Behind the Scenes

Shooting for the Stars

The GEOGRAPHIC goes way back with NASA. "Exploring Tomorrow With the Space Agency" ran in July 1960 and featured a portrait of the seven original astronauts in sport jackets taken by Society photographer Dean Conger. He would soon spend more than two years at NASA, loaned by Editor Melville Bell Grosvenor to help document the Mercury program. "The astronauts weren't all that interested in photography," says Conger (right, with Alan Shepard after his inaugural flight). "They had other things on their minds."

WILLIAM TAUB; NASA (ARCHIVE); MARK THIESSEN; NGS (TOP RIGHT); FRANCIS CRISSMAN; DAILY RECORD (WAYNE)

The Society has four times presented astronauts, including the crew of the Apollo 11 moon mission (top), with its highest honor, the Hubbard Medal for exploration. And some have honored us. Former astronauts Michael Collins and Frank Borman are now members of our Board of Trustees.

Meeting by Design

Nine-year-old David Whitmore (right) made the front page of his local newspaper in Wooster, Ohio, when he got candidate John Glenn's autograph at a Democratic fund-raiser for Glenn's 1970 senatorial primary campaign. "I delivered the newspaper that picture was published in!" remembers David. Thirty years later the pair crossed paths again (top). David, now a GEOGRAPHIC layout editor, designed this issue's article on the nation's oldest astronaut in space. What did it feel like to meet Glenn again? "I hardly remember the first time," admits David, who was tagging along at the function with his dad. "I think it must have been baby-kissing time, and I was the closest thing they had to a baby." David did score another autograph from Senator Glenn at this most recent meeting—but this time it was for his own kids.

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1996 Popular Science "Best Of What's New"**
1996 Automobile Journalists Assoc. of Canada "Car of the Year"*
1995 AutoWeek "Most Significant"*†
1995 Kiplinger's "Best Minivan"*†
1994 Kiplinger's "Best Minivan"*†
1994 MotorWeek "Best Minivan"*†
1992 MotorWeek "Best Minivan"*†
1991 MotorWeek "Best Minivan"*†
1991 Automobile Magazine "All-Star"*†
1991 Kiplinger's "Most Improved"*†
1990 Automobile Magazine "All-Star"*†
1989 Automobile Magazine "All-Star"*†
1988 Automobile Magazine "All-Star"*†
1988 MotorWeek "Best Minivan"*†

AMERICA'S MOST

1987 MotorWeek "Best
1986 MotorWeek "Best
1985 Car and Driver "
1984 Zinc Institute Awa

SAFETY AWARDS:

1997 Kiplinger's "First
1996 Prevention Magaz
1995 Kiplinger's "First
1995 Prevention Magaz
1993 Prevention Magaz
1992 Prevention Magaz
1992 Kiplinger's "Safet
1991 Kiplinger's "Safet
1991 Prevention Magaz

VALUE AWARDS:

1998 Consumers Digest
1998 SmartMoney "A Be
1997 Kiplinger's "Best
1997 Consumers Digest
1996 Consumers Digest
1995 Consumers Digest
1994 Consumers Digest
1994 Kiplinger's "Best S
1994 Motor Trend "Top
1993 Consumers Digest
1992 Consumers Digest
1992 Kiplinger's "Top Se
1992 Motor Trend "Best
1991 Consumers Digest
1991 Motor Trend "Top
1990 Motor Trend "Top
1990 Consumers Digest
1989 Consumers Digest

*Chrysler Town & Country
†Plymouth Voyager and/or Grand Voyager

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MINIVANS

AWARD-WINNING MINIVANS (cont'd)

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...est"*
...of Excellence for Corrosion Protection†

...Safety"*
..."Safe Car of the Year"*
...Safety"*
..."Safe Car of the Year"*†
..."Safe Car of the Year"*
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..."Safe Car of the Year"*

...Best Buy"†
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...r"†
...New Car Buy"†
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...the USA"*
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...ew Car Buy"†
...Best Buy"†
...Best Buy"†

AMERICA'S MOST AWARD-WINNING MINIVANS (cont'd)

1989 Motor Trend "Top 10 New Car Buy"†
1988 Motor Trend "Top 10 New Car Buy"†

QUALITY AND CUSTOMER SATISFACTION AWARDS:

1998 Strategic Vision "Total Quality Award"* for Best Ownership Experience in Minivans"**
1997 Strategic Vision "Total Quality Award"* for Best Ownership Experience in Minivans"**
1996 Strategic Vision "Total Quality Award"* for Best Ownership Experience in Minivans"**
1993 R.L. Polk & Company "Highest Owner Loyalty Rating"*†
1991 J.D. Power and Associates "Number One Minivan in Customer Satisfaction"*
1989 J.D. Power and Associates "Number One Domestic Minivan in Customer Satisfaction"†*
1988 J.D. Power and Associates "Number One Domestic Minivan in Customer Satisfaction"†*
1987 J.D. Power and Associates "Number One Minivan in Customer Satisfaction"†*

VALUE AWARDS	20
QUALITY AND SAFETY AWARDS	17
Design and Engineering Awards	30

TOTAL AWARDS: 67 AND COUNTING

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HUMAN ACHIEVEMENT

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DAVID ALAN HARVEY

A Sticky Situation

They were chasing a "very strange-looking water tower," says NATIONAL GEOGRAPHIC Editor Bill Allen, who was fascinated by the structures he saw while driving around the Cuban countryside with photographer David Alan Harvey and illustrations editor John Echave for the story in this issue. John, who was born in Cuba, tried to satisfy Bill and Dave's curiosity about the odd-looking towers by pulling the car off the road to prove that the things were indeed built to hold water. The rough terrain promptly punctured their oil pan. What to do? Bill Allen, in black shirt, chewed on a solution. The hole was sealed with a wad of pink bubble gum—attached by one of the farmers who stopped to help—and the group was soon on its way.

MARK THISSEN

Rocks in Our Headquarters

Somebody left a pile of boulders in the courtyard of Society headquarters—and we like it that way. They might look like natural formations, explains artist Elyn Zimmerman of her sculpture "Marabar," "but they were broken out of the quarry in blocks and had to be shaped to look that natural." Inspired by a landscape described in E. M. Forster's *A Passage to India*, Elyn placed 500,000 pounds of South Dakota granite around a narrow pool so that the boulders' polished faces mirror the water. Not everyone who sees the sculpture knows what to make of it. Soon after our M Street building's 1984 dedication, one visitor shook her head as she walked past. "I had rocks like that when I built my house too," she said. "It's easier to work around them, isn't it?"

TEXT BY MAGGIE ZACKOWITZ

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Ideas that, like P3, are designed to work in harmony with humans. And, ultimately, to help create a new dimension in mobility. Seems P3 is exactly like his great grandfather, after all.

HONDA

Thinking.

Forum

Our February 1999 Millennium issue on biodiversity was cited by one reader as "an issue every household should be required to read." Another noted, "We have got to move past the notion that we as a species are at the center of our ecosystem. We are a part of biodiversity and have a responsibility to limit our impact on this fragile web."

Taking Stock of Life

Drawing attention to the perils facing biodiversity is commendable, but it is naive and dangerous to highlight the main role of nature as being one of pharmacy, supermarket, or suburb. Like education for education's sake, biodiversity is important not for what it can yield but rather for what the consequences would be if it was diminished. The subtle species interactions we know so little about serve to maintain balance in a world we harm with little conscience. Our species is truly foolish if we believe we can simply innovate our way out of ecosystem collapse. The natural chains and webs we are currently destroying are bound to us as well.

GUY MARJERRISON
Toronto, Ontario

I think the situation is far worse than you express. After all, the rich Western world is largely responsible for what is happening now. We have the money and the knowledge to save what still can be saved. But do we have the will? Because it means we have to share our wealth with poorer countries, we will have to alter the way we are living and consuming.

R. KROMHOUT
Alphen aan den Rijn, Netherlands

Your Millennium issue on biodiversity reminded me of a John Muir quote that I treasure: "When we try to pick out anything by itself, we find it hitched to everything else in the universe."

SHIRLEY RUTHERFORD
Orangevale, California

We are fast approaching a threshold where we will no longer be able to rectify the damage thrust upon the Earth. The genetic diversity of the planet should be viewed as one massive foundation upon which all life is dependent. When a life-form becomes extinct, a hole appears in the foundation. The holes are appearing at an alarming rate, and nearly all are caused by human activity. The year 2000 is nearly upon us. Perhaps we should adopt a new way of thinking as well as a new millennium.

SCOTT T. WATANABE
Los Angeles, California

Biodiversity Map

I was dismayed to see no mention of bacteria on the map's diversity of life chart. Some scientists estimate that over one million species of bacteria inhabit our planet. Many contribute to Earth's life-support systems, help grow our food, recycle our wastes, and make biotechnology possible. If the bacteria all died off today, all other life would be dead within days. If all mammals but humans died off today, we could survive. Bacterial diversity is stunning: Microbes thrive in subfreezing ice, in boiling water, deep in rocks, within our guts, in deepest ocean trenches. This diversity helps us understand how life may have originated on this planet and how it may exist on other planets.

CATHERINE McGOWAN
East Lansing, Michigan

The rescue of *Zea diploperennis* from the brink of extinction figured prominently on the biodiversity map. The choice of this plant to represent the plight of Earth's biota is ironic. If its genes do fulfill their promise and cause corn productivity to increase so much that millions more people can be fed, then the resulting human population growth might crowd out numerous other plants and animals. The "nick-of-time" rescue of this one wild species could thus drive others to extinction. If we want to preserve biodiversity, we should make sure that the species we single out for rescue are not useful to humans.

STEPHEN G. WARREN
Seattle, Washington

The Variety of Life

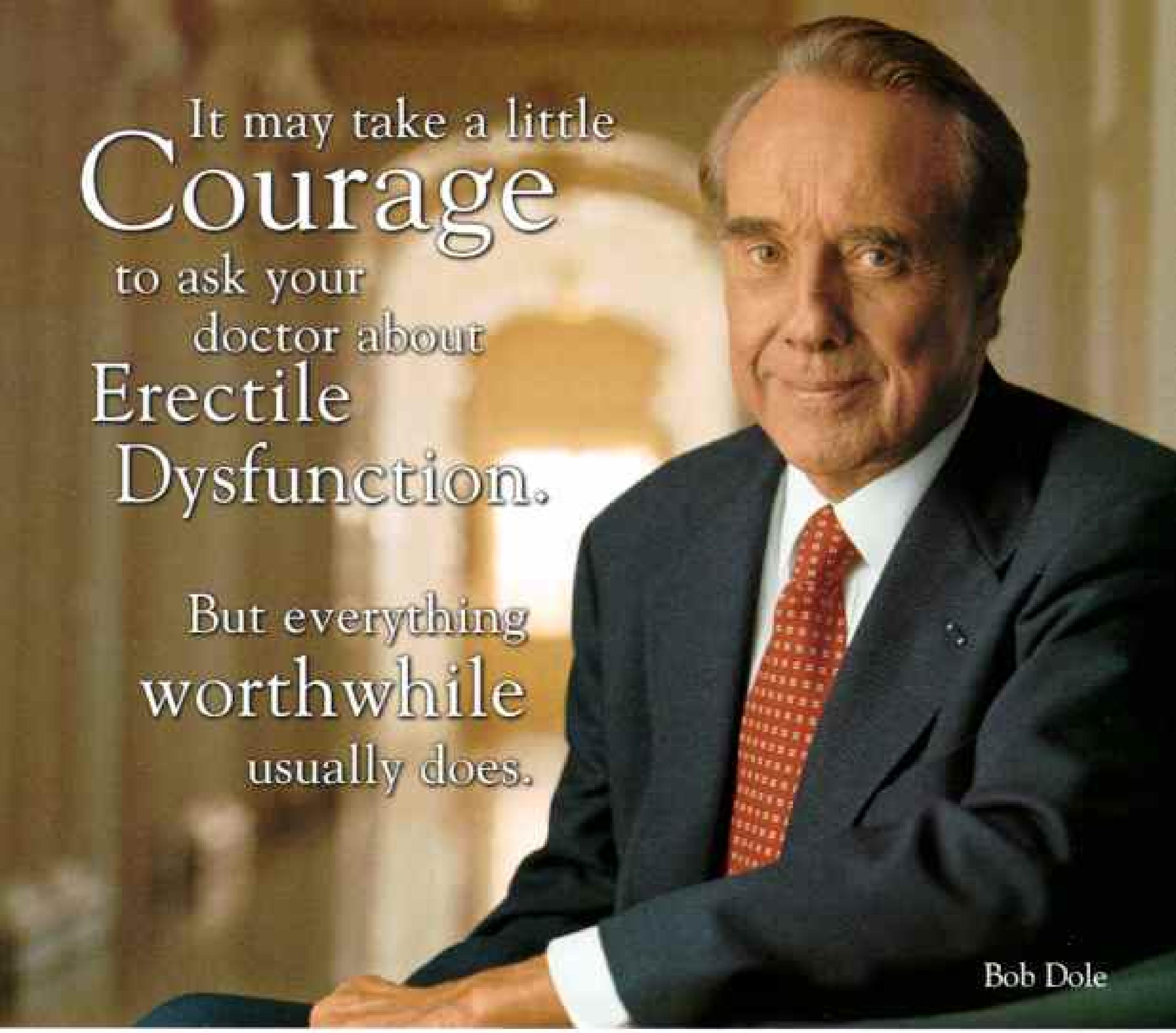
I have a professional affection for the ancient horseshoe crab. One summer in graduate school at the University of New Hampshire my funding ran out. I was rescued, however, by the local horseshoe crabs, whose pricey blue blood supplies the amoebocyte lysate that pharmaceutical companies buy to detect bacterial contamination in their products. These strange creatures paid my rent, helped an industry, and occasionally startled my colleagues as they scrambled down the hallways searching for a return to the sea.

EDWARD McSWEEGAN
Crofton, Maryland

Isn't it odd that the Smithsonian sends a man to Ecuador to power-fog forests and wait for insects to drop to the ground so he can then proclaim the wonders of diversity? This is science today. We intrude on nature—even destroy it—and then stand back and say, "Isn't that amazing," when we knew that all along.

RUSS WOLLMAN
Raleigh, North Carolina

Your article featured several pristine areas and the multitude of unrecorded life-forms that inhabit them. Today many diverse species survive unnoticed in our backyards, not revealing themselves until further development puts their habitat in jeopardy. An example of this phenomenon



When I was diagnosed with prostate cancer, my first concern was ridding myself of the cancer. But I was also concerned about possible postoperative side effects, like erectile dysfunction (E.D.), often called impotence. So I asked my doctor about treatment options.

I'm speaking out now in the hope that men with E.D. will get proper treatment for a condition that affects millions of men and their partners.

Most E.D. cases are associated with physical conditions or events, like the prostate cancer surgery I underwent. The most common causes of E.D. include diabetes, high blood pressure, spinal cord injury, or surgery for the prostate or colon. E.D. can also be associated with smoking, alcohol abuse, or psychological conditions such as anxiety or stress.

The good news is that many effective treatments are available for E.D. But the important first step is to talk to your doctor. Together, you and your doctor can decide which treatment is best for you.

Now it's up to you to get the treatment you need for E.D. My advice is to get a medical checkup. It's the best way to get educated about E.D. and what can be done to treat it. It may take a little courage, but I've found that everything worthwhile usually does.

For more information about erectile dysfunction, please call 1-800-433-4215.

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occurred recently near my Connecticut home when the stream environment of a small population of rare American brook lamprey *(Lampetra appendix)* was threatened by the expansion of a golf course. A nine-hole addition would allow more players access to morning tee times, while the lampreys' home would become a water hazard. Many interesting species such as these could easily vanish if the material interests of a few are given priority over the aesthetic interests of the many. I cannot think of a greater tragedy than a planet inhabited by only a few species, with those animals that previously filled us with wonder listed among the things that were.

MATTHEW C. FITZPATRICK
Ellington, Connecticut

The Sixth Extinction

On page 56 you quote an archaeologist, Dolores Piperno, who contends that it isn't true "that people in the past in simpler societies lived in harmony with the natural world." She cites a dramatic loss of plant diversity brought on by people practicing slash-and-burn agriculture with primitive technology. However, the myth (which Joseph Campbell reminded us is a story, not a lie) of humans living in harmony with nature remains valuable to us even now, as another myth—that we are the masters of nature—brings us to the brink of disaster. Our society is not, at least voluntarily, going to return to primitive simplicity, but we still need to know that harmony is possible—if not for us right now, then maybe for our grandchildren.

JOHN W. WALL
San Francisco, California

The Endangered Species Act, a noble attempt at having government oversight and regulation solve the problem of plant and animal extinction, has worked in some instances, mainly with threatened and endangered animals. The record is less clear when it comes to plant species. Perhaps the efforts of Kew Gardens in England should be copied in the United States. To date there is no federally mandated program based upon the Kew protocols except for agricultural crops.

H. WILLIAM BARNES
Warrington, Pennsylvania

The Sixth Extinction is under way, and the culprit has been identified. Man. Clearly it is time to institute war crimes trials. Sadly, I realize too late that my very existence poses a lethal threat to biodiversity. Mea culpa. No doubt a jury of my peers, composed of snail darters and horseshoe crabs, will sit in judgment of me. I would throw myself on the mercy of the court but would probably get eaten.

CHASE W. WOLFE
Milwaukee, Wisconsin

Restoring Madagascar

An old adage maintains, "Your freedom ends where my nose begins." As populations and mobility increase, our noses get closer and closer, which means more bloodied noses and fewer unbridled freedoms. As an engineer I have tried to "buy time" in meeting the needs of people until more long-term answers can be found. Despite progress, we are running out of time to find them. Author Virginia Morell illustrated our plight when she documented the tension between long-term conservation in Madagascar and immediate demands to support a rapidly growing population there. It may be folly to consume depleted resources until there will be none left to support anyone, but it has always been easier to see such folly in someone else's culture. Western societies are equally at fault, even if we cannot see ourselves so clearly. We are all one world, ever smaller. What each of us does affects everyone else.

GALE C. CORSON
Santa Rosa, California

On page 64 it states that Madagascar's population of 14 million will double by the year 2021. No amount of capturing, counting, tagging, and preserving will produce food, shelter, or clothing for an additional 14 million people.

MYRLE L. PARDOE, JR.
Eldersburg, Maryland

In Search of Solutions

The offering of remedial suggestions fell short in not addressing the relentless growth of the Earth's human population. It is unrealistic to expect biodiversity to be preserved by changing the attitudes of the coming billions of hungry people.

DEAN O. CLIVER
Davis, California

Millennium Moments

The question posed at the end of this piece, "Can man save this fragile Earth?" misses the point. Humankind will likely destroy enough of its life-support system and become extinct long before all life on Earth becomes extinct. A more relevant question is, "Does humankind want to be a part of this planet's future?" If the answer is yes, then the question becomes, "Can humankind save itself?"

RICHARD BOIANKIEWICZ
Toronto, Ontario

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

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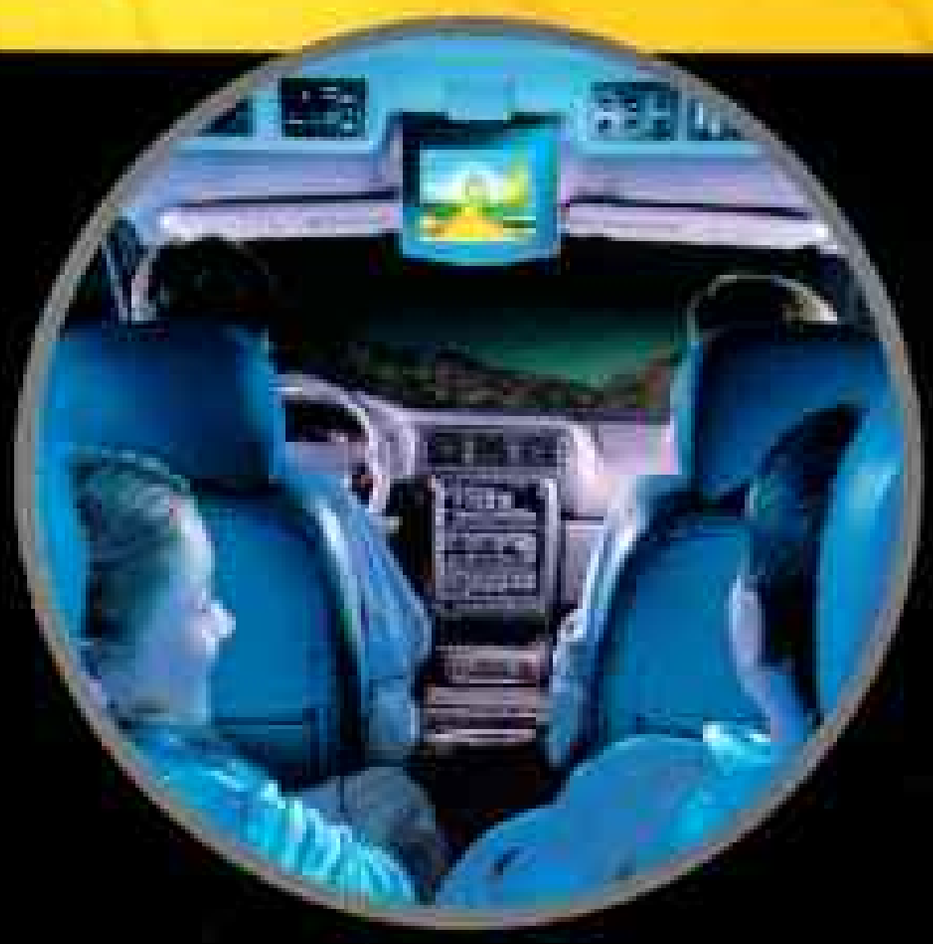

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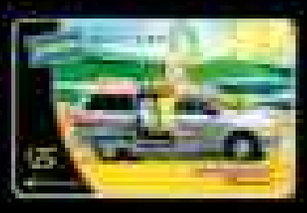

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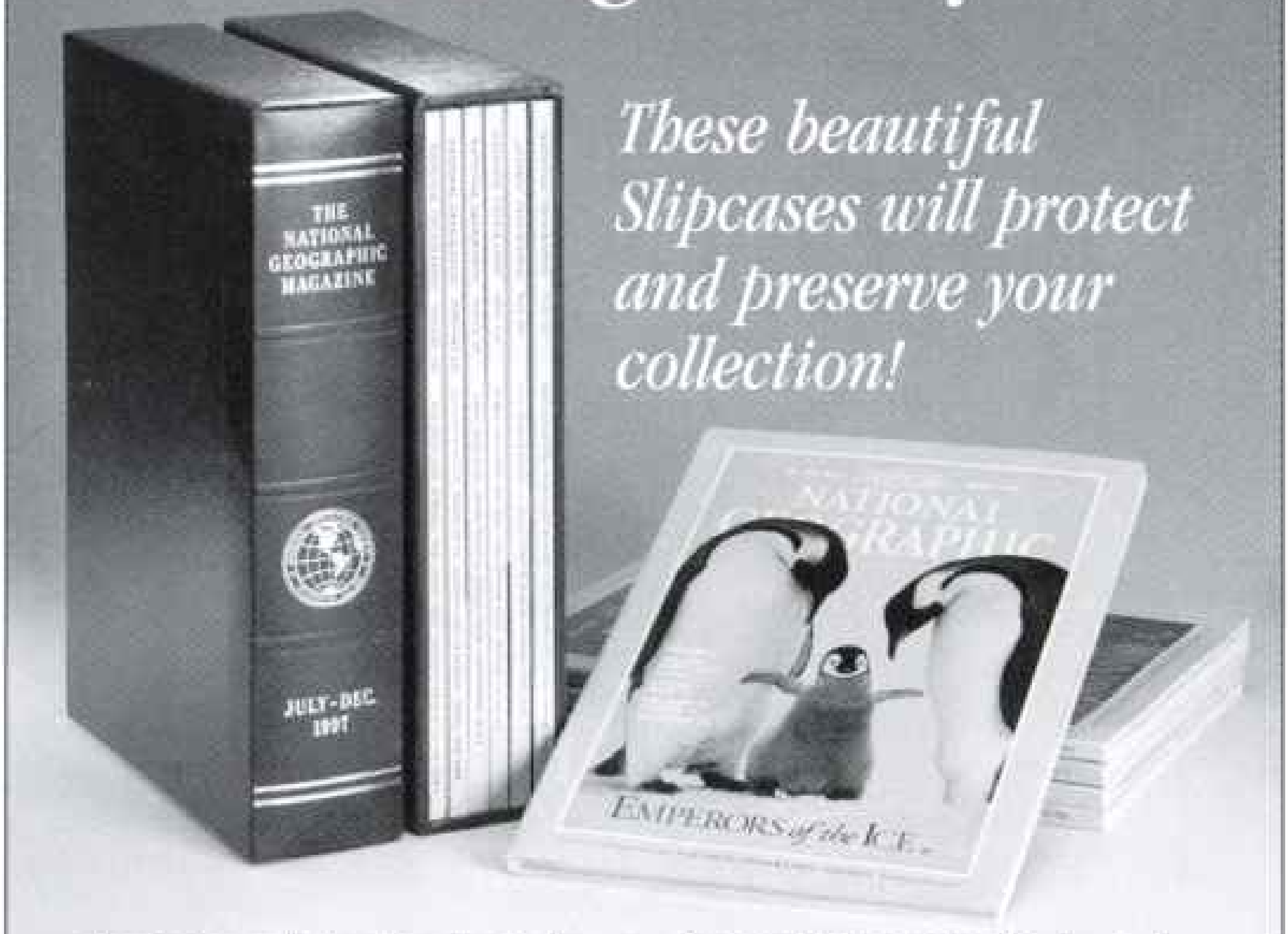

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JAMES A. SUGAR, BLACK STAR

New Planes Take Flight Into the Future

A pair of odd-looking aircraft soar over California, pushing the envelope on flight duration, altitude, and objectives.

NASA's Centurion (right), a lightweight, battery-powered, remotely piloted "flying wing" 206 feet wide, first took to the air late last year, reaching an altitude of 645 feet. A successor to the much smaller Pathfinder (Geographica, September 1996), it will monitor atmospheric changes and, NASA hopes, will soon fly to 100,000 feet. It paves the way for a later solar-powered aircraft, a "holy grail—an eternal plane that can stay in the air by storing solar energy during the day to enable it to fly at night," says project manager John Del Frate of NASA's Dryden Flight Research Center in Edwards, California.

A manned craft named Proteus (above), designed and developed by veteran airplane innovator Burt Rutan, has reached 50,000 feet over Mojave, California, and should soon fly as long as 15 hours at up to 65,000 feet. Proteus's modular fuselage can be removed and refitted for a variety of tasks. It, too, may monitor the atmosphere, and it could carry out surveillance, relay telecommunications data, even, Rutan hopes, launch small manned spacecraft while in flight.

TOM TSCHIDA, DRYDEN FLIGHT RESEARCH CENTER, NASA

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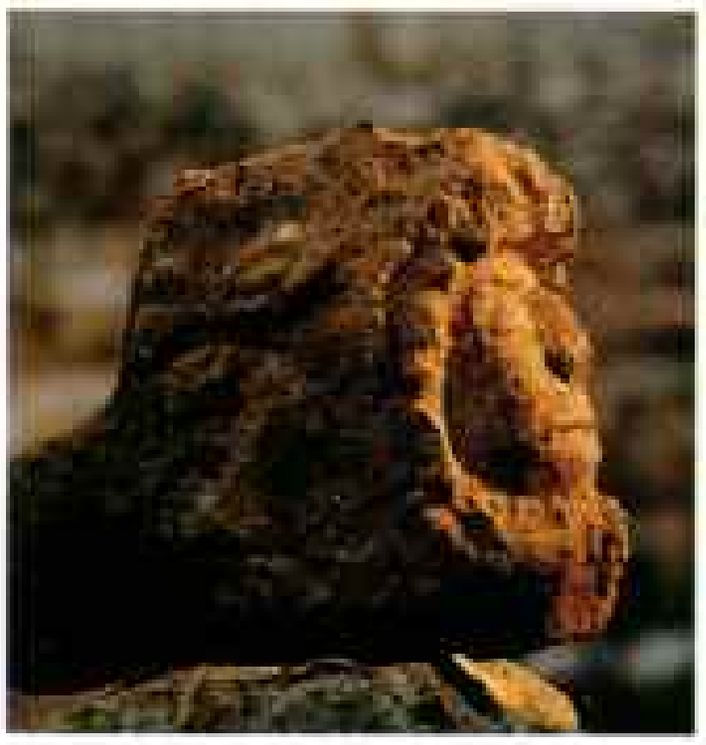
■ NGS RESEARCH GRANT

New Site Reveals Secrets of Yucatán

As Michael Smyth directed a team surveying the Maya site of Sayil in the northern part of Mexico's Yucatán Peninsula, a local resident urged him to investigate a 60-foot, vegetation-covered mound a mile away. For the past four years Smyth (right) has done just that. Now the site, called Chac, "is giving us a key to how cities evolved in this semiarid, hilly region," says the Rollins College anthropologist.

Chac's origins date from about A.D. 300, at least two centuries earlier than any other known settlement in the area. The small stone carving at right was found near an altar that is one of more than 300 structures, including a palace; a large pyramid adjacent to a plaza, numerous vaulted buildings, and underground cisterns that stored rainwater. Last year the site yielded a large stucco mask, perhaps of a feathered serpent. "Nothing like that has ever been found in the region," Smyth says. His team also has uncovered terraces on which Chac's farmers grew the crops—corn, for certain, and probably beans and squash—that sustained a population of perhaps 6,000.

BOTH BY KENNETH GARRETT



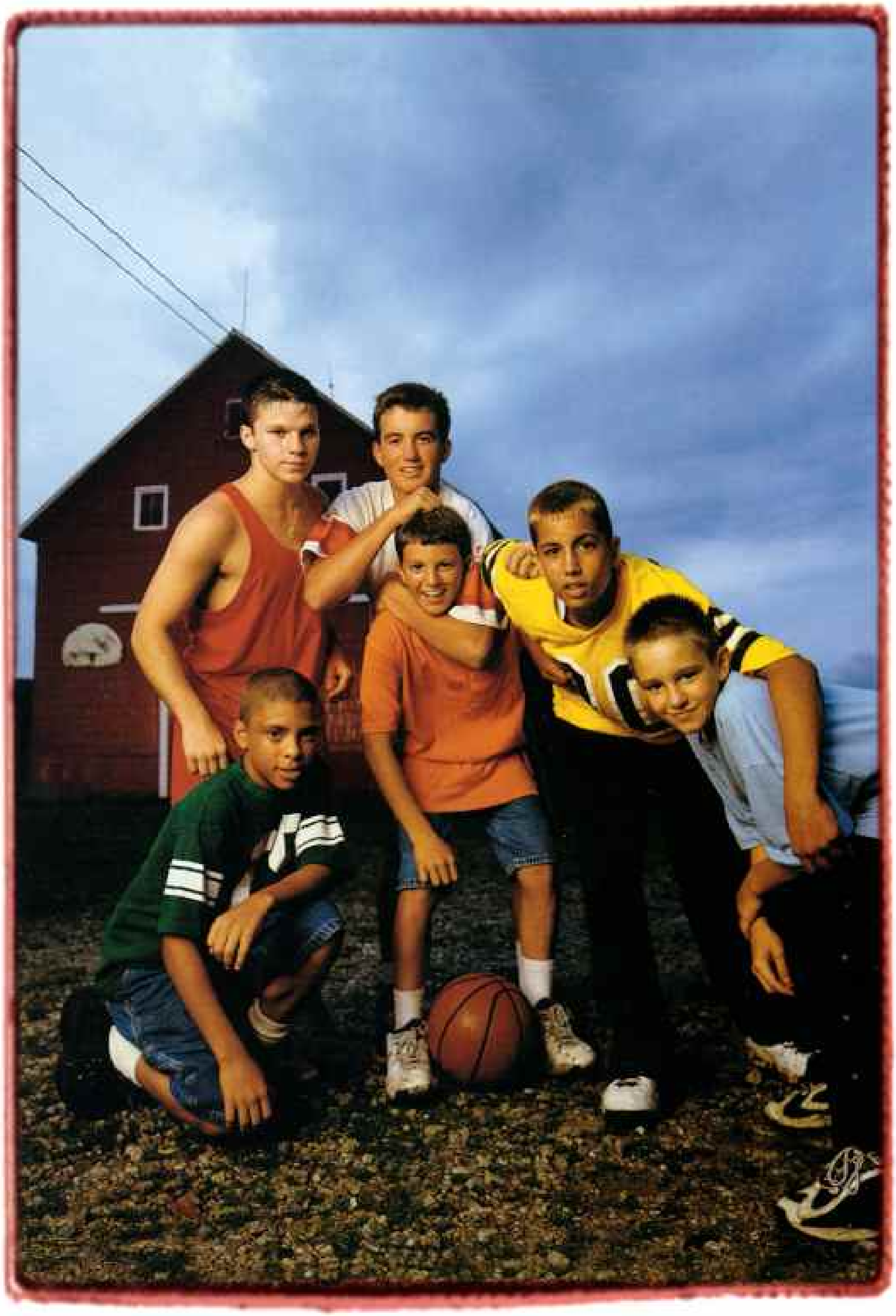
Around A.D. 750 Chac apparently was invaded; Smyth has found numerous stone projectile points and caved-in walls suggesting an attack. Survivors may have moved to Sayil, he says.

THE HUNTINGTON LIBRARY, SAN MARINO, CALIF./SUPERSTOCK

A Family Tree for a Grande Dame

Bawdy, zesty, lusty, the Wife of Bath in Geoffrey Chaucer's *Canterbury Tales* is one of literature's great characters. But she and her fellow pilgrims pose a problem: Many manuscript copies survive, but Chaucer's original does not, so experts debate which versions are closest to his words.

To solve the problem, Chaucer scholar Peter Robinson of England's De Montfort University worked with biologists who sort traits of related living things to show how they evolved from a common ancestor. Robinson's team entered every word of all 58 known manuscripts of "The Wife of Bath's Prologue" into a computer, then used the biologists' techniques to create a family tree of the manuscripts based on how they agree and disagree. "This gave us a much clearer picture of how the text developed," Robinson says. "Several manuscripts appear closer to Chaucer's original than we previously thought."



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GEORGE EASTMAN HOUSE, ROCHESTER, NEW YORK

Skipping's Half a Gallop but Inefficient for Humans

Children skip for fun but later discard the gait in favor of walking or running. Wondering why, Italian biomechanicist Alberto Minetti compared human gaits with those of animals. He found that the front and rear pairs of legs of a galloping four-footed animal—like the horse in Eadweard Muybridge's classic 1877 photographic study of animal locomotion (above)—move in the same way as the legs of a skipping child. Galloping horses use energy efficiently, Minetti learned, but skipping humans are airborne more of the time and employ fewer flexible parts of their legs and back. That makes the gait inefficient for them, at least on Earth. As some Apollo astronauts found on the moon, skipping works well in microgravity. "For balance and motor control it's probably easier to skip there than to run and walk," Minetti notes.

A Link to the Outside World

The January 1950 GEOGRAPHIC dubbed the South Atlantic island of Tristan da Cunha "the loneliest isle" for good reason: It's the remotest inhabited island on Earth. The nearest neighbors of its 290 residents live on St. Helena, 1,500 miles to the northeast, off Africa's southwestern coast. Until last year mail and news arrived every few months, when a ship docked. Now life is speeding up, lessening what British administrator Brian Baldwin calls "the isolation factor." Baldwin has created an Internet connection on his computer terminal, so it can be used to send and receive e-mail, download news, even receive the results of medical tests. "Only a handful use it so far, but the number is growing steadily," he says.

JEFF BRICE

MARC'S NIGHTHAWKER, PAINTING: ART INSTITUTE OF CHICAGO

Life Imitates Art—or Vice Versa?

Elaine Mason recalls her artist husband, James, lying on a sofa and suddenly saying, "You know what? I want to do 'Sunday Afternoon on the Island of La Grande Jatte' in topiary." Happily for him she was then an arts administrator for the Columbus, Ohio, parks system. Now his 100-foot-by-300-foot living re-creation (left) of Georges Seurat's great pointillist painting graces a park in downtown Columbus. Mason crafted 54 topiary sculptures—including three dogs and a monkey—out of Japanese yews mounted on armatures. "The parks department trims it; I just watch it grow now," he says. Adds his wife: "We were out working on it when someone came by and said, 'Oh, that's that painting!' That's when we knew it worked."

TEXT BY BORIS WEINTRAUB

"I got Lyme disease last year and I'm being treated for serious health problems. I couldn't prevent it then, but *now* you could."

LYMErix™
Lyme Disease Vaccine (Recombinant OspA)

Protect yourself and your family with *LYMErix*, the world's first vaccine to prevent Lyme disease. Call your doctor *now*.

If you live or plan to travel where Lyme disease is a problem, there are important facts you should know. For example, you can get bitten by the tick that carries the disease while out gardening, walking, barbecuing, even playing with your dog. And, if you don't have any early symptoms, you might not know you have Lyme disease. You could be one of the few people who develop serious health problems. Left untreated, Lyme disease can lead to potentially serious joint and neurological conditions. Why put yourself or your family at risk?

There is a vaccine that has been shown to be safe and effective in preventing Lyme disease. It's called *LYMErix*. *LYMErix* is for people 15 to 70. As with any vaccine, *LYMErix* may not protect 100% of individuals. Vaccine efficacy rates were 78% against definite Lyme disease and 100% against asymptomatic infection after three doses (after two doses, vaccine efficacy rates were 50% and 83%, respectively). *LYMErix* is administered in three doses. To ensure optimal protection, it is important that you receive all three doses. *LYMErix* may be associated with local injection-site reactions including redness and swelling, flu-like symptoms, arthralgias and myalgias.

Ask your doctor about *LYMErix*. Or call toll free 1-888-LYMERIX, ext. 200 for information.

Please see important product information on next page.

www.lymerix.com

TAKE IT SERIOUSLY.
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Manufactured by SmithKline Beecham Biologicals, Rixensart, Belgium. Distributed by SmithKline Beecham Pharmaceuticals, Philadelphia, PA 19101

LYMErix™
Lyme Disease Vaccine (Recombinant OspA)

Brief Summary. Please see complete prescribing information in SmithKline Beecham Pharmaceuticals literature.

INDICATION AND USAGE: *LYMErix* is indicated for active immunization against Lyme disease in individuals 15 to 70 years of age. Individuals most at risk may be those who live or work in *Borrelia burgdorferi*-infected tick-infested grassy or wooded areas (e.g., landscaping, brush clearing, forestry, and wildlife and parks management), as well as those who plan travel to or pursue recreational activities (e.g., hiking, camping, fishing and hunting) in such areas. Most cases of Lyme disease in the United States are thought to be acquired in the peri-residential environment, through routine activities of property maintenance, recreation, and/or exercise of pets.

Previous infection with *B. burgdorferi* may not confer protective immunity. Therefore people with a prior history of Lyme disease may benefit from vaccination with *LYMErix*. Safety and efficacy for this vaccine are based on administration of the second and third doses several weeks prior to the onset of the *Borrelia* transmission season in the local geographic area (see DOSAGE AND ADMINISTRATION in complete prescribing information). *LYMErix* is not a treatment for Lyme disease. As with any vaccine, *LYMErix* may not protect 100% of individuals. Do not administer *Lymerix* to persons outside of the indicated age range.

CONTRAINDICATIONS: Contraindicated in people with known hypersensitivity to any component of *LYMErix*.

PRECAUTIONS: General: *LYMErix* will not prevent disease in those who have unrecognized infection at the time of vaccination. *LYMErix* will not provide protection against other tick-borne diseases such as babesiosis or ehrlichiosis. Treatment-resistant Lyme arthritis (antibiotic refractory), a rare complication of *B. burgdorferi* infection, has been associated with immune reactivity to OspA of *B. burgdorferi*. Since the underlying etiology is not clearly understood, it is recommended that *LYMErix* not be administered to such patients. As with other vaccines, although a moderate or severe febrile illness is sufficient reason to postpone vaccination, minor illnesses such as mild upper respiratory infections with or without low-grade fever are not contraindications. Before the injection of any biological, the physician should take all reasonable precautions to prevent allergic or other adverse reactions, including understanding the use of the product concerned, and the nature of the side effects and adverse reactions that may follow its use. Prior to immunization with any vaccine, the physician should review the patient's immunization history for possible vaccine sensitivity, previous vaccination-related adverse reactions and occurrence of any adverse-event-related symptoms and/or signs, in order to determine the existence of any contraindication to immunization and to allow an assessment of benefits and risks. Epinephrine injection (1:1000) and other appropriate agents used for the control of immediate allergic reactions must be immediately available should an acute anaphylactic reaction occur.

Packaging for the *LYMErix* Tip-Lok™ syringe contains dry natural rubber, which may cause allergic reactions; packaging for the vial does not contain natural rubber.

Use a separate sterile syringe and needle or a sterile disposable unit for each patient to prevent transmission of infectious agents from person to person. Dispose of needles properly and do not recap. As with any vaccine administered to immunosuppressed persons or persons receiving immunosuppressive therapy, the expected immune response may not be obtained. For individuals receiving immunosuppressive therapy, consider deferring vaccination for 3 months after therapy.

Laboratory Test Interactions: *LYMErix* immunization results in the generation of anti-OspA antibodies, which can be detected by an enzyme-linked immunosorbent assay (ELISA) for *B. burgdorferi*. The incidence of positive IgG ELISA tests depends on the sensitivity and specificity of the ELISA assay and the titer of anti-OspA antibody. In general, there is an association between anti-OspA titer and IgG ELISA index or Optical Density (OD) ratio; the higher the titer of anti-OspA achieved, the higher the IgG ELISA index or OD ratio. Therefore, because vaccination may result in a positive IgG ELISA in the absence of infection, it is important to perform Western blot testing if the ELISA test is positive or equivocal in vaccinated individuals who are being evaluated for suspected Lyme disease. Following vaccination, the appearance of a 31kD OspA band, possibly accompanied by other lower molecular weight bands on an immunoblot (Western blot), should not interfere with the determination of positivity when assessed by CDC/ASTPHLD criteria.

Drug Interactions: No data are available on the immune response to *LYMErix* when administered concurrently with other vaccines. As with other intramuscular injections, do not give *LYMErix* to individuals on anticoagulant therapy, unless potential benefit clearly outweighs risk of administration.

Carcinogenesis, Mutagenesis, Impairment of Fertility: *LYMErix* has not been evaluated for carcinogenic or mutagenic potential, or for impairment of fertility.

Pregnancy: Teratogenic Effects: Pregnancy Category C. Animal reproductive studies have not been conducted with *LYMErix*. It is also not known whether *LYMErix* can cause fetal harm when administered to a pregnant woman or can affect reproductive capacity. Give *LYMErix* to a pregnant woman only if clearly needed. Health care providers are encouraged to register pregnant women who receive LYMErix [Lyme Disease Vaccine (Recombinant OspA)] in the SmithKline Beecham Pharmaceuticals vaccination pregnancy registry by calling 1-800-366-8900, ext. 5231.

Nursing Mothers: It is not known whether *LYMErix* is excreted in human milk. Because many drugs are excreted in human milk, use caution when *LYMErix* is administered to a nursing woman.

Pediatric Use: Safety and efficacy in pediatric subjects younger than 15 years of age have not been evaluated. Therefore, the vaccine is not indicated for this age group at this time.

ADVERSE REACTIONS: During clinical trials involving 8,479 individuals receiving a total of 18,047 doses, *LYMErix* has been generally well tolerated. Subjects with the following conditions: chronic joint or neurologic illness related to Lyme disease; diseases associated with joint swelling (including rheumatoid arthritis) or diffuse musculoskeletal pain; second- or third-degree atrioventricular block or a pacemaker were excluded from the efficacy trial because such conditions could interfere with the assessment of Lyme disease in the trial. Therefore, data are limited regarding the safety of the vaccine in subjects with these conditions (see below).

Unsolicited Adverse Events: The most frequently reported (≥1%) unsolicited adverse events within 30 days of vaccination for all subjects receiving at least one dose (n=10,936) in the double-blind, placebo-controlled efficacy trial are shown in Table 1.

Table 1. Incidence (≥1%) of Unsolicited Adverse Events Occurring Within 30 Days Following Each Dose* and Overall (after Doses 1, 2 or 3)

Event	Dose 1 Vaccine (N = 5489) %	Dose 1 Placebo (N = 5467) %	Dose 2 Vaccine (N = 5287) %	Dose 2 Placebo (N = 5417) %	Dose 3 Vaccine (N = 5001) %	Dose 3 Placebo (N = 5018) %	Overall Vaccine (N = 5489) %	Overall Placebo (N = 5467) %
Local								
Injection site pain	17.9‡	4.9	8.7‡	2.9			21.6‡	6.9
Injection site reaction							1.9‡	0.6
General Body as a Whole								
Asthenia	1.5†	1.1	1.2	0.9			2.7§	2.2§
Chills/Rigors							2.2‡	0.7‡
Fatigue	2.2†	1.5	1.7†	1.4†			3.8§	3.4§
Fever	1.3‡	0.3‡					2.2‡	1.1‡
Infection viral	1.5†	1.5					2.5†	2.4§
Influenza-like symptoms	1.4‡	0.8‡					2.3‡	1.5‡
Malaise							1.1†	1.2§
Musculoskeletal System								
Arthralgia	5.1†	3.8†	3.1†	2.5‡	1.2§	1.1§	8.7§	6.5§
Back pain							1.9‡	1.1§
Myalgia	2.9‡	1.7‡	1.5‡	0.9‡			4.5‡	2.3‡
Stiffness							2.3‡	1.1†
Nervous System								
Dizziness							1.1†	1.2§
Headache	3.1†	2.9‡	2.1†	2.1‡			5.5†	5.0‡
Respiratory System								
Bronchitis							1.1‡	1.2§
Coughing							1.5‡	1.4‡
Pharyngitis	1.3‡	1.1‡	1.1‡	1.2‡			2.1‡	1.8‡
Rhinitis	1.5‡	1.4‡					2.4‡	2.1‡
Sinusitis	1.1‡	1.1†	1.2‡	1.1†			2.1‡	2.1‡
Upper respiratory tract infection	2.1‡	2.1‡	1.4‡	1.1‡			4.3‡	4.3‡
Skin/Appendages								
Rash							1.1†	1.2§

* Includes events obtained through spontaneous reports following each dose and events reported 1 month after doses 1 and 2 (when all subjects were queried regarding the occurrence of any adverse event since the previous vaccination).
§ p-value <0.05, ‡ p-value <0.01, † p-value <0.001

The most frequently reported (≥1%) unsolicited adverse events occurring more than 30 days (late) after vaccination for all subjects (n=10,936) were similar in nature to those listed in Table 1, and most occurred at a frequency of <5%, in both the vaccine or placebo groups. The only late adverse events occurring with an incidence of >5% in vaccine or placebo recipients were arthralgia (13.64% vs. 13.55%, respectively) and headache (5.06% vs. 4.72%, respectively). No significant differences in late adverse events were noted between treatment groups after any dose and overall.

Separate post hoc analyses were conducted to assess two subsets of musculoskeletal events which occurred either early (≤30 days) or late (>30 days) post-vaccination. There were no significant differences, either early or late, between the vaccine and placebo recipients with regard to experiencing arthritis, aggravated arthritis, arthropathy or arthrosis. However, vaccine recipients were significantly more likely than placebo recipients to experience early events of arthralgia or myalgia after each dose (for dose 1: odds ratio (OR), (95% CI) = 1.35 (1.13, 1.61); dose 2: OR = 1.28 (1.05, 1.56); dose 3: OR = 1.59 (1.18, 2.16)). With regard to late events of arthralgia or myalgia, there were no significant differences between vaccine and placebo recipients.

There was no significant difference in the rates of cardiac adverse events between vaccine and placebo recipients. Neurologic adverse events which occurred at a rate <1% in the vaccine group and were noted to occur with a similar frequency in placebo recipients included: carpal tunnel syndrome, migraine, paralysis, tremor, coma, dysphonia, ataxia, multiple sclerosis, myasthenia gravis, meningitis, trigeminal neuralgia, nystagmus, neuritis, neuralgia, nerve root lesion, neuropathy, hyperesthesia, hyperkinesia, and intracranial hypertension.

Overall, approximately 18% of subjects enrolled in the study had a prior history of some musculoskeletal condition (19% vaccinees, 18% placebo recipients). In a post hoc subgroup analysis, there was no significant difference between vaccine and placebo recipients with regard to development of musculoskeletal events (defined as arthritis, arthropathy, arthrosis, synovitis, tendinitis, polymyalgia rheumatica, bursitis or rheumatoid arthritis and lasting more than 30 days) in those with a prior history of musculoskeletal conditions. However, both vaccine and placebo recipients with a prior history of musculoskeletal conditions were more likely to experience musculoskeletal events than subjects without such prior history.

Solicited Adverse Events: The frequency of solicited local and systemic adverse events was evaluated in a subset of subjects (n=938) who comprised the total enrollment at one study center in the efficacy trial. Of these 938 subjects, 800 completed a 4-day diary card following each of three doses, and were evaluable according to protocol. Table 2 shows the percentage of subjects reporting a solicited symptom following any one of the three doses and overall. The majority of the solicited events were mild to moderate in severity and limited in duration.

Table 2. The Incidence of Local and General Solicited Adverse Events (Including Severe Events) Reported After Each Dose and Overall

Events	Dose 1 Vaccine (N = 462) %	Dose 1 Placebo (N = 356) %	Dose 2 Vaccine (N = 422) %	Dose 2 Placebo (N = 346) %	Dose 3 Vaccine (N = 402) %	Dose 3 Placebo (N = 299) %	Overall Vaccine (N = 462) %	Overall Placebo (N = 356) %
Local Symptoms								
Redness, any	21.64[a]	8.29	16.82[a]	3.04	25.12[a]	11.81	41.79[a]	22.85
Redness, severe*	2.2[a]	0.8	1.5	0.6	2.5[a]	0.3	4.2[a]	0.0
Soreness, any	61.39[a]	36.66	76.30[a]	50.36[a]	82.59[a]	52.26	93.52[a]	66.29
Soreness, severe†	1.2	0.0	1.0	0.3	3.0[a]	0.3	4.3[a]	0.0
Swelling, any	14.43[a]	4.27	11.44[a]	3.27	15.75[a]	6.79	29.65[a]	11.31
Swelling, severe*	0.0	0.0	0.5	0.0	0.5	0.0	0.8	0.0
General Symptoms								
Arthralgia, any	11.54[a]	4.52	10.70	6.29	13.43[a]	7.54	25.62[a]	16.29
Arthralgia, severe†	0.7	0.0	0.2	0.3	0.5	0.3	1.0	0.6
Fatigue, any	25.00	16.63	20.19[a]	11.91	21.89[a]	16.33	40.80[a]	32.87
Fatigue, severe†	0.5	0.00	1.5	1.2	1.0	1.0	3.0	2.3
Headache, any	20.65	16.10	14.43	12.31	16.90	16.34	39.56	37.19
Headache, severe†	0.5	0.05	1.2	0.5	1.2	1.8	3.0	2.8
Rash, any	4.73[a]	1.51	4.98[a]	2.01	5.47[a]	1.76	11.69[a]	5.28
Rash, severe*	0.0	0.0	0.2	0.5	0.2	0.0	0.2	0.0
Fever ≥99.6°F	1.49	0.75	1.06	0.50	1.00	1.01	3.46	2.26
Fever >102.2°F	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

* Severe = measuring >3.0 cm and persisting longer than 24 hours.
† Severe = preventing everyday normal activity.
a. p-value <0.05. b. p-value <0.01. c. p-value <0.001

Subjects with Previous Lyme Disease: Subjects with previous Lyme disease were assessed using two definitions: subjects whose baseline sera were evaluated for Western blot (WB) positivity and subjects who at study entry self-reported a previous history of Lyme disease.

Study participants did not routinely have baseline sera tested by WB for Lyme disease. WB at baseline was performed for subjects who were noted to have a positive or equivocal WB during a visit for suspected Lyme disease or when tested at months 12 or 20. Baseline serology was thus found to be positive in 250 subjects out of 828 tested. The nature and incidence of adverse events (either early or late) did not differ between vaccinees determined to have been WB-positive at baseline (n=124) compared to vaccinees determined to have been WB-negative at baseline (n=151).

There were 1,206 subjects enrolled in the study who self-reported a previous history of Lyme disease (610 vaccinees, 596 placebo recipients). For adverse events occurring within the first 30 days, there was an increased incidence of musculoskeletal symptoms in vaccinees with a history of Lyme disease compared to vaccinees with no history of Lyme disease (20% vs. 13%, p<0.001). No such difference was observed in the placebo group (13% vs. 11%, p=0.24). Subjects with a previous history of Lyme disease had an increased incidence of late (>30 days post-vaccination) musculoskeletal symptoms compared to subjects without a history of Lyme disease in both the vaccine and placebo groups. There was no significant difference in late musculoskeletal adverse events between vaccine and placebo recipients with a history of Lyme disease (33% vs. 35%, p=0.51).

Subjects with a self-reported prior history of Lyme disease had a greater incidence of psychiatric disorders (early and late), central, peripheral and autonomic nervous system disorders (late), and gastrointestinal disorders (late) than subjects with no prior history of Lyme disease. However, there was no significant difference in the incidence of any of these disorders between vaccine and placebo recipients with a prior history of Lyme disease.

Among the 10,936 subjects enrolled in the efficacy trial and followed for 20 months, a total of 18 deaths occurred (10 vaccine, 5 placebo). None of these deaths were judged to be treatment-related by investigators. In the vaccine group, causes of death included: cancer (5), myocardial infarction (3), sudden death (1), cardiac arrest (1). In the placebo group, causes of death included: cancer (1), sudden cardiac death (1), cardiac arrest (1), septic shock (1), homicide (1).

As with all pharmaceuticals, it is possible that expanded commercial use of the vaccine could reveal rare adverse events not observed in clinical studies.

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Rixensart, Belgium

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SmithKline Beecham Pharmaceuticals
Philadelphia, PA 19101

BRS-LY:L1

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(The name comes from

the Indian word that means,

"Bright Child.")

The Chevy Suburban. Holds up to nine.

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CHEVY SUBURBAN LIKE A ROCK

NATIONAL GEOGRAPHIC MAGAZINE

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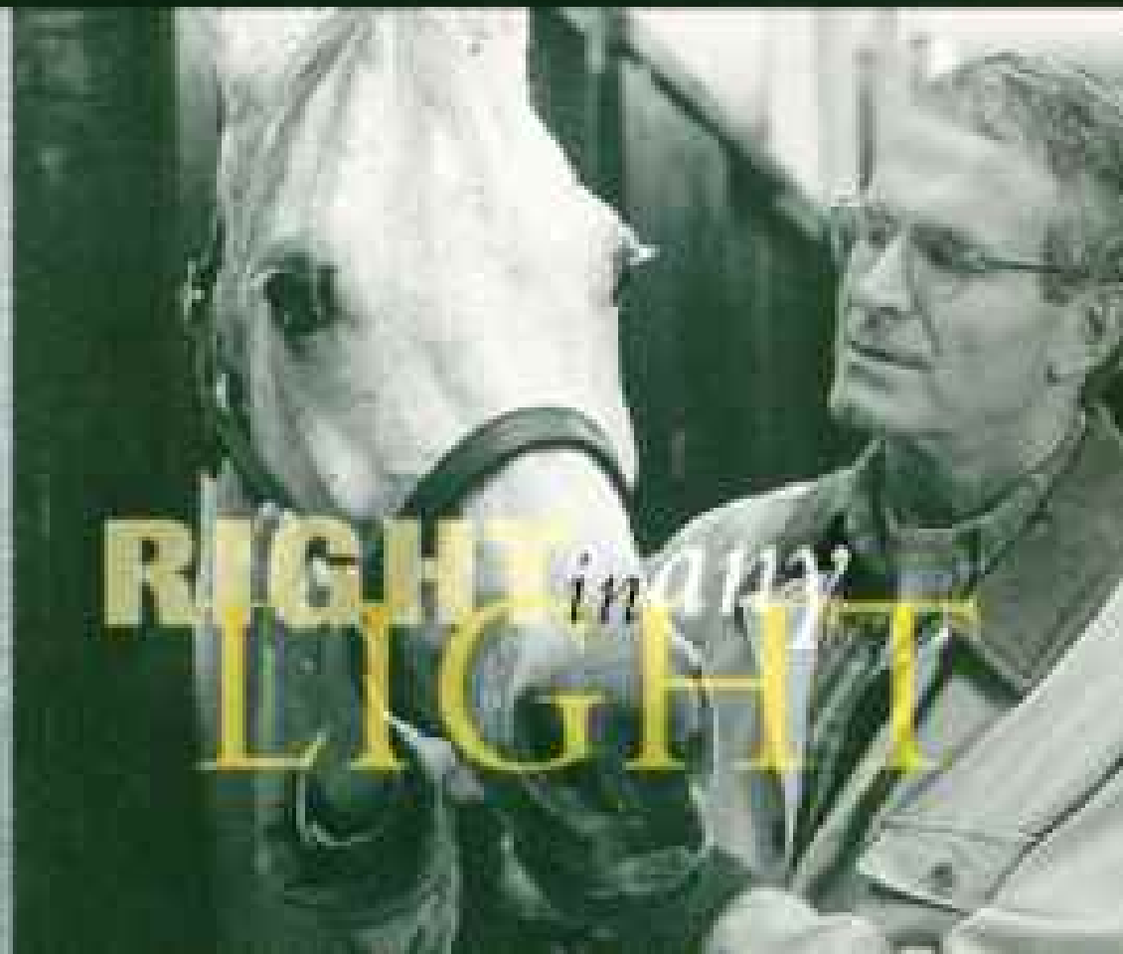

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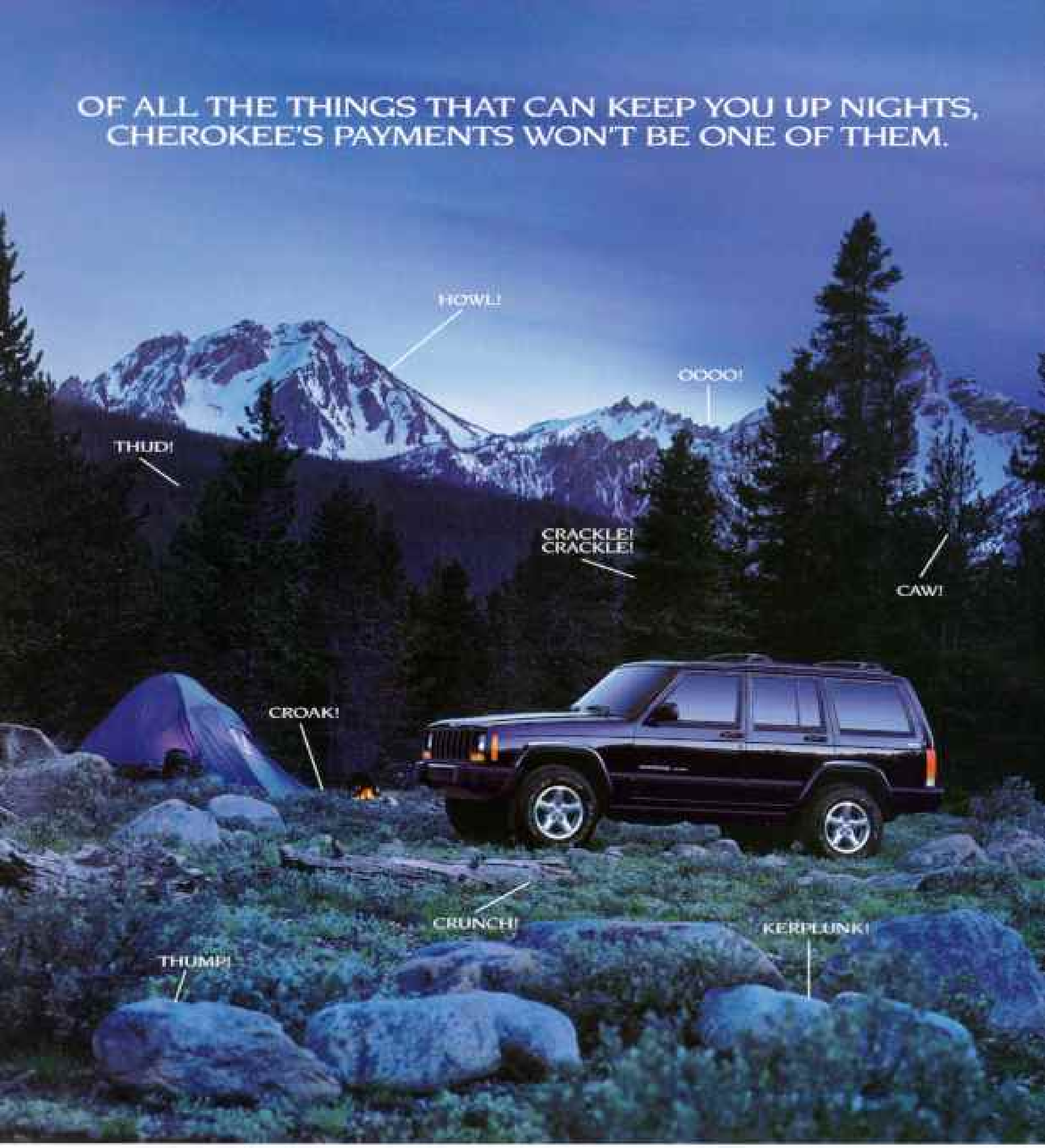

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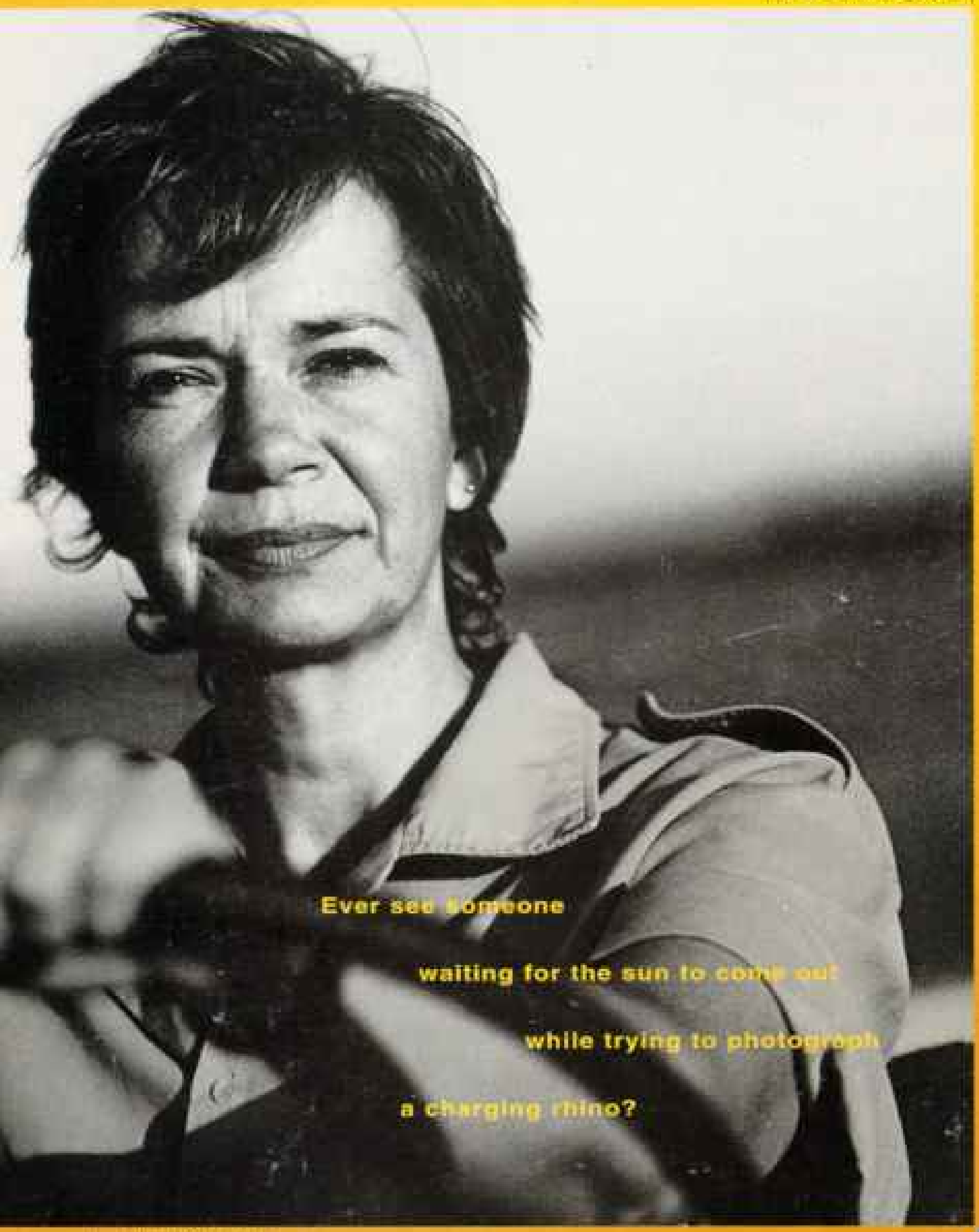

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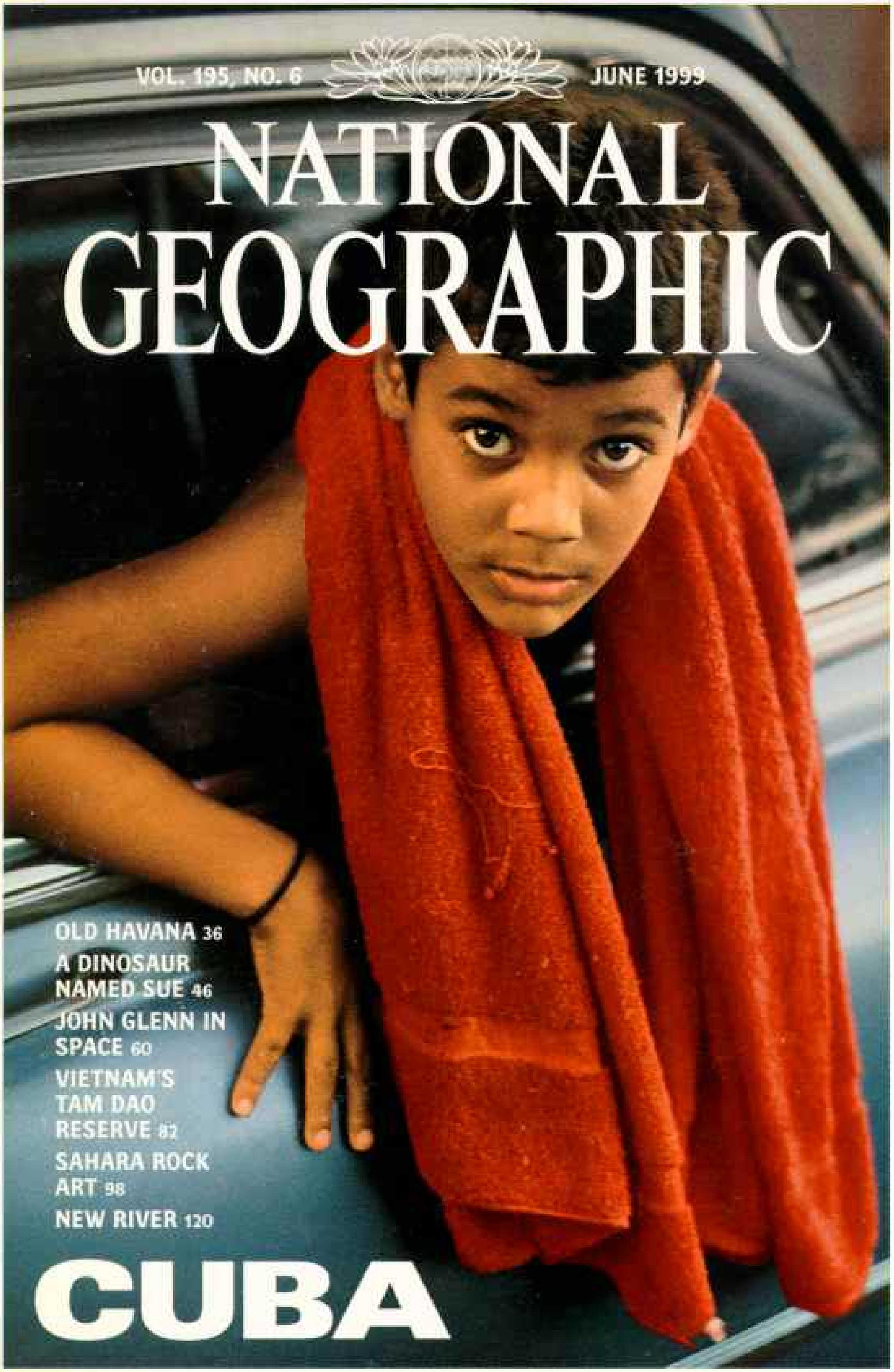

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Photo by Terry Dale Gussow

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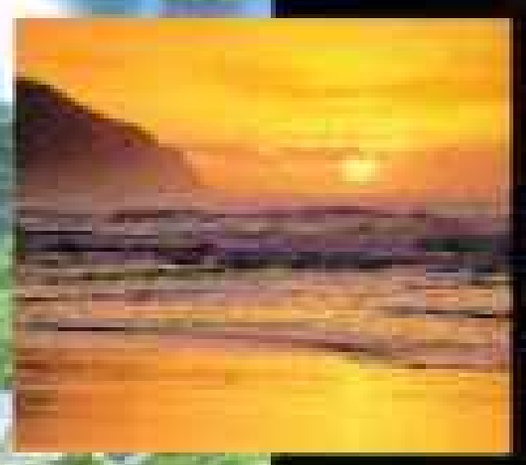

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VOLUME XLI NUMBER ONE

FLASHBACK

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Window Into Cuba's Past

Square Dealing in Old Havana

The GEOGRAPHIC's first article on Cuba ran in May 1898, and we've published more than a dozen stories about that country since. Today our archives are filled with a century of Cuban photographs; none of the pictures shown here have previously appeared in the magazine.

In this 1920s view the Lonja del Comercio, a trade center built on Old Havana's Plaza de San Francisco in 1909, echoes 400 years of European architectural influence.

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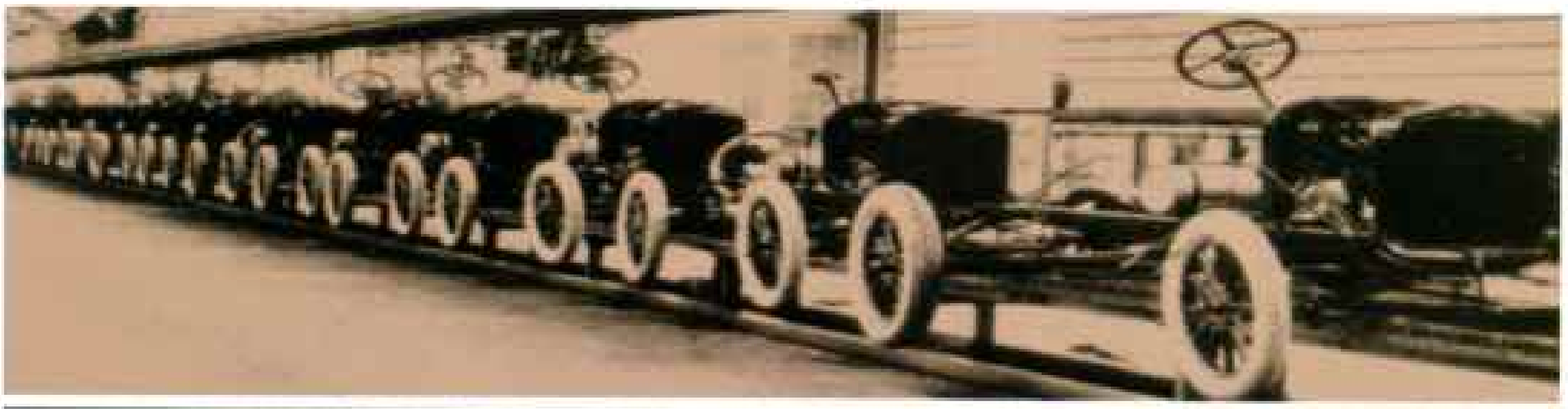
Henry Ford dreamed of "making the desirable affordable."



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The finest cigars in the world come from Cuba, say devotees—and the finest Cuban cigars have always been hand-rolled. In the 1920s at Havana's Henry Clay and Bock & Company, the leaf rollers' daily tedium was eased by a *lector* on an elevated platform (above), who read aloud from newspapers, novels, union tracts, even letters. At that time few women worked as rollers in the large factories, but small companies sometimes employed ladies—like these pictured on a popular Cuban postcard dated 1916—to roll tobacco for the domestic market.

BOTH FROM AMERICAN PHOTO COMPANY

Haves and Have-Nots

Cubans lined Havana's streets in 1938 (above) to cheer Col. Fulgencio Batista, who had run the country for five years through puppet leaders. He won a four-year term as president in 1940 and in 1952 overthrew the existing government to become dictator. Corruption was rampant under Batista, but the economy flourished, led by a booming gambling industry. Still, many Cubans lived in poverty, and popular discontent paved the way for Fidel Castro in 1959.

At Havana's La Beneficencia orphanage nuns took in children by means of a pass-through (right). Our July 1920 article on Cuba explained a similar image: "This foundling asylum has a door where the mother of the unwanted baby may go in private, place it in a cupboard in the wall, then shut the door. On the other side of the wall a Sister of Mercy opens the cupboard, and the ill-starred child finds a home where loving hearts are open to its misfortune."

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SCOTT McKINLEY

■ EXPLORER, WEDNESDAY, JUNE 2

Journey of the Cutthroats

Each spring, when Wyoming's Yellowstone River runs full and fast, cutthroat trout begin a perilous journey often 40 or more miles upstream to gravel beds that become the nursery for their fry. Provided they can dodge artful predators like this river otter (above) dining on one luckless cutthroat, trout run the epic gantlet to their spawning grounds for as many as four seasons.

EXPLORER's new film *Cutthroats of Yellowstone* follows the odyssey of the fish, a life-sustaining source of food for many of the animals in the ecosystem. "We wanted to tell this story through the eyes of the animals—not only the trout but also the animals that depend on it," says producer Jeff Hogan. Using an unobtrusive remote-controlled camera about the size of a double-A battery, Hogan was able to capture the drama above and below the waterline. Footage of a grizzly bear trying to scoop a meal or an osprey struggling to snatch a three-pound fish offers an intimate view of both predator and prey.

■ PROGRAM GUIDE

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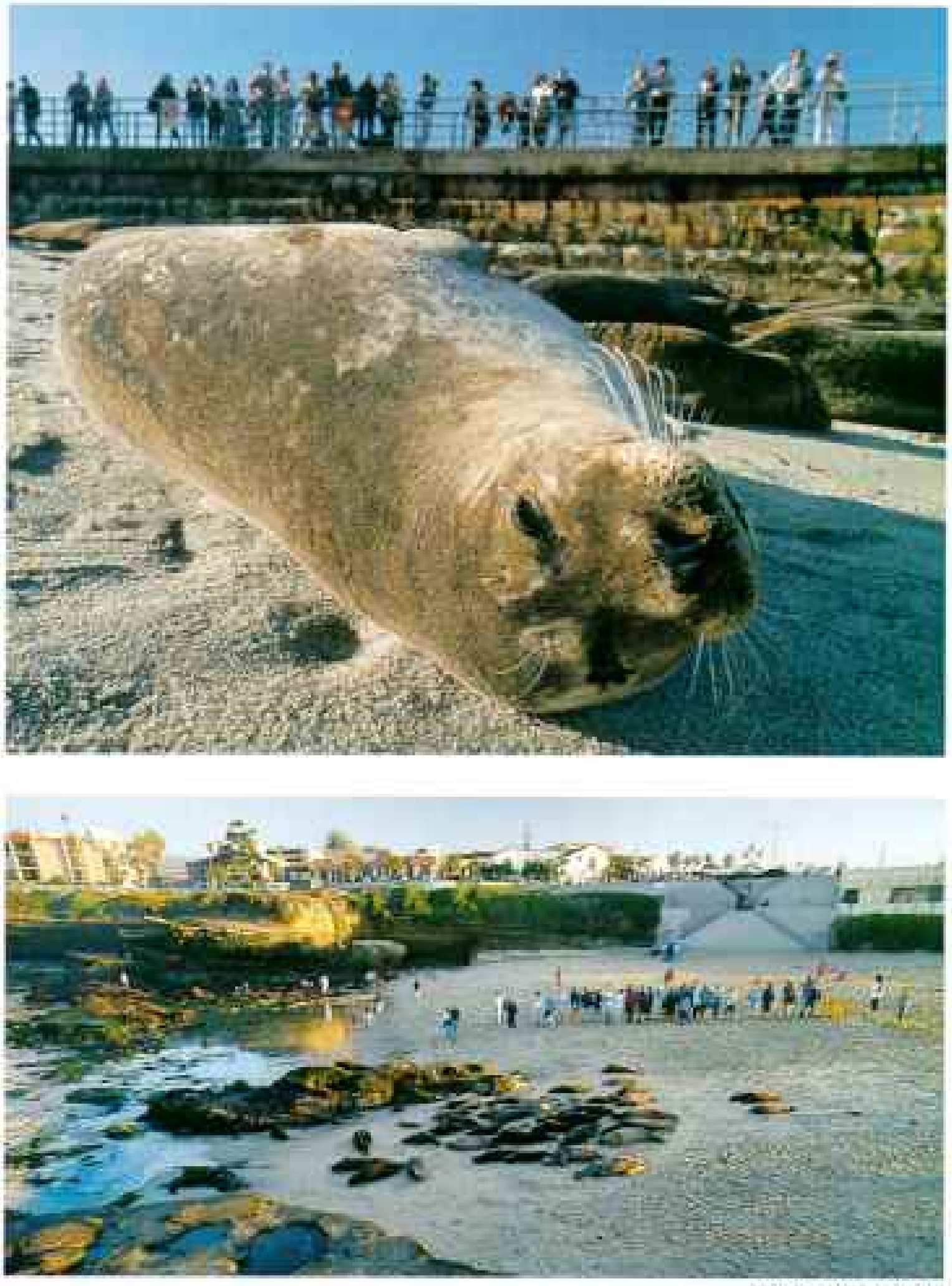
EarthAlmanac

A Beach for Both Seals and People?

Generations of bathers have been swimming at Childrens Pool Beach in La Jolla on the southern California coast since the 1930s. But in the past few years flippered sunbathers have taken over. As many as 200 harbor seals at a time now haul out on the strand. The most serious problem: The seals' waste has fouled the water with fecal coliform bacteria, causing health officials to close the area to swimmers for almost two years. Now people can only gawk at the seals.

"Over many decades a lot of sand has accumulated, almost completely filling the cove," says Terri Williams of the regional park and recreation department. "For the seals it's nice and warm and soft." The city had planned to dredge about 70 percent of the beach to re-create the configuration it had around 1940, hoping that less sand would mean fewer seals. But last March seal lovers forced the city council to scrap the plan.



BOTH BY JAMES A. SUGAR

R. J. CHANDLER, VIREO

Impostors Sing for Their Supper

Cuckoos lay eggs in other birds' nests; those adults feed the single huge cuckoo chick after it kicks the resident offspring out. But why do the foster parents—such as this reed warbler—feed the cuckoo as if it were their own? Nick Davies, Rebecca Kilner, and David Noble of Cambridge University found that the cuckoo duplicates the frequency of the absent chicks' calls. If there were three little warblers, the cuckoo would sound like a trio.

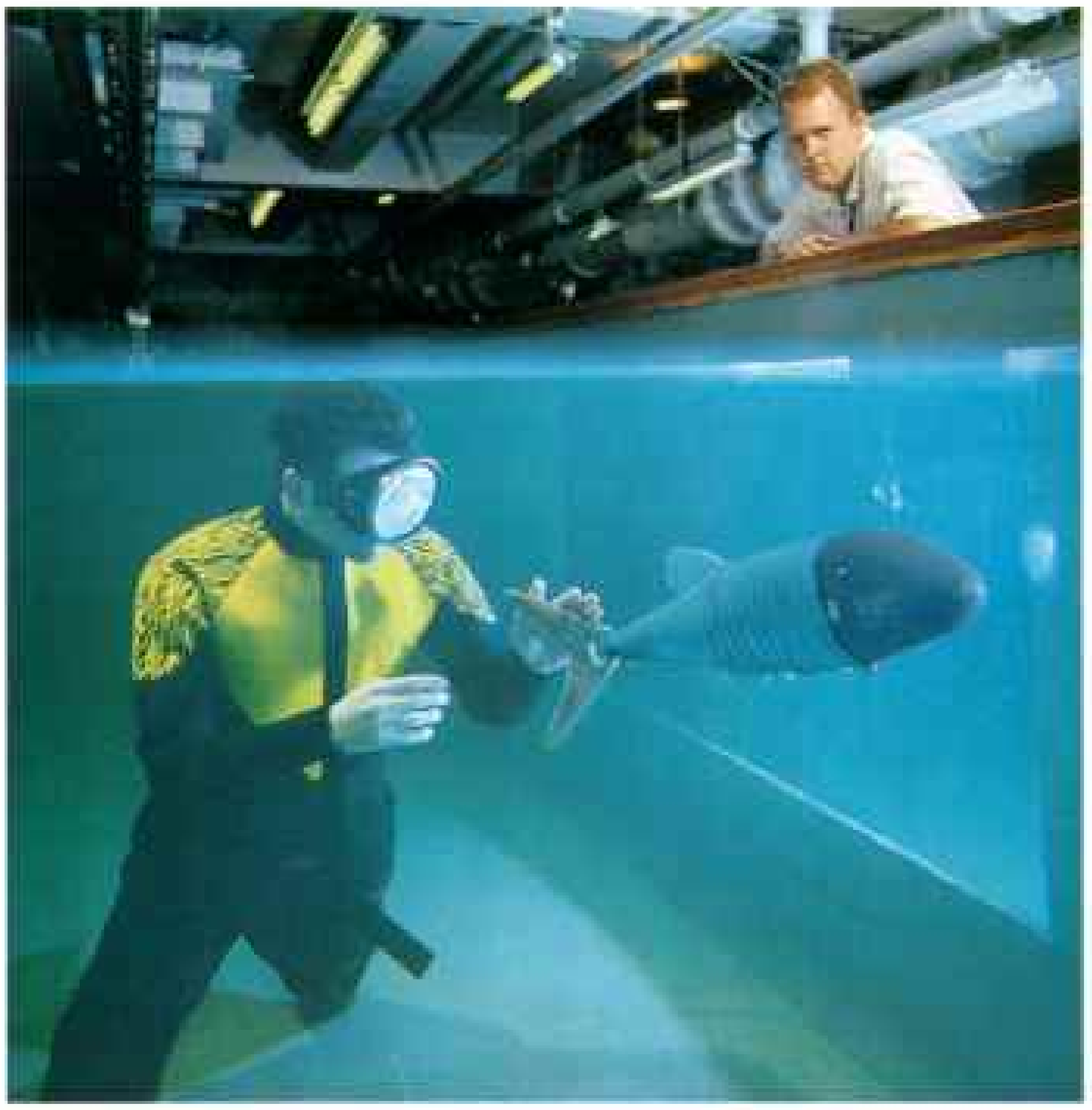
Robot Fish May Lead to Agile Submersibles

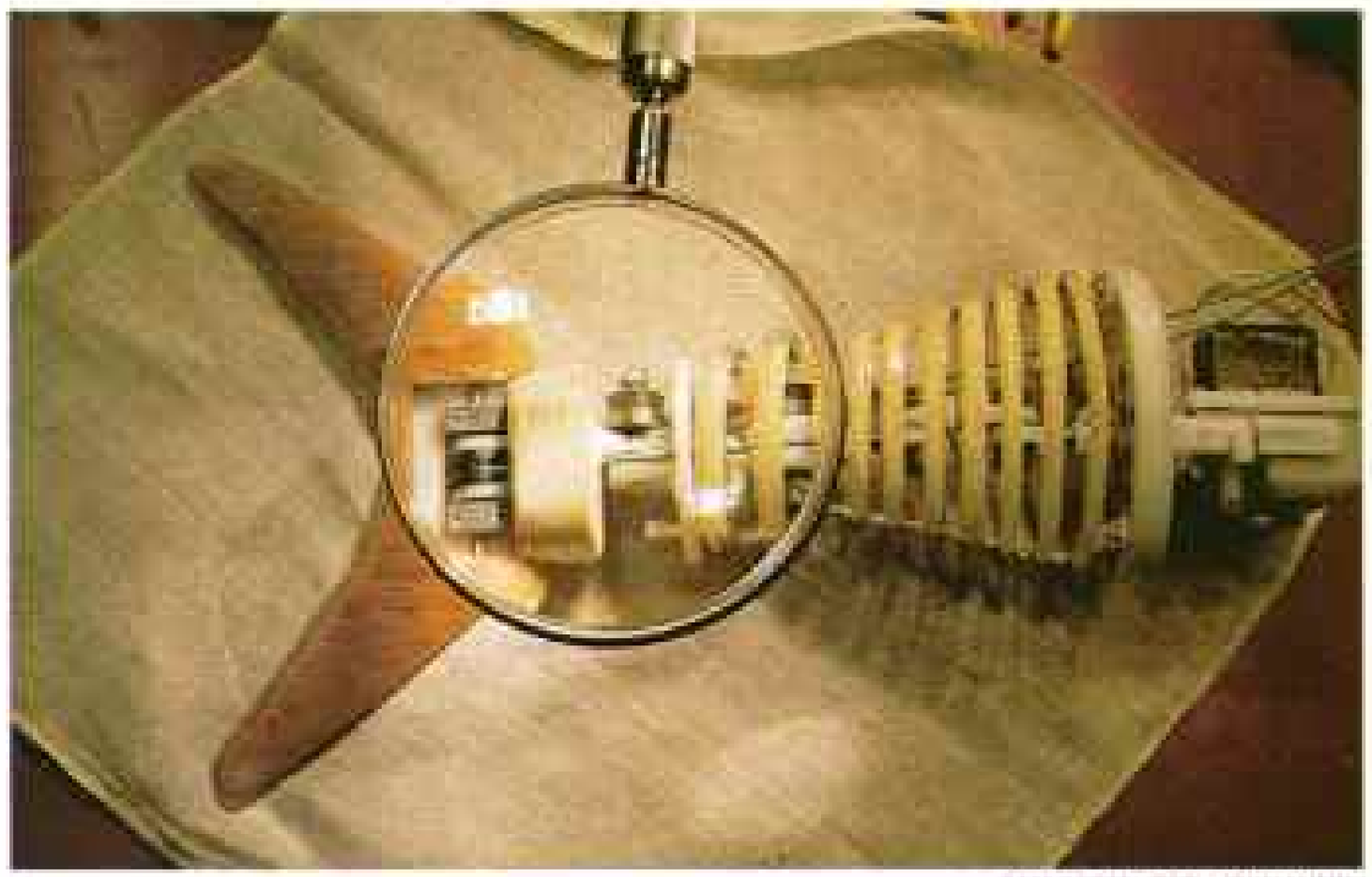
The MIT engineers are at it again, trying to figure out how fish swim in order to make machines that swim like fish.

First came Charlie the Robotuna, a 52-inch-long prototype modeled on a bluefin tuna (Geographica, July 1995). But Charlie was tethered and the engineers needed something much more maneuverable. Here it is: Wanda the Robot Pike, based on a pike called the chain pickerel, a fish that can accelerate like a submarine dragster and turn on a dime.

"What we ultimately hope to do is use these robotic fish to help us design small research submersibles that move as if they had flexible skeletons—like fish," says graduate student John Kumph, working with Wanda in the MIT Towing Tank (top right). "Current submersibles, like those that can enter the *Titanic*, are bulky, slow, and use a lot of thrusters."

The MIT team hopes to learn a lot about reducing drag and increasing maneuverability from Wanda. The 32-inch-long robot has a fiberglass spiral skeleton. A close-up shows the mechanism that controls the tail fin's angle. A Lycra-and-silicon skin makes the pike sleek, and five motors supply power. Kumph has added a digital radio transceiver for improved control.





SAM OGDEN (TOP); JOHN KUMPH

■ NGS RESEARCH GRANT

Tracking Asia's Little-Known Sloth Bears

Sloth bears of the Indian subcontinent have seldom been studied. With Society support, Cliff Rice of Washington State's Department of Fish and Wildlife and his Indian colleagues radio collared seven bears over three years. One was this cub's mother. Using a telemetry recorder, they monitored the mother's forays outside the den for a month—the first time such behavior was clearly documented. TEXT BY JOHN L. ELIOT

T. R. S. YOGANAND

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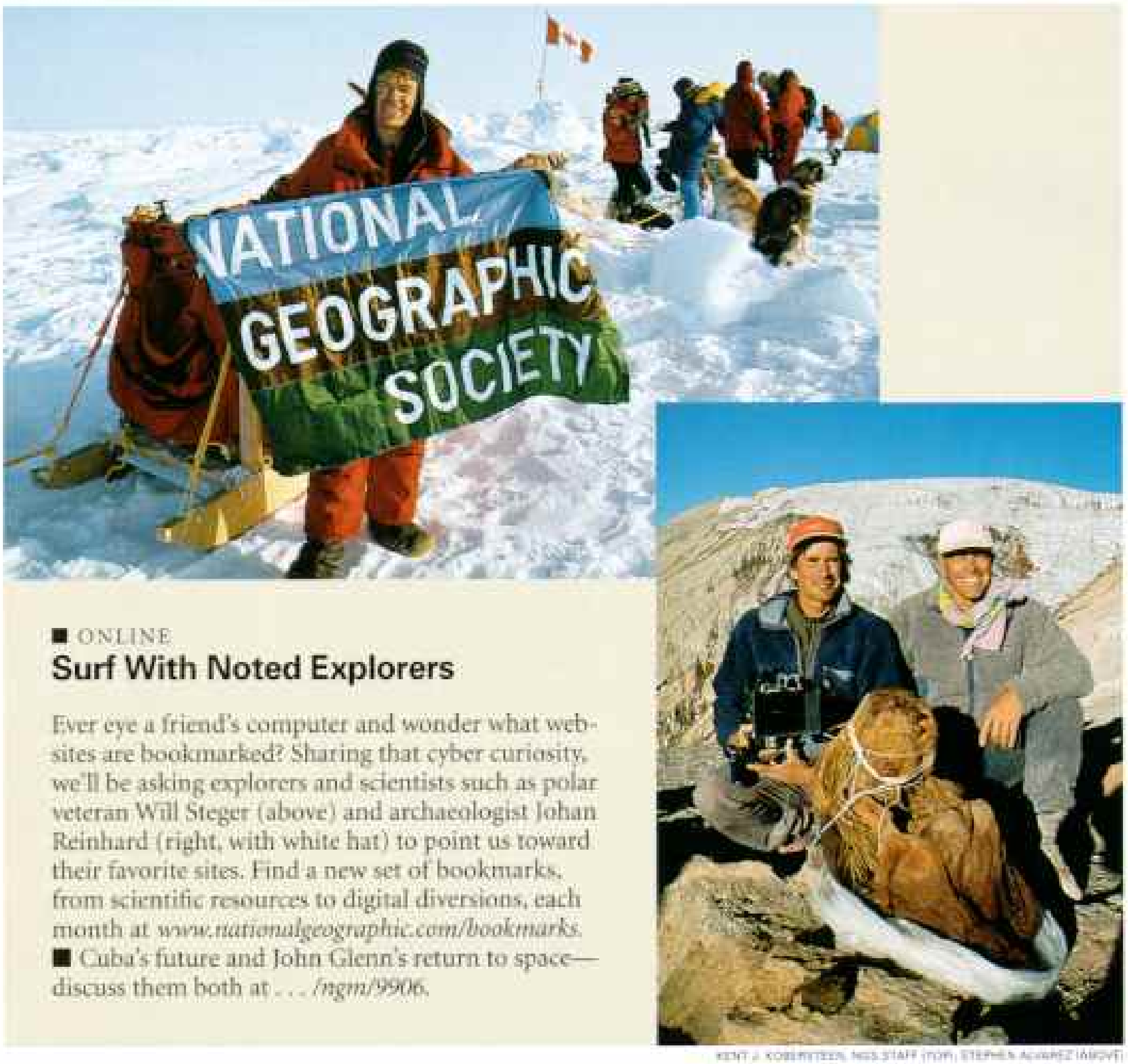

■ ONLINE

Surf With Noted Explorers

Ever eye a friend's computer and wonder what websites are bookmarked? Sharing that cyber curiosity, we'll be asking explorers and scientists such as polar veteran Will Steger (above) and archaeologist Johan Reinhard (right, with white hat) to point us toward their favorite sites. Find a new set of bookmarks, from scientific resources to digital diversions, each month at *www.nationalgeographic.com/bookmarks.*

■ Cuba's future and John Glenn's return to space—discuss them both at . . . */ngm/9906.*

KENT J. KOBERSTEEN, NGS STAFF (TOP); STEPHEN ALVAREZ (ABOVE)

■ TRIVIA TREK

Are We Both Speaking English?

"Would you like some of my scroggin?" said an EXPLORER cameraman to our online correspondent, who was relieved to receive a handful of trail mix. What country was the setting for this cross-culinary encounter? Search at . . . */trek.*

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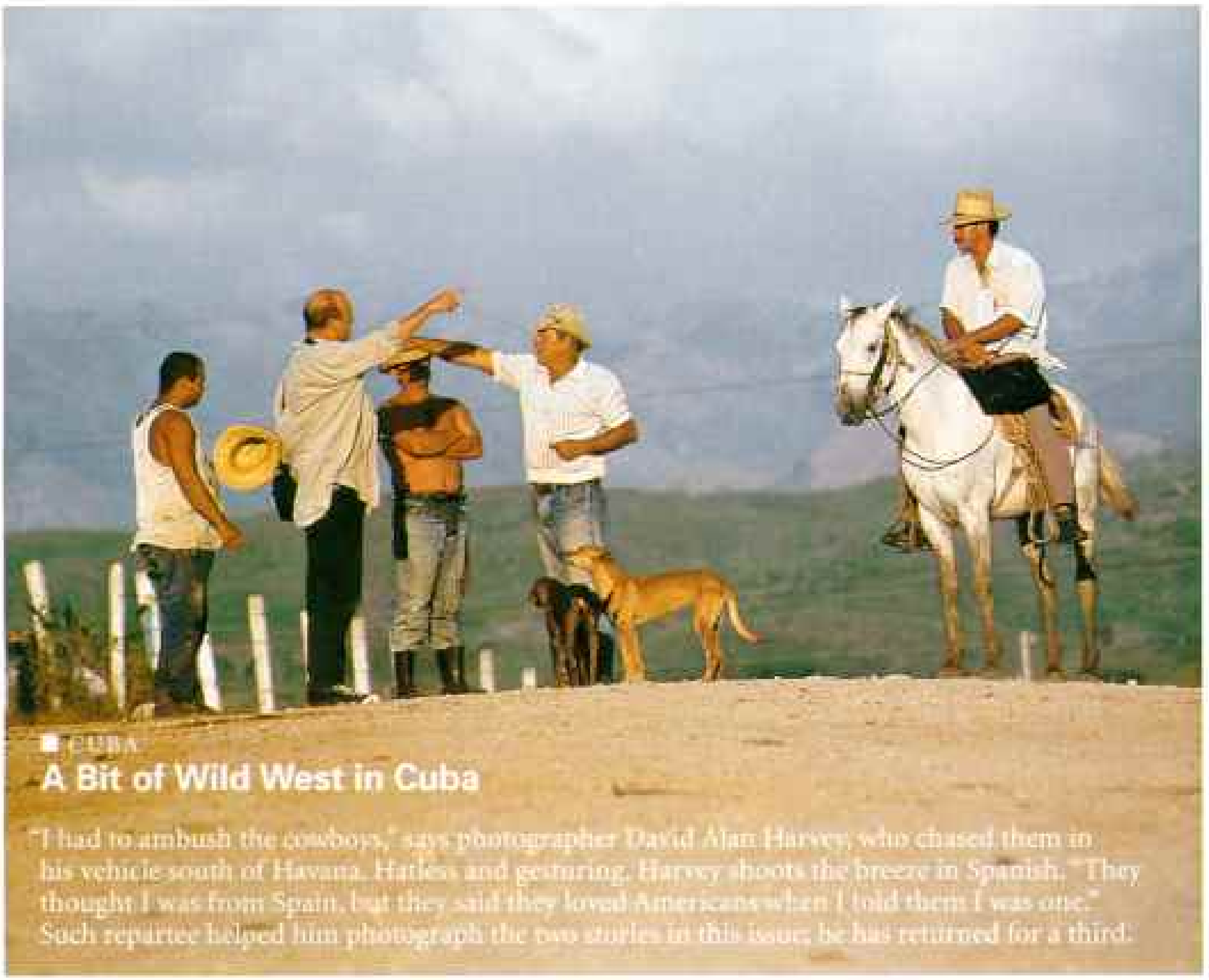
On Assignment



■ CUBA

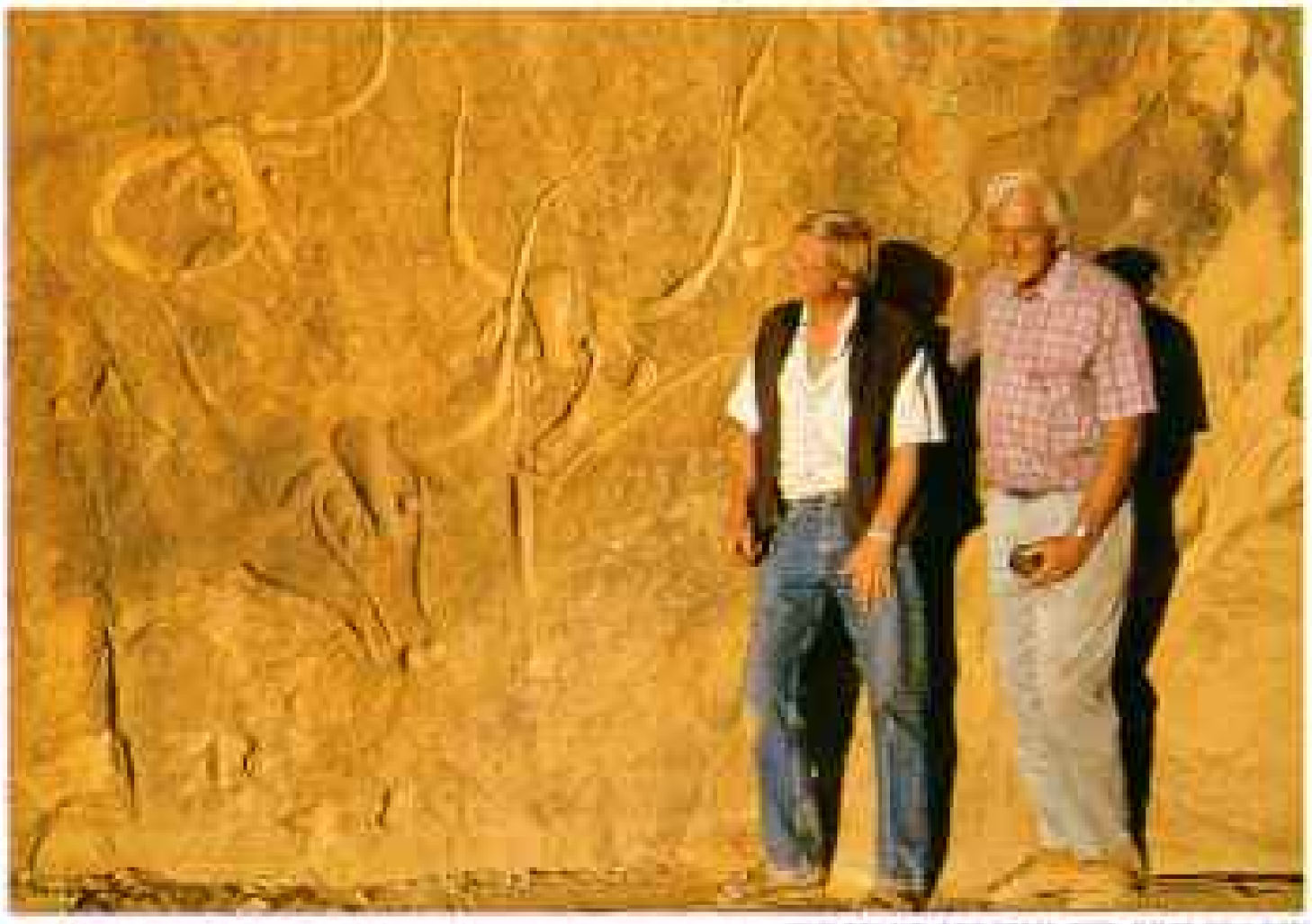
A Bit of Wild West in Cuba

"I had to ambush the cowboys," says photographer David Alan Harvey, who chased them in his vehicle south of Havana. Hatless and gesturing, Harvey shoots the breeze in Spanish. "They thought I was from Spain, but they said they loved Americans when I told them I was one." Such repartee helped him photograph the two stories in this issue; he has returned for a third.

■ SAHARA ROCK ART

Team Effort to Save Africa's Ancient Art

"Pure genius," says David Coulson, at near right, of the artist who some 7,500 years ago engraved an Algerian rock wall with a work called the "Crying Cows." For the past several years Coulson has photographed such art in many places across Africa. To preserve it, he set up the Trust for African Rock Art, working with Alec Campbell, at far right, founder of Botswana's National Museum. A Society grant helps support their efforts.



JOHN EDWARD, NGS STAFF (TOP); DAVID COULSON

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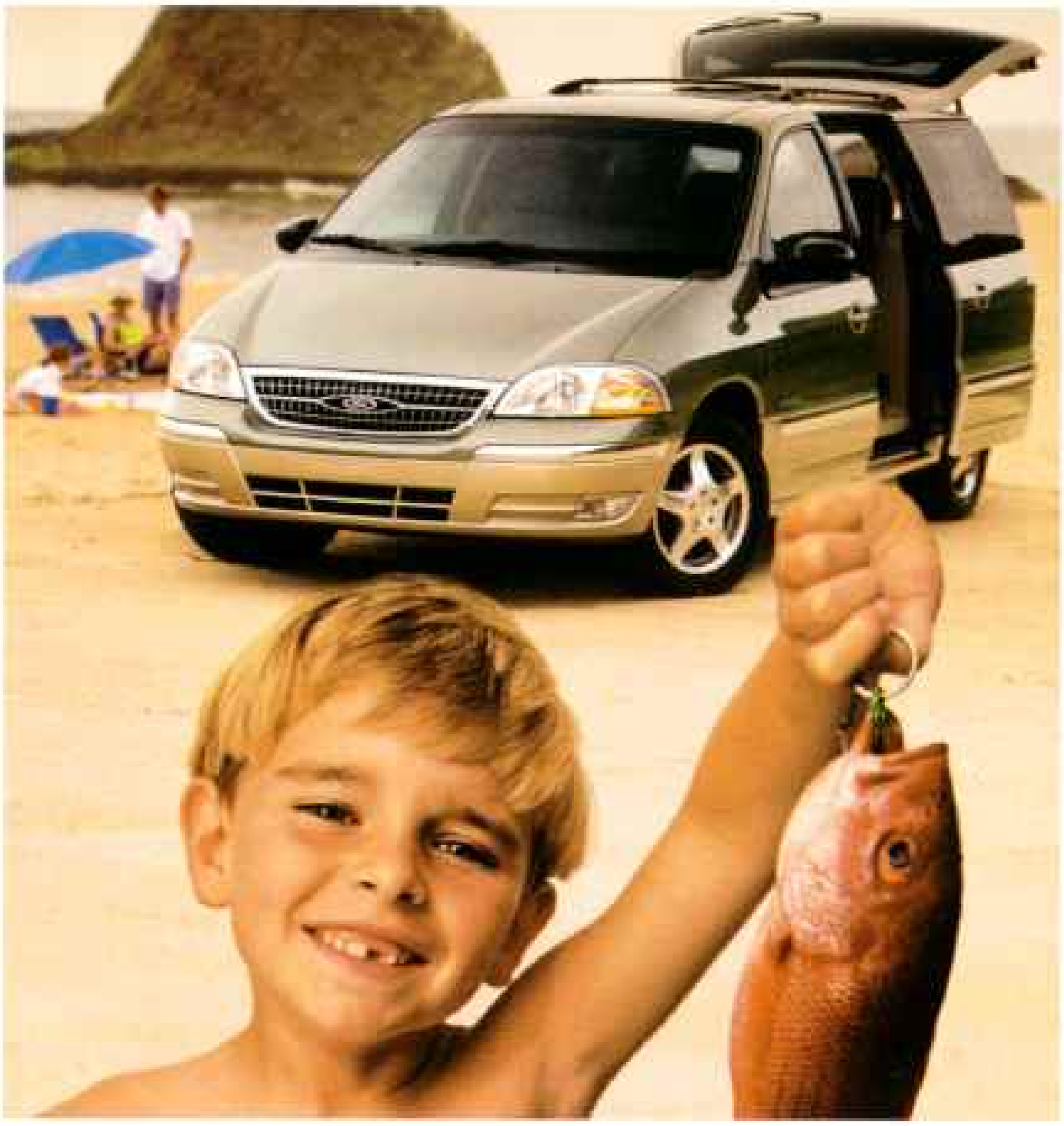

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