NATIONAL GEOGRAPHIC

From the Editor

A BATTLE IS RAGING on the high seas between the pirates and the good guys.

On one side are entrepreneurs who locate sunken vessels, then mount expensive expeditions to salvage anything of monetary value. On the other are archaeologists who insist that no artifacts be recovered unless the site is painstakingly excavated.

Consider this month's case of the *Whydah*, a sunken pirate ship found by treasure hunter Barry Clifford. When an exhibition of *Whydah* artifacts—like the coins and jewelry shown here—was announced in England, archaeologists condemned it as commercial exploitation of a historic site, causing an uproar that forced its cancellation. Similar pressure shut the doors of U.S. museums.

The *Whydah* exhibition is currently at our headquarters in Washington, D.C. The reason: Regardless of the controversy, these objects provide an important glimpse into early 18th-century pirate life. And there is a larger message. The two camps must learn that their missions are not always irreconcilable. If included in the initial survey phase before excavation—when the historical context is still intact—archaeologists gain access to sites otherwise out of reach to their perpetually underfunded operations. And salvagers can benefit from the archaeologists' valuable insight into the historical worth of their discoveries.

Bill Allen

ALL BY BILL CURTSINGER

THE RISE AND FALL OF THE CASPIAN

SEA

Abandoned Soviet warships bear witness to the mercurial fortunes of the Caspian region, which began the century producing half the world's oil and ends it reeling from the U.S.S.R.'s collapse. Now a new oil rush has begun, and Russia, Iran, and three fledgling nations are jockeying with Western oil companies to shape the Caspian's next century.

Decked Out

Gas masks help naval crews practice responding to chemical attack, but Azerbaijan's first line of defense is more enterprising. With billions of

Sulfur Lode

A by-product of oil extraction, red liquid sulfur dries into yellow blocks at the Tengiz oil field in Kazakhstan. Though Tengiz is the world's largest

oil strike in 20 years, the oil does not flow easily as the landlocked Caspian leaves Kazakhstan isolated from global markets. A new pipeline, from Tengiz to Novorossiysk on the Black Sea, is in the works, but oil prices are low and profits questionable.

Fish out of Water

Pike perch seem plentiful at this Kazakh processing plant, but the catch here has fallen sharply in recent years—and that's not the worst news.

The Caspian's sturgeon, ancient fish that survived the transition from dinosaur age to mammal era, may not survive the transition from communism to free market. The source of 90 percent of the world's caviar, they are being decimated by poaching and pollution.

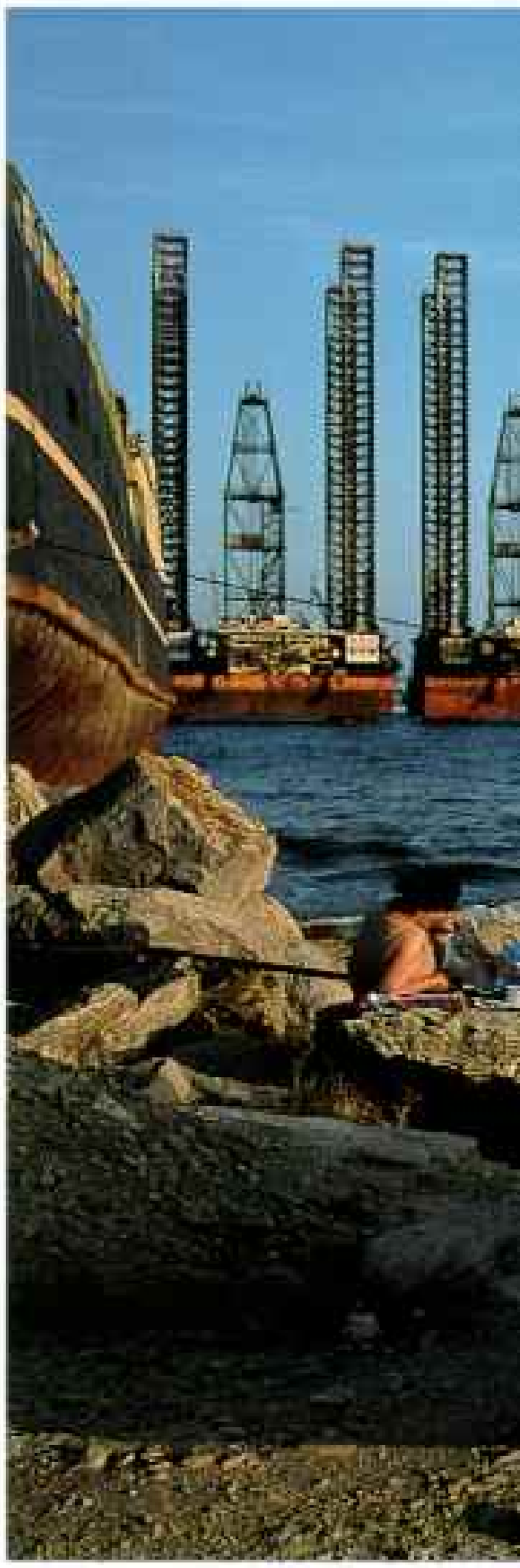
BY **ROBERT CULLEN**

PHOTOGRAPHS BY **REZA**

ON A CLEAR, warm Sunday last autumn Jamshid Khalilov, a 22-year-old student at the Azerbaijan State Oil Academy, rose early to study. Jamshid lives on the third floor of a dormitory a mile from the Caspian Sea in the Azerbaijani capital of Baku. In Baku Bay oil derricks spike the horizon like dead trees, and the water seems to carry a gray, viscous film.

Jamshid is a pleasant, earnest young man, slightly built, with a blunt, square face and the dark eyes characteristic of most Azerbaijanis. He wore a thin sport shirt, Reebok warm-up pants, and shower clogs when I visited him, unannounced. He insisted that I take the lone chair in the room while I asked my questions. Jamshid said he had been studying English for five years, but his fluency was limited, so we conversed in Russian, his second language.

"As a boy I wanted to be a doctor," he said. "But then I decided there were better opportunities in oil." In 1994 he enrolled in the oil academy, a state school housed in an aging building near the Baku railway station. The student



The view from the beach may be bad, but the water is worse: The sea around Azerbaijan's capital, Baku, is notoriously polluted after decades of careless oil extraction. Long an industrial dumping ground, the Caspian has become cleaner in recent years as scores of factories have closed. The present oil boom could reverse that trend.

stipend is only four dollars a month, so he worked the overnight shift in a cafeteria, which provided him with some extra money, hot food, and a cot to sleep on when he could snatch an hour of rest.

Jamshid studied in a time of high expectations and rapid change for Baku and the Caspian region, expectations and change caused by oil. The Caspian in the '90s is like an old, once wealthy city neighborhood gone to seed and then suddenly rediscovered and made fashionable again by a new generation of gentrifiers. It's hot.

Oil is not a new discovery here; Marco Polo noted its abundance 700 years ago. Oil and related natural gas lie under the Caspian waters and shore in two zones, one extending from Baku east toward Turkmenistan and the other westward from Kazakhstan under the waters of the northern end of the sea. What is new is the politics of the Caspian. Three new littoral states—Azerbaijan, Kazakhstan, and Turkmenistan—have emerged from the wreckage of the Soviet Union and invited the world to share in what was once a Russian monopoly.

It's still not clear how much oil is left in the Caspian basin. Some estimates suggest there is nearly 200 billion barrels, roughly as much as the proven reserves of Iran and Iraq combined. Actual production in the region is far more modest—about 1.1 million barrels a day, or 1.5 percent of the world's total. But booms are based on potential, and the Caspian's potential has made it a kind of ingenue in world politics,

courted by distant governments and corporations. The region has begun to matter in world politics and to matter for more than its traditional claims to fame: caviar and the largest inland body of water in the world. It has become a place that arouses hope in the mind of a young man like Jamshid Khalilov.

Jamshid came to Baku from Gäncä, a city in the Azerbaijani hinterlands. His father, an engineer, worked in a metals factory. But since the disintegration of the Soviet Union in 1991, the factory had all but ceased to operate. His father remained on the payroll, earning only about $20 a month—barely enough for a daily loaf of bread. So Jamshid was on his own.

He was starting from conditions as dispiriting as the soiled sea around Baku. The courtyard of his dormitory is littered with broken glass and, on the morning I visited, hundreds of shiny yellow peanut packages festooned with a cartoon of Superman. Refugee children from Azerbaijan's still unsettled conflict with Armenia played soccer amid the debris. Their families have been squeezed in among the students, straining the dormitory's already meager capacity to provide basic services or a quiet place to study. There is no heat in winter. Water generally runs only for an hour in the morning and an hour at night. The floorboards in the halls are rotting away. The stench from the communal toilets is always present.

Jamshid shares his room with two other students. They sleep on iron cots with creaking springs. Flies buzz about. Wallpaper peels from the walls, and boards have been mounted in empty window frames, shutting out the wind. There is a single table and a hot plate in the corner.

The room offers a sharp contrast to the changes that have been visible to Jamshid on the streets of Baku in recent years. Shortly after independence, cosmetic changes began to occur. The Cyrillic alphabet the Soviets had

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After the U.S.S.R.'s fall, communist statues toppled in droves. Yet one still casts a shadow over Baku (opposite): Bolshevik Nariman Narimanov, who died of suspicious causes after criticizing Stalinist policies in the 1920s. With less muscle to flex, Russia has been scrambling to keep some control, pursuing pipeline deals and initially holding with Iran that the Caspian is a lake with common resources. The other nations, those with most of the oil, have argued that it's a sea with national sectors but have begun to shift positions. All five countries are negotiating in Baku.

In the multicultural Russian city of Astrakhan, people don traditional garb to celebrate World War II Victory Day (below). But with Soviet control gone, ethnic fighting colors the Caspian region more vividly than ethnic dancing. In Turkmenistan's capital, Ashgabat (opposite), a new stadium marks the latest in a string of grandiose projects ordered by the impoverished country's autocratic leader.

imposed on Azerbaijan's Turkic language was replaced by a Latin variant. The red banners exhorting Azerbaijanis to fulfill the plans of the last party congress disappeared from the streets. Marlboro billboards went up, exhorting them to smoke like cowboys. Baku entered a period of what might be called kiosk capitalism. Small traders opened sidewalk booths or hole-in-the-wall stores, selling things like cigarettes, vodka, candy bars, tomatoes, and sausages. Then came an overlapping era of ersatz capitalism. Small entrepreneurs, many of them Turkish, opened copies of Western consumer outlets. On one corner in downtown Baku, a restaurant called Pizza Hat faces a "Polo" store that sells knockoffs of Ralph Lauren sportswear called, inscrutably, Polo-Garage.

THE BIGGEST CHANGES took place in the mid-1990s, after Western oil companies signed a series of joint-venture deals with the Azerbaijani government. Baku entered an era of showcase capitalism. Mercedes-Benz opened a dealership on the seaside boulevard still called Oil Workers' Prospekt. Hyatt opened a hotel. Irish bars and a Cajun restaurant opened for expatriate oil workers. New buildings of glass and granite sprouted here and there on the grimy, crumbling Baku skyline. They stood out like a man wearing a tuxedo in a soup kitchen line. Much of the city still lacked regular running water, but there were more and more BMWs on the streets above the leaking pipes.

Not much of this new money, the down payment on promised billions, trickled down to the average Azerbaijani. But some did. Hikmet Islamov, a 1986 graduate of the oil academy, went to work for the Azerbaijan International Operating Company (AIOC), the first and biggest of the joint ventures between Azerbaijan and foreign companies. Islamov spent a year in Houston, training with engineers at Brown & Root, a participant in the joint venture along with 11 oil companies, chief among them BP Amoco.

He picked up a taste for Turnbull & Asser shirts and a sense of how Western economies operate. Back in Azerbaijan he rose through the AIOC ranks to become manager of the oil terminal at Sangaçal, south of Baku. "By the time I am 50," he told me, "I expect to be a vice president. Minimum."

The AIOC's public relations officials took pains to publicize success stories like Islamov's. They wanted the Azerbaijani public to know about them, to feel that local boys and girls had a chance in the new dispensation.

And so Jamshid Khalilov permitted himself to dream a little. He thought it would be nice to have enough money to court a girlfriend, a pleasure beyond his means at present. He thought that sometime in the future, he would like to have a house, a car, a family, and a vacation abroad once in a while. "My parents have never had a house, or a car, or a chance to travel," he told me.

But going after that better life was an intimidating thought. In the Soviet era students bore little responsibility for their futures. They were sucked up by the system in a practice called,

in Russian, *raspredyelyeniye*, or "assignment." The state determined where their talents were needed. The state sent them there.

To get a job with the AIOC, Jamshid would have to meet the requirements of another culture, to pass an interview and a written exam. On average one applicant in ten is accepted. Those who are rejected must take whatever work they can find. Jamshid knows recent graduates of the academy who are waiting on tables and driving cabs. "You have to be strong not to be afraid," Jamshid told me. "Now they pick only the most capable."

A year before the end of his studies at the academy, Jamshid applied for a job. He could always, he knew, finish his degree in part-time study if he succeeded. He recalled vividly the atmosphere he encountered at the AIOC. Carpet covered the floors. Art hung on the walls. People spoke quietly and politely to one another. They dressed well. Everyone's desk had a computer.

It was, Jamshid recalled, "another world."

He had an interview. Then he sat down to take the written exam that would help determine whether he could enter that world.

Had Jamshid known a woman named Sara Ashurbeili, living not far from him in Baku, he might have been more skeptical of the chances that an oil boom would bring permanent prosperity to the Caspian. Sara Ashurbeili, who was 90 when I spoke with her, remembers the end of an earlier oil boom.

Before the first Texas gushers, back when Arabia's major resource was thought to be dates, the Caspian was rich with petroleum. Marco Polo wrote of "a fountain from which oil springs in great abundance." So bountifully was the area endowed that toward the end of the last century the problem was not finding oil but figuring out what to do with it once it exploded from the ground. Wildcatters with tools little more sophisticated than ropes and shovels could strike a "fountain" that would burst hundreds of feet in the air and spew oil for days until a way could be found to cap it.

Such fountains made Baku a boomtown in

Refugee Nation

An Azerbaijani refugee ignores oil's shadow as he herds sheep past abandoned buildings near Baku. Forced from their homes in the Azerbaijani–

Armenian war, 10 to 15 percent of Azerbaijanis live hand-to-mouth in boxcars and tents. They're not alone at the margins. Most Azerbaijanis live in poverty, even as Baku fills with cell phones and German cars—a pattern typical of oil-rich underdeveloped nations.

the 1870s. The city retains vestiges of this era, mansions with carved portals that once housed oil barons' families. One of them is a handsome limestone building where the letter "A" is still visible in an elaborate wrought-iron design over the gate to the courtyard. This was Sara Ashurbeili's childhood home.

Stooped and white-haired, Sara now lives several blocks away with two sisters in a two-room apartment that smells of cats. Streaks of rust run down the concrete walls outside. "My father was a Baku oil millionaire," she said when I asked her to tell me about her memories. "We were raised in the European manner, not the Azerbaijani." She paused as one of her sisters insisted that I have cookies with my tea.

Hers was an unusually privileged childhood. Most of the oil workers lived in hovels. Joseph Stalin got his start in revolutionary work trying to organize them for the Communist Party. She remembers when the Reds took over Baku. "They came to us at night. They had revolvers, and they frightened my mother into an asthma attack."

For a time they were lucky. The Bolsheviks confiscated her father's houses and his oil wells but permitted the family to go to Turkey.

"In 1926 my father heard that the situation in Baku had improved because of the New Economic Policy. They weren't persecuting capitalists anymore. My father loved Baku. He decided to come back."

It was an ill-timed decision. Far away, in Moscow, the brief liberalization of the New Economic Policy was ending as Stalin consolidated his power.

"My father wasn't very clever," Sara said. "They arrested him for being a former capitalist. They put a stool pigeon in his cell. This provocateur started to curse Stalin. My father said, 'What do you want? He's a dictator.' This comment was reported. He was sent to Kazakhstan and shot."

Under Khrushchev, Sara's father was posthumously rehabilitated. She began to work as a historian, and she published a history of medieval Baku. By the time she celebrated her 90th birthday, Azerbaijan was independent

again, and Sara Ashurbeili was regarded as a cultural treasure. By then the first Caspian oil boom was only a memory, replaced by a post-Soviet reality of rusty derricks and poisoned soil and water.

During the latter years of the Soviet Union, Caspian oil production stagnated and declined. The legacy of Soviet production methods is evident on the ground near Tengiz, the oil field on the northeast shore of the Caspian in Kazakhstan, now being redeveloped by Tengizchevroil, a joint venture that involves Chevron, Mobil, and the government of Kazakhstan. The Soviets sloppily exploited the Tengiz area for years, leaving behind pools of oil scum on the desert floor. In 1985 a well caught fire and burned for a year. Satellites recorded a plume of smoke that stretched hundreds of miles northward. Glazed shards of crystallized sand, turned a topaz blue by the intense heat, still litter the site. At one old Soviet derrick I visited not far from the sea, leaks of water and salts had created shallow pink ponds on the brown land, which glistened and fluttered in the breeze.

Tengiz looks more efficient under the joint venture's management than it evidently was in Soviet times. The ground around the wells is clean and neat. Gas flares from four tall stacks, contributing to a slight haze over the project. Tidy, stadium-size piles of yellow sulfur, separated from the crude oil and gas in an on-site plant, wait for buyers. The Western expatriates and their Kazakh partners work in prefabricated metal buildings with the look of a military base. Outside the earthen dikes that protect the complex from the sea, flamingos sometimes wade in the shallow water.

The largest oil deposit at Tengiz begins more than 12,000 feet below ground. Several years after they began investigating, Chevron geologists had yet to find its bottom, but they tentatively ranked it as one of the world's ten largest deposits, with more than 25 billion barrels of oil. The idea that it may be only one of many enormous, partly neglected deposits awaiting exploitation was one of the factors behind the boom psychology of the mid-90s.

As the 48-mile-long Stalin-era complex of oil wells known as Oily Rocks (opposite) rusts into the sea, Western oilmen crowd Baku's new restaurants and nightclubs to define the next century's grand projects. But breathless comparisons of the Caspian to the Persian Gulf have become a thing of the past. Several test drills have been disappointing, and one major consortium has stopped looking for oil.

Another was that just as the demise of the Soviet Union made the Caspian potentially accessible to the West, Iraqi oil was embargoed during the gulf crisis in 1990. Simultaneously the U.S. sought to restrain the development of Iranian oil exports to punish that nation for its involvement with terrorism. All the while, global demand for oil was pushing close to global capacity. The Caspian looked like a logical place to replace production lost in Iraq and Iran.

That idea suited the new governments in the region. They were looking for allies to buttress their fragile independence against the two powers that have traditionally controlled the Caspian—Russia and Iran. They saw Western oil companies as a source of investment and technology. And they reckoned that once the companies were involved, their governments' interests would be engaged. Thus they eagerly sought Western investment.

Rootless

"Nothing here grows," says a bitter refugee as she surveys her failed garden on oil-polluted land near Baku. "Everything rots, everything dies." Uprooted

from her village in Armenia in 1988, the 65-year-old Azerbaijani woman was later forced to flee western Azerbaijan as ethnic tensions grew into full-scale war. Armenians have controlled a fifth of Azerbaijan's territory since 1994, when a cease-fire was declared.

The Caspian's water level has seesawed dramatically for millennia, a phenomenon not entirely understood and too often forgotten. The swing set below is one of many structures built during a period of low water. Rising eight feet since 1978, the sea has flooded many coastal towns in Kazakhstan, even turning the village of one hunter (right) into an island. For now, the sea has stopped rising.

THIS MESHING of interests quickly led the United States to become a leading booster of Caspian oil development. President Clinton entertained the leaders of Kazakhstan, Azerbaijan, and Turkmenistan at the White House. The Department of Energy published estimates of the Caspian's potential oil reserves—179 to 195 billion barrels—which, if proved, could make the region one of the world's major sources of oil. (Saudi Arabia, in comparison, has proven reserves of 261 billion barrels.) The numbers were high enough to induce the U.S. to exhort the oil industry to build the new pipelines that would be required to transport the anticipated Caspian oil to Western markets without letting much of it pass under Russian or Iranian control.

So far, however, reality remains stubbornly short of the anticipated bonanza. The 1997 output in the Caspian was more comparable to Argentina's than to the oil giants of the Persian Gulf. The AIOC's first offshore project, called Chirag 1, was pumping only 90,000 barrels a day at the beginning of this year, about a tenth of the overall production goal the consortium hopes to reach early in the next century.

Doubts are growing about how much oil will be discovered and how profitable it will be. A geologist in one of the Western consortiums told me his company had recently drilled two dry holes in North Apşeron, an offshore Azerbaijani field. And in the wells that have proved to contain oil, drillers have found problems with maintaining pressure, in part due to mud volcanoes on the floor of the sea. Tapping these deposits will require frequent and expensive injections of water, the geologist said. He called the oil-boom talk "a scam."

Even if great pools of oil are recovered, there are doubts about whether, and how profitably, it can be shipped to Western markets. The east-west pipelines that the Clinton administration has touted as the solution to this problem would cost billions of dollars and would, of necessity, skirt areas of political turmoil and ethnic violence. It remains to be seen whether Western investors will back them, particularly if the market price of oil remains low. Late last year, for just those reasons, the oil companies that would have to invest in the Baku-to-Ceyhan pipeline into Turkey told the State Department they intended to hold off until market conditions change in their favor. Negotiations continue.

"There's been a lot of media hype" about a Caspian oil bonanza, said Robert Ebel, an energy and national security expert at the Center for Strategic and International Studies in Washington, D.C. "Potential is one thing, but you still have to drill wells that produce oil." Ebel predicts that in the year 2010 the Caspian region will export about 2.5 million barrels of oil a day—roughly the amount Britain now draws from the North Sea. "It would not be pivotal" in the world market, he said, "but it could be significant at the margin."

Even if that prediction is right and the Caspian increases its production by a factor of three or four, the Caspian governments would then face the challenge of using the oil money

as the foundation for prosperous, modern societies. A tour of the nations with Caspian shorelines raises several doubts about their ability to do so.

Corruption is a pandemic problem, so open that even the most casual visitor can see it. I took the overnight ferry once from Turkmenbashy, on the eastern shore, to Baku. The boat was full of Azerbaijanis, Turkmens, and other nationalities, most of them trying to make a little money by taking something available on one side of the sea and selling it on the other.

The boat docked at mid-morning. The passengers lined up. And then they stood in the heat for hours, waiting for the customs officers of the port of Baku to admit them, one by one, to a little shack for a shakedown. "If you don't give them $15 or $20," a Georgian standing behind me in line said bitterly, "they find something wrong with your documents." In front of us a stocky Turkmen woman carrying vegetables in a sack, wearing a woven head scarf, decided she had had enough. She started to complain, loudly. A young soldier walked up to her and cuffed her head with the back of his hand. She quieted down. And the line moved slowly, sullenly forward.

Corruption in the Caspian is like a hidden tax. I spoke to one man in the Baku suburb of Suraxani who told me that his child had just started the first grade. She came home after the first day and announced that the school had reading textbooks for only a handful of the students in each class. It turned out that the rest of the primers for his child's school had disappeared into the marketplace. There they could be bought for the equivalent of five dollars, not an insignificant sum in an economy where a laborer might make the equivalent of $40 a month. My acquaintance wanted his daughter to get off to a good start in school, so he scraped together five dollars and bought her a textbook. He opened it. The first page was devoted to a photo of a smiling President Heydar Aliyev with the caption "A gift to the first grader from the government of Azerbaijan."

Centuries ago, when salt was used as currency, this salt lake in Azerbaijan might well have been a gold mine. Now it's little more than a health hazard. Refugees brave blazing sun to scrape up salt and sell it roadside—but not for human consumption. Much of it has been contaminated by wastes from drilling.

And so it goes, on up the line. A representative of a Western oil company mentioned to me that his company was having trouble getting cooperation from an official of the Azerbaijani state oil company, cooperation the Azerbaijanis were obligated to provide. When the company inquired about the delay, it was told that the matter might be speeded up if someone would find a way to enroll the official's son at Harvard—on a scholarship.

The official American view, a State Department diplomat told me, is that corruption in the Caspian, while a serious problem, is not so egregious that it will prevent American corporations from doing business there legally. And the evidence, according to oil company sources, is that for the multibillion-dollar consortium agreements on which the American presence in the Caspian is predicated, the powers that be make certain that no bribes are required. They want American involvement in the region as a counterbalance to Russia, Iran, and other nearby powers. But below that level, anyone's wallet is fair game. And thus it's fair to ask whether, if the Caspian oil boom proves to be more than hype, a substantial portion of the money that rolls in will not roll right out again in the form of Mercedes-Benz sales and numbered bank accounts, leaving the people as impoverished as ever.

EVEN IF CORRUPTION does not siphon the oil windfall away, there is reason to doubt that the Caspian nations can take full advantage of the sums scheduled to be invested. If they are to do so, each oil dollar from the West will need to reverberate several times through the local economies, helping to finance a network of businesses. Thus far, that hasn't happened.

The joint venture at Tengiz, when I visited it, operated like an expedition into space, relying on the surrounding area for almost nothing. Equipment and materials were imported. Even food for the thousands of employees was trucked in by suppliers based in Western Europe. Over the past few years the joint venture has begun to buy some food and materials from local suppliers, but much of its money is still spent abroad.

"It's disappointing," said Charlie Auvermann, a Tengizchevroil spokesman. In other countries where Chevron operates, such as China, he said, local suppliers line up to sell Chevron everything from trucks to tomatoes. Many of the dollars Chevron invests thus strengthen local businesses. But the Kazakh economy has been very slow to respond to the opportunity Tengizchevroil represents. The region has no entrepreneurial history and almost no business community. Many of its

leaders evidently still think in the old ways.

As part of its agreement with Kazakhstan, which is expected to give the state treasury roughly 80 percent of oil profits, Tengizchevroil donated 50 million dollars to a fund for the betterment of the people of the Atyrau region. At the insistence of the local government the bulk of that sum was spent on the sort of services and ventures that the state traditionally provided in communist days: a boiler plant, a bakery, a hospital, housing for flood victims.

The village closest to Tengiz is called Qaraton, and there the oil boom was only a promise, and the old system seemed very entrenched. Qaraton's roads were potholed and dusty, and its masonry was crumbling. Tengizchevroil sent occasional help to the village when asked—a truck or a tractor. More recently the joint venture donated two million dollars to finance new housing. Qaraton showed few if any signs of budding enterprise.

The mayor, Rakhirzhan Murgabayev, a thin, vigorous 38-year-old, confirmed the village's poverty. "In 1991 the wind blew from the sea, and the water came up and flooded us. In 1992 the government built a dike that has kept the sea away." There was still no shortage of things in Qaraton that needed fixing, he agreed, from streets to schools. "But our economy is broke."

I asked why no one in the village had found a way to sell anything to the joint venture.

"I don't know why," he said after a pause. "We were interested in it, but there has to be

initiative. We could sell them flour and grain, but we don't have equipment." He meant the trucks, the harvesters, the storage facilities of a modern agricultural system. "Maybe if the joint venture supplied the equipment. . . ."

I heard this sort of fatalistic answer many times around the Caspian. In Baku one evening I bought a couple of Turkish beers from a seaside kiosk, sat on a bench and shared them with a young welder named Aidin Gusseinov. He had just completed a 14-day stint on the AIOC's Chirag 1 offshore platform. I asked him whether he had ever thought of starting a welding business with the training he'd had, trying to get a piece of the construction money being spent in Baku. He shook his head. "That depends on people higher than me."

"Why not you?" I asked.

"They wouldn't let me. They'd beat me down, say, 'You're nothing.'"

"Who are 'they'?" I wanted to know.

They, Aidin explained, are the people with money and power in Azerbaijani society, the people driving BMWs. They are often the children of those who had power in the communist era. Only *they* allow themselves to think boldly. Everyone else, Aidin said, is a slave whose lot in life is to work like a slave.

It was the saddest conversation I had in my travels about the Caspian. I had thought that someone of Aidin's age might think differently from those raised and educated under the Soviet system. The truly debilitating Soviet legacy, its effect on attitudes, will be much more difficult to shed than, say, the Cyrillic alphabet.

But the future of the Caspian depends on shedding it and taking advantage of whatever oil moves from the Caspian to the world market. That is in part because the Caspian nations have been destroying the other resource that traditionally sustained them—fish.

Not so long ago the Caspian Sea teemed with fish. A writer of the early Soviet period, Konstantin Paustovsky, published this description of the docks at the Russian port at Astrakhan in a book called *The Black Gulf:* "Night and day sunburnt

people on the fishing rafts, all covered in scales as with a coat of mail, hauled the mottled carcasses of the sturgeons from their fishing smacks with a boathook and flung them down with a heavy thud on the planks. Endless files of blue-trousered girls bore carp to the refrigerator, holding the golden, stupid fish by their wet coral gills."

There are places where Paustovsky's Caspian still exists. Below Astrakhan the Volga River, the sea's largest single source, splits into a thousand smaller streams as it flows through a vast, marshy, sparsely inhabited delta. White-tailed eagles, ducks, herons, and hundreds of other species depend on these wetlands. The marsh serves as a filter, cleansing the river of some of the pollution dumped into it by upstream factories. By the time the last reeds of the delta give way to the open Caspian, the water is shallow, clear, fresh to the taste. Large flocks of whistling swans float on its wind-ruffled surface.

After a long night poaching sturgeon for caviar, a former phone company technician in Azerbaijan can gaze at portraits of Stalin and Brezhnev and remember better days (opposite). The end of the U.S.S.R. meant the end of his job—as it has for countless people in the Caspian region. For many the black market for caviar is the only one that pays. And the law? Local authorities are usually in on the action.

The Caspian still has miles of undeveloped coastline, particularly along its eastern shore in Kazakhstan and Turkmenistan. Along the Turkmen coast there are more camels to be seen than humans. The water close to the shore is turquoise blue. Small pink flowers find purchase in the scrubby lee of the seaside dunes.

But by the time the waters reach the Caspian's lower end, under the brow of the Elburz Mountains in Iran, the sea is a deep, dark gray and fouled with the discharge from sewer pipes and factory drains. Poachers too have done their work. And the fishing reflects all of this.

The costs of pollution are borne by people like Ismail Abaszadeh, a master in the preparation of caviar. On a warm September morning not long ago Ismail rose with the sun in the Iranian port of Bandar-e Kiashahr, some 600 miles south of Astrakhan. In a room furnished largely with carpets, he quickly recited the dawn prayers of the Muslim. His wife, Narges, rose quietly with him and prepared a breakfast of tea, bread, and goat cheese. He said goodbye to Narges and walked his bicycle through a dusty, rocky alley, past a photo shop and a doctor's office, and then onto pavement where he started to ride, passing police headquarters, an appliance store, and the shops of some rice merchants.

The road was dotted with people on their way to work—men sitting astride sputtering motorcycles and women wrapped in the black chador, perched like ravens on the side of the road, waiting for buses. He pedaled until the pavement turned to sand near the Sefid River. There was no bridge, no car ferry. Ismail crossed in a 15-foot open boat, the kind the Caspian fishermen use. Then he pedaled a couple of miles farther to the fishing base where he works. Then he waited.

It was mid-morning before the fishermen, working nets set about half a mile from shore, pulled up a sturgeon, a variety the Iranians call *chalbash* and the Russians call *osyetr*. At the dock two fishermen leaped from their boat and placed the quivering fish in a wooden litter. Inside the processing building, Ismail and his assistants put on white boots, smocks, caps,

Faith Renewed

Mosques again flourish in Azerbaijan, a mostly Muslim country that saw all but 18 of its 2,000 mosques shut down under Soviet rule. Their

traditions muted by years of official atheism, Azerbaijanis are gravitating toward a moderate practice of Islam—to the chagrin of Iran, which fears its people will look north with envy. Meanwhile, Azerbaijani leaders fear Islamic revolution and quash potential sparks.

BRUNO BARBEY

masks. They washed their hands and pulled on rubber gloves, as if getting ready for surgery.

THE FISH WAS brought in and laid out on the granite floor. The chalbash looks like a cross between a catfish and a stegosaurus; it has whiskers and rows of sharp, bony protrusions along its back where other fish would have fins. They washed, weighed, and measured it: a shade less than five feet long, a bit more than 37 pounds. Carefully, an assistant sliced open the fish's belly and revealed the roe: thousands of gleaming black eggs, each about the size of the point on a dull pencil. This man scooped out the roe and removed it to a sink, placing it on top of a nylon sieve. The assistant gently massaged the mass of roe and supporting tissue; the eggs fell through onto a finer screen.

Finally it was time for Ismail to work. He washed the strained roe in fresh, icy water and picked away a few bits of flesh. He placed it in a stainless steel bowl and carried it through a doorway into a smaller, colder room. He weighed it. This chalbash yielded seven pounds of roe. Ismail consulted a chart hanging on the wall. He told an assistant to measure out 185 grams (six and a half ounces) of salt.

"I worked my way up to this job through several stages," he would explain later. "I went to a school where they taught me things like sanitation rules and quality control. I became an assistant master, and I worked with a master for two years. He retired, and for five years I have been a master.

"I don't have any discretion about how much salt to add," he said. "I go by the chart, which shows how many grams of salt to use per kilo of roe, depending on the time of the year."

But then came the stage in the process that cannot depend solely on charts. Ismail took the salt and gently kneaded it into the roe. He never tasted the product. He felt it.

"A master has to sense exactly how long to knead the salt and the roe," he said. "If you don't do it long enough, the caviar will be immature. If you do it too long, the eggs turn into pulp. It comes from experience."

Within a couple of minutes, his fingers told him that this roe had become caviar. Tenderly, an assistant transferred it into tins and secured the lids with granite disks. The caviar would remain in a refrigerator for a day or so until a special truck came to pick it up and start it on its way to Europe and Asia. There it would sell for about $630 a pound; finer varieties of caviar, from the sturgeon species called beluga, go for well over a thousand dollars a pound. For his work in creating this wealth Ismail Abaszadeh says he receives about six dollars a day.

"I can live well on what I make," he told me. What bothers him is the idle time he must put in waiting for the sturgeon. "Twelve years ago we had more fish than this. And when I have nothing to do, it makes me unhappy."

He is not the only unhappy one. At the other end of the Caspian I watched the men of a Russian village called Tsvetnoye spread a big net they call a *nyevod* in midstream. They laboriously worked it back toward the muddy shore and waded into the shallows to claim their catch. There were only two sturgeon, both males. A morning's work by a dozen men produced no caviar.

During Soviet times fishing limits were strictly enforced. Now they are not, and sturgeon stocks have plummeted. In Astrakhan Vladimir Ivanov of the Caspian Fishery Research Institute told me that in the early 1980s the Soviet Union recorded sturgeon catches of 20,000 to 26,000 tons a year. These days the official catch for all the Caspian nations is about 3,000 tons.

Ivanov said poachers are largely to blame. "If we can't get an agreement with the other Caspian states that stops poaching, we may have to ban fishing completely for several years."

IT'S NOT HARD to find poachers. One Sunday in May I left my room in Atyrau, Kazakhstan, and walked along the bank of the Ural River. I passed dozens of Kazakhs who seemed to be whiling away the time talking and playing cards on the riverbank. A closer look revealed small sticks stuck in the mud, and an even closer look revealed translucent filament attached to the sticks.

When one of the sticks, which the poachers call "watchmen," bent, the card players sprang into action. Their leader was a hefty woman named Anna, wearing a pink housedress and orange socks. She pulled up the filament, a line perhaps 50 yards long hung with dozens of fish-size loops. A male *sevryuga* had swum into one of the loops. Anna hauled in the line until the fish was flopping at the edge of the water. A boy clubbed it on the head and dragged the carcass into some bushes. Anna took the brick to which the far end of the line was tied and handed it to a second boy in a leaky skiff. He rowed it out to the middle of the Ural and dropped it in. Anna resumed playing cards.

She would, she said, get less than a dollar a pound for the fish's meat when she sold it in the Atyrau market. She'd keep some of it to feed her family. If an inspector caught her, she would give up the fish and a few dollars

When the authorities are around, men stay off this Iranian beach. When they're not, men and women sometimes share the sand, a once unthinkable defiance of Iranian law. The world's westernmost Buddhist society, Russian Kalmyks like the woman below know what it's like to wait out iron rule. Exiled to Siberia by Stalin, Kalmyks returned after his death and are now rebuilding their temples.

Hanging On

A Turkmen woman hangs sturgeon steaks to dry on the island of Gyzylsuw. Two hours by slow boat from Turkmenbashy, Turkmenistan's largest port.

Gyzylsuw seems even farther afield: According to the island's governor, photographer Reza was the first foreign visitor in anyone's memory. While Russians and other Soviet-era immigrants fill Turkmenistan's cities, most indigenous Turkmens still live rural lives.

With industrial pollution streaking their backdrop, Turkmen folk dancers on the Cheleken Peninsula battle evil spirits in a rehearsal of a traditional dance with ever evolving interpretations. Asked what evil spirits they fought, the group's director pointed at the black ribbon on the horizon: "That is our bad spirit."

as a bribe. Even if the sevryuga had been bearing roe, Anna would not have earned much. Poachers don't get the money that middlemen further up the line receive. In the streets of Turkmenbashy a few days after I met Anna, someone offered me a couple of pounds of caviar in a mason jar for $40. People like Anna sell their futures so cheaply because they are living on the verge of desperation.

"I wouldn't do this if there was work, if I didn't have five kids to feed," said Alik, another of the Atyrau poachers. He'd worked as a truck driver in Soviet days, but he'd been laid off. He was wearing his socks upside down, the holes in the heels resting on his insteps. "I catch a sturgeon; half of it feeds my family for three days, and I sell the other half," he said.

It is hard to argue with Alik, except that his efforts are multiplied by those of thousands like him. Even more damage is done by poachers with boats and nets who fish the Caspian itself. The result is a threat—if not to the species, then to the fishing and caviar industry.

But Alik is a middle-aged man. For him and many of his generation along the Caspian shores, the prospect of a shining future that justifies short-term sacrifice is even more remote now than in Soviet times. Life has been no happier for them than it was for Sara Ashurbeili. No place demonstrates this better than Sumqayit, a city on the Azerbaijani coast north of Baku, which I toured with a man named Salman Jamarlov, an engineer on the staff of the city's committee on ecology.

Sumqayit was once a city of promises. Moscow planners decreed its expansion from a village to a model center for petrochemical industries, with parks and promenades and a seaside boulevard fringed with topiary hedges. But Moscow drove Sumqayit to meet rising quotas for plastics and fertilizers. Hundreds of thousands of tons of toxic wastes each year were released into the atmosphere or dumped into a creek that fed them to the Caspian. Jamarlov remembered that as a young man, in the '50s and '60s, he never wondered what happened to those wastes. Gradually, as he rose into management, he started to realize what was being done and to fear "that the sea will punish us for what we are doing to it."

The environmental crisis worsened. Stillbirths and miscarriages rose dramatically. Pollution overwhelmed the sea around Sumqayit and Baku, creating a virtual dead zone.

Sumqayit cracked apart as the Soviet Union did. In 1988 long-repressed hostility between Azerbaijanis and Armenians erupted. In a pogrom the Armenians were driven from the city. With the breakdown of trade between

Soviet republics, Sumqayıt's factories started to shut down.

Now the city groans under this legacy. Refugee Azerbaijanis driven from Armenia in reciprocal pogroms have crowded into Sumqayıt as they did in Baku, finding no work and creating instant slums. Factories sit idle on the edge of the sea. Untreated sewage spills from big pipes into the Caspian. Children, inured to the smell and the danger, play nearby. Jamarlov observed in embarrassed silence as I watched these kids.

"I won't be able to see the changes we need," he said. "I hope my children will."

Salman Jamarlov was then 58. His children, I reckoned, were of the same generation as Jamshid Khalilov, the student at the state oil academy. Perhaps he was right. Perhaps Jamshid's generation will see change for the better.

Jamshid told me he did not pass the Azerbaijan International Operating Company's employment test. He missed the cutoff score in the written exam required to move on to the next stage in the selection process—missed it, he was told, by a single point. He intends to apply again after he receives his degree in the spring of this year. Jamshid still dreams of entering that other world he glimpsed. Like all the people of the Caspian, he can only hope that he has not already run out of chances. □

Join our online forum to discuss the problems of the Caspian Sea and those who live on its shores at *www.nationalgeographic.com/ngm/9905*.

Africa's Wild Dogs

By RICHARD CONNIFF

Photographs by CHRIS JOHNS
NATIONAL GEOGRAPHIC PHOTOGRAPHER

Matted with blood, an African wild dog—named Tremblant by researchers—pauses from devouring his impala kill to watch for other pack members. Only distantly related to other canids, Lycaon pictus *once ranged across most of the continent. Now wild dogs compete with humans for their ever dwindling hunting grounds.*

Back from a kill, Bell, the breeding female of her pack, is greeted by 11 pups, anxious to nurse and beg a meal of regurgitated meat. African wild dogs dote on their young; this eight-week-old brood was left in the care of a pack baby-sitter—an older brother or sister—while mother hunted.

Signaling submission by their posture and grins, two grown offspring of Bell—Ditty, left, and Riff—approach their mother's den to entice her new pups to come out to play. After a hunt, they also regurgitate meat for the litter. In most packs only the dominant male and female reproduce; a chief role of older siblings, which are nearly full-grown at one year, is to provide care and food for the annual batch of new arrivals. Initially the young adults stumble over each other trying to outdo the other providers. But their enthusiasm wanes as the pups, and their voracious appetites, grow.

SOMEWHERE DEEP in Botswana's Okavango Delta, a million miles from nowhere, a dog named Nomad leads his pack on a wild chase through the bush. The sun paints a gaudy orange stripe across the horizon. Night threatens at any moment to rush down and set the lions afoot. Our Land Rover bucks and jumps through a dense thicket of mopani trees, struggling to keep up, then breaks out onto a floodplain through the cat-piss smell of windshield-high sage. Giraffes and tsessebes scatter ahead of us, kicking up panicky clouds of dust. Nomad is the orphan child of a male named Chance and a bitch named Fate, and maybe more sensible men would take the hint and give up, go home, get dinner.

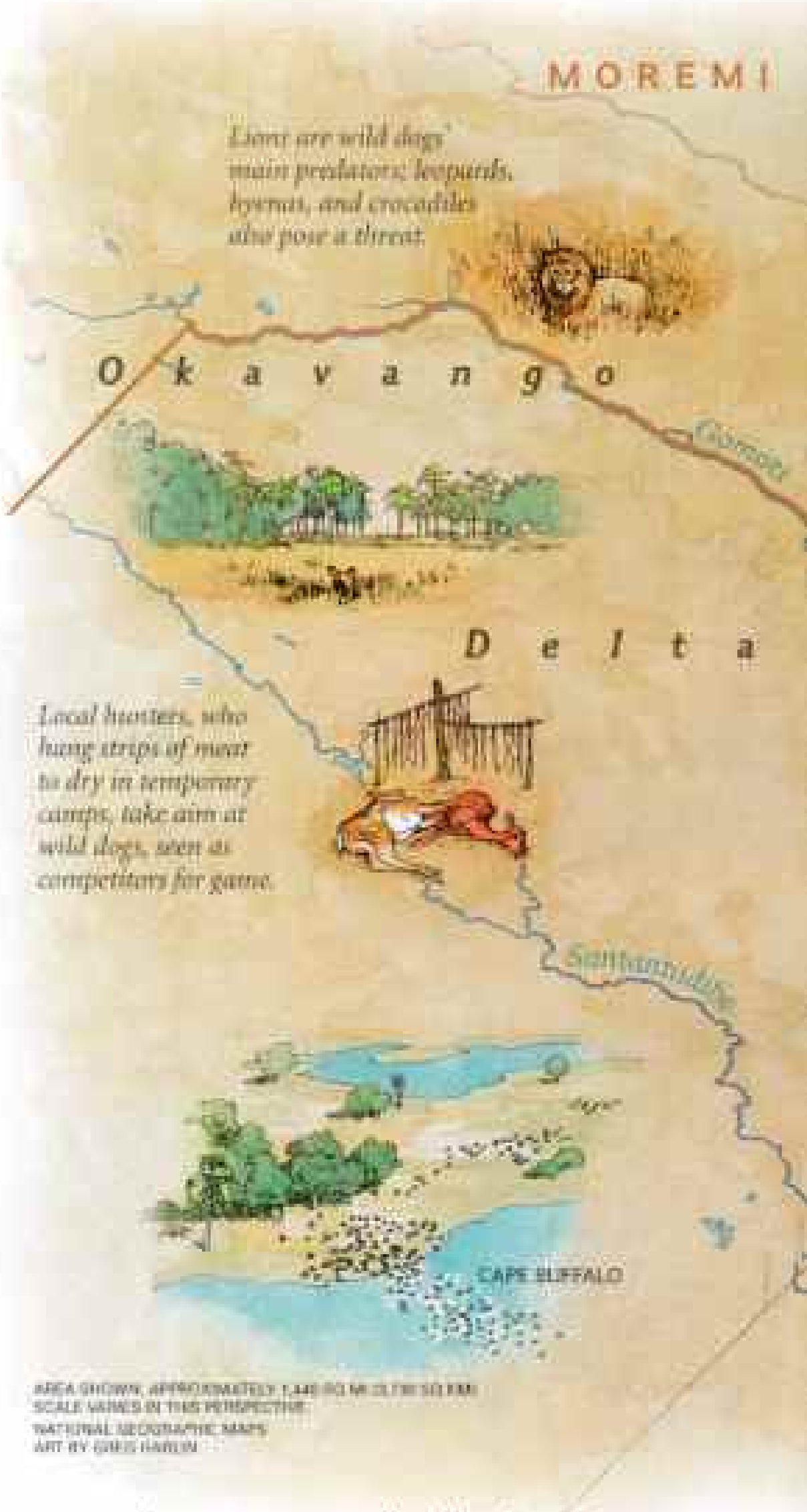
The driver, a wildlife biologist named John "Tico" McNutt, spots a herd of impalas, fast food for the wild dogs we are following. But there are no dogs in sight. He listens to his earphones for the signal from Nomad's radio collar, and then the Land Rover dives back into the bush. "Uh-oh," McNutt says as he muscles the wheel one way and then the other. "Uh-oh." He circles a tree once to get his bearings, then lurches off in the direction that makes his earphones ping strong as a heart monitor. Thorny acacia branches howl down the sides of the truck and leap in at the open windows. A rotten log explodes under our tires, showering us with debris. "Captain, we've been hit!" McNutt reports and guns the engine.

And then we see the dogs out ahead of us, long-legged and light-footed, barely skimming the ground. They stand more than two feet tall at the shoulder, mottled all over with patches of brown, yellow, black, and white. Their ears are round as satellite dishes, and their mouths are slightly open. Everything about them as they glide through the mopanies seems effortless. Then they vanish, dappled shadows moving among the dappled shadows of dusk.

They're commonly called African wild dogs, an unfortunate name suggesting house pets gone bad. In fact, *Lycaon pictus*, the lone species in its genus, is utterly wild and only distantly related to our domestic dog or any other canid. Wild dogs most closely resemble wolves in their social behavior, though they seem more gentle. They are like wolves, too, in that humans have vilified and persecuted them into extinction over most of their range.

Wild dogs once roamed throughout sub-Saharan Africa in every habitat except jungle or desert. A traveler in the 1960s sighted them even in the snows of Mount Kilimanjaro. But they hang on now in just a few isolated pockets, with a total population estimated at fewer than 5,000 animals. They are nearly as endangered as the black rhino, but less celebrated. Farmers still trap them because wild dogs sometimes eat their calves. Hunters occasionally shoot them because they think the dogs steal their game or because they abhor the dogs' reputedly barbaric killing methods. Until the late 1970s even national park managers routinely killed them. The lore was that wild dogs are an "abomination," capable of killing humans, practicing cannibalism, and whenever possible subjecting their prey to a lingering, brutal death: A pack will chase an animal relentlessly, according to various lurid accounts, "tearing away ribbons of skin or lumps of flesh" until the terrified victim "sinks exhausted, when the pack continue to rend out pieces from the living animal."

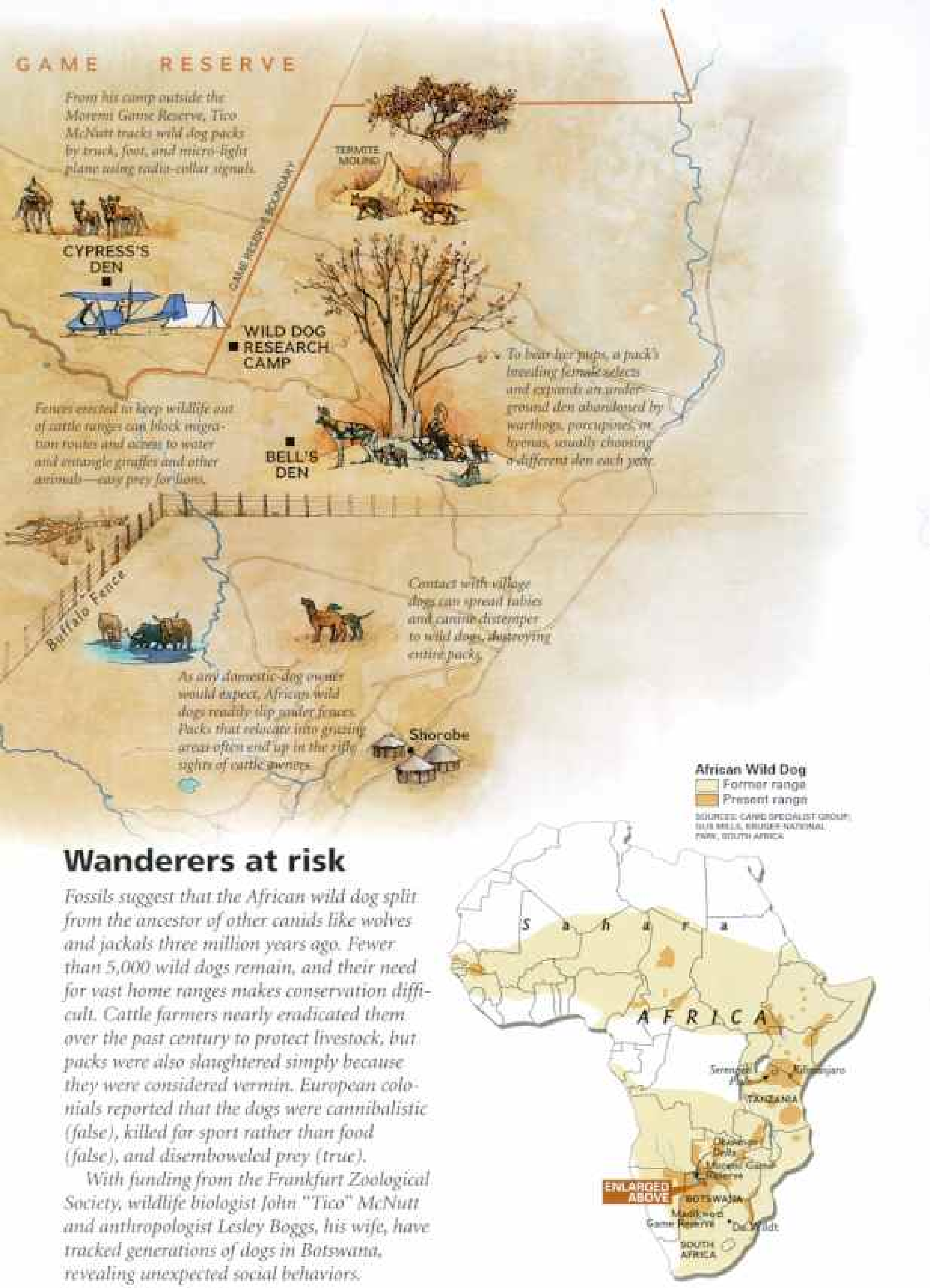
One misguided hunter dreamed, in 1914, about the "excellent day . . . when means can be devised . . . for this unnecessary creature's complete extermination." Only now, with that day upon us, has it dawned on people that maybe wild dogs aren't so bad after all. They do indeed kill by disemboweling their prey. But death is typically quick and no more barbaric than the noble lion using its jaws to strangle a flailing zebra. Wild dogs also run in packs, as alleged. But within the pack they practice family values to a degree that would please, or possibly shame, our leading politicians.



THE OKAVANGO DELTA is a 6,200-square-mile expanse of floodplains and sand ridges, one of the last places in Africa big enough to accommodate wild dogs in their accustomed freedom. Tico McNutt began studying the dogs here in 1989. He is 42 years old, tall and lean, with blue eyes and a second-day stubble. For nearly ten years McNutt has followed the lives of dozens of wild dog packs and hundreds of individual dogs. He knows almost every dog in his study area by the distinctive mottling of its fur. Often he knows its parents, grandparents, and even great-grandparents as well, allowing him to construct detailed genealogies and observe the rise and fall of dynasties. He names his packs according to theme, and the names sometimes betray longing for his Seattle roots. There are packs named for weather (Typhoon, Tempest, Squall), movie stars (Dustin, Streep, Uma), and beers (Zambezi, Full Sail, Tusker).

He and his wife, Lesley Boggs, an anthropologist specializing in human–wildlife conflict, have written a book, *Running Wild: Dispelling the Myths of the African Wild Dog*. They live in a stand of trees next to a dry floodplain on the edge of the Moremi Game Reserve, in the heart of the Okavango. Their camp is improbably settled and homey, with a basketball hoop in the driveway and a kitchen tent softly lit by kerosene lamps. They go to sleep to the hyenas coyly calling *"ooo-WOOO-ooo"* and wake up to the francolins, plump seed-eating birds, bawling

RICHARD CONNIFF's *Spineless Wonders: Strange Tales of the Invertebrate World* was recently published in paperback.

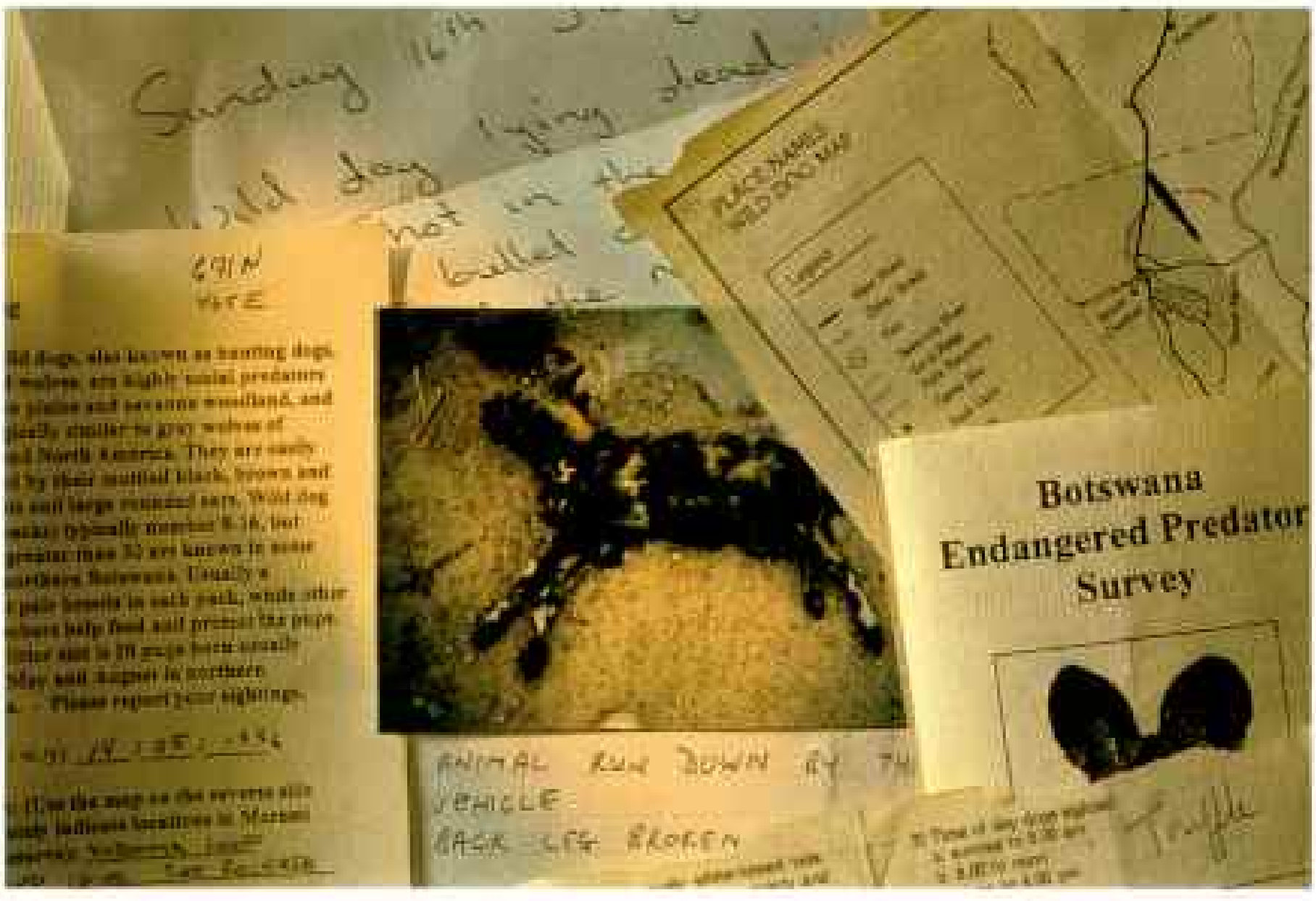


Wanderers at risk

Fossils suggest that the African wild dog split from the ancestor of other canids like wolves and jackals three million years ago. Fewer than 5,000 wild dogs remain, and their need for vast home ranges makes conservation difficult. Cattle farmers nearly eradicated them over the past century to protect livestock, but packs were also slaughtered simply because they were considered vermin. European colonials reported that the dogs were cannibalistic (false), killed for sport rather than food (false), and disemboweled prey (true).

With funding from the Frankfurt Zoological Society, wildlife biologist John "Tico" McNutt and anthropologist Lesley Boggs, his wife, have tracked generations of dogs in Botswana, revealing unexpected social behaviors.

Wild dogs are protected by law in Botswana, but cattle farmers are allowed to kill dogs that threaten their stock. After shooting a dog that attacked one of his calves, this man angrily presented its radio collar to McNutt. "If a rural livestock owner has only seven or eight cows, the loss of a single calf is significant," says McNutt. Dogs are shot, poisoned, and snared, and fall prey to cars. "Some people run over them on purpose," says McNutt, who collects reports of dog deaths (below).



like crows just outside the tent. A hornbill named Hominy lives in camp and steals rice cakes from their young son, Madison.

The dogs McNutt has collared wander through a study area nearly the size of Rhode Island, much of it roadless. He tracks them at times on foot or in a micro-light airplane but mainly by bushwhacking in his Land Rover. He gets three or four thorn-flattened tires a week trying to keep up. When his engine overheats, he cleans the debris out of the radiator screen with a feather from a marabou stork.

DRIVING OUT FROM CAMP one morning, McNutt picks through the dusty gray tangle of hyena, lion, spring-hare, and francolin tracks to point out the footprints of wild dogs. "They're very symmetrical, very line of direction," he says. "It reflects the balance and light-footedness of the animals as they're moving." He eases down the road, head hanging out the window. "There are three or four dogs here. Cool." He accelerates. "We might just catch up with them."

A few minutes later he spots a dog moving through the woods. "It's Ditty. She may still be hunting." Two yearlings join her. Their high bellies testify that they have not eaten, but it's time to knock off. They lie down in the shade, undisturbed by McNutt's familiar truck—until I open the side door and take a seat on the ground. This isn't necessarily a bright idea: Sitting down in a group of wild animals is the sort of dumb trick that gets bush-macho day-trippers ripped to bits by irritated lions, and quite rightly. Predators deserve more respect than that. But the image of wild dogs as wanton killers is so viscerally embedded in human mythology that it bears firsthand refuting, and McNutt has assured me that I will lose no more than one or two lumps of flesh.

The two yearlings immediately lift their heads. They stand and separate. The sharp edges of their carnassial teeth seem to glint with a scintilla of truth in the old lore. One dog circles behind the truck and begins to creep toward me from the right. The other pads softly through the mopani scrub, head down, and draws closer on my left. A cartoon called "Our Fascinating Earth" leaps to mind, characterizing wild dogs as one of "the most vicious of African carnivores . . . and among the few animals that MAY ATTACK MAN." The dogs advance to within ten feet. Ditty suddenly appears between the two and strides boldly up to the back of my neck. She sniffs once, then drops back, and all three dogs move off, their curiosity satisfied. They flop down in the shade, having deemed me rather a bore.

"These are wild animals," McNutt says when I get back into the truck. "They eat animals the size of us all the time. And they're hungry. And yet they showed no aggression whatsoever." In the course of his fieldwork McNutt has been rammed by an angry hippo, choked with dust when a charging lion skidded to a stop beside his truck, and cornered in the camp shower by a deranged honey badger. But he has never been injured by a wild dog. Ditty's pack has a musical theme, so we name the two yearlings that did not eat me Lyric and Chorus.

In truth, what impresses McNutt about the dogs isn't their viciousness but how gentle and considerate they are with one another. One day we find a pack lying by a great pyramidal termite mound, nose to rump, like any heap of idle, flea-harried house dogs. But every heap has its etiquette: One of the dogs stands, walks ten feet away from the others, sits, and claws furiously at his neck with a hind leg. Then he returns to his place in the heap. A social nicety, McNutt suggests, lest he spread his parasites to a neighbor. Another time when he had just collared a dog and was waiting for it to regain consciousness, a sibling walked up, grabbed the dog by the collar, and dragged it back to the safety of the pack.

Their highly evolved social etiquette also bears on much larger issues. This heap of dogs, for instance, got its start as a pack in the usual fashion when three brothers from a pack named for mountains joined up with two sisters from a pack named for islands. In most packs only one male and one female do the breeding. The other adults spend their lives helping to rear nieces and nephews. At the moment, in a burrow underneath a termite mound, a female named Cypress (for an island in Puget Sound) is nursing a new litter. She slouches up out of her burrow and approaches one of the other dogs. Dipping her head down under his mouth, she makes a soft mewling sound. His belly begins to heave in response.

By our standards, what follows may sound like an abomination. By theirs, it is selfless everyday caregiving. *(Continued on page 52)*

At last light a pack of dogs living on a dry sand ridge in Botswana's Okavango Delta heads off for the evening hunt. Packs hunt in the cool of late and early day; sleeping through sizzling daytime heat. A subordinate pack member usually leads the hunt, with the incentive of being first to eat. Once the rest of the pack catches up, subordinate adults eat last. But there are dangers: Running flat out, the lead dog can stumble and break a leg, and while feeding alone risks ambush by lions. A hunt is no trip to the grocery store—only one in three expeditions succeeds.

Deadly play

"In nine years of observing wild dogs, I'd never seen them kill a warthog," says Tico McNutt. The unlucky exception was spotted by five yearlings, which playfully chased the warthog into a shallow hole and began nipping at it. As the older dogs watched, the youngsters prodded the animal out of the hollow. It was then that an adult male, Zermatt (left, wearing a radio collar), joined in the attack. When the warthog retreated to the hole (below), the adults crowded in to haul it back out, sinking their teeth into its hindquarters. Less than 60 seconds later (right) the warthog lay dead, its intestines strewed about, the adult muzzles sunk into its underbelly.

"Youngsters often get excited about warthogs," says McNutt, "but adults don't pay much attention. I think they just decided to join in when they saw it wasn't going to get away. The warthog's skin is thick, much tougher than an impala's. And they have very sharp, dangerous tusks. I've seen lions take a lot longer to kill warthogs."

A nursing female depends on the other dogs to gorge themselves at the kill and then regurgitate back at the den. Some dogs will heave up a portion of their meal seven or eight times a day, especially once the puppies are weaned and begin to beg. The demands of this kind of food sharing are probably the main reason most packs can support only a single breeding female, and here the social etiquette can turn harsh. To reduce competition, McNutt says, the dominant female will often take over or even kill a sister's litter. These aren't our family values, but they are family values nonetheless. "If it's a small pack, maybe five or seven adults," he says, "they're better off having the experienced hunters out hunting, not back at the den rearing young."

THE HUNT begins one afternoon with the arrival of a small procession of ghouls—hooded vultures, a hyena, and us, all waiting for the wild dogs to go out and kill, a chore for which the dogs themselves appear at first to have no great enthusiasm. They drag themselves up from the heap and mill around greeting one another. They lean forward and languidly bridge their back legs out behind. One of them moseys off. "This, believe it or not, is it," McNutt says. The others tag along in loose file, with a desultory wagging of tails.

A subordinate named Blackcomb takes the lead, climbing up on a termite mound to peer over the grass. The pace picks up to a trot when there are antelope in sight, then drops back to

a walk when their prey escape. McNutt's Land Rover lurches and zigzags to keep up, and the vultures and the hyena hopscotch behind. The harsh glare of midday softens, and the shadows grow longer and more dangerous. The dogs hunt in eerie silence. We hear a single sharp bark—an impala warning its herd—and the dogs instantly jump their pace up to a full run. They are capable of pursuing their prey at 25 miles an hour, with bursts up to 35. But when we catch up with a couple of dogs a few minutes later, they are disoriented, seeming to have lost sight of one another and their prey. Blackcomb is absent, so McNutt keeps our truck bumping cross-country in response to whatever he is hearing on his earphones. We find Blackcomb before the other dogs do,

Nabbed with stolen goods, a hyena becomes a target, caught between its desire to make off with the remains of an impala carcass and the need to defend itself. "Dogs and hyenas are antagonists," says McNutt, "but usually the dogs have eaten most of the kill before hyenas make a move to steal it."

with his nose in the warm belly of an impala. He has made this kill by himself, and the victim's supposedly slow, brutal death appears to have been instantaneous. The impala lies in a single bright patch of blood in the grass. Blackcomb feeds, looks up, feeds again, and finally leaves to bring in his pack mates. The feast that follows takes place, like the hunt, in silence. The dogs grip the carcass from opposite sides, then lift their heads and yank back in unison, as if on the count of three. The only sound is breaking bone and shredding muscle. Cypress, who has come out from the den, twitters softly, and her sister, Gabriola, backs away.

"The thing that distinguishes wild dogs is that they're so easygoing with each other," McNutt remarks. Where wolves would enforce their hierarchy by snarling and showing their teeth, "you can't help but notice how quiet and cooperative the dogs seem to be in the same context." And yet, as Gabriola searches for scraps on the outskirts of the kill, it's clear that a hierarchy is operating here too. Because the subordinate adults are last in line at the kill, says McNutt, they'll be more motivated to make a kill next time. The risk of leading the hunt brings a subordinate the reward of cramming its belly for a few minutes, as Blackcomb did, before the twinge of social conscience causes it to bring in the rest of the pack. "It's a neat system."

On the way back to camp McNutt speculates on why wild dogs have evolved into such thoroughly social creatures. They typically travel in packs of about ten individuals, in part because group living comes at relatively little cost. The most one dog, weighing 40 to 80 pounds, can stuff down its gut at a feeding is about ten pounds of meat, but their prey average more than 100 pounds. So food for one is food for a crowd. Each extra mouth also brings a pair of those acutely sensitive satellite-dish ears for added vigilance against "kleptoparasites" like hyenas, which might easily steal the kill of a

solitary dog. The pack also provides protection against the bane of wild dog life, which is lions.

One evening when Blackcomb is again leading the hunt, he suddenly stops for no visible reason and rears up on his hind legs. His brother Tremblant joins him, peering a hundred yards ahead and making a low, rolling *ru-ru-ru* growl, which means "there's a lion out there." The lion, a subadult, yawns massively in the face of the dogs. "It's that old cat-and-dog thing," McNutt remarks. The lion eventually gets up and plods off into a field of phragmites, the feathery seed heads backlit by the setting sun so they flame like a thousand torches. Blackcomb and the others follow, close enough to nip at the lion's haunches. The lion spins on them and snaps but continues his retreat. Then two more lions appear, and the dogs suddenly recall, with a parting *ru-ru-ru*, that they had an appointment with an impala on the far side of town. In one study, predators—almost always lions—killed 42 percent of the wild dog juveniles and 22 percent of the adults. Humans are the other great cause of wild dog mortality, and these two factors, combined with the footloose behavior of the species, are the reason wild dogs present such a challenge for conservation.

EXCEPT DURING the denning season, wild dogs seldom stay in one place for more than a day or two. In the Okavango a typical pack wanders through a home range of about 175 square miles, and nearly four times that in the Serengeti. Few national parks in Africa are big enough to sustain a healthy population of wild dogs. And in almost every national park the dominant species—and the most popular tourist attraction—is the lion. If the dogs seek refuge from lions by going outside the parks, they quickly come into conflict with humans, usually after they kill one of the cattle that have displaced their traditional prey.

Thus almost every attempt over the past 20 years to repopulate parks with wild dogs has failed dismally: "Starved or killed by lions within 4 months. . . . Shot on nearby farm. . . . Left the reserve and were poisoned." An exception is at Madikwe Game Reserve, a day's drive from the Okavango, on South Africa's border with Botswana. Madikwe is an experiment, an artificial park of about 230 square miles created over the past eight years on derelict ranchland, primarily to bring tourist revenue into South Africa's North West Province and only secondarily for conservation. It's enclosed by a fence more than 90 miles long, built with steel reinforcing cable and a 7,000-volt electric wire. The creators of the park have established a balanced population of prey and predators, including just enough lions to gratify tourists. But they have chosen to make wild dogs a featured attraction. One Madikwe staffer puts it this way: "Lions are common as muck in South Africa. Wild dogs are not."

Madikwe now has two packs of dogs, put together as a sort of blind date between wild-caught males from Botswana and South Africa and captive-bred females. One pack has already produced its first litter. Some conservationists hope eventually to establish wild dogs in a half dozen new Madikwes around southern Africa, including new transborder national parks and private conservation areas formed by neighboring game ranches. To maintain genetic diversity, these parks would swap breeding stock, much as zoos do now. What Madikwe promises is a future in modern Africa for wild dogs—if only as a managed, marketed, and fenced-in species.

This is an approach Tico McNutt finds deeply, almost inexpressibly disturbing. "I don't believe we're going to get very far," he says carefully one evening when we are out watching dogs, "if we justify conservation only by assigning an economic value to an animal or an ecosystem. Surely that's not the only reason. It's not the reason I'm interested in conservation."

Even the creators of Madikwe argue that it would be better to preserve existing wilderness than to attempt to re-create it. But they also say that economic values are what actually motivate people to save a wild area in the first place. "You don't realize its value until it's gone, and then it takes an enormous amount of capital to reestablish it," says Richard Davies, project manager for Madikwe. His business plan is for Madikwe to generate about 17 million dollars a year in revenue by 2010, with some of the profits going to neighboring communities. "There's a strong lesson here for countries to the north of us that are squandering their wildlife," says Davies, and he means Botswana in particular.

This is the dispiriting subtext to Tico McNutt's research: He names his wild dogs, records their genealogies, and chronicles their

Born into captivity, a week-old litter nurses in an artificial den at South Africa's De Wildt Cheetah and Wildlife Centre. Five days later an unknown virus killed the mother. Her 12 pups were moved to another facility, where two died from the same virus, autopsies showed (below). Tough and independent, even in the wild the dogs are nevertheless vulnerable to rabies, distemper, and anthrax. "In our study population in 1996," says McNutt, "five packs died in a three-week period."

Tug-of-war erupts as two four-month-old pups tussle over a strip of impala skin brought to them as a souvenir from a hunt. The pups, their bellies swollen with regurgitated meat, are on the threshold of being physically strong enough to keep up with their pack in the field.

footloose lives in the expectation that they will not be able to live this way much longer, even in a wilderness as vast as the Okavango. On the surface it's a familiar story of villagers with cattle steadily encroaching on wildlife. In Shorobe, a cluster of mud huts on the edge of the Okavango, a group of threadbare farmers sit in the dust to talk beside a well they have just drilled for a new water hole, and they sound like livestock ranchers everywhere. They long to kill predators. They gripe about government compensation programs, which pay for their lost animals slowly or not at all. They live outside the loose perimeter known as the southern Buffalo Fence, and they occasionally lose livestock to roaming lions, hyenas, and wild dogs.

When I suggest it might be better not to keep cattle this close to a wildlife refuge, my translator does me a favor by refusing to translate, and explains: "Wildlife belongs to the government, and livestock belongs to the farmer. If it gets into the farmers' minds that you think wildlife is more valuable than cattle, then you will be starting a fire." And he adds, "According to Botswana culture, you cannot live without cattle." It could be Wyoming, outside Yellowstone National Park. But the farmers are also attuned to new possibilities. They envy another village up the road that operates its district as a wildlife management area and profits from concessions for hunting, sight-seeing, and tourist lodges. "We can live with wildlife on one side of the Buffalo Fence and livestock on the other," a farmer says. "All we want," says another,

Bloody coats and distended bellies explain a rough-and-tumble celebration among adults of a pack: They have just killed and eaten an impala. Play is frequent among pack members. Interactions like open-mouth wrestling help to strengthen social relationships but may also contribute to the rapid spread of some diseases.

"is some benefit from our natural resources."

Environmental critics say the larger threat to the Okavango and its wild dogs is commercial cattle ranching. This industry is heavily subsidized by the European Union, which opened its markets to Botswana beef in 1972 on condition that the cattle come from disease-free areas. To limit disease, the country built a network of veterinary cordon fences. These fences have cut off ancient animal migration routes. In one notorious incident in 1983, 50,000 wildebeests piled up dead against a new fence that prevented them from reaching water. Populations of some species have plummeted by more than 80 percent just since 1978, and the fences have lately begun to close in around the last great enclave of wildlife in the Okavango.

"We're seeing significant loss of range for large mammals, and as their numbers go down, predators must also go down," says Karen Ross, director of Conservation International's Okavango Program. She counts more than 900 miles of new fences erected around the delta just since 1995. "If cattle move into this area, conflicts with wild dogs are going to increase."

According to a recent report from the University of Botswana, the economic benefits of the European subsidy program have gone almost exclusively to commercial ranches controlled by the nation's wealthy ruling elite, not to rural villagers. The same powerful interests are likely to benefit if the Okavango floodplains are converted to ranchland. "People aren't starving in Botswana," Tico McNutt says. "It has to do with a small number of people getting an economic gain out of it."

OUT IN THE OKAVANGO one evening, McNutt and I are talking about dogs and doing our best not to think about all that. Probably we should be savoring all that is sublime and unfettered about wild dogs in their natural element. But the truth is that at the moment we are just having a good time. We joke about the sly twist of destiny that caused three brothers from the Painters pack (Braque, Bacon, and Rothko) to hook up for a time with the Four Females From Hell before settling down with a trio of females named for single malt whiskies (Tamdhu, Islay, and Talisker). I suggest that following the different packs as their lives unfold over time must have a quality like soap opera for him.

"The thing that motivates me most to stay on a set of tracks all day and again the next day," he says, "is to find out if it's one of the hundreds of dogs I've come to know. You've been with their mothers and fathers when they were born, and you see them grow to reproductive age and

Hunting at dusk, adults and pups trot across a floodplain during the Okavango Delta's September dry season. Youngsters four months and older do their best to follow the pack, but older dogs sometimes hide tired pups in the brush, safe from lions, and return for them later.

then disperse and disappear. When you find them again, it's exciting."

"So tell me about the Four Females From Hell," I say. Their names, he says, were Trumpet, Viola, Tympany, and Bell, and at various times he saw them with seven different groups of males, several of which died or disappeared soon afterward. Among the suitors, somewhere between the Painters and Toto from the Wizard of Oz pack, was a male named Piccolo. "Then the females disappeared," McNutt says, and after two years he figured that lions or farmers had killed them. But one day a new pack showed up in his study area, and it dawned on McNutt that the male was Piccolo and the female was Bell. "I found them hanging out together with yearlings," he says. They had become the parents of Ditty, the same dog that sniffed at the back of my neck, and Lyric and Chorus, who did not eat me. "At least one of the Four Females From Hell had successfully reproduced and stabilized," McNutt says, gratified, and with an "I knew the bride when she used to rock-and-roll" sort of smile.

Later a solo male showed up on the fringes of the pack, and it turned out that McNutt knew him too. His name was Newkie (short for Newcastle), a Beer-pack dog whose older brother had once courted the Four Females From Hell. Newkie also had a history in McNutt's notebooks. McNutt had watched him grow to reproductive age and then strike out on his own. While he was away, an epidemic hit the Beer pack, possibly rabies or canine

Mickey Mouse ears, among the biggest in the canid family, alert a four-month-old pup to intruders. Its dappled coat provides ideal camouflage in these delta woodlands, but it is not the African wild dog's nature to stay put. A born wanderer, it will inevitably walk into human territory—and a world of trouble.

distemper picked up from a villager's dog. "Newkie came back and found everyone dead," McNutt says. Newkie settled into his old home, finding solace for his social nature in the scent marks of his pack, which lingered like ghosts for months afterward. Then he began to shadow the Music pack, hoping to lure away Ditty or possibly to replace Piccolo as the dominant male. Ditty showed no interest, and Piccolo repeatedly pushed him off. But McNutt noticed that Piccolo's rebellious son Riff sometimes ran interference for Newkie against Piccolo. Now Riff had left his home pack to join up with Newkie. Together, says McNutt, they have a better chance of attracting females than either of them would have on his own.

But this is as far as the story goes this evening. McNutt cannot say if Newkie will get a girl, or if Ditty will finally strike out on her own, or if Bell and Piccolo will grow old and dowdy together. He will have to stay tuned for the next episode. We watch the birds known as queleas come rolling into their evening roosts, undulating like swarms of insects above the marsh. A couple of red-necked falcons pick off stray birds to eat for dinner. In the distance a hippo sounds its sonorous bassoon note.

The Land Rover turns back to camp, and it occurs to me that the lives of the dogs are as messy and tangled as our own. As rich with the tidal coming and going of generations. McNutt is wheeling around trees and stray elephants, muttering, "Uh-oh, uh-oh," and I am thinking about another night when I watched a litter of yearlings playing in the dark. A half dozen of them chased each other in a tight circle around a sage bush, diving into the middle, then shooting out the sides. They jaw-wrestled and played tug-of-war with one another. They made mock charges and danced apart, then stood with mouths slightly open, eyes bright, seeming to grin. One paused to catch his breath, as if having called time-out. Then he crept up to pounce on a littermate and set the chase going again. All this took place, like almost everything wild dogs do, in silence. The sounds we heard in the darkness were the dry rustling of the bush, the huffing of the dogs' breaths, the soft, horselike thumping of their footpads on dry earth. A person passing by 50 feet away might have thought there was nothing much going on out there.

We left them like that, dancing together in the darkness. "You always leave wanting to come back," a friend had told me. With luck the dogs might still be there if I ever get the chance. They would be lying in their doggy heaps or hunting like dappled shadows at dusk. Better to think about that, I figured, than the other possibility, which is that soon there may be no wild dogs at all. □

PIRATES OF THE WHYDAH

By DONOVAN WEBSTER
Photographs by
BILL CURTSINGER and BRIAN SKERRY

"X" marks the spot on an 18th-century chart where, in April 1717, a storm off Cape Cod destroyed the treasure-filled pirate ship Whydah Galley. *She capsized in turbulent shoal waters and was lost to history until treasure hunter Barry Clifford found her in 1984. Today the former slave ship's artifacts, including her bell, evoke the so-called golden age of piracy, roughly 1680 to 1725.*

MAP OF CAPE COD FROM HARVARD MAP COLLECTION; BILL CURTSINGER (ABOVE)

Barren Bank

Cape Cod

Gray Owle

Race Point

Tobet mount

High Land of C. Cod

Sharp Land of C. Cod

Fourest

Griffins I.

Billingsgate

James I.

Hasthams

Crab Bank

Stony ground

Barnstable Bay is not dangerous by reason of so many Flatts Vessells have Run a Shoar, and have got of again

Note that the Depth of Water at some Bars are but little the Depths of Water are set down in feet at high and low Water, and to be known from Fathoms if there is the letter F. placed by them

Barnstable Bay

Course Brown Sand

The Place where I came through with a Whale Boat being ordered by y^e Govern.^mt to look after 5 y^e Fleet Ship Whale Bellame Comand.^r cast away y^e 26^th of April 1717 where I found One Hundred & Two Men Drowned.

Wreck Point

Fine Brown Sand

Yarmouth

Barnstable

Channel way

Bishops & Clarks

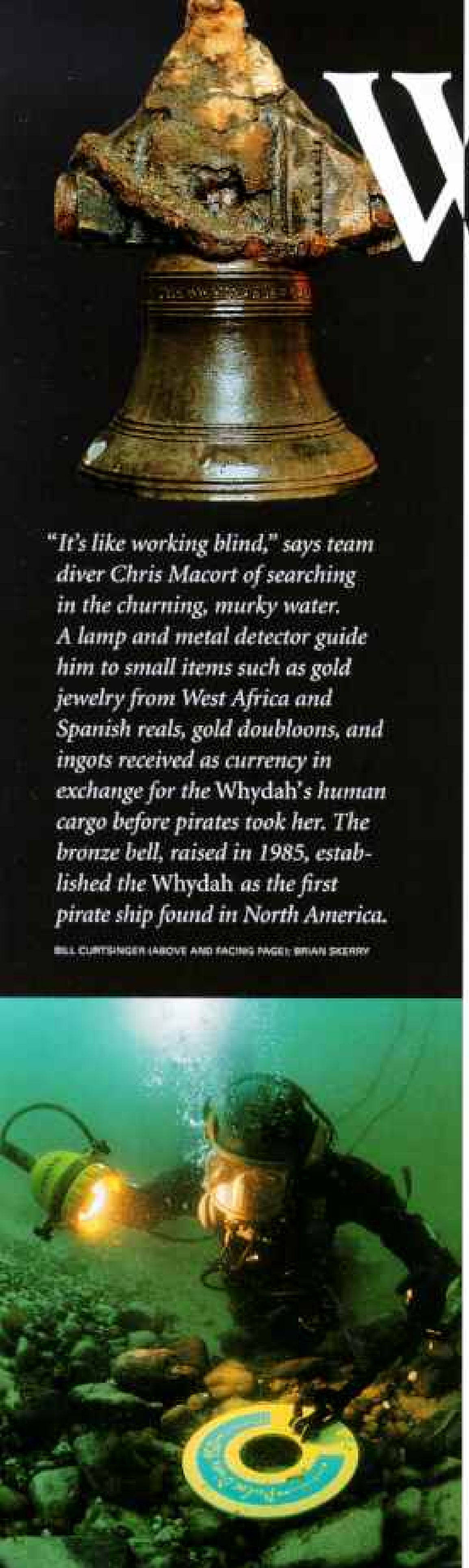
Dry

Old Role & Crown

Course Brown Sand

10 feet

Horsehow



"It's like working blind," says team diver Chris Macort of searching in the churning, murky water. A lamp and metal detector guide him to small items such as gold jewelry from West Africa and Spanish reals, gold doubloons, and ingots received as currency in exchange for the Whydah's *human cargo before pirates took her. The bronze bell, raised in 1985, established the* Whydah *as the first pirate ship found in North America.*

BILL CURTSINGER (ABOVE AND FACING PAGE); BRIAN SKERRY

WITHIN SIGHT OF THE PALE, bluff-lined beach of Cape Cod, at a spot a quarter mile from shore, a flood of bubbles bursts across the surface of a glassy sea. Emerging from the center of the explosion, clad head to toe in a blue neoprene dry suit, pops 53-year-old professional treasure hunter Barry Clifford. Decked out with an aluminum scuba tank and a full-face diver's mask, Clifford is flutter-kicking his swim fins for all he's worth, slicing through the iridescent foam and lugging an unwieldy, four-foot black cylinder to the surface.

Gently, almost gingerly, Clifford sets the object on an aluminum platform hung from the rail of the 65-foot workboat *Vast Explorer II.*

"That's a swivel gun!" he says, breathing hard and patting the small cannon with a gloved hand. "It would have been mounted on a pivot near the ship's stern. Swivel gun! Guaranteed. The stern almost has to be nearby."

After 15 years of searching the ocean floor off the town of Wellfleet, Massachusetts, Clifford believes he's finally zeroing in on what's left of the hull and loot from the first pirate ship ever discovered in North America. Called the *Whydah Galley,* it was said to be heavy with treasure stolen from at least 53 ships when it sank in a storm on April 26, 1717.

The swivel gun—the latest find in an artifact trail that includes more than 100,000 pieces—has Clifford so jazzed he launches himself onto the platform behind it. The cannon drips with weeds and is encrusted with shards of scallop shells. In the July sun, it exudes a dank odor of seawater mixed with spoiled eggs. As we gently hoist it across the *Vast*'s rail, Clifford grins.

"There's more," he says.

He pulls a mesh sack from his belt and removes a plastic bag filled with sand that's flecked with gold dust.

"Nice," says Cathrine Harker, an underwater archaeologist from Scotland.

"There's a river of gold dust down there," Clifford says. "Really fine dust. Oh, yeah. . . ."

DONOVAN WEBSTER once spent two days among seafaring brigands off the Philippines for a story on modern pirates. Photographer BILL CURTSINGER has contributed to NATIONAL GEOGRAPHIC since 1971. BRIAN SKERRY is the co-author of *Complete Wreck Diving.*

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Tracking "Black Sam"

Prowling the Caribbean Sea and western Atlantic, Samuel "Black Sam" Bellamy plundered more than 50 vessels during his yearlong pirate career. In February 1717 he chased down and commandeered the English slave trader Whydah, *a fast, three-masted merchant galley like the one at right. Plotting a course for Richmond Island off Maine, Bellamy continued raiding along North America's east coast. On April 26 what may have been a diversion to visit his mistress on Cape Cod became a date with doom; Bellamy, with all but two of the 146 men on board, perished in the storm.*

GALLEY ADAPTED FROM ENGRAVING FROM THE SCIENCE MUSEUM, LONDON

Bellamy aboard *Whydah*
Route
Known capture
Bellamy aboard other ships
Route
Known capture
Pirate anchorage

North America
Richmond Island
Me.
Mass.
Cape Cod
APRIL 26, 1717 WHYDAH SINKS IN STORM
Gulf of Mexico
SPRING 1716 BELLAMY BECOMES A PIRATE
FEBRUARY 1717 BELLAMY CAPTURES WHYDAH
Bermuda Islands
Atlantic Ocean
TROPIC OF CANCER
Yucatán Peninsula
Isla de Roatán
Central America
Cayos Miskitos
Kingston
Hispaniola
Puerto Rico
Caribbean Sea
Portobelo
La Blanquilla
Los Testigos
Pacific Ocean
South America
90°
80°
70°
60°W
40°
30°
20°N

Scale varies in this perspective.
NATIONAL GEOGRAPHIC MAPS
SOURCE: KENNETH J. KINKOR

M.E. CUNNINGHAM

Emblazoned with brass dragons on its side plates and handle, this Scottish-made flintlock pistol was recovered from the wreck site still loaded with lead shot, wadding, and part of a cartridge. In keeping with the rough democracy practiced on pirate ships, such treasures were auctioned to the highest bidder among the crew.

He peels back the wrist on his left dive glove and extracts two Spanish pieces of eight, silver pieces blackened like small, charred pancakes. He smiles, turning the centuries-old coins in his gloved fingers.

"Look at these," he says, the grin of treasure fever now spreading across his nine-person crew. "The last time a human touched them, they were either being handled by a pirate—or being used to buy human lives."

THE *WHYDAH*'S STORY begins in London in 1715 when the hundred-foot three-master was launched as a slave ship under the command of Lawrence Prince. Named for the West African port of Ouidah (pronounced Wih-dah) in what is today Benin, the 300-ton vessel was destined for the infamous "triangular trade" connecting England, Africa, and the West Indies. Carrying cloth, liquor, hand tools, and small arms from England, the *Whydah*'s crew would buy and barter for up to 700 slaves in West Africa, then set out with them on three to four weeks of hellish transport to the Caribbean. Once there, the slaves were traded for gold, silver, sugar, indigo, and cinchona, the last being a source of quinine, all of which went back to England.

The *Whydah* was fast—she was capable of 13 knots—but in February of 1717, on only her second voyage, she was chased down by two pirate vessels, the *Sultana* and *Mary Anne*, near the Bahamas. Led by Samuel "Black Sam" Bellamy, a raven-haired former English sailor thought to be in his late 20s, the pirates quickly overpowered the *Whydah*'s crew. Bellamy claimed her as his flagship, seized a dozen men from Prince, then let the vanquished captain and his remaining crew take the *Sultana*.

By early April the pirates were headed north along the east coast, robbing vessels as they went. Their destination was Richmond Island, off the coast of Maine, but they diverted to Cape Cod, where legend says Bellamy wanted to visit his mistress, Maria Hallett, in the town of Eastham near the cape's tip. Others blame the course change on several casks of Madeira wine seized off Nantucket. Whatever the reason, on April 26, 1717, the freebooter navy sailed square into a howling nor'easter.

According to eyewitness accounts, gusts topped 70 miles an hour and the seas rose to 30 feet. Bellamy signaled his fleet to deeper water, but it was too late for the treasure-laden *Whydah*. Trapped in the surf zone within sight of the beach, the boat slammed stern first into a sandbar and began to break apart. When a giant wave rolled her, her cannon fell from their mounts, smashing through overturned decks along with cannonballs and barrels of iron and nails. Finally, as the ship's back broke, she split into bow and stern, and her contents spilled across the ocean floor.

The following morning, as farmers and other locals arrived at the wreck site, more than a hundred mutilated corpses lay at the wrack

A swift seizure

Claiming their prize, Bellamy and his crew capture the Whydah *without incident, scratch out an inventory, and divide the loot. Bellamy rewarded her captain's cooperation by sparing his life. A show of weapons—including grenades (above) and pistols loaded with shot from leather pouches (below)—often persuaded foes to surrender without a fight. "There was little bloodshed," says expedition historian Kenneth J. Kinkor. "Sailors didn't get paid enough to risk their lives against pirates."*

ART BY DON MAITZ; PHOTOGRAPHS BY BILL CURTSINGER

line with the ship's timbers. To halt looting, colonial governor Samuel Shute sent Cyprian Southack, a cartographer and sea captain, to recover what might be salvaged for the crown. When Southack arrived, he reported "at least 200 men from several places at 20 miles distance plundering the Pirate Wreck of what came ashoare [when] she turned bottom up."

Of the *Whydah*'s crew of 146, only two men survived: John Julian, a half-blood Indian who soon vanished, and Thomas Davis, a Welshman who was captured and put on trial in Boston. There he testified that the amount and variety of stolen booty on the *Whydah* were dizzying, including 180 bags of gold and silver that had been divided equally among the crew and stored in chests between the ship's decks.

After Southack issued public demands for the return of items salvaged from the wreck, the cape's locals handed back some wooden beams, guns, and a few gem-studded rings cut from the fingers of dead pirates. But Southack recovered little of the *Whydah*'s legendary booty. He did, however, note the location of the shipwreck on one of his maps (pages 64-5). This map, along with Southack's journals and letters, became Barry Clifford's most valuable tool in his search for the lost treasure.

"YOU'D BETTER get down here," Clifford calls out to Bob Cembrola, a marine historian and longtime associate who is waiting on the deck of the *Vast Explorer II*. Clifford is down on the sea bottom, talking through a two-way speaker in his diver's mask. "We got a great big section of hull, with all the timbers showing. Wow!"

It is afternoon on day three of Clifford's treasure-collecting expedition in July 1998. During his years of searching, Clifford has found plenty of artifacts from the *Whydah* (including the ship's bell, inscribed "The Whydah Gally—1716"), but he's never found any of the hull, which he believes may contain the missing treasure.

Cembrola dives to join Clifford 30 feet below

in a green murk of weeds and algae. When he returns to the surface, he's carrying a chunk of blackened, rough-hewn timber, pinned by a long, hand-forged screw.

"Of course, I'd like more conclusive proof," he says, his black wet suit dripping with seawater. "The dimensions are right, and it's the right shape. The wood looks old enough. It's in the right location, and the artifacts in and around it are consistent with the other artifacts that have been collected. I could be wrong, but for the moment I'd say that's a section of the *Whydah*'s hull."

As bits and pieces of the pirates' weapons, clothing, gear, and other possessions have been plucked from the wreck, researchers have logged the locations where they were found, then gently stowed them in water-filled vats to prevent drying. The artifacts have revealed a picture of the pirates quite unlike their popular image as thuggish white men with sabers.

The abundance of metal buttons, cuff links, collar stays, rings, neck chains, and square belt buckles scattered on the seafloor shows that the pirates were far more sophisticated—even dandyish—in their dress than was previously thought. In an age of austere Puritanism and rigid class hierarchy, as Clifford's team points out, this too was an act of defiance—similar in spirit, perhaps, to today's rock stars.

The most common items found in the wreck haven't been eye patches and rum bottles but bits of bird shot and musket balls, designed to clear decks of defenders but not to damage ships. The pirates, it seems, preferred close-quarters fighting to destructive cannon battles.

Among the custom-made weapons recovered have been dozens of homemade hand grenades: hollow, baseball-size iron spheres, which were filled with gunpowder and plugged shut. A gunpowder fuse was run through the plug's center, to be lit moments before the grenade was tossed onto the deck of a victim ship. Pirates didn't want to sink a ship; they wanted to capture and rob it.

ALL BY BRIAN SKERRY

Recovery

"I don't think we'll get everything out in my lifetime," says Barry Clifford, whose team on Vast Explorer II *has salvaged more than 100,000 artifacts. Resting gently on a bed of cobblestones, a pewter syringe was most likely last used by the* Whydah*'s surgeon, James Ferguson, to administer a compound of mercury to treat syphilis. Archaeologist Cathrine Harker examines a grooved grindstone, probably used for sharpening knives.*

Worked by 282 years of currents, a sealing wax stamp has found an anchorage between two stones. "We can't know if the pirates brought this piece aboard," says Harker, "or if it was part of the Whydah*'s original cargo or if it came from a sailor's personal effects."*

ALL BY BRIAN SKERRY

Finally, among the coins and weapons there remains one truly impressive find: a leg bone with a small black leather shoe, complete with its silk stocking. Along with salvaged clothing, the bone strongly suggests that the average pirate was about five feet four inches tall—not the giant of Hollywood movies.

TALL AND THIN, with a shock of unruly black hair and sideburns, Kenneth J. Kinkor resembles Abe Lincoln gone piratologist. As research director of the *Whydah* Project, Kinkor's job for the past decade has been to open a window on the golden age of piracy from 1680 to 1725. Removing a padlocked chain, Kinkor raises the lid of a deep freezer in the small conservation laboratory at the expedition's museum on MacMillan Wharf in Provincetown, Massachusetts. Reaching inside, he pulls out a bundle of white fabric wrapping a foot-long black pistol stock and hands it over.

"The owner of this pistol belonged to no nation," Kinkor says. "These men gave up such loyalties when they became pirates. They were African slaves, displaced English seamen, Native Americans, and a scattering of social outcasts from Europe and elsewhere. They had no common language, no shared religion. They were truly a deviant subculture held together by a common spirit of revolt."

In his 1724 book, *A General History of the Robberies and Murders of the Most Notorious Pyrates*, the novelist and journalist Daniel Defoe quotes Bellamy through a secondary source, a Captain Beer who did battle with the *Whydah* from his sloop. "I am a free Prince," Bellamy is said to have speechified, "and I have as much Authority to make War on the whole World as he who has a hundred Sail of Ships at Sea and an Army of 100,000 Men in the Field; and this my Conscience tells me."

Unlike their reputation as tyrants, many pirate captains were elected by their crews in a rough version of democracy. "'Pirate' was literally their nationality, their social structure," Kinkor says. "They were thrown together outside the law and designed their own laws to govern community behavior. Black, white, English, French, whatever. They were as free as men could be at that time."

Thanks to court testimony of captured pirates and the depositions of merchant captains who had fallen prey to Bellamy, Kinkor believes that 30 to 50 men on Bellamy's crew were black. "Most of them were former slaves," he says. "The pirates would raid slave ships and offer male slaves their choice: Join the pirate ranks or continue to the New World in slavery. Which would you take?"

Once aboard a pirate ship, it didn't matter if a man happened to be an English refugee from Monmouth's Rebellion of 1685, when Protestant forces attempted to seize the crown from James II, who was Roman Catholic. Nor did anyone care if he was one of the thousands of out-of-work sailors decommissioned after Queen Anne's War in 1713. All any loot-minded individual needed to do was take a small step from being a legal privateer seizing goods at sea by royal authority to going "on account" as an outlaw. And between 1680 and 1725 as many as 10,000 men—and even a few women—plowed the seas as pirates, their allegiance to navy and king thrown overboard.

A crowd of tourists has gathered on MacMillan Wharf in Provincetown to gape at the treasure hunters as they trundle vats of artifacts from the workboat to the project's small museum. Before long, news of Clifford's find has spread across the wharves, and several local

Discoveries of a season

"This is not like the Titanic," *says Kenneth Kinkor. "The storm broke this ship apart, scattering its pieces." In the summer of 1998 divers found lead-lined sections of what may be the gunpowder room (above left and below). Fighting the cape's currents, Clifford (above right) clings to his air and communication lines and heads to the surface with a heavily encrusted swivel gun, one of many small cannon that Bellamy's pirates mounted on the* Whydah.

fishermen are coming in to congratulate him and his crew. For Clifford this is the beginning of a frenetic period of phone calls and visits. Within the week, as the story makes the front section of the *New York Times*, old friends and former investors will telephone, and offers will come in to build a larger museum.

"It's like being queen of the prom," Clifford says of the instant attention. "Everybody wants to be at my side."

In his book, *Expedition Whydah*, Clifford characterizes Black Sam Bellamy as equal parts hero, freedom fighter, and likable scoundrel. But Clifford, with his rugged good looks and natural salesman's charisma, might as well have been describing himself, considering his longtime skirmish with certain members of the historic preservation community over the project.

From the start Clifford's claim to the *Whydah* has rankled preservationists, who argue that historic resources on public land should remain in public hands. Much to their dismay, Massachusetts' highest state court ruled in 1988 that under the federal "law of finds"—neatly summed up by the expression "finders keepers"—the pirate ship was Clifford's to do with as he saw fit.

Two years before his court victory Clifford had made a deal with a group of 300 or so investors pieced together by a brokerage firm. The group raised six million dollars to fund the salvors for three years, with an eye toward auctioning the pirate loot. But at the end of three productive dive seasons the backers decided that auctioning the artifacts would net too little profit, and so the idea was scrapped.

"Most treasure hunters don't make money by selling treasure," says Paul F. Johnston, curator of maritime history at the Smithsonian Institution and one of Clifford's most outspoken critics. "Instead they make money selling shares to investors. They're selling dreams."

Clifford shrugs off such criticisms. "I just have to factor them into the job, like rough seas, broken boat parts, and the weather," he says with a gleam in his eye. "Some of those academic guys are jealous. I took the chance. I spent nine years looking for the *Whydah*, and I'm the one who found her."

Clifford points out that he has met all the conditions of his salvor's permit, hiring people to record finds, keeping artifacts together, and conserving them in a lab. But preservationists still mistrust him, suspecting that, sooner or later, he will sell off the treasure.

Right now, though, Clifford decides it's time for a celebration, inviting his team into an amber-lit fisherman's bar. For the next hour, as they gobble pizza and drink beer, there are invocations of "180 bags of pirate treasure" yet to be found. Exhausted and grinning, Clifford shakes his head at all the speculation.

He knows that a proper excavation of the *Whydah*'s stern, if that is what the newly discovered wood on the bottom proves to be, must wait for the next dive season, the summer of 1999, when the weather and resources will allow it. Only then will he know whether the wreck will yield its legendary gold or whether its greatest treasure will be what it has taught us about the true lives of pirates. □

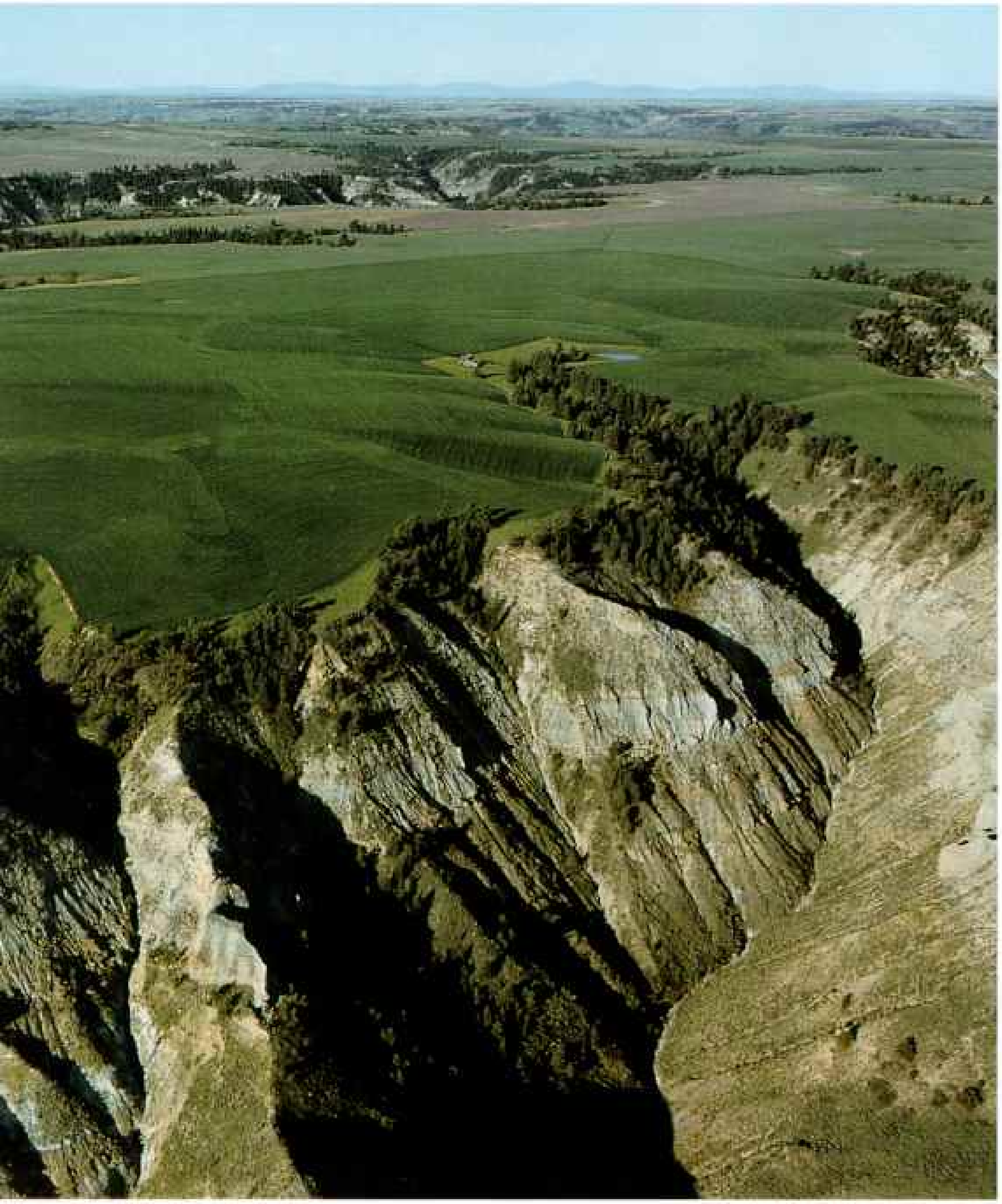
An early example of the Freemasons' symbol was crudely engraved on a dinner plate, perhaps by a pirate member of the fraternal society. "Lust for gold defined this period," says Clifford (below), "but the stories the artifacts tell are the real treasures."

ALL BY BILL CURTSINGER

Learn more about the *Whydah* pirates at *www.nationalgeographic.com/whydah*. Also check local television listings for National Geographic EXPLORER's "Pirates of the *Whydah*," premiering May 26 on TBS.

Grainfields spill their color across the badlands of the Missouri Breaks, a lonesome swatch of eastern Montana where the Great Plains roll to an abrupt and wild end. The Missouri River and its tributaries have cut deep paths through underlying sandstone and shale, fracturing the open country. Rough and remote spaces rule the Breaks, perfect for folks who insist on carving their own way.

THE Missouri



Breaks

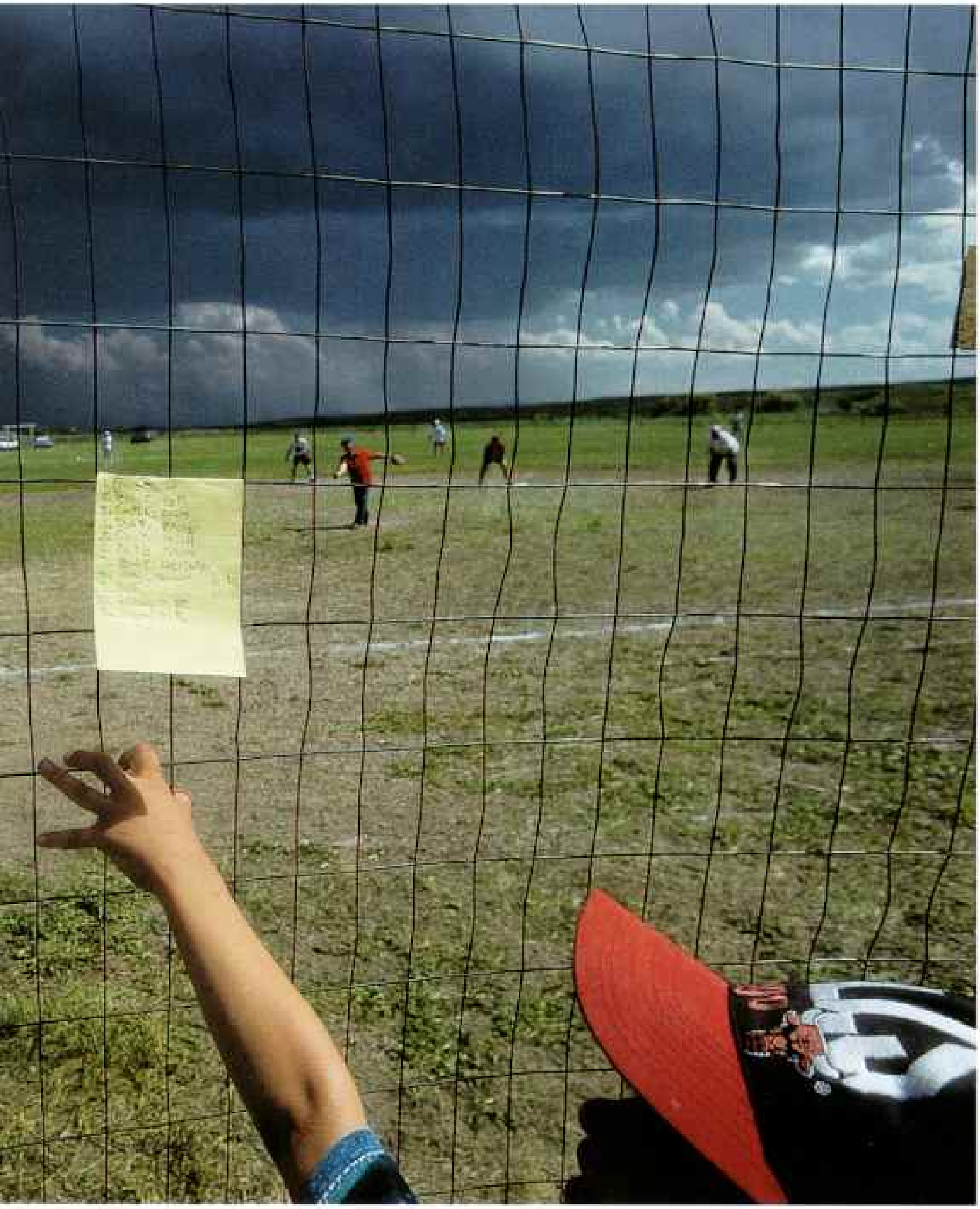
By JOHN BARSNESS

Photographs by
WILLIAM ALBERT ALLARD
NATIONAL GEOGRAPHIC PHOTOGRAPHER

At home in the saddle, *a rancher works stock on a spread 60 miles from the nearest town.*

"My boys always look for an excuse to get on a vehicle, but in these parts a horse is what goes everywhere."

Score one for neighborliness *when volunteer firefighters from Winifred and Hilger,*



small towns 23 road miles apart, defy summer storm clouds to assemble for their annual softball duel.

APPROACHING the Missouri Breaks in a pickup truck you cross wheat fields and Angus pastures, and the gravel roads run like the arrows Blackfeet hunters made from serviceberry branches: almost straight, deviating only slightly across long gentle hills. In the distance blue mountains named Bears Paw rise like islands in a yellow sea. Your map claims they are 35 miles away, but they seem to ride just beyond the grasshopper-splashed windshield.

And then the Montana landscape falls away from the prairie, disintegrating into broken sandstone ridges, and there's the Missouri River, so far below that it could be a snake easing along an eroded cow path. Braking the pickup and looking down, slightly dizzy from the suddenness of empty space, you finally understand the name: Missouri Breaks. Across the river rise minareted cliffs, and along the top rides a horseman, seeming as slow and tiny as an Appaloosa ant above the Mesozoic canyon. And as far as you can see, there is nothing else except a few barbed-wire fences and green cottonwoods along the bends of the river.

When the Lewis and Clark expedition made its way up the Missouri in 1804 and 1805, one of its jobs was to scout the land for commercial potential. Before reaching the Breaks the explorers' journals frequently mentioned the level, plowable prairies of the Dakotas, but on the evening of May 26, 1805, Clark wrote: "This Countrey may with propriety I think be termed the Deserts of America, as I do not Conceive any part can ever be Settled, as it is deficent in water, Timber & too steep to be tilled." Today, in the nearly 300 miles between the villages of Fort Benton and Fort Peck, there are no other towns on the banks of the Missouri, or even many cattle ranches, and in all that distance only three bridges and two cable-driven ferries cross the river.

Someday both ferries may be replaced by bridges, but right now you feel much more connected to the river on a ferry than on any span of concrete: its plank decking rumbling as your pickup bumps aboard, and then a talk with the ferryman as the Missouri pulls against the steel cables.

But to truly understand the Breaks you must "do a Lewis and Clark," as a friend puts it: Slide a boat onto the gentle river. It isn't a dangerous journey, but with your pickup waiting several days downstream, it contains something of the mystery of original exploration.

In a recent June I floated with my friend Buck Damone, who's the perfect guide since he works for the federal Bureau of Land Management and is in charge of recreation on the upper Breaks, where the Missouri is designated a national wild and scenic river. He knows the history (both human and natural) and the few people of that unsettled country.

We put in at Coal Banks Landing—an old steamboat landing next to a place named

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Author JOHN BARNESS, former editor of *Gray's Sporting Journal*, was born and raised in southwestern Montana, where he lives today. This is his first assignment for NATIONAL GEOGRAPHIC.

A flourish of cottonwoods traces the Judith River as it meets the Missouri (foreground). Cut as fuel for steamboats, cottonwoods nearly vanished on the big river in the 1800s. Today dam-regulated flows on the Missouri hinder growth of the best shade tree in the West.

Virgelle. For a while Virgelle disappeared from highway maps, but in recent years it has come back, though it really isn't a town. One of the ferries crosses the river here and some of the buildings still stand, looking very much inhabited by their owner, Don Sorensen. Don restored the circa 1912 Virgelle Mercantile into a general store and bed-and-breakfast, complete with period furnishings, and turned another building into a player-piano dance hall.

Virgelle's customers are mostly river travelers, canoeists heading downriver past the pale formations called the White Cliffs. Most put in at Coal Banks Landing, some renting Don's canoes. Later they have his employees shuttle them back up from Judith Landing. "We're a full-service ghost town," Don said, showing us around. "Anything your heart desires. What do you need?"

"Just some bug dope," I said. The notation "Musquetoes troublesome" appears frequently in Lewis's and Clark's journals and is still true between May and September.

"Ah. I just happen to have a supply, exorbitantly priced for fools like you. Squeeze or spray?" Don was right about the price, but

anything's fair in the Breaks, 75 miles from the nearest Wal-Mart.

"Squeeze," I said. "You know, Lewis and Clark said the Breaks are basically uninhabitable."

Don rolled his eyes. "Of course they are."

Complete with deet, we drove down the dusty gravel road to Coal Banks and slid the BLM boat down the ramp into the river. Soon we were around the first bend of the river, beyond even the tenuous civilization of Virgelle.

Buck pointed to an old log building, then to a herd of mule deer. People did settle along the river, but today all that remains are a few cabins built by homesteaders and "woodhawks," who cut cottonwood fuel for the steamboats. It seems as though the Breaks have drifted backward 150 years. When the first steamboats came up the river just before the Civil War, the cottonwoods along the banks began to fall. The pronghorn, deer, elk, bighorn sheep, and buffalo that fed Lewis and Clark also began to disappear. As their prey thinned, the wolves, mountain lions, and grizzly bears ate cattle—and so began to disappear as well.

But railroads killed the steamboats, and by 1900 the fast-growing cottonwoods began to return. The big animals, however, took longer to come back. The Great Depression lasted longer in rural America than in the rest of the country (some say it has never totally left the Breaks), and starving people pay little attention to game laws. The deer replenished themselves, but it wasn't until the 1950s and '60s that elk and bighorn sheep were replanted in the Breaks.

Today it's possible to see many of the large ungulates Lewis and Clark ate—including buffalo, which are raised on a few ranches. You will not see a grizzly, though you might catch a glimpse of a mountain lion. Sightings by ranchers confirm that wolves are present in the deepest Breaks.

WE PUTTED down the wide brown river, looking at the geometric shapes of the White Cliffs, prairie falcons twisting above, feeling the pleasant conceit of the 20th-century traveler escaping into another time. As we drifted, I remembered other floats with Buck, our stops at the odd or secret places of the Breaks. On another June trip we put ashore to visit a homestead log cabin with a sod roof. Inside, the windowless cottonwood walls kept out the sun, and after my pupils widened to the darkness, I found a cow horn embedded between two logs, a funnel for bladder relief during blizzards. A few miles downriver we hiked up a box canyon to a petroglyph of a horseman and the sun etched into a sandstone wall—and a real, breathing bighorn ram, who eased to his feet from behind some sagebrush and stood looking at us, so close we could see the annual rings in the full circle of his horns.

But on this hot day all we saw were a few deer and tepee rings. Toward evening we camped under tall cottonwoods and applied deet as we sat around the fire. The leaves of the big trees turned in the breeze above us.

"There aren't as many of these as there used to be, you know," Buck said. "We just aren't getting new cottonwoods on some stretches of the upper river. Cottonwoods need occasional high floods, but now the dams keep the spring flooding down.

"The dams have changed the winter ice here too; they allow more ice to form, and when it breaks loose in spring, it takes out the trees. And cattle come down here in the hot part of the summer and eat seedlings. The BLM has no control over the dams, but we are looking at better ways to manage the cows."

Buck's originally from Maine, a tall, pale redhead trained as a forester. You can still hear an occasional Down East flatness in his *r*'s as he speaks, but over the years he's transferred his affections from hardwood forests to these sparse stands of cottonwoods. He stirred the fire. "We're getting about a 10 percent yearly increase in canoes on the river. They all camp under the trees."

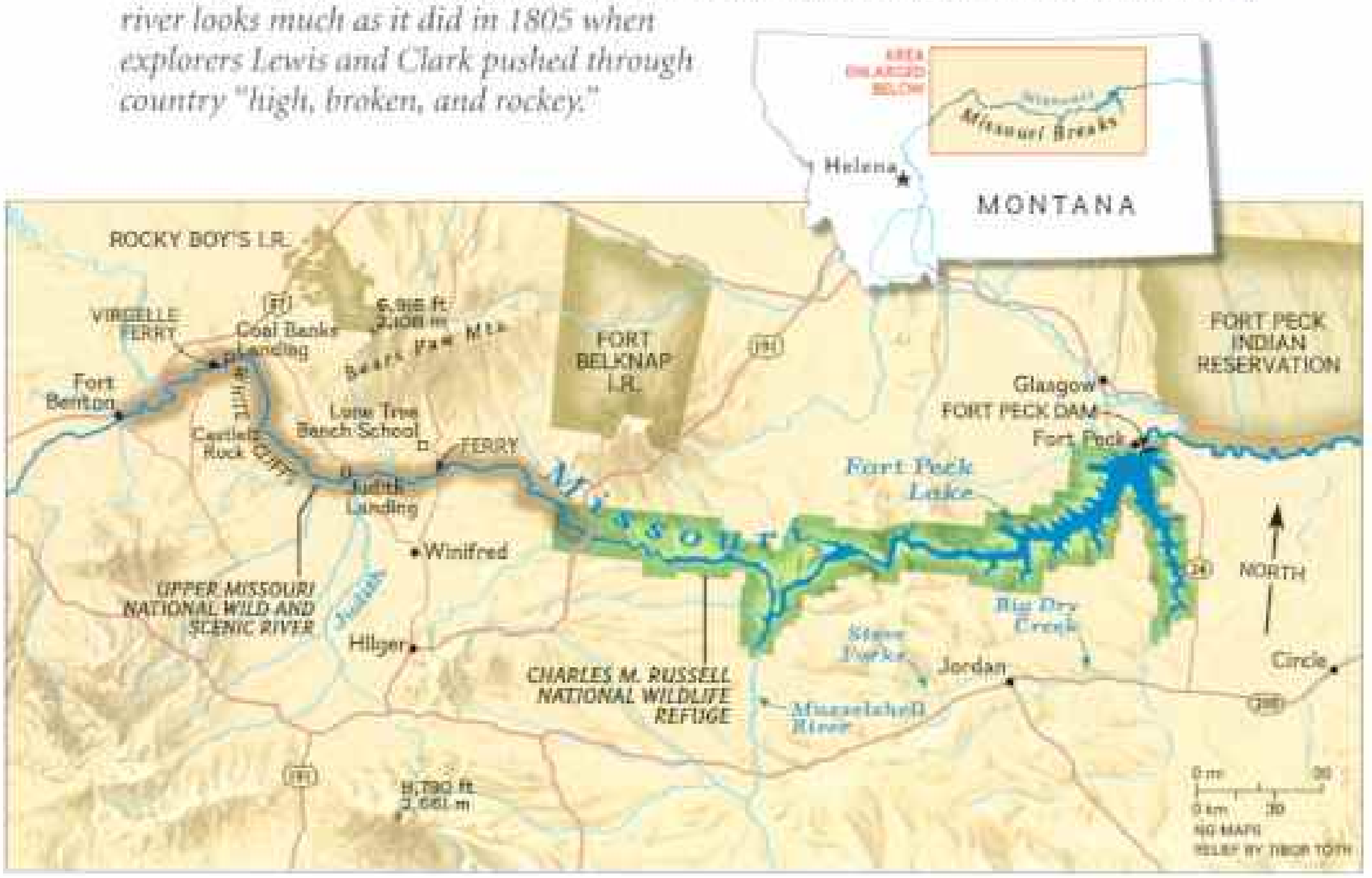
I nodded. "Who wants to camp in the sun at 95 degrees?"

We talked a little more as the Milky Way appeared, almost tactile, as if someone had mixed particles of light with blue-black paint and brushed it against the sky.

Buck and I rode up and down the river the next morning, ran out of gas, and let the river pull us downstream.

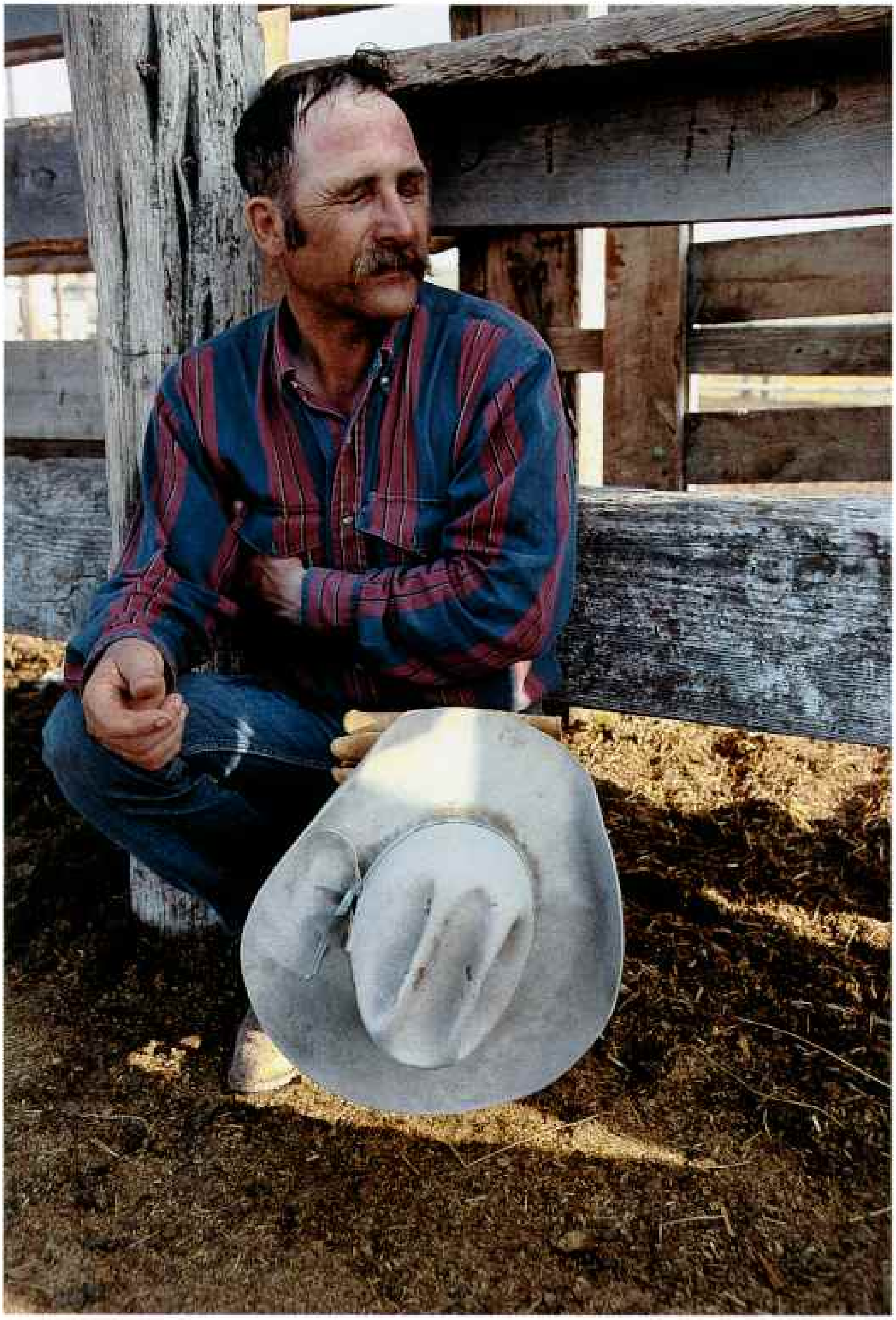
"I never get to do this, you know," Buck said, easing back against a life vest. "I'm always in a hurry to administrate. Sunblock?" He tossed me a tube. It was ten o'clock, the temperature

The three smartest, most popular, coolest dressed kids at Lone Tree Bench, enrollment three, enjoy recess outside their one-room schoolhouse, one of several that still dot the Breaks—among the most sparsely settled chunks of the lower forty-eight. The Missouri River bisects the semiarid rangeland for nearly 300 townless miles between Fort Peck and Fort Benton. Since the 1930s the Fort Peck reservoir has flooded 135 miles of river. The portion of the upper Missouri that is designated a wild and scenic river looks much as it did in 1805 when explorers Lewis and Clark pushed through country "high, broken, and rockey."



Castle Rock commands *a rise above the flow of the Missouri along the White Cliffs.*

a procession of eroded bluffs, most of them christened by explorers, fur traders, and steamboat captains.



Banged-up ribs force rancher Jack Hinnaland to take a break from branding colts. For an occasional rodeo rider it's a familiar feeling: "I've been broken up a few times," says Hinnaland, who specializes in raising bucking broncs. A wild horse gives a crew all it can handle at the Father's Day rodeo in Jordan (facing page).

already 90, and we were down to T-shirts and hiking shorts.

So we drifted down the river, the best way to see the Breaks, letting the boat turn circles on the current. We never saw a modern building that day or any other humans except two canoes full of tourists. All the ranch houses—and even the few small towns—are perched well back from the river, watered by wells that are often a thousand feet deep. Unless there's a need to chase some cows or catch some catfish on a Sunday afternoon, the people almost never drop down to the river. The river itself is a summer tourist place, and I'd learned more about the mortality of cottonwoods than about the people who actually live around the Breaks. For that, I'd have to travel east, to Jordan.

JORDAN, MONTANA (population 494), has been called the most isolated town in the lower 48. You must drive an hour from there through empty sagebrush and badlands to get to any place of any size—say Circle (population 805), 70 miles east. Jordan is the seat of Garfield County—about the same size and shape as an upside-down Connecticut but with only 1,500 citizens—and gained its 15 minutes of fame when the notorious Freemen holed up in a ranch west of town and held off the FBI for 81 days in the spring of 1996.

Garfield County is bounded on the north and east by 130 miles of Fort Peck Lake. The reservoir was formed by a huge earthfill dam built during the late 1930s, a flagship of Franklin Delano Roosevelt's New Deal. Fort Peck itself, originally a fur post, boomed briefly into a loose collection of shantytowns housing over 10,000 workers and their families. The dam's massive spillway graced the cover of the first issue of *Life* magazine, in 1936.

In Fort Peck you hear some of the same economic diversity, Chamber of Commerce talk heard on the upper river, where Fort Benton is rebuilding its old trading post into a tourist attraction. Fort Peck is trying to attract some of that money. There's talk of a big museum showing off the history of the dam, the million-acre Charles M. Russell National Wildlife Refuge surrounding the lake, and dinosaur bones. Because of their deep erosion, the Breaks are one of the major fossil-digging areas in the world.

But all this talk of diversity barely touches Jordan, because the only thing anyone there is interested in is beef. Beef has been the Breaks' major resource since the last ice age. Before the white man the Breaks were buffalo country, the beef of the Plains Indians; white cowboys

simply changed buffalo into Angus and Hereford and herd rather than hunt them.

Not much else can grow in that steep and untillable country, and since no ferries cross the reservoir, the country north of Jordan is a landlocked peninsula connected only by a few clay-dirt and gravel roads to the rest of the world. The Garfield County Breaks are quintessential cattle country, though sometimes I suspect cows are just an excuse for people of the cowboy attitude to live out there.

AND JUST WHAT IS the cowboy attitude? To help answer that question, I recruited my friend Boone Whitmer, who spent much of his childhood on Steve Forks of Big Dry Creek, west of Jordan, where his maternal grandfather homesteaded. Today Boone farms wheat east of Fort Peck, in the tillable country Lewis and Clark described before they reached the Breaks.

We met at QD's Cafe, the only restaurant in Jordan, on a December afternoon. The waitress eyed us curiously; not many strangers are seen after snow falls on Garfield County. Boone recognized one of the women at a table behind us, and we went over and talked for a while.

The woman started by asking Boone how his mother was, and then they ran out the string of all his uncles, cousins, sisters, and brothers: where they were, what they did, who had died. This is the way humans meet in any lightly settled country. If somebody cannot explain who he's related to, then he might be an enemy.

The next morning we drove west, the temperature just below zero and the snow squeaking under our tires. After half an hour we stopped at two decrepit log cabins next to a new ranch house. The owner wasn't home, but Boone knew him, so we let ourselves into the larger log house, built by Boone's grandfather before World War I.

Boone was a high school basketball star and had to duck through the door. Inside the log walls, the living space extended perhaps 15 by 30 feet. "We all lived here," Boone said. "My dad and my two brothers and I slept in the little cabin, and my six sisters, my mother, and my aunt and uncle slept in here. My aunt hung up blankets for walls." He looked up at the rafters, made of ponderosa logs hauled on wagons from the timbered Breaks 20 miles away. "This country didn't get electricity until the fifties. We cooked and heated the place with wood—that was my job, chopping wood—and lit the place with kerosene lanterns."

I looked at the brown log walls. "That must have been pretty dim."

Boone nodded. "One year we got snowed in for two months. For the last couple weeks all we had to eat was boiled wheat and an old ewe sheep a neighbor brought. She got pretty rank by the end, but there was nothing else to eat." He paused again, thinking. "A lot of people still rode horses then—I mean, this was 1955—because the roads were just gumbo, graded out of the sagebrush, impossible for cars when it got wet, and the snow drifted so bad in winter. We hauled hay to the cattle with a sled and a team of horses."

"It was still the Wild West."

Boone nodded. "Even in the fifties most of the men carried guns. The funny thing was, they were all worried about the Soviets dropping the bomb too."

"Anybody build a fallout shelter?"

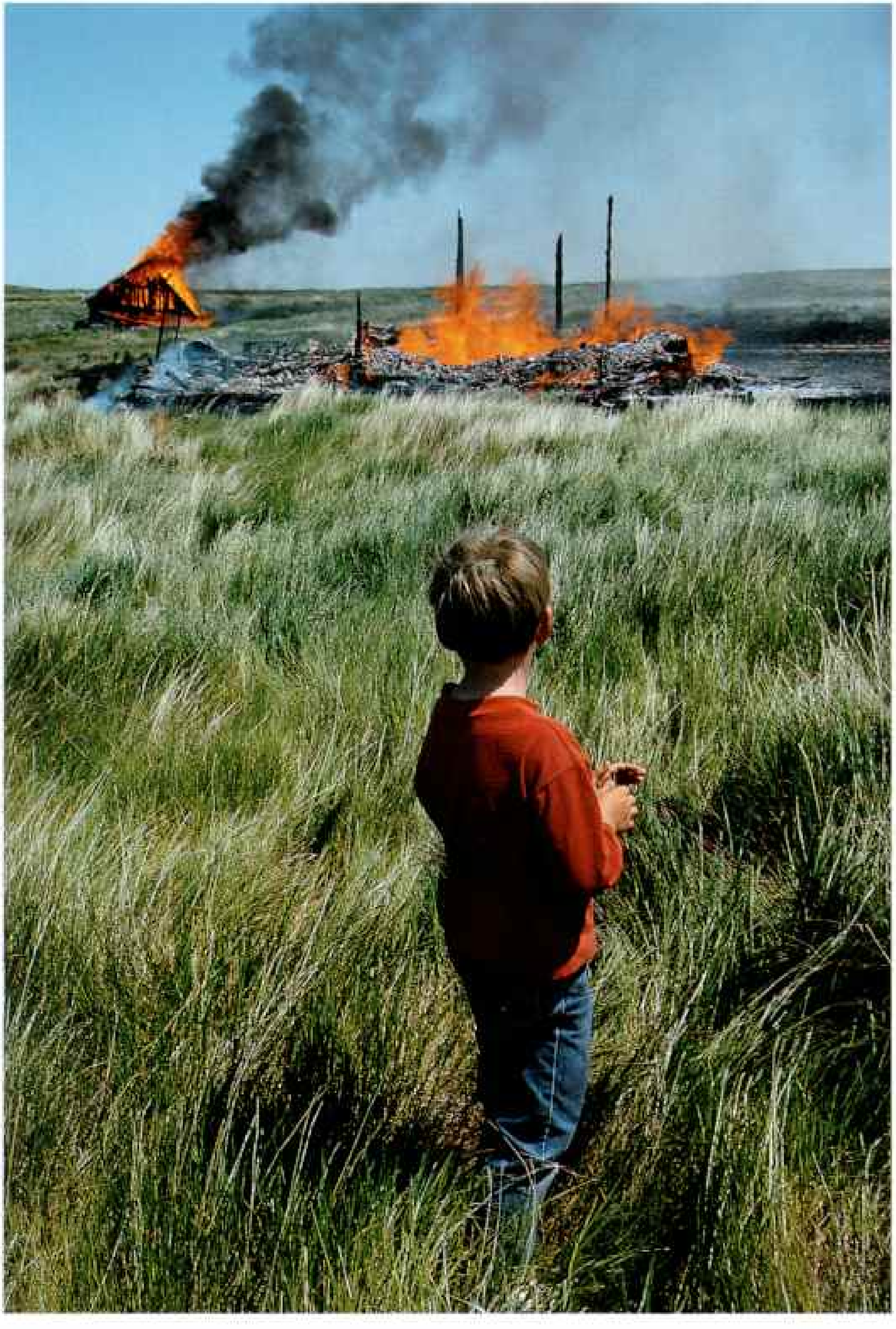
Boone laughed. "No, not that I can remember. We all had root cellars."

From the homestead we drove farther up Steve Forks to the Meckel ranch, where Boone's childhood buddy Danny still lived. As we pulled into the yard, four Border collie pups came running up, falling on their backs in the snow when we bent to pet them.

Danny was waiting for us, a strong-looking bearded man of about 50. As soon as we sat down and had our coffee cups filled, he pushed a tape into the VCR. "Got home too late last night to watch the rodeo," he said. It was the week of the National Finals Rodeo in Las Vegas, and Danny had not intended to miss it. As we watched several young men get bucked off, I mentioned that one of the things I always liked about the Breaks was chasing cows around on horseback. The country is steep and broken, but the soft sandstone of the hills allows a good horse to go almost anywhere.

"Oh, yeah," Danny said. "It's great horseback country. Matter of fact, we used to have human hunts during the summer, when we didn't have much excuse to chase cows. We'd get the high school track team and let them loose in the hills a couple miles from the Musselshell River. The first rider to bring one back won."

"Alive?"



Fireworks country-style mesmerize young Graydon Udelhoven as derelict farm buildings from the early 1900s blaze during a training session for Winifred firefighters. Bad weather and worse cattle prices emptied the Breaks of most homesteaders by the 1930s. "It was such a tough life," says a rancher, "even I can't imagine it."

Still life with pheasants *and tire jack: The contents of a pickup bed tell a hunter's*

tale. Driving dirt roads to see your dog flush prey under a big sky counts as Breaks heaven.

Danny cackled. "Oh, sure. One year this kid who'd just got out of basic training with the Army thought nobody'd catch him. They had 15 minutes' start, and then we went after 'em. I was riding this big black horse I had, could really go. I just loped him up the highest hill and saw this Army kid running on the next ridge over. So I dropped down in the draw and switchbacked up the other side. It was all sand along the top of the ridge, and the kid was running so hard he never heard us. The first thing he felt was the horse breathing on his neck. He looked around, and his eyes got huge. Then he stopped and raised his hands."

Boone asked about the puppies. "Those're Freemen dogs," Danny said, smiling. "Their mother belonged to one of the head guys. He's in jail, so a neighbor took her. She had ten pups, and I took four. I think they'll be pretty good cow dogs." Few people I met in Garfield County talked much about the Freemen, but I got the feeling from those who did that their old neighbors had broken some sort of social contract—and not the one with the United States government.

From Steve Forks the land slopes upward to the north and west, toward the highest part of the Garfield County Breaks, the hills that rise a thousand feet above Fort Peck Lake. The road goes right past the Freemen "compound," as television commentators called it. It is just a ranch, and not a very big one, with the timbered Breaks on the far horizon.

As the road topped out on a high ridge, a sign told us it was "Impassable When Wet." Since the ground was frozen, not wet, we shifted into four-wheel drive, the road now a two-rut trail that twisted through the timber. Three or four miles after the sign we found a house even smaller than Boone's old homestead, surrounded by pine corrals and connected by gray boards to a couple of ancient trailers. We passed a mailbox with the name Huston and then a neatly hand-painted sign warning any and all federal agents, communists, and other ne'er-do-wells to stay away.

We found Dave Huston down below the corrals, having just fed his bulls, an almost tiny man with a long aquiline nose. Boone introduced himself, going through the clan introductions again. Dave looked at him closely and said, "Then Spike must be your uncle."

"That's right."

"How the hell is old Spike?"

"Good. He's retired now, living in the veterans home over in Glendive."

Vehicles line up like cows at a feedlot for Fire Department Day, the best excuse around for ranchers and farmers to come socialize in tiny Winifred. Up in Hilger, Ervin Zimmerman (left) can always find company and an audience in the Pioneer Bar, where his version of "Your Cheatin' Heart" keeps the beer coming.

Dave spit some tobacco juice on the ground. "Spike always was retired. Oh, he'd work, but you had to drive a stake in the ground to make sure he was movin'. And what's your story, young fella?" He looked at me.

"I was told you've been here since before the dam was built."

He squinted at me. "Son, I was here before the flies."

We helped Dave feed a few more animals, bumping through the shin-deep snow in his new pickup. He talked the whole time, starting with Boone's relatives. "I remember your uncle Joe John. He thought he was gonna be a rodeo rider. He was in the chute on top of a bronc, and the boys on the gate asked if he was ready. Joe John says, 'I was born ready.' When they opened the gate, Joe John came out before the horse. He got bucked off in the chute!

"It was probably a good thing Joe John got out of this country. It was pretty rough in those days."

As Dave talked, we got the chores done, and I noticed that even though the place was obviously old and well used, every gate swung easily, and every tool had a place. Finally we'd fed all the cattle and goats, and a flock of wild turkeys was scratching through the hay Dave had scattered on the ground for his calves.

In the house his wife, Kathryn, a slim and elegant woman even smaller than Dave, had cake and coffee ready. "Did you tell the one about Joe John at the rodeo?" she asked. When Boone and I laughed, she said, "Oh, I guess you did," smiling at her husband as if they were both 20 years old. Dave admitted to being 80, but in the Breaks you never ask a woman her age or a man how many cattle he runs. Kathryn did say they'd been married 52 years—living and working alone in the wildest Breaks, at an age when half the eastern seaboard feels lucky to drive a golf cart.

Dave lit a cigarette. "You wanted to know about the Breaks before the dam. Well, after they cleared out most of the rustlers, people started farming on the flats down there. They weren't big farms, but in the early thirties people were makin' big money raisin' alfalfa seed. Then the Corps said they had to sell to the government or they'd be flooded by the lake. One guy I knew made $6,700 off alfalfa one year, and they offered him $7,700. Barely more than one year's take!

"The only guy I heard of who got the price he wanted was an old cowboy who had a little place above Fort Peck. The way the story goes,

Landmark for the lost, target for the bored, warning for the speed-tranced, a road sign almost counts as company in the big empty Breaks. "It's nothing to drive 250 miles to a game or dance," says a resident. "That's how you find things out here."

he'd saddle up and ride to the Corps headquarters, then sit down and put his boots up on the colonel's desk, spurs and everything. Then he'd get out his sack of Bull Durham and roll cigarettes, and not too neatly either. After a few months of that the colonel said to give him whatever he wanted, just keep him away from his desk.

"I worked on the dam too for a couple years. It was a rough town and a tough job, but four times what you could make as a ranch hand. We were workin' in one of the tunnels one time, and this steel beam killed a guy. They just laid him over to the side and didn't haul him out until the shift changed. But it was the only real work around."

Kathryn nodded her head. "It was hard back then. Before the dam, half the people in the hills were making moonshine. My father had his still out in the chicken house. He figured the law wouldn't look there, and they never did. One year just before Christmas he got pneumonia and was in the hospital. We didn't have any money at all, so my mother went to visit him and asked how to draw the whiskey off. She came home and filled up a bunch of

jars. We sold them at a dance and made $44, and had a real nice Christmas. Some of the snootier women got mad and said if we were that broke, they'd have helped out." She laughed, giving her opinion of that offer.

"Oh, times are a lot better now," Dave said. "Everybody's complaining about cattle prices, but they'll come back. They always do." He looked at me. "What else would you like to know?"

"Just one thing," I said, and told them about Lewis and Clark and the uninhabitable Breaks. "Now why would anyone want to live in country like that?"

Dave just shook his head and smiled, but Kathryn looked thoughtful. "I guess we live here because we like to be left alone. Oh, it's nice to have people visit, like you folks. And we like people all right. But we like them on our own terms."

By the time we left the high Breaks, the sun was on the horizon, turning the tops of the snowy, blue-shadowed hills a solstice white, as if we were surrounded by miles of frozen whitecapped waves. The stars came out and lit the white landscape, about as brightly as a kerosene lantern in a log house. We drove into Jordan and headed to the Hell Creek Bar, one of two alternatives to QD's Cafe in all of Garfield County, for a beer and a burger.

The bar was crowded for a Thursday night, full of ranchers in their warmest outdoor clothes and even a few wives, standing around under the mounted heads of deer and antelope. It was also oddly quiet. We took the one free table, over by the jukebox. One of the bartenders came over to take our order. I mentioned that it seemed busy for a weeknight.

"They found those men today," the bartender said. A week before, two local ranchers had flown out in a small plane to check on their cattle. They never returned. The wreckage and bodies had just been found, after one of the biggest searches in Montana history, by one of their neighbors on a snowmobile. The bar was in the middle of an impromptu wake, mourning neighbors.

Outside, the sky was clear over Garfield County, and the temperature had dropped below zero. Boone stood there, hands in his coat pockets, looking up. Even with the neon lights of the bar, there was the Milky Way, as substantial as a glacier. "If I could, I'd move back here. I'd get some cows and buy some place up Steve Forks."

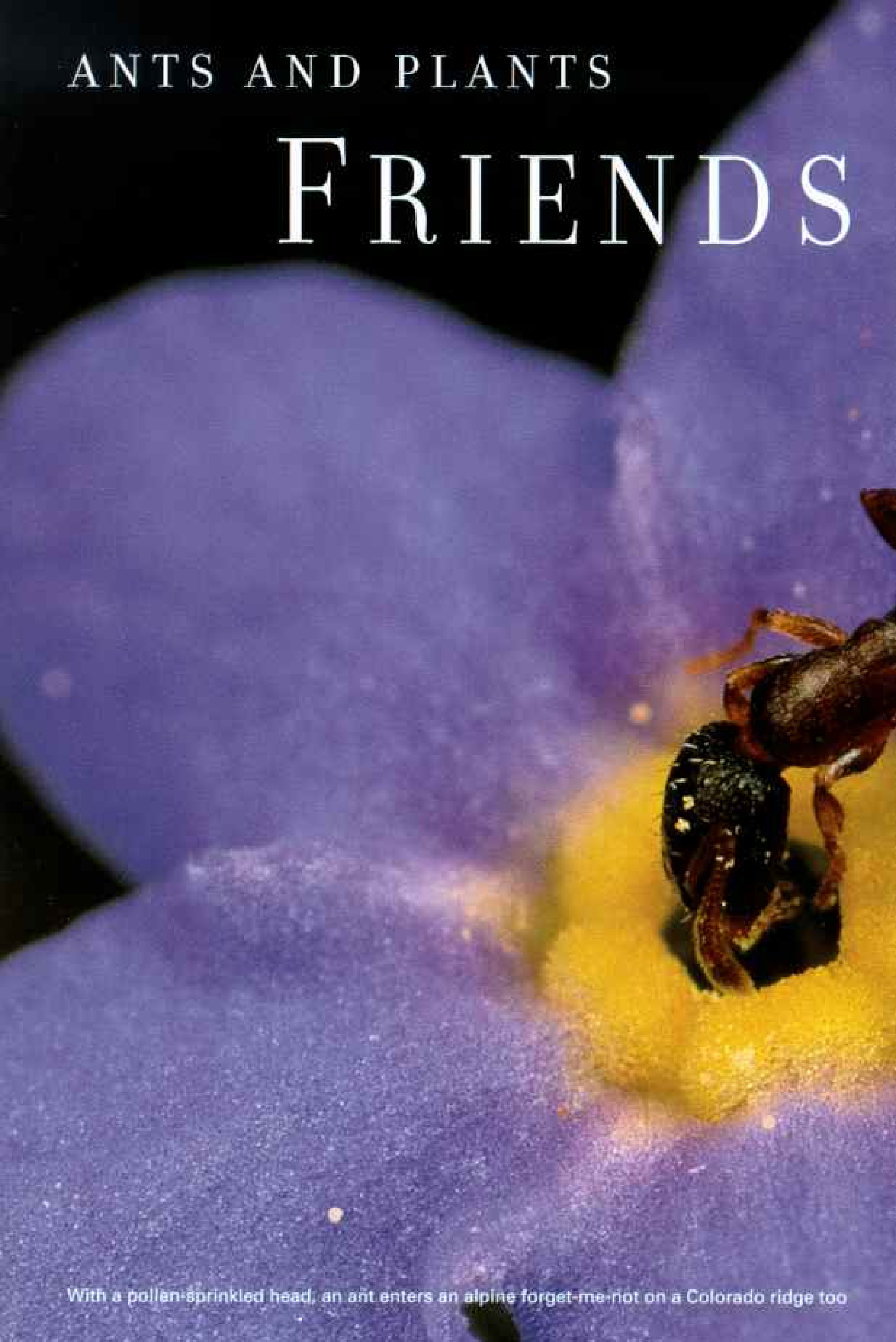
"Why?" I knew Boone's new place was a very profitable wheat farm.

He took his eyes from the sky and looked at me, a big man who had almost starved on a homestead when he was a child. "Freedom," he said.

And he was right. I could hear it, murmuring through the door of the Hell Creek Bar: a freedom that meets other people only on its own terms—and yet forces you to care, almost too much, about every one of your neighbors scattered across a rivered desert. That is the contract that allows people to live in that uninhabitable country. □

ANTS AND PLANTS

FRIENDS



With a pollen-sprinkled head, an ant enters an alpine forget-me-not on a Colorado ridge too

Article and photographs by MARK W. MOFFETT

AND FOES

cold for most pollinators. Ants and plants often—but not always—act as allies.

Engulfed by plant resin 90 million years ago, a *Sphecomyrma freyi* worker in amber (below) was the first known ant specimen from the Cretaceous period. Modern ants can suffer the same fate, such as one (right) trapped in resin spilling from the trunk of a rain forest tree in French Guiana.

Sphecomyrma, found in 1966, proved to be a classic missing link, intermediate between modern ants and their wasp ancestors. Yet it was apparently already social, as are today's ants, with a queen atop the pyramid of a highly organized colony. The fact that ants live in colonies means that they can be especially valuable to plants when they act as defenders. In return for sugary rewards a colony can send out workers to guard every square millimeter of a plant's surface. And because workers do everything for the common good—protecting their food source and the reproducing queen are their foremost tasks—they sacrifice themselves at an instant's notice. So the workers' thorough coverage and extreme devotion to duty make them highly desirable for any plant that finds a way to make use of a colony's efforts.

Of course, for the same reasons that ants can be one plant's best buddy, they can just as easily be another plant's worst enemy. If the tenacious ants want to take something plants, or humans, don't want to give (leaves in the case of leafcutters, seeds in the case of seed predators, or coleslaw in the case of a picnic), they often take it with sheer force of numbers.

In my global quest to document the relationship between ants and plants, I have seen many intriguing interactions, some rarely photographed, such as the ant acting as a potential pollinator on the previous pages and other examples on the pages that follow.

Naturalist Mark W. Moffett's odyssey into the world of ants has included Geographic articles on marauder ants (August 1986), trap-jaw ants (March 1989), leafcutter ants (July 1995), and part one of "Ants and Plants" (February 1999).

A CLOSE-KNIT BUNCH

High in a tree, weaver ants grab an adjacent leaf and stem with mandibles and toes and pull, gradually binding them together. In the Old World tropics a single weaver colony may have dozens of leafy nests, defended fiercely. Some treetop ant species construct nests of mulched plant material called carton; others live in dead wood, canopy soil, or hollow twigs.

GOOD EATS

Sometimes plants lure ants with nectar and other foods. *Ecta-tomma tuberculatum* ants in Peru drink a sweet sap that oozes from green spots along the petal margins of passion flower blooms (facing page). With open jaws, workers aid the plant by keeping pests from invading the flower. Likewise, *Myrmicaria* ants (right) defend a young bamboo in Malaysia in exchange for nectar found between the plant's segments. This *Camponotus* ant (top right) prefers the nectar when it has been digested and excreted by another insect, which itself escapes the ant's wrath. On plants in French Guiana, caterpillars—soon to become metalmark butterflies—ply ants with a liquid excreted from the end of their abdomens. Grapelike clusters on their heads (top) appear to produce chemicals that keep the ants alert to potential threats to the caterpillars. While the ants are distracted from guarding the plants, the caterpillars feast.

NOMADS' MARCH

While many ants tend aphids and mealybugs for their honeydew excrement, the migrating herdsman ants of Malaysia, *Dolichoderus cuspidatus,* take this lifestyle to the extreme. In fact these ants and their mealybugs literally cannot live without each other. The ants tend the mealybugs, place them on plants to feed, and diligently stand guard (middle left). The ants' nests are temporary, consisting of

10,000 exposed and interlinked bodies (above). Hidden within are the queen and the young—and thousands of mealybugs, mostly adult females that give birth there. In true nomadic fashion, like Bedouin with goats and camels, the ants shift the site of their bivouacs to transport the mealybugs to fresh pastures (top left). The queen, surrounded by guards, marches alongside (bottom left).

STICKY SITUATION

In South Africa the flowers of *Erica massonii* have petals as sticky as flypaper, but ants persist in climbing the flower despite fatalities. Why should some flowers reward ants, while this one kills them? Perhaps because *Erica* grows in poor soils, it has no nectar to spare. Only sunbirds—the plant's pollinators—extract nectar without getting glued.

BAD ANT, GOOD ANT

In Namibia, a rare sighting: an African species of the marauder ant, most often found in Asia. Workers retrieve seeds (above right) and tear them apart for a meal. Other ants, rather than destroying seeds, bury them as if they were gardeners. In the unique *fynbos* shrubland near Cape Town, South Africa (top), entomologist Hamish Robertson examines one of the 1,300 plants that depend on such ants. As payoff for being planted, each seed provides its ant assistant with a meal: the soft, nutritious elaiosome at its tip (above left). Not all fynbos ants are deserving, however. These Argentine ants, accidentally introduced into South Africa from South America, eat elaiosomes and discard the seeds without burying them, thus jeopardizing the fynbos community. Half a world away in Colorado a plant helper, a species of *Formica* ant (right), drives off a fly that attacks embryos of the Aspen sunflower. Sometimes allies, sometimes enemies, the dramas of ants and plants never end. □

From Fins

It never walked on land. But the aquatic animal thought to have left these stone footprints in Ireland more than 365 million years ago moved through the muddy shallows on four feet—an evolutionary milestone that would change life on Earth forever. These tracks and other recent fossil finds have forced scientists to rethink when and how life came to land.

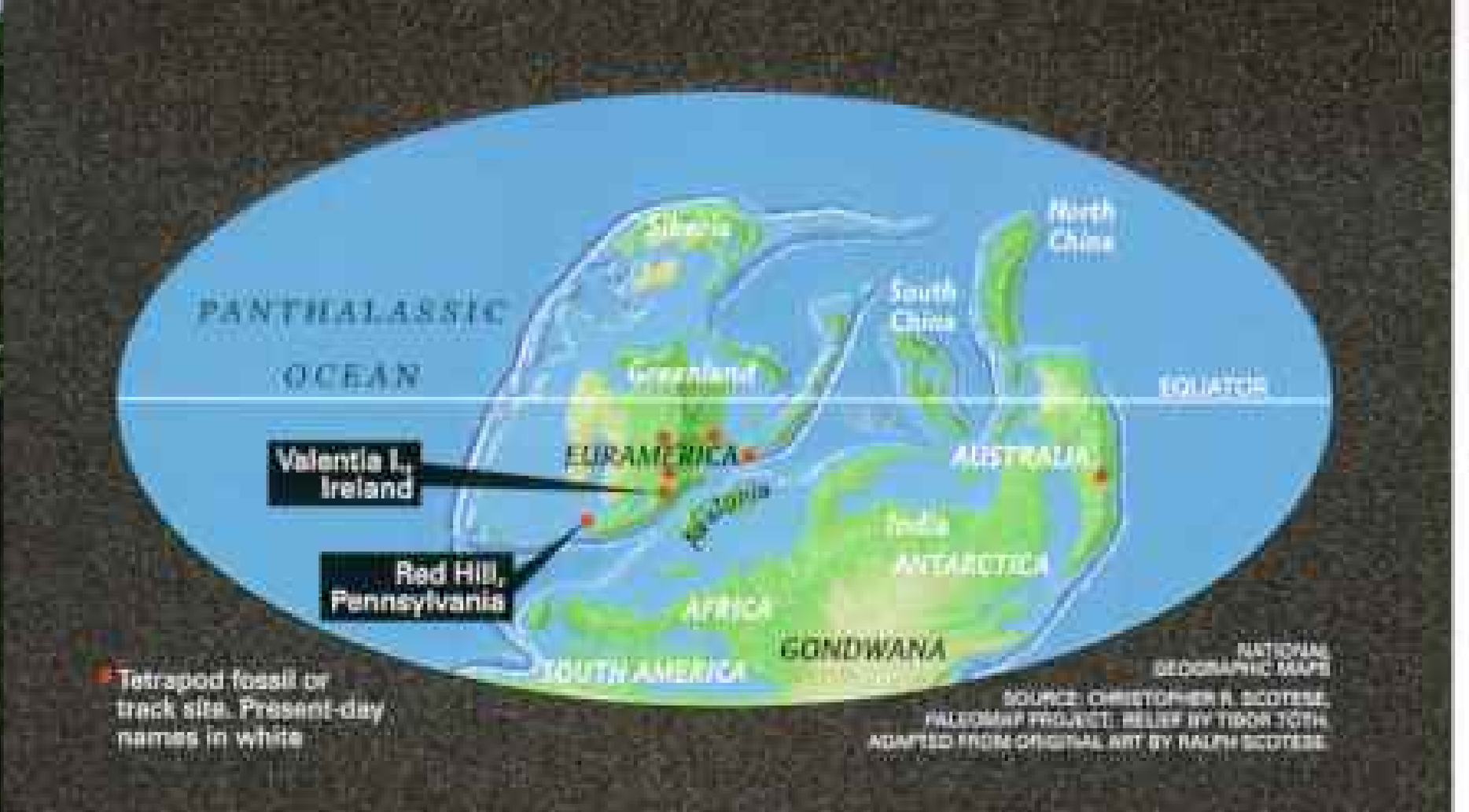
to Feet

By **KERRI WESTENBERG**
Photographs by **JONATHAN BLAIR**

"Come to see our big fossils?" asks Joseph O'Shea as he greets a visitor from the red doorway of his house on Valentia Island off the remote southwest coast of Ireland. O'Shea, a whiskered, bright-eyed man in his 80s, is delighted with the unexpected company. "Never seen them myself," he says, pointing a gnarled finger across a green pasture, "but they're on the far side of that field at the edge of the sea."

Until 1992 no one had seen what has drawn me to this isolated coast just south of Dingle Bay—the fossilized footprints of a mysterious animal that lived more than 365 million years ago during the Devonian period. That year Iwan Stössel, a Swiss geology student, was walking the coast and came across this set of 150 tracks, each the size a basset hound might leave. Paleontologists call the kind of animal that made these prints a tetrapod, which translates from Greek as "four-footed." Such animals, with four limbs rather than fins, were new during the Devonian, which is known as the age of fishes because of its abundance of fish fossils. But until recently scientists could say little about tetrapod evolution. Only one nearly complete early tetrapod, a creature called *Ichthyostega*, had ever been found.

That dearth of fossils has long frustrated specialists because tetrapods supposedly made one of the greatest breakthroughs in the history of life on Earth, one that made possible the evolution of humans. By developing those four limbs they became the first large animals able to crawl out of the water, where life first



Discoveries From the Devonian World

On the trail of an ancient tetrapod—the name scientists use for any animal with a backbone and four limbs—Swiss geologist Iwan Stössel (left, in plaid shirt) and friend Tom Dennehy clear rocks from the fossilized tracks on Ireland's Valentia Island. A stunned Stössel discovered the footprints in 1992. "When I saw the trackway, I knew it was important," he says. "The oldest tetrapod fossils then known were younger than these rocks." The mysterious walker, like all early tetrapods found to date (at sites shown on map above), lived in tropical wetlands during the late Devonian (time line, facing page).

evolved, onto dry land. But new fossil discoveries, such as these footprints, have suggested answers—and created controversy—about just when and how those first steps were taken.

The Valentia Island footprints are the longest of the known tetrapod trackways. Although today the Valentia tracks lie at the edge of the ocean, symbolizing the emergence of animal life from the sea, their current position is only a geologic fluke. When they were laid down, Ireland was landlocked and south of the Equator. In fact, the Valentia footprints were probably left in a shallow tropical stream.

With geologists Ken and Bettie Higgs from University College Cork, I follow Joseph O'Shea's directions, crossing the pasture and climbing down onto rocks near the shore. On a 30-foot-long ledge the tracks lay gleaming in the sun, distinct and deep and puddled with salt water. They wind across the ledge, as if the tetrapod that made them all those years ago had meandered leisurely.

I try to imagine what this animal would have looked like, but I conjure up only an unclear image of a fish with limbs. The creature left no bones, only clues that could be deduced from the tracks. Stössel, who measured the footprints, estimates the animal was more than three feet long and powered its steps with large back legs. And because the trackway showed no hint of a tail being dragged behind, scientists have concluded that this creature was not walking on dry land. Instead, it waded through shallow water with its tail buoyed up.

We linger at the shore, talking about the world this creature inhabited. At the beginning of the period 410 million years ago most of the world's landmass was divided into two continents, Euramerica and Gondwana (map, above). I could have walked from Ireland back to America. Oxygen levels were similar to those of today because plants, which produce that gas through photosynthesis, had begun colonizing land 15 million years earlier. Mats

of algae, bacteria, and fungi stretched over moist patches on the continents, while along shorelines and on floodplains grew short, stick-like plants without leaves. The only sizable animals on land were spider-like creatures that lived in the vegetated regions.

During the ensuing 50 million years, the Devonian world grew increasingly green as the interactions of plants and animals worked the rock into soils. By the end of the period the planet's two large continents were covered in places by forests of primal shrubs and trees the size of Douglas firs and were being melded by plate tectonics into a single supercontinent.

As we look out to sea, Ken tells me that Devonian waters were filled with gigantic predatory fish with crushing jaws and protective armor made of external bone. Sharks ate their way up deep, wide rivers. The Valentia tetrapod descended from one of the fish that lived close to the river's edge in waters too shallow for the predatory giants.

Still, the Valentia tetrapod remains a phantom to me. To put flesh on the animal that made those fossil footprints, I seek out scientists specializing in the Devonian.

In Stockholm, I ask Hans Bjerring of the Swedish Museum of Natural History what the creature might have looked like. He shows me a drawing of *Ichthyostega*, discovered in Greenland in 1929 and for most of this century the sole example of early tetrapods. The drawing portrays the animal standing at the edge of a pond in a sparse landscape. The tetrapod has broad, powerful shoulders, a long, rounded tail, and short, sturdy limbs.

This representation was based on the studies of the late Erik Jarvik, who until his death last year was one of the world's leading experts on ancient fish and an elder colleague of Bjerring's. As a young man, Jarvik had helped collect the original *Ichthyostega* specimens, and he undertook the description of the tetrapod in the early 1930s. The task took decades.

Unlike Jarvik, most specialists during that time believed the animals that evolved limbs arose from an ancient fish population that lived in lakes that dried up episodically. Those fish had to use their fins to drag themselves to other ponds. The fins eventually evolved into limbs, according to this theory.

Bjerring, however, scoffs at that scenario as "hocus-pocus." He thinks that *Ichthyostega* evolved in swamps clogged with water plants. "It isn't easy to swim around thick vegetation," he explains. Fins became limbs, he maintains, because they made it easier to maneuver through the swampy mire. In fact, he doubts that *Ichthyostega* ever actually stepped foot on land. Many specialists now agree.

POWERFUL EVIDENCE that limbs evolved while tetrapods were still waterbound comes from a fossil discovered in the mountains of Greenland in 1987 by Jenny Clack, a paleontologist at Cambridge University's Museum of Zoology. That fossil of a tetrapod known as *Acanthostega* and dating from 360 million years ago emerged from a ton of rock Clack brought to her lab and painstakingly investigated for clues to the past. Among the hundreds of specimens she uncovered was the most complete Devonian tetrapod ever found, an *Acanthostega* that she affectionately calls Boris.

She leads me to the museum display case where Boris is kept. More than any artist's drawings could do, Boris lets me visualize what tetrapods looked like. Still partly encased in rock and curled up like a sleeping dog, Boris has stumpy legs, a tail almost the length of his body, and short ribs emerging from his backbone like the teeth of a comb. He also has a snout like a crocodile's and a jaw filled with sharp teeth. He seems to be smiling devilishly.

The fishy ancestry of land vertebrates can be seen in the belly fins of *Eusthenopteron*, an extinct lobe-finned fish found in Quebec's Miguasha Park. "These fins contain the same bones as our arms and legs," says paleontologist Richard Cloutier, holding the fossil.

1. Lycopsid, tree-like club moss
2. *Archaeopteris*, early forest tree
3. *Rhacophyton*, fern
4. Early seed plant
5. Megalichthyid, lobe-finned fish
6. *Hyneria lindae*, lobe-finned fish (8-12 feet)
7. *Hynerpeton bassetti*, tetrapod (3-4 feet)
8. Groenlandaspidid, placoderm fish
9. Early ray-finned fish

The World Where Limbs Evolved

A 12-foot-long reason to take to the land: Devonian tetrapods like *Hynerpeton* (7) shared waterways with fearsome fish such as *Hyneria* (6). Both were discovered in the same fossil bed near Hyner, Pennsylvania, the site on which this scene is based. Early limbed vertebrates like *Hynerpeton* were built for the water. They breathed with a fish's gills and swam with a fish's tail. Their legs helped them push aside debris or hold their place in currents. So why would tetrapods, so well suited to water, eventually turn to land? Avoiding predators was just one possible motive. A short walk might lead them to meals. Or perhaps landlocked pools offered safe places to lay their eggs.

TOOL KIT FOR WALKING

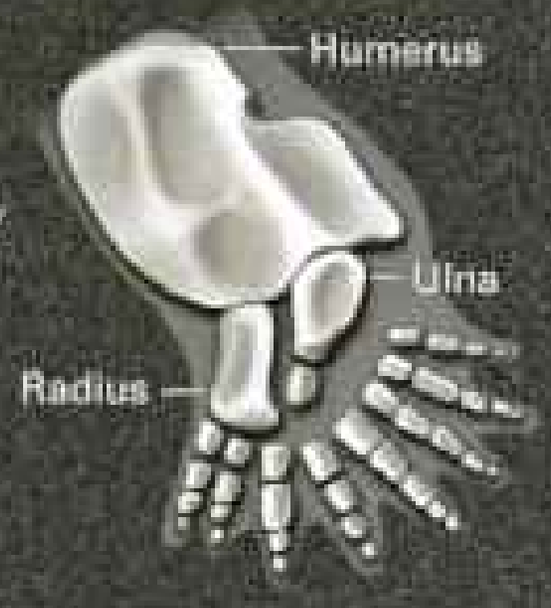
The three strong bones in all land vertebrate arms can be traced back to the fins of lobe-finned fishes. But limbs evolved at first for life in water; the arm bones of most early tetrapods (far right) were too weak to bear weight without water's buoyancy. The same parts were later adapted for walking on land.

ART BY KAZUHIKO SANO; DIAGRAMS BY JEN CHRISTIANSEN, NGS STAFF

Lobe-finned fish *(Eusthenopteron)*

APPROXIMATELY ONE-HALF ACTUAL SIZE

Tetrapod *(Acanthostega)*



"Boris clearly didn't walk on land," says Clack. She points out the anatomical reasons for her conclusion. His wrists and ankles are too weak to support his weight on land. His ribs are too small to support the muscles needed to hold his body off the ground. His fish-like tail would have dragged on land, slowing him down or getting constantly scraped and infected. He had gills as well as lungs.

Clack shows me more evidence that Boris was a water dweller, placing the beautifully preserved skull of another *Acanthostega* in my hand. It too was collected in Greenland. She points out a series of holes, each about twice the size of the periods on this page, that run along the jawline and below the eyes.

"These holes are part of a sensory system like the type fish use today, stretching from head to tail, to detect vibrations in the water, such as those made by moving predators and prey," she explains.

Like Bjerring, Clack believes *Acanthostega* evolved its limbs and toes to maneuver in swampy waters. "If you can grasp onto vegetation, then you can hold your position in a stream," she explains. "You can feel your way through murky water. You can dig in the mud for prey. You can avoid bigger predators by crawling into plant-choked waters where swimming would have been difficult."

So must we conclude that early tetrapods never walked on land? Must the first groundbreaking ancestors of humans come from another source? Probably not.

Writer KERRI WESTENBERG secretly dreams of becoming a paleontologist. This is her first article for the GEOGRAPHIC. JONATHAN BLAIR has photographed 33 articles for the magazine on subjects as diverse as ancient extinctions, Roman ruins, and meteorites.

Part fish, part amphibian, *Acanthostega* (model, far left) is a "missing link" says Cambridge paleontologist Jenny Clack (left, in blue), who nicknamed this fossil specimen Boris. Clack returned from Greenland in 1987 with a rock that showed only the tip of an *Acanthostega* skull. Three years of cleaning by Sarah Finney, to Clack's right, revealed a surprise at the end of its arm: eight fingers instead of the five that are standard.

MODEL RACING PAST BY RICHARD HAMMOND. SPECIMEN FROM GEOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Land's early pioneers, ancient plants left traces beneath a sheep pasture in Rhynie, Scotland. Nigel Trewin, at far left, and Lyall Anderson, both of the University of Aberdeen, examine drill cores rich in fossils from 400-million-year-old plants. Vegetation colonized shores and wetlands millions of years before animals. The green invasion prepared the way for land vertebrates by forming swamps, spurring the evolution of legs for navigating through debris-choked water and lungs for breathing air when plant decay used up water's dissolved oxygen.

At a site called Scat Craig in northeastern Scotland, Per Ahlberg, a young paleontologist from the Natural History Museum in London, has found pieces of a new tetrapod that lived earlier in the Devonian than any other of its relatives. The animal, named *Elginerpeton* after a town near Scat Craig, confuses any simple story of how and when limbs evolved. Ahlberg takes me to the place where the perplexing fossils were found.

"We've only found parts of its jaw, pelvis, shoulder, and limbs," he says as we pull on Wellington boots and make our way down an overgrown path, crossing a cold, shallow stream. "Those pieces, however, tell us a lot. *Elginerpeton* was as large as you—five feet long, and it already had developed robust hind limbs."

Was this earliest of tetrapods a land dweller? Does *Elginerpeton*, which lived some 370 million years ago, prove that at least some tetrapods left the water during the early days of the Devonian? Not exactly.

"It had this peculiar twist to its hind limb," Ahlberg explains. "The leg stuck out sideways, like a salamander's or crocodile's, but the sole of the foot faced backward rather than down. That would be no good for walking at all, as the animal couldn't put its foot flat on the ground. But it would be ideal for paddling in water."

So why did the rest of the limb seem built for crawling on land? Ahlberg suspects that *Elginerpeton*'s ancestors had evolved the ability to walk—whether in water or on land—but that *Elginerpeton* itself had returned to a strictly aquatic life for unknown reasons.

Elginerpeton's ancestors may well have given rise to other tetrapods that stayed on land. In 1984 a Russian paleontologist discovered the limbs of a tetrapod called *Tulerpeton*, which seemed made for crawling. But it's difficult to say it was a land dweller because it was found surrounded by ancient fish fossils at a site that during the Devonian was a coastal lagoon.

OTHER TETRAPOD FOSSILS have emerged in recent years from Latvia and Australia. But only one clear-cut candidate for a land-dwelling tetrapod has emerged—a creature named *Hynerpeton*, discovered in 1993 near the town of Hyner in north-central Pennsylvania.

"I was very lucky to find this particular bone," said Ted Daeschler, a Devonian specialist at the Academy of Natural Sciences in Philadelphia. He is holding a three-inch-long piece of *Hynerpeton*'s shoulder that only an anatomist could appreciate. Striations on that chunk of shoulder, however, revealed a lot about *Hynerpeton*'s behavior. They showed where the animal's forelimb muscles had attached to the shoulder, and judging from the size of those muscles, Daeschler believes the

SPECIMEN FROM GEOLOGICAL MUSEUM, UNIVERSITY OF COPENHAGEN

Wanted: More Bones

Theories about tetrapod origins are built on a few rare fossils. In the 12 years since this *Acanthostega* skull (above) was unearthed, the number of known tetrapods has jumped from two to eight. Per Ahlberg (right) recognized a tetrapod jaw among fish fossils at Oxford's University Museum in 1990. He tracked down matching parts in four other collections and named the long-overlooked creature *Elginerpeton*. Surprising fossils keep emerging. Ted Daeschler (below) has dug up a Devonian fish fin that may have finger-like bones.

Who walked here? A model based on known fossils and posed to fit the Valentia Island tracks suggests an answer: a tetrapod, its tail floating in water without leaving a mark. Now on dry land, these tracks foreshadow vertebrates' new world to come.

three-foot-long tetrapod had developed the most robust and muscular forelimbs of any known Devonian animal.

"No doubt about it," he says. "This animal could have done push-ups in the water or on dry land."

Hynerpeton's shoulder bone also indicates that the animal would have relied on its legs to give its body momentum, rather than strictly flexing its backbone and tail as fish do.

The only Devonian tetrapod found in the United States, *Hynerpeton* lived 365 million years ago, making it the third oldest tetrapod yet discovered. If *Hynerpeton* indeed lived on land, it would suggest that the move onto land occurred early. And while some tetrapods returned to the water, others would have thrived in their new terrestrial world. Over millions of years, in the ensuing periods known as the Carboniferous and Permian, they would have given rise to the ancestors of both dinosaurs and mammals.

Daeschler returns regularly to the site where he found *Hynerpeton*'s shoulder fragment, seeking more clues to the world tetrapods pioneered. The site, called Red Hill, is a road cut bulldozed through an outcrop of the same kind of reddish sandstones that have yielded the Devonian fossils of Greenland and Europe. Its rocks span a long stretch of Devonian time, and the enormous variety of fish, arthropods, and plants it has revealed from the late Devonian makes it one of the world's most important sites from that period. Daeschler invites me to visit Red Hill for a weekend dig. Hoping I might actually find a piece of a tetrapod myself, I enthusiastically join him and two vans full of fossil hunters along Pennsylvania Route 120 on a chilly October morning.

The fossil hunters, a mixture of amateur and professional paleontologists, quickly scramble up the steep sides of the road cut. Wielding rock hammers and Swiss army knives, they begin extracting bits and pieces of Devonian fish, the most abundant fossils at Red Hill. I find nothing—not even fish teeth.

"Your eyes aren't trained to see fossils yet," Daeschler says, comforting me.

Attempting to learn, I stay close to Del Szatmary, a New Jersey police officer who has found many fossils at Red Hill. Glancing down at the base of the road cut, he spots intriguing markings on a small rock by his feet. Those markings turn out to be those of an extinct spider-like animal. Not exactly a tetrapod, the quarter-inch-long fossil nevertheless is a new species that fills an important gap in the evolutionary history of arachnids.

I SPEND THE REST OF THE DAY a bit jealous. My fieldwork is nearing its end. By now I can walk a site like Red Hill and see a piece of a tree and imagine a Devonian forest there. I have no trouble envisioning Szatmary's arachnid poised on the foliage of that forest. If I could find even a toe of a tetrapod, my mind's eye could turn it into a salamander-like creature the size of a crocodile, a predator lurking in those woods.

In fact, a toe would be particularly satisfying. I have spent many hours thinking about limb parts—and even the number of digits each limb might possess: To their surprise, paleontologists have found tetrapods with as many as eight toes, confounding their assumption that five has always been the norm.

I have learned that limbs probably evolved for something totally different than what we, descendants of tetrapods, use them for. But that's how evolution works. Something evolves that solves one problem and opens up a world of new possibilities. Consider what the limbs humans inherited from tetrapods have done. They not only put our species on dry land, they also let us run, build, draw pictures, make music. In fact, some scientists argue that if tetrapods had not developed limbs, the big brain of humans would never have developed.

"What purpose would it have served?" asked Erik Jarvik in a 1980 book I'd read. "It was when the basic pattern of our five-fingered hand for some unaccountable reason was laid down . . . that the prerequisite for the origin of man and the human culture arose."

Indeed, without that fortuitous invention, old Joseph O'Shea could never have lifted his gnarled finger that sunny day in Ireland and pointed me the way to those tracks at the edge of the sea. □

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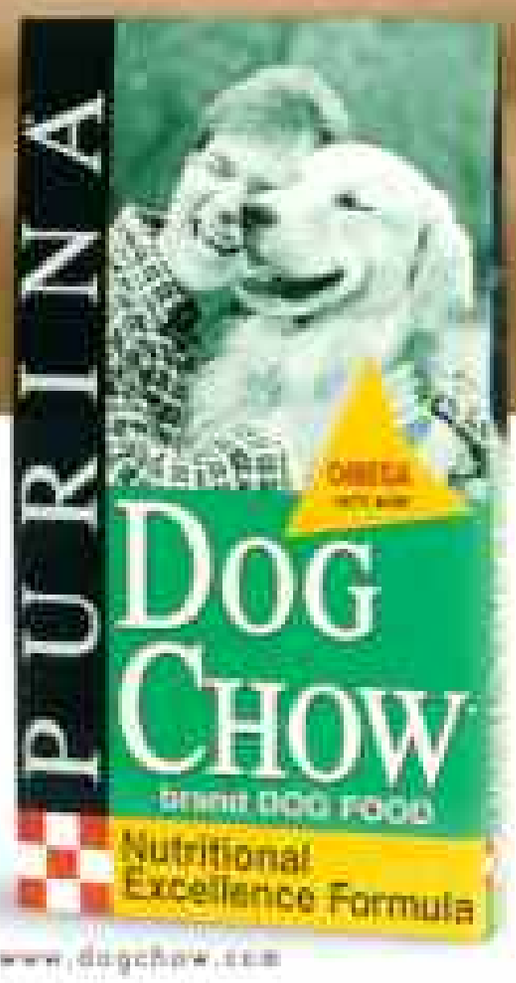

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NATIONAL GEOGRAPHIC

MAY 1999

The Cover

Predators in training, young African wild dogs wrestle with a strip of impala hide. Photograph by National Geographic photographer Chris Johns

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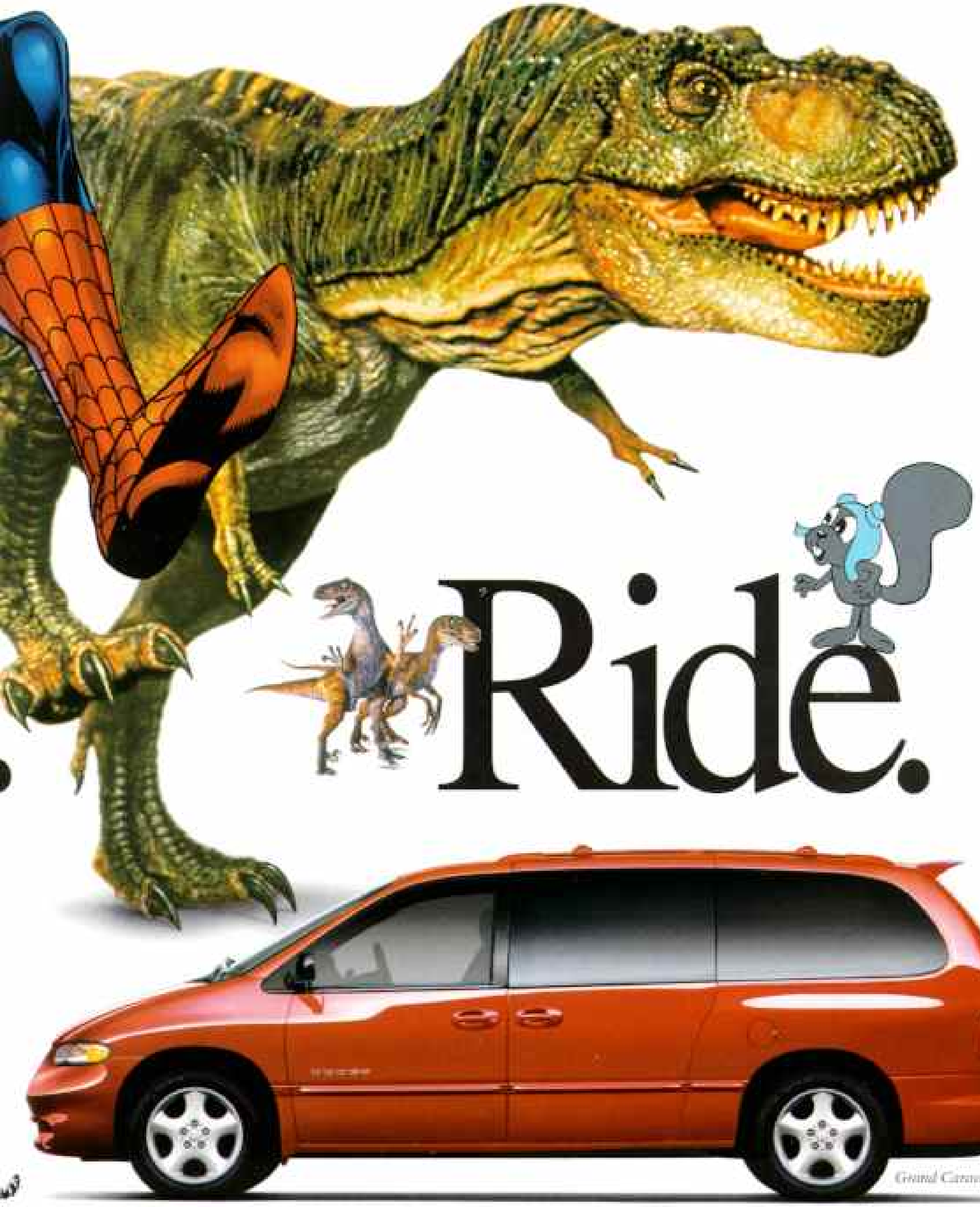

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NATIONAL GEOGRAPHIC

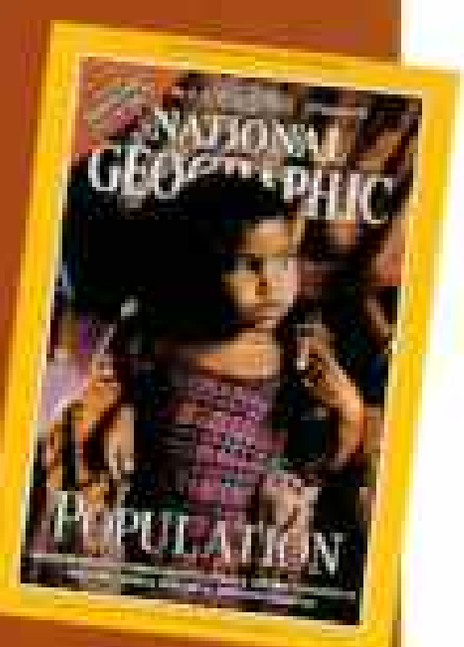
Behind the Scenes

Getting More Pirates per Galleon

We've always loved a good pirate tale. In February 1922 the GEOGRAPHIC published "The Haunts of the Caribbean Corsairs," an ode to "buccaneers, hiding like wolves in their lairs . . . wont to spring upon the gold-laden Spanish galleons, carry off their booty to some lonely island retreat, and there divide the loot to be spent in riot and debauch." The article was likely a favorite of John Oliver La Gorce, later President of the Society; he and artist N. C. Wyeth shared a fascination with the subject. Wyeth sketched a threatening bookplate (above left) for La Gorce and portrayed his friend as an arms-crossed pirate (top, at center) in "The Duel on the Beach." The painting is on display accompanying the exhibit "Pirate Ship *Whydah*" in Explorers Hall through June 20.

An Issue of State

"Your population issue really put across what we've been trying to say," remarks State Department official Margaret Pollack. She ordered a thousand copies of the October 1998 GEOGRAPHIC, which were sent to every U.S. Embassy and distributed at the 1998 symposium on Women, Population and Science in Washington, D.C.



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For her innovative approach to helping students flourish in the real world, State Farm is proud to present Ms. Ann Greiner with our Good Neighbor Award and her school, Grady High in Atlanta, Georgia, with a $5,000 check. We'll bet her students already have big plans for it.

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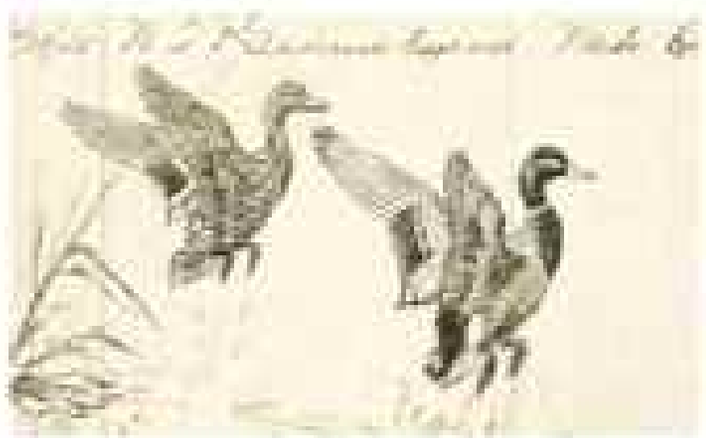

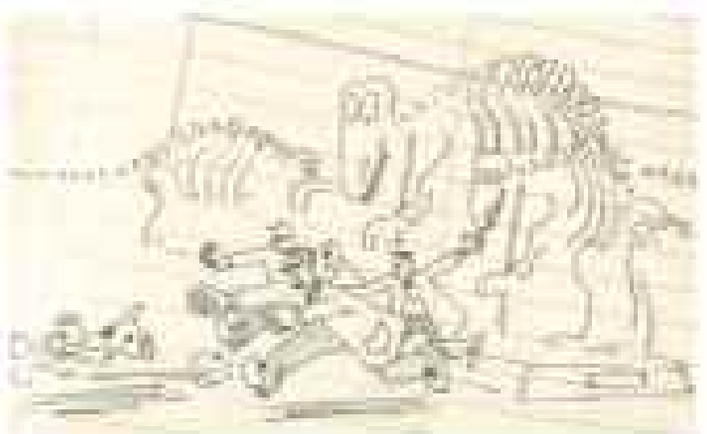

Drawing on His Experience

He showed signs of becoming an artist at the age of four. Walter A. Weber, whose career as a GEOGRAPHIC artist would eventually span 32 years, was visiting the Chicago zoo in 1910 when he drew a picture on his sandwich wrapper. "It was of a white peacock and astounded my parents by its likeness," he recalled. Decades later Weber was still drawing during lunchtime—and still astounding people with his talent. Guest books in our Records Library collection reveal an unexpected cache of Weber's wildlife illustrations among the signatures. According to Dick Pearson, retired Assistant to the President, Weber's on-the-spot sketches provided entertainment during certain Society luncheons in the 1940s and '50s. "They were set up to honor explorers and other important visitors," says Dick. Some guests signed their names with cartoon flourishes: Jacques-Yves Cousteau's signature was accompanied by a comical octopus; Smithsonian anthropologist Henry B. Collins poked fun at paleontologists (center right). But none of their works rivaled Weber's creations. One question remains, however. When did he have time to eat?

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Outstanding in Their Fieldwork

What do you get when you partner teachers on their summer break with research geographers? Tennessee Geographic Alliance coordinator Sid Jumper and biogeographer and research grantee Sally Horn—both of the University of Tennessee, Knoxville—wanted to find out. In a cooperative effort between the Society's Geography Education Outreach and the Committee for Research and Exploration, six state geographic alliance teachers from across the country spent ten days in the Dominican Republic helping Sally hunt for evidence of ancient glaciers (top). They found it. "Two of them discovered a spot that will be an area of major study on my next trip," she says. In December the teachers met with Sally (right, at center) at her Knoxville lab to study sediment samples they had collected. "I hope more research grantees will think of ways to include teachers," says Sally. "Bringing teachers into the field is a great way to bring geography into the classrooms."

SALLY P. HORN (TOP); JON S. MOLLERMAN

Survey 2000's Smashing Success

People won't sit at a computer for 20 minutes just to answer questions, experts told Valerie May, managing editor of National Geographic Online, when she proposed a survey on geographic mobility. They were right. "People stayed on 40 minutes to finish," she says of last fall's Survey 2000. Valerie hoped for 18,000 participants; she got 50,000.

"The response was so heavy that we bought a new server with six times more computing power to handle the responses," Valerie says. "It was great!" Results of the survey are scheduled for the December 1999 GEOGRAPHIC.

MICHAEL PEREZ, PHILADELPHIA INQUIRER

One More Time

Earl V. Shaffer was the first to hike the Appalachian Trail in one trip and was the lead in our August 1949 story on the famous footpath. In 1965 he hiked it again—the first to make the trek in both directions. Now Earl has made history once more. Just before his 80th birthday he became the oldest person to hike the 2,160-mile route. It will be his last "first" though, he says. "I'm mighty, mighty, mighty glad it's over."

TEXT BY MAGGIE ZACKOWITZ

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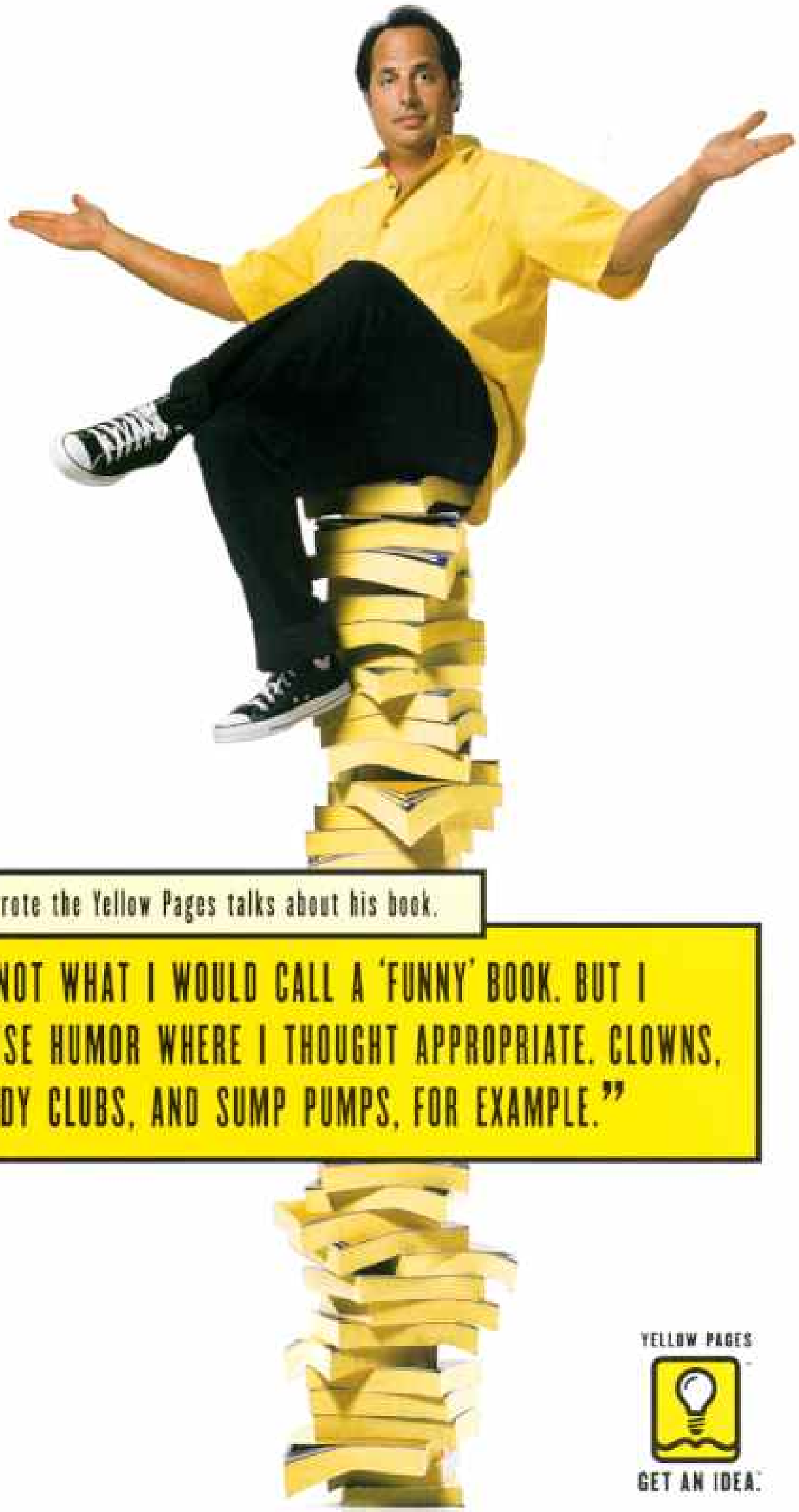

The man who wrote the Yellow Pages talks about his book.

"IT'S NOT WHAT I WOULD CALL A 'FUNNY' BOOK. BUT I DID USE HUMOR WHERE I THOUGHT APPROPRIATE. CLOWNS, COMEDY CLUBS, AND SUMP PUMPS, FOR EXAMPLE."

YELLOW PAGES

GET AN IDEA.

Forum

With eight articles, our January issue received much praise for its varied topics. One member wrote that it covered his science-hungry son's favorite subjects—volcanoes and snakes. Another said, "The photos from Coral Eden are the best I have seen in your magazine."

Coral Eden

About six years ago I had the opportunity to visit my in-laws, who are missionaries in Irian Jaya, Indonesia. One of the highlights was a week-long snorkeling trip on the northern coast. We were told by the tribal people that we were the first to snorkel or dive the coral reef in that isolated area. The photographs in your article could capture only a small fraction of what I believe may be one of the most beautiful things in all creation. What a travesty it would be if we lost these places and future generations could not see their magnificence.

ANDREW NATHAN LAYMAN
Warsaw, Indiana

I can understand author-photographer David Doubilet's concerns about overfishing of coral fish and the destruction of coral to catch these fish. I do not understand why he finds it unfortunate that "these days the fishermen catch the fish not to eat or trade locally but to sell." It would seem that once the fish are harvested, it does not matter, from an ecological viewpoint, whether the fish are given away to neighbors as gifts or sold for consumption. Specialization and trade are necessary for us to rise above a subsistence standard of living.

DAVID KAHN
Montville, New Jersey

After reading your articles on endangered reef ecosystems, I was surprised to see two Banggai cardinalfish (pages 20-21) in a tank in a local bookstore. If their habitat is as restricted as you state, then it seems that consumers in the U.S. could be at least as much to blame for the ultimate demise of these elegant fish as the Indonesian divers who harvest them. Until tropical fish aquarists demand that fish be certified as having been harvested using sustainable techniques, such destruction will continue.

NOEL LUDWIG
Honolulu, Hawaii

Coral in Peril

I first learned about the use of cyanide when I inquired about my fish's health to my local fish dealer. I mentioned that they were dying very quickly. One minute they were swimming around in healthy, vibrant color, the next they were convulsing. No warning, no signs of stress. I was told in confidence that it sounded like a case of cyanide poisoning. The dealer said, "If the poison doesn't kill them on the spot in the ocean, it can linger and will certainly end in death." I wasn't sure if I believed it. But your article has confirmed what I hoped was not true.

ANTONINA M. LANDI
Rye, New York

I am five years old and like to read the NATIONAL GEOGRAPHIC magazine with my mamma. We enjoyed the article "Coral in Peril." But I became very sad and cried when I learned about fishermen poisoning the fish and corals. I think that this is not very good, not very fair, and not right. I want these corals to still be alive when I am big enough to scuba dive and see them.

GITA KESHAVA
Vernon, British Columbia

Lawrence of Arabia

I couldn't help but notice the similarities between your description of T. E. Lawrence—a man fascinated early in life with the knights and lifestyles of the Middle Ages—and that of the fictional character Sir Lancelot. Could the modern day hero, "fully conscious of his own failings," have lived his life emulating aspects of the greatest knight who ever lived? Both were illegitimate, saw themselves as champions of the downtrodden, sought to avoid physical contact, ate a meager diet, refused material rewards, and were in constant search for penance.

RANDY L. CLARK
Raleigh, North Carolina

We were a little disappointed to find no mention of Gertrude Bell in your excellent article. A friend and confidante of Lawrence, Bell had at least as much, if not more, influence in drawing the borders of the modern Arab states.

JOHN AND MARTINE HOUSE
Columbus, North Carolina

British adventurer Gertrude Bell did have a hand in postwar territorial settlements and helped establish Lawrence's friend Feisal as king of a new nation, Iraq.

While visiting relatives in Dorset, England, I went and searched for Lawrence's grave. I was surprised that a man described as "one of the greatest beings alive in our time" lies in a simple grave with no details on his life or exploits. In fact it was sad to see in a small, fairly unkempt graveyard one of England's heroes with no suitable monument.

MARK EDMONDS
Melbourne, Australia

Charles M. Doughty traveled through Arabia from 1876 to 1878 in much the same way Lawrence traveled through Syria in 1909. Lawrence himself wrote an introduction to a 1921 edition of Doughty's book *Travels in Arabia Deserta*, where he asserted that he and his English friends considered the

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"Doughty" sort of a bible in respect to the land, tribes, and people of Arabia, and that he could not have done without it.

WALTER WEISS
Baden-Rütihof, Switzerland

The geopolitical asides in the Lawrence story make us aware of what the European powers—and now we in the U.S.—have wrought in the Middle East.

SIMONE BROCATO
Columbus, Georgia

Hitting the Wall

I was a bit dismayed to read the Baffin Island first ascent article. The Society supports many worthwhile projects that result in knowledge gained, but this seemed to be nothing more than an attempt to conquer and subdue nature.

MICHAEL J. YOCHIM
Yellowstone National Park, Wyoming

The article revealed some of the fascinating techniques used by mountain photographers. Does anyone work harder for a picture than these brave fellows? I had always assumed they were really Tinkerbells fluttering around snapping shots of crazy rock climbers at their tasks. Indeed, NATIONAL GEOGRAPHIC has given me a new and awesome sense of the term mountain photographer.

JOHNNY ARMSTRONG
Ruston, Louisiana

The first tenet any novitiate of outdoor exploration learns is if you pack it in, pack it out. I wonder how much of the 1,300 pounds of supplies actually returned with the climbers. Spectacular climbing achievement and stunning photography in no way absolve one of the responsibility for preventing wanton desecration of pristine locales, even those as remote and seemingly insignificant as Baffin Island.

J. D. RICHARDSON
Austin, Texas

Author Greg Child assures us that the climbers removed all their equipment and trash by helicopter.

Ravens

Years ago while in Yellowknife in the Northwest Territories of Canada I was awakened by the howls of a dog. Looking from my hotel window, I determined the source: The dog was chained to his doghouse, and just in front of his nose a raven was teasing him. Meanwhile, the raven's partner was eating the contents of the dog's bowl. Minutes later the pair traded places. At the end the dog was hoarse and probably hungry.

JEAN-PIERRE GERMAIN
Landgraaf, Netherlands

Ravens smart? You bet. Seeing your pictures of these magnificent birds raiding snowmobile compartments (pages 112–13) brought back memories of a sled trip last winter to the Kakwa region of northwestern Alberta. I watched as one huge specimen unzipped the three horizontal zippers on the windshield bag, pulled out some Kleenex, a flashlight,

gloves, and sunglasses to access a sandwich and two chocolate bars, which he or she promptly devoured.

LARRY J. REYNOLDS
Grande Prairie, Alberta

A couple of years ago my work took me to Whitehorse in the Yukon. The temperature that winter dropped as low as minus 45° Celsius. Someone pointed out what the ravens were doing to survive. They would cover the light sensors on the streetlights with their wings, causing the lights to turn on and giving them the opportunity to warm up on top of them.

PAT CARVACHO
St. Catharines, Ontario

My family had a pet raven for 25 years. Our raven spoke and made chicken and horse sounds. He took the voices of my three brothers and me, so it was very hard to distinguish if it was the raven calling or if it was a brother. When we were young, he would wait for the school bus and say each of our names as we arrived. Ravens are truly remarkable creatures. I hope their intelligence is researched more fully.

JOHN MILLICAN
Amarillo, Texas

Crows, another member of the corvid family, have demonstrated to me that they are just as intelligent as ravens. On the oak-lined street where I used to live, I would watch the crows drop acorns in the path of oncoming cars so they would smash open the hard nuts. This method was quite successful. On a few occasions I even turned slightly right or left to ensure their easy meal.

KAREN NELSON
Alameda, California

Popocatépetl

I am puzzled by a statement made by Claus Siebe on page 131. The geologist says, "We're well into the margin between eruptions, and the more time that goes by, the more probability there is that it [a major eruption] will occur." My understanding is that the time between eruptions for volcanoes follows an exponential probability distribution, which means that the expected time until the next eruption is constant. Thus, the amount of time that has passed does not increase the probability of an eruption.

ERIC HUGGINS
Honolulu, Hawaii

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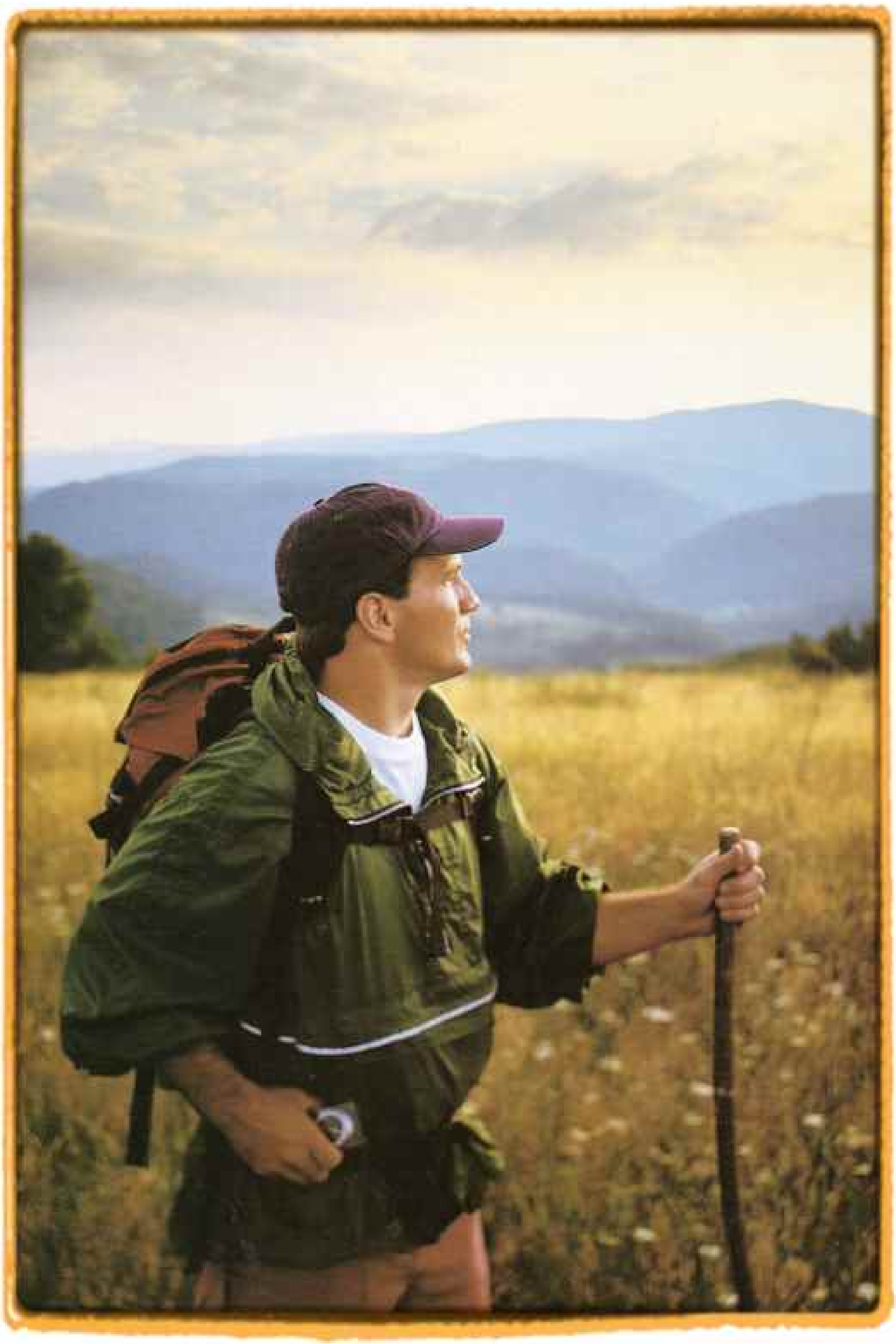

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It's as if the term "the great outdoors" was invented for West Virginia. The majestic mountain scenery has been known to inspire a passion for nature in even the most jaded urbanite. The countryside can take your breath away, so the next time you're driving through this

Toyota Motor Manufacturing

West Virginia, USA

natural wonder, do what the locals often do. Stop the car and see what the mountain air will inspire in you.

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Photography's New Stage: the California Gold Rush

The forty-niners went to California by the thousands, making the daunting journey overland across the continent, by boat around Cape Horn, or by boat and land across Panama. With them went another adventurous group, daguerreotypists, practicing a new craft: photography.

When the first tiny nugget of gold turned up at Sutter's Mill in 1848, photography was barely a decade old. Yet it had already established itself as an integral part of American life. The California gold rush was among the first major historical events to be chronicled by the camera lens.

"In the 1850s it was still a novelty to have your picture taken, and the significance, especially for miners traveling thousands of miles and gone for perhaps years at a time, was far greater than it is today," says Marcia Eymann of the Oakland Museum of California. "It was a physical connection to family members back home, a way for them to understand what the miners were going through."

The museum mounted an exhibition of more than 150 images of the forty-niners and their world that concludes its tour this fall at Sacramento's Crocker Art Museum. Two miners proudly show off gold-nugget stickpins—hand-tinted by the photographer—in their shirtfronts (top). One daguerreotypist wrote of the miners' "bearded, whiskered faces . . . their dams and mining places," evoking this camp at Spanish Flat in El Dorado County (above left). The images also reveal changes in the California landscape, like this detail from an 1851 view of an infant San Francisco (above).

The daguerreotype era, like the gold rush, ended in the 1850s, replaced by less expensive photo reproductions on paper. But it created images that allow us "to look directly into the faces of the men and women who chose to make the journey—and to see how it changed them forever," Eymann says.

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BRIEF SUMMARY (For full Prescribing Information, see package insert.)

INDICATIONS AND USAGE: CLARITIN is indicated for the relief of nasal and non-nasal symptoms of seasonal allergic rhinitis and for the treatment of chronic idiopathic urticaria in patients 6 years of age or older.

CONTRAINDICATIONS: CLARITIN is contraindicated in patients who are hypersensitive to this medication or to any of its ingredients.

PRECAUTIONS: General: Patients with liver impairment or renal insufficiency (GFR < 30 mL/min) should be given a lower initial dose (10 mg every other day). (See **CLINICAL PHARMACOLOGY: Special Populations.**)

Drug Interactions: Loratadine (10 mg once daily) has been coadministered with therapeutic doses of erythromycin, cimetidine, and ketoconazole in controlled clinical pharmacology studies in adult volunteers. Although increased plasma concentrations (AUC 0-24 hrs) of loratadine and/or descarboethoxyloratadine were observed following coadministration of loratadine with each of these drugs in normal volunteers (n = 24 in each study), there were no clinically relevant changes in the safety profile of loratadine, as assessed by electrocardiographic parameters, clinical laboratory tests, vital signs, and adverse events. There were no significant effects on QT_c intervals, and no reports of sedation or syncope. No effects on plasma concentrations of cimetidine or ketoconazole were observed. Plasma concentrations (AUC 0-24 hrs) of erythromycin decreased 15% with coadministration of loratadine relative to that observed with erythromycin alone. The clinical relevance of this difference is unknown. These above findings are summarized in the following table:

Effects on Plasma Concentrations (AUC 0-24 hrs) of Loratadine and Descarboethoxyloratadine After 10 Days of Coadministration (Loratadine 10 mg) in Normal Volunteers

	Loratadine	Descarboethoxyloratadine
Erythromycin (500 mg Q8h)	+ 40%	+46%
Cimetidine (300 mg Q6h)	+103%	+ 5%
Ketoconazole (200 mg Q12h)	+307%	+73%

There does not appear to be an increase in adverse events in subjects who received oral contraceptives and loratadine.

Carcinogenesis, Mutagenesis, and Impairment of Fertility: In an 18-month carcinogenicity study in mice and a 2-year study in rats, loratadine was administered in the diet at doses up to 40 mg/kg (mice) and 25 mg/kg (rats). In the carcinogenicity studies, pharmacokinetic assessments were carried out to determine animal exposure to the drug. AUC data demonstrated that the exposure of mice given 40 mg/kg of loratadine was 5.6 (loratadine) and 19 (descarboethoxyloratadine) times higher than in humans given the maximum recommended daily oral dose. Exposure of rats given 25 mg/kg of loratadine was 28 (loratadine) and 67 (descarboethoxyloratadine) times higher than in humans given the maximum recommended daily oral dose. Male mice given 40 mg/kg had a significantly higher incidence of hepatocellular tumors (combined adenomas and carcinomas) than concurrent controls. In rats, a significantly higher incidence of hepatocellular tumors (combined adenomas and carcinomas) was observed in males given 12 mg/kg and males and females given 25 mg/kg. The clinical significance of these findings during long-term use of CLARITIN is not known.

In mutagenicity studies, there was no evidence of mutagenic potential in reverse (Ames) or forward point mutation (CHO-HGPRT) assays, or in the assay for DNA damage (rat primary hepatocyte unscheduled DNA assay) or in two assays for chromosomal aberrations (human peripheral blood lymphocyte clastogenesis assay and the mouse bone marrow erythrocyte micronucleus assay). In the mouse lymphoma assay, a positive finding occurred in the nonactivated but not the activated phase of the study.

Decreased fertility in male rats, shown by lower female conception rates, occurred at an oral dose of 64 mg/kg (approximately 50 times the maximum recommended human daily oral dose on a mg/m² basis) and was reversible with cessation of dosing. Loratadine had no effect on male or female fertility or reproduction in the rat at an oral dose of approximately 24 mg/kg (approximately 20 times the maximum recommended human daily oral dose on a mg/m² basis).

Pregnancy Category B: There was no evidence of animal teratogenicity in studies performed in rats and rabbits at oral doses up to 96 mg/kg (approximately 75 times and 150 times, respectively, the maximum recommended human daily oral dose on a mg/m² basis). There are, however, no adequate and well-controlled studies in pregnant women. Because animal reproduction studies are not always predictive of human response, CLARITIN should be used during pregnancy only if clearly needed.

Nursing Mothers: Loratadine and its metabolite, descarboethoxyloratadine, pass easily into breast milk and achieve concentrations that are equivalent to plasma levels with an AUC_{milk}/AUC_{plasma} ratio of 1.17 and 0.85 for loratadine and descarboethoxyloratadine, respectively. Following a single oral dose of 40 mg, a small amount of loratadine and descarboethoxyloratadine was excreted into the breast milk (approximately 0.03% of 40 mg over 48 hours). A decision should be made whether to discontinue nursing or to discontinue the drug, taking into account the importance of the drug to the mother. Caution should be exercised when CLARITIN is administered to a nursing woman.

Pediatric Use: The safety of CLARITIN Syrup at a daily dose of 10 mg has been demonstrated in 186 pediatric patients 6-12 years of age in placebo-controlled 2-week trials. The effectiveness of CLARITIN for the treatment of seasonal allergic rhinitis and chronic idiopathic urticaria in this pediatric age group is based on an extrapolation of the demonstrated efficacy of CLARITIN in adults in these conditions and the likelihood that the disease course, pathophysiology, and the drug's effect are substantially similar to that of the adults. The recommended dose for the pediatric population is based on cross-study comparison of the pharmacokinetics of CLARITIN in adults and pediatric subjects and on the safety profile of loratadine in both adults and pediatric patients at doses equal to or higher than the recommended doses. The safety and effectiveness of CLARITIN in pediatric patients under 6 years of age have not been established.

ADVERSE REACTIONS: CLARITIN Tablets: Approximately 80,000 patients, aged 12 and older, received CLARITIN Tablets 10 mg once daily in controlled and uncontrolled studies. Placebo-controlled clinical trials at the recommended dose of 10 mg once a day varied from 2 weeks' to 6 months' duration. The rate of premature withdrawal from these trials was approximately 2% in both the treated and placebo groups.

REPORTED ADVERSE EVENTS WITH AN INCIDENCE OF MORE THAN 2% IN PLACEBO-CONTROLLED ALLERGIC RHINITIS CLINICAL TRIALS IN PATIENTS 12 YEARS OF AGE AND OLDER
PERCENT OF PATIENTS REPORTING

	LORATADINE 10 mg QD n = 1923	PLACEBO n = 2545	CLEMASTINE 1 mg BID n = 536	TERFENADINE 60 mg BID n = 584
Headache	12	11	8	8
Somnolence	8	6	22	9
Fatigue	4	3	10	2
Dry Mouth	3	2	4	3

Adverse events reported in placebo-controlled chronic idiopathic urticaria trials were similar to those reported in allergic rhinitis studies.

Adverse event rates did not appear to differ significantly based on age, sex, or race, although the number of nonwhite subjects was relatively small.

CLARITIN REDITABS (loratadine rapidly-disintegrating tablets): Approximately 500 patients received CLARITIN REDITABS (loratadine rapidly-disintegrating tablets) in controlled clinical trials of 2 weeks' duration. In these studies, adverse events were similar in type and frequency to those seen with CLARITIN Tablets and placebo.

Administration of CLARITIN REDITABS (loratadine rapidly-disintegrating tablets) did not result in an increased reporting frequency of mouth or tongue irritation.

CLARITIN Syrup: Approximately 300 pediatric patients 6 to 12 years of age received 10 mg loratadine once daily in controlled clinical trials for a period of 8-15 days. Among these, 186 children were treated with 10 mg loratadine syrup once daily in placebo-controlled trials. Adverse events in these pediatric patients were observed to occur with type and frequency similar to those seen in the adult population. The rate of premature discontinuance due to adverse events among pediatric patients receiving loratadine 10 mg daily was less than 1%.

ADVERSE EVENTS OCCURRING WITH A FREQUENCY OF ≥ 2% IN LORATADINE SYRUP-TREATED PATIENTS (6-12 YEARS OLD) IN PLACEBO-CONTROLLED TRIALS AND MORE FREQUENTLY THAN IN THE PLACEBO GROUP
PERCENT OF PATIENTS REPORTING

	LORATADINE 10 mg QD n = 186	PLACEBO n = 262	CHLORPHENIRAMINE 2-4 mg BID/TID n = 178
Nervousness	4	2	2
Wheezing	4	2	5
Fatigue	3	2	5
Hyperkinesia	3	1	1
Abdominal Pain	2	0	0
Conjunctivitis	2	<1	1
Dysphonia	2	<1	0
Malaise	2	0	1
Upper Respiratory Tract Infection	2	<1	0

In addition to those adverse events reported above (≥ 2%), the following adverse events have been reported in at least one patient in CLARITIN clinical trials in adult and pediatric patients:

Autonomic Nervous System: Altered lacrimation, altered salivation, flushing, hypoesthesia, impotence, increased sweating, thirst.

Body As A Whole: Angioneurotic edema, asthenia, back pain, blurred vision, chest pain, earache, eye pain, fever, leg cramps, malaise, rigors, tinnitus, viral infection, weight gain.

Cardiovascular System: Hypertension, hypotension, palpitations, supraventricular tachyarrhythmias, syncope, tachycardia.

Central and Peripheral Nervous System: Blepharospasm, dizziness, dysphonia, hypertonia, migraine, paresthesia, tremor, vertigo.

Gastrointestinal System: Altered taste, anorexia, constipation, diarrhea, dyspepsia, flatulence, gastritis, hiccup, increased appetite, nausea, stomatitis, toothache, vomiting.

Musculoskeletal System: Arthralgia, myalgia.

Psychiatric: Agitation, amnesia, anxiety, confusion, decreased libido, depression, impaired concentration, insomnia, irritability, paroniria.

Reproductive System: Breast pain, dysmenorrhea, menorrhagia, vaginitis.

Respiratory System: Bronchitis, bronchospasm, coughing, dyspnea, epistaxis, hemoptysis, laryngitis, nasal dryness, pharyngitis, sinusitis, sneezing.

Skin and Appendages: Dermatitis, dry hair, dry skin, photosensitivity reaction, pruritus, purpura, rash, urticaria.

Urinary System: Altered micturition, urinary discoloration, urinary incontinence, urinary retention.

In addition, the following spontaneous adverse events have been reported rarely during the marketing of loratadine: abnormal hepatic function, including jaundice, hepatitis, and hepatic necrosis; alopecia; anaphylaxis; breast enlargement; erythema multiforme; peripheral edema; and seizures.

OVERDOSAGE: In adults, somnolence, tachycardia, and headache have been reported with overdoses greater than 10 mg with the Tablet formulation (40 to 180 mg). Extrapyramidal signs and palpitations have been reported in children with overdoses of greater than 10 mg of CLARITIN Syrup. In the event of overdosage, general symptomatic and supportive measures should be instituted promptly and maintained for as long as necessary.

Treatment of overdosage would reasonably consist of emesis (ipecac syrup), except in patients with impaired consciousness, followed by the administration of activated charcoal to absorb any remaining drug. If vomiting is unsuccessful, or contraindicated, gastric lavage should be performed with normal saline. Saline cathartics may also be of value for rapid dilution of bowel contents. Loratadine is not eliminated by hemodialysis. It is not known if loratadine is eliminated by peritoneal dialysis.

No deaths occurred at oral doses up to 5880 mg/kg in rats and mice (greater than 2400 and 1200 times, respectively, the maximum recommended human daily oral dose on a mg/m² basis). Single oral doses of loratadine showed no effects in rats, mice, and monkeys at doses as high as 10 times the maximum recommended human daily oral dose on a mg/m² basis.

Schering®

Schering Corporation
Kenilworth, NJ 07033 USA

Rev. 3/98

19628426T-JBS

CLARITIN REDITABS (loratadine rapidly-disintegrating tablets) are manufactured for Schering Corporation by Scherer DDS, England.

U.S. Patent Nos. 4,282,233 and 4,371,516

Mystic Aquarium and
Dr. Robert D. Ballard. Dedicated
to preserving history.

And frequently, making it.

Dr. Robert Ballard
Discoverer of the Titanic

Perhaps the only maritime event to capture as much attention as the tragic night the Titanic sank is the magic day she was found – by undersea explorer Dr. Robert D. Ballard. Since then, Dr. Ballard has led myriad other expeditions, discovering the wrecks of The Bismarck, ancient Roman trading vessels, and most recently, the Yorktown which sank during The Battle of Midway. All with the noble intent of preserving antiquity and providing a lasting legacy of learning. And this summer, Dr. Ballard's making history yet again, by bringing his Institute for Exploration to Mystic Aquarium to premiere Challenge of the Deep. Spanning the history of man's fascination with underwater exploration, Challenge of the Deep is a one-of-a-kind, interactive exhibit, guaranteed to quench your appetites for both excitement and adventure. Who'd know more about any of that than Dr. Ballard? So come make your own incredible discoveries at Challenge of the Deep, today.

The original grand staircase aboard the Titanic

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Camp Jeep 1999
August 6-8

It happens for one incredible weekend every summer. Fun-loving Jeep species migrate from all across North America for three days of four-wheeling, tubing, fly-fishing, and dozens of other fun outdoor activities. It's the fifth annual Camp Jeep—a special gathering exclusively for Jeep owners, their friends, and families.

For the first time Camp Jeep will be held in breathtaking Virginia at the historic Oak Ridge Estate near Charlottesville. There's so much to see and do for all ages and the price is just $225 per Jeep vehicle.* This summer, venture outside of your normal range. To register for Camp Jeep, call 1-800-789-JEEP or visit www.jeepunpaved.com/camp_jeep.

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*Price allows everyone in your vehicle to take part in all events all three days. Camp Jeep is an event for Jeep owners and their guests. Only Jeep vehicles will be allowed in Camp Jeep. Always use seat belts. Remember a backseat is the safest place for children.
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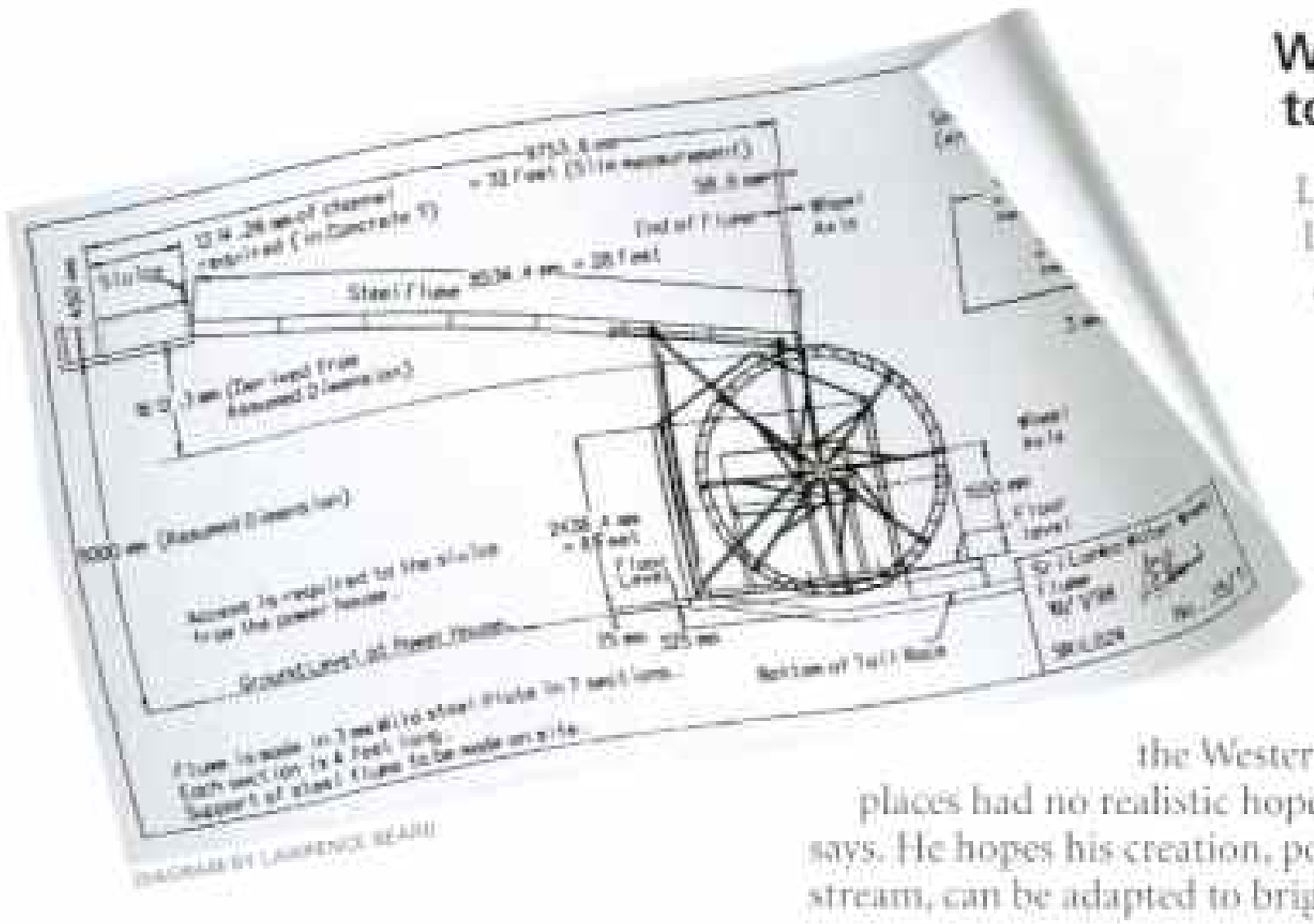

DIAGRAM BY LAWRENCE BEARD

Wheeling in Power to a Village in the Dark

Lights glow nightly in the tiny, isolated Sri Lankan village of Lower Amanawala, and village women now have use of an electric iron, thanks to a waterwheel conceived and installed by an English landowner. After Paul Bromley built a waterwheel on his Cheshire estate, he set out to devise a practical model for a rural community in a developing nation. "It's hard for the Western mind to comprehend that such places had no realistic hope of getting electricity," Bromley says. He hopes his creation, powered by water from a nearby stream, can be adapted to brighten rural villages elsewhere.

Woof, Meow, and Tweet in a U.S. Accent

In a dog-eat-dog world, the U.S. sits in the catbird seat. Some 40 percent of the world's 500 million pets call it home. Nearly 60 percent of the nation's households include at least one of 70 million cats, 56 million dogs, 40 million birds, 100 million fish, 13 million hamsters and other small mammals, and 8 million reptiles, according to pet industry surveys. The highest percentage of pet ownership elsewhere is in Britain, where cats and dogs rule. But 21 million pet fish reign in France, more than cats and dogs combined.

MARTIN PARR, MAGNUM (ABOVE); DAVID PENDERGAST

A Lost Taino Village Emerges From the Sea

For the past 15 years Cuban fishermen have collected wooden objects such as this 6.9-inch-long deity figurine that washed up on the island's north coast. Now the artifacts have been linked to a village of the Taino, who dominated the Antilles until the Spanish conquered the islands in the 16th century. The coastal village may have endured into the 17th century because hills and nearby cays shielded it from Spanish eyes, say Canadian and Cuban archaeologists. In shallow water along a stretch of slowly eroding shore, they uncovered remains of at least two dozen structures buried in the mud. Among them: a huge communal dwelling, its rafters, support posts, and roof thatch all beautifully preserved. "That was staggering," says David Pendergast of the Royal Ontario Museum, the team's co-leader.

TEXT BY BORIS WEINTRAUB

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Why are there no monuments to practicality?

There are no holidays set aside to honor the highly efficient. No marble statues standing in tribute of the very reliable. Not even a single collector's plate commemorating the pragmatic.

But thankfully, the engineers at Honda have created their own lasting tribute to practicality. It's called, quite simply, the 1999 Accord Sedan.

From its sculptured exterior to its ergonomic interior, every element of the Accord Sedan was designed to meet extraordinarily high standards of efficiency, quality and durability—without sacrificing form for function. The result? A stylish, highly refined testament to the fact that "practical" doesn't necessarily mean "boring."

Inside the spacious, comfortable cabin, you'll notice helpful features everywhere you look. Controls and instruments are easy to read and well within your reach. Specially tinted glass protects the interior from heat and UV rays. And, sound-absorbing materials provide for a peaceful ride.

Of course, all these amenities are provided for a utilitarian reason: to put you in a position to fully enjoy the performance of the with 2.3 liter VTEC™ engine. And the responsive handling of the rear multi-link and front double wishbone suspension.

For a closer look at our homage to practical thinking, just give us a call at 1-800-33-HONDA. Or, simply visit us on the Internet at www.honda.com.

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The commitment of the Anheuser-Busch Adventure Parks to conservation and wildlife preservation spans all seven continents and keeps us working around the clock, 365 days a year. With help from environmental partner organizations and people like you, SeaWorld and Busch Gardens have been out there making a difference for more than 40 years. To us, caring for the environment means rolling up our sleeves.

Whether conducting research to help preserve the few remaining black rhinos or caring for endangered Hawaiian monk seals and Lear's macaws, our commitment to conservation runs deep.

Entertaining millions of people in our parks each year allows us to share our knowledge, experience and passion for the environment. For we believe the creatures that inhabit our land, sea and air are a precious gift we all share.

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NATIONAL GEOGRAPHIC MAGAZINE

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"For the increase and diffusion of geographic knowledge."

THE NATIONAL GEOGRAPHIC SOCIETY is chartered in Washington, D.C., as a nonprofit scientific and educational organization. Since 1888 the Society has supported more than 6,400 explorations and research projects, adding to knowledge of earth, sea, and sky.

Maleo (*Macrocephalon maleo*) **Size:** Length, 55 cm **Weight:** Approx. 1,300 g **Habitat:** Tropical forests in Sulawesi, Indonesia **Surviving number:** Estimated at 5,000-10,000

Photographed by Andrea Florence

WILDLIFE AS CANON SEES IT

The shy maleo bonds for life, rarely venturing more than a few meters from its mate. Pairs gather at communal nesting sites in forest or beach locations where geothermal activity or solar radiation provide a suitable underground temperature. Each pair excavates a hole about 60 centimeters deep, buries its large egg, then leaves the egg to self-incubate in the heated soil or volcanic sand. Two months later the newly hatched chick digs its way upward, emerging alone but self-sufficient and able to fly immediately. Over-harvesting of eggs and habitat destruction threaten these remarkable birds of Sulawesi. As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.

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**Sienna test data: December 12, 1997. Vehicles evaluated to date: 81 (high-speed, 40% frontal offset crash test).

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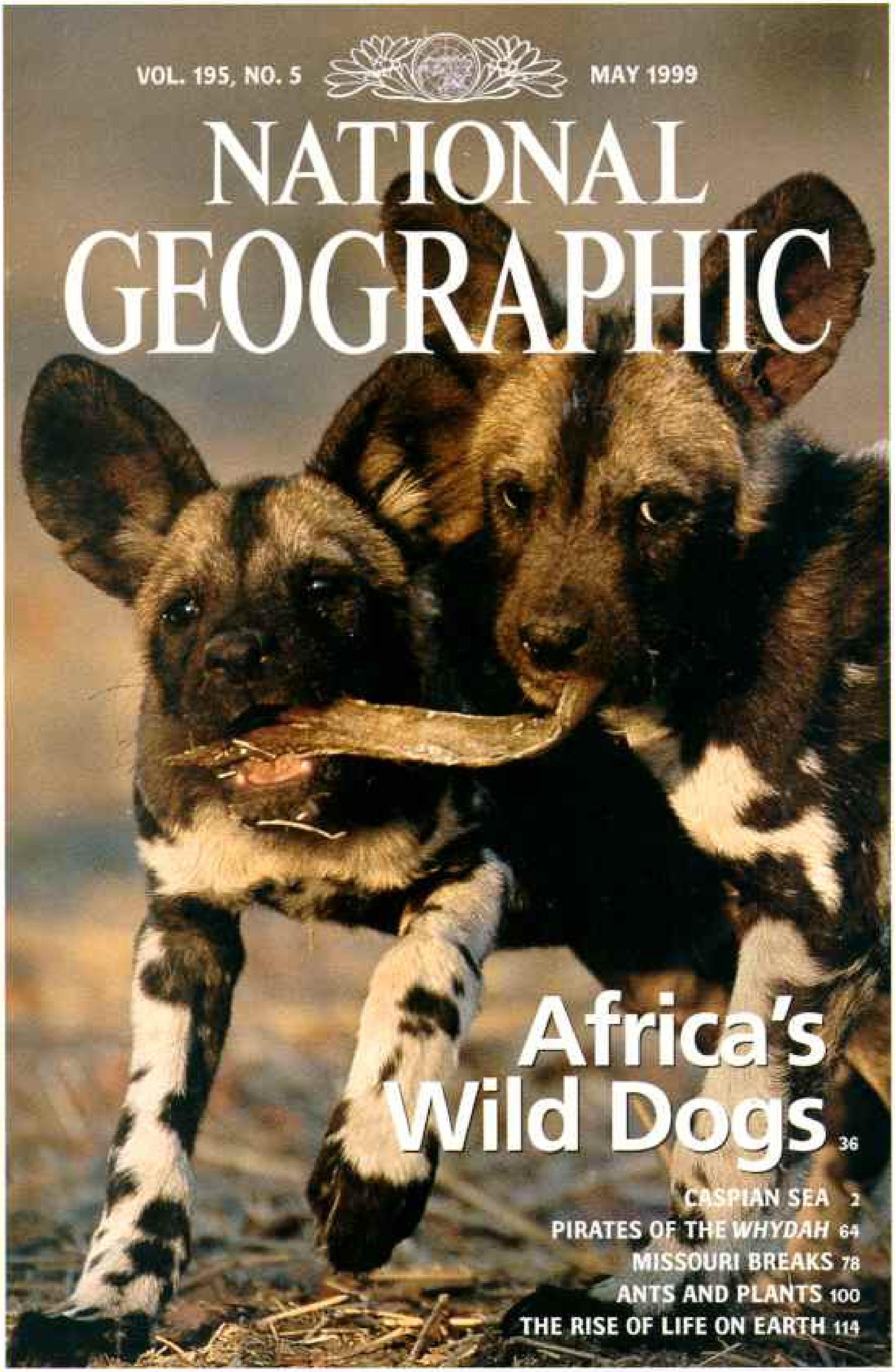
DOUBLE MAP SUPPLEMENT: CASPIAN SEA

VOL. 195, NO. 5 MAY 1999

NATIONAL GEOGRAPHIC



Africa's Wild Dogs 36

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UNDERWOOD & UNDERWOOD

■ FROM THE GEOGRAPHIC ARCHIVES

The Dogs of War

The world had gone wild, but the dogs were well trained. In March 1919 our tribute to man's best friend was filled with photos of canines on the World War I front. "Everyone must carry their masks with them if they expect to be immune from the poisonous fumes that periodically pervade the battle lines. All animals in use behind and within the lines are provided with protective coverings," read notes accompanying this 1917 shot of a French officer and his dog. Some animals carried messages across rough terrain; some sniffed out the wounded for the Red Cross. And some, according to our article, "each with a big can of hot soup strapped to either side, are sent through the front-line trenches to carry this cheering fare to the fighting men."

RadioShack is answering the call of the wild

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Ideal for all kinds of activities.

Prices start at only $49.99 each.

Touring expansive African grasslands or exploring the remotest corners of a state park, reliable communication helps you share the fun. And can be as vital as water and a first aid kit.

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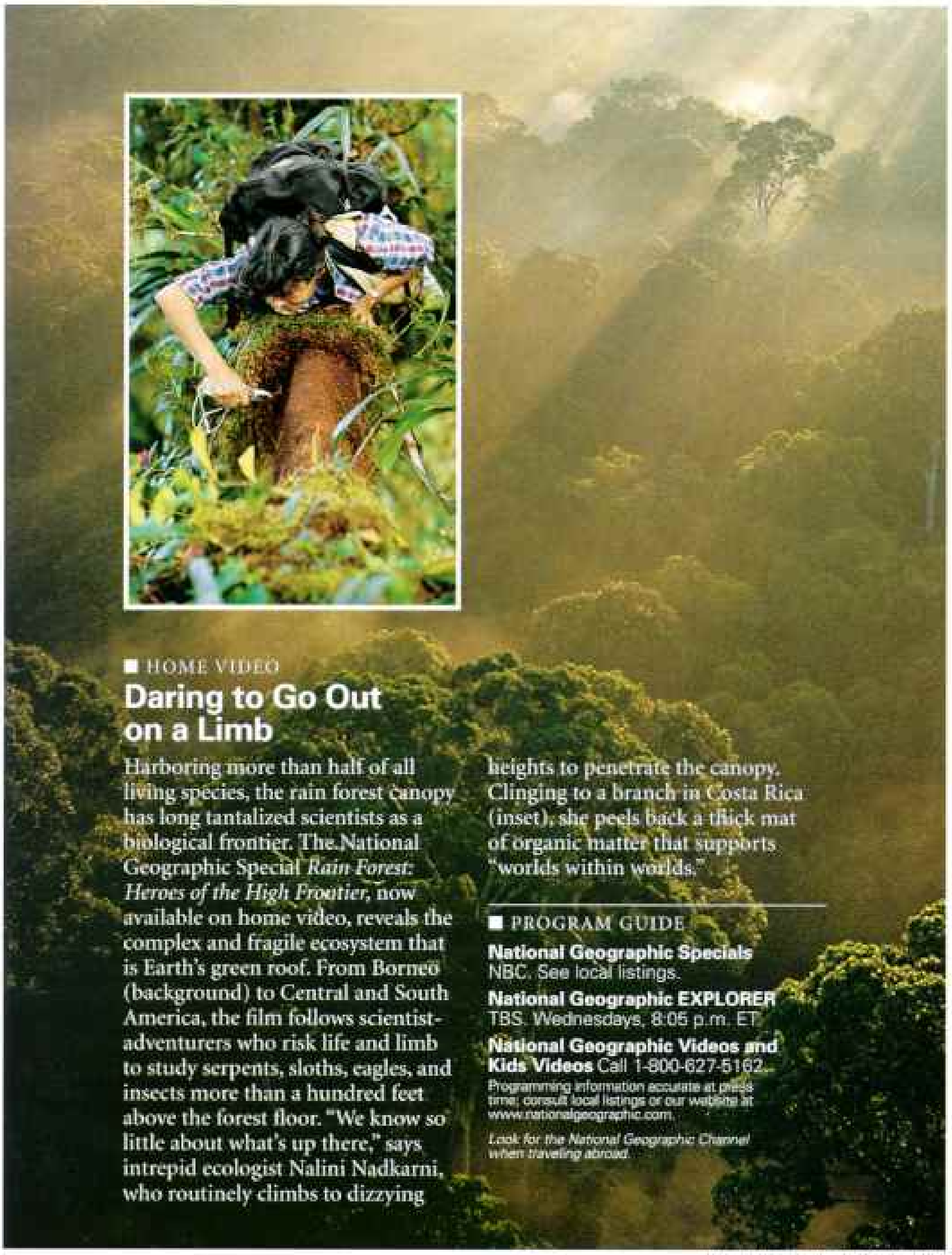

■ HOME VIDEO

Daring to Go Out on a Limb

Harboring more than half of all living species, the rain forest canopy has long tantalized scientists as a biological frontier. The National Geographic Special *Rain Forest: Heroes of the High Frontier*, now available on home video, reveals the complex and fragile ecosystem that is Earth's green roof. From Borneo (background) to Central and South America, the film follows scientist-adventurers who risk life and limb to study serpents, sloths, eagles, and insects more than a hundred feet above the forest floor. "We know so little about what's up there," says intrepid ecologist Nalini Nadkarni, who routinely climbs to dizzying heights to penetrate the canopy. Clinging to a branch in Costa Rica (inset), she peels back a thick mat of organic matter that supports "worlds within worlds."

■ PROGRAM GUIDE

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MARK W. MOFFETT (INSET); FRANS LANTING

Linda begged Steve to log off the Internet for a day.

"How about we see the world in person this afternoon?" she challenged.

And before you could say "download," their Ford Expedition

took them to places so unreal and so far out there, Steve thought,

"Hey, the information superhighway is for wimps."

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Control-Trac system for automatic 4WD traction when needed.
Industry Exclusive: New available power adjustable pedals for improved driving comfort.
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NATIONAL GEOGRAPHIC

Earth Almanac

MELISSA FARLOW

Urban Sprawl: Backlash at the Ballot Box

Strip malls and other metropolitan tentacles have consumed more than 40 million acres of rural land since 1950. Last fall many voters in the United States said "enough." Of 240 initiatives on state and municipal ballots to preserve remaining open space, some 170 passed. The most ambitious initiative was New Jersey's. By nearly two to one, voters approved setting aside almost a billion dollars over ten years to preserve undeveloped farmland and woodland. Funds will be used either to buy land outright or to pay owners not to develop it.

Land-use maps like this one will aid the selection process. More land may be preserved in the Hackensack Meadowlands, a multiuse, 19,730-acre tract that includes private housing (above). Over 2,000 Meadowlands acres already have been set aside. To the south lies another likely beneficiary: the 1.1-million-acre Pinelands, perhaps the largest body of open space on the mid-Atlantic seaboard.

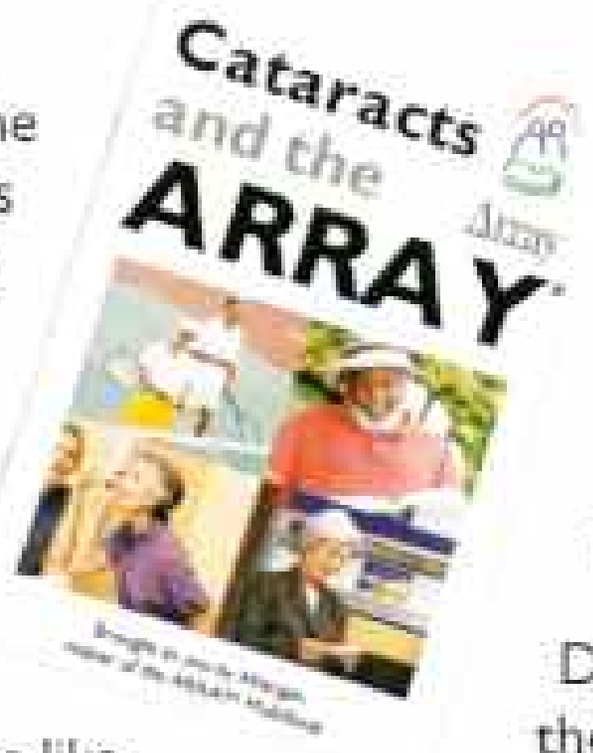
Could you have cataracts?

Despite wearing glasses, do you have difficulty . . .

	Yes	No
1. Seeing in the distance or reading?	❑	❑
2. Distinguishing road signs at dusk?	❑	❑
3. Recognizing colors?	❑	❑
4. Recognizing friends and family at a distance?	❑	❑
5. Driving at night?	❑	❑

If you answered "yes" two or more times, you may have cataracts. If you do, don't worry. Cataract surgery is now safer, faster, and more comfortable than ever before.

A cataract is a clouding of the eye's natural lens. In today's cataract surgery, the lens is removed and replaced with a man-made implant to restore vision. Traditional implants are designed to provide good vision at one distance—usually far—so most people need glasses for close-up activities like reading or crafts.



The Proven ARRAY® Multifocal

Now cataract patients have an important option—the ARRAY® multifocal lens implant. Only the ARRAY® multifocal is designed to provide good distance vision *and* near vision. Compared with traditional implants, the ARRAY® can reduce the need for glasses in activities like reading, watching TV, or watching a movie.

Some people who receive traditional implants or multifocal implants report halos or glare at night. These effects are more common with multifocal than traditional implants, although individual results may vary.

Doctors have successfully used the FDA-approved ARRAY® to restore vision in tens of thousands of eyes, nationwide.

So if you or someone close to you has cataracts, the ARRAY® offers new hope for greater freedom from glasses.

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ALLERGAN Please see patient information on the adjacent page. **http://www.arraylens.com**

ARRAY® Multifocal Silicone Posterior Chamber Intraocular Lens

PLEASE NOTE: To hear a recorded version of this text, call 1-800-438-2623.

ARRAY® Multifocal Silicone Posterior Chamber Intraocular Lenses (SLM2/UV)

Caution: Federal (USA) law restricts this device to sale by or on the order of a physician.

Description

Allergan ARRAY® Multifocal Silicone Posterior Chamber Intraocular Lenses are available as biconvex optical lenses with an anterior multifocal surface, designed to be implanted in the capsular bag. The optical portion has the capability of being folded prior to insertion, allowing the lens to be inserted through an incision of approximately 3.2 mm while preserving a full size lens body after implantation.

When implanted, Silicone Posterior Chamber Intraocular Lenses replace the natural lens of the eye and function as a refracting medium in the correction of aphakia.

Indications for Use

Allergan ARRAY® Multifocal Silicone Posterior Chamber Intraocular Lenses are indicated for the visual correction of aphakia in persons 60 years of age or older in whom a cataractous lens has been removed and who may benefit from useful near vision without reading add and increased spectacle independence across a range of distances where the potential visual effects associated with multifocality are acceptable.

Warnings

1. A very small percentage of patients (less than 1% in the US Clinical Study) have been dissatisfied to the point of requesting removal of the multifocal lens.
2. In a driving simulation study under one of nine low contrast conditions, 22% more multifocal patients than monofocal patients did not notice a hard-to-see object in the road until they were closer than 100 feet. The distance of 100 feet is important because at speeds of 30 mph or faster, a driver may not be able to stop safely within 100 feet. In the simulation, however, drivers could also drive around objects, and there was no difference in collisions with the objects.

Precautions

1. There is a chance (11%) that your vision may not be good enough to read small print without glasses with the multifocal IOL.
2. Please discuss with your physician whether this is the right lens for you. The following may affect your choice of IOL:
   - In rare instances, this lens may make some types of retinal surgery more difficult.
   - If the pupil of your eye is very small (less than 2.5 mm), the chances are greater that your near vision with a multifocal lens will not be better than with a monofocal lens.
   - If the health of your eye makes it unlikely that your vision will be good after your cataract is removed, you may not get the full benefit of the multifocal IOL.

Comparisons Between the Monofocal and Multifocal IOL

Both the monofocal and ARRAY® multifocal IOLs have been thoroughly studied and are designed to replace the natural lens of the eye. The following table compares the other features of these two types of implants:

	Monofocal IOL	ARRAY® Multifocal IOL
DISTANCE VISION	This IOL generally gives good distance vision.	This IOL generally gives good distance vision, but it may not be quite as sharp as with a monofocal IOL.
INTERMEDIATE VISION (between 2 and 5 feet)	Intermediate vision is expected to be comparable between these two types of IOLs.	
NEAR VISION	This IOL generally does not provide good near vision without glasses.	Most patients can expect near vision to be better than with a monofocal IOL, but there may still be some circumstances where you will need glasses for near work.
USE OF GLASSES	If you have this lens in both eyes, there is a 60% chance you will always wear your glasses for near work. There is a 34% chance you will wear your glasses all of the time (for any distance).	If you have this lens in both eyes, there is a 12% chance you will always wear your glasses for near work. There is an 8% chance you will wear your glasses all of the time (for any distance).
HALOS AND GLARE	With this IOL, there is a chance that you may have severe difficulty with halos around lights (6%) or with glare (1%).	With this IOL, the chances of having severe difficulty with halos (15%) and glare (11%) are higher when compared to a monofocal IOL. You may grow accustomed to them or continue to notice them. In rare instances (less than 1%), patients have requested that the IOL be removed.
LOW CONTRAST VISION (DRIVING)	Under poor visibility conditions, your vision may not be as sharp as in good light.	Under poor visibility conditions, your vision may be further reduced than it would be with a monofocal IOL. Under these conditions you may have more difficulty recognizing some traffic signs and hard-to-see objects in the road. Therefore, you may need to take extra care when driving, especially in poor light conditions.

ALLERGAN

DANIEL LEDUC/AFP/CHOIX PHOTOGRAPHE/REUTERS

Avian Comfort Station in a Big Blow

When Hurricane Georges took aim at Florida last September, Miami Metrozoo officials had to keep 35 flamingos out of harm's way. Stushed in a zoo men's room, the birds stayed unruffled as Georges lashed the Keys but spared the Florida mainland. Not so for several Caribbean islands, where the storm caused more than three billion dollars in damage. In 1998 a record 90 billion dollars in losses came from weather-related disasters worldwide; at least 32,000 people died.

MATS FORSBERG, ARCTIC PICTURE STOCK

Walrus Put Seals on Their Menu

Diving deep to the seafloor, walrus usually feed on clams, shrimps, crabs, and other invertebrates. But these huge pinnipeds—the massive males can weigh up to two tons—are opportunistic feeders. Their prey occasionally includes bearded seals or ringed seals (above). "The walrus hit the seal in the water to stun it, then dragged it onto the ice and stabbed it with its tusks," says Mats Forsberg, who witnessed this incident in Norway's Svalbard Islands. His 1991 photographs are the only such known to exist.

MICHAEL FOSTER, BRUCE COLEMAN

Gila Monsters Losing Desert Homes

Burgeoning development in the Sonoran and Mojave Deserts threatens Gila monsters, the only venomous lizards in the U.S. "Las Vegas and Phoenix are among the fastest growing areas in the West," says David Brown, an Arizona State University biologist. "Construction workers find Gila monsters on their sites and often call animal shelters to rescue them." Nevada and Arizona state laws protect the foot-long reptiles.

TEXT BY JOHN L. ELIOT

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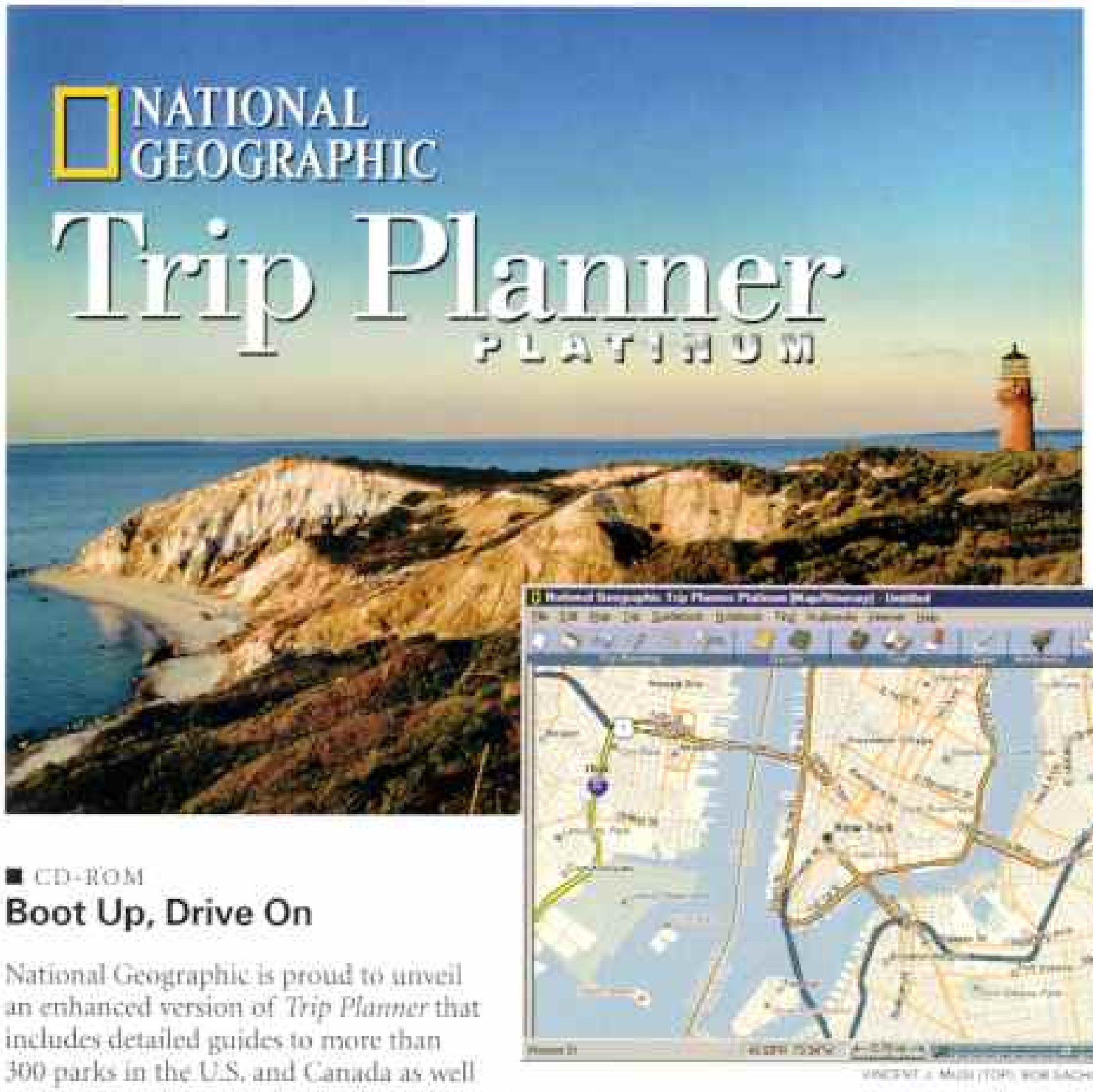

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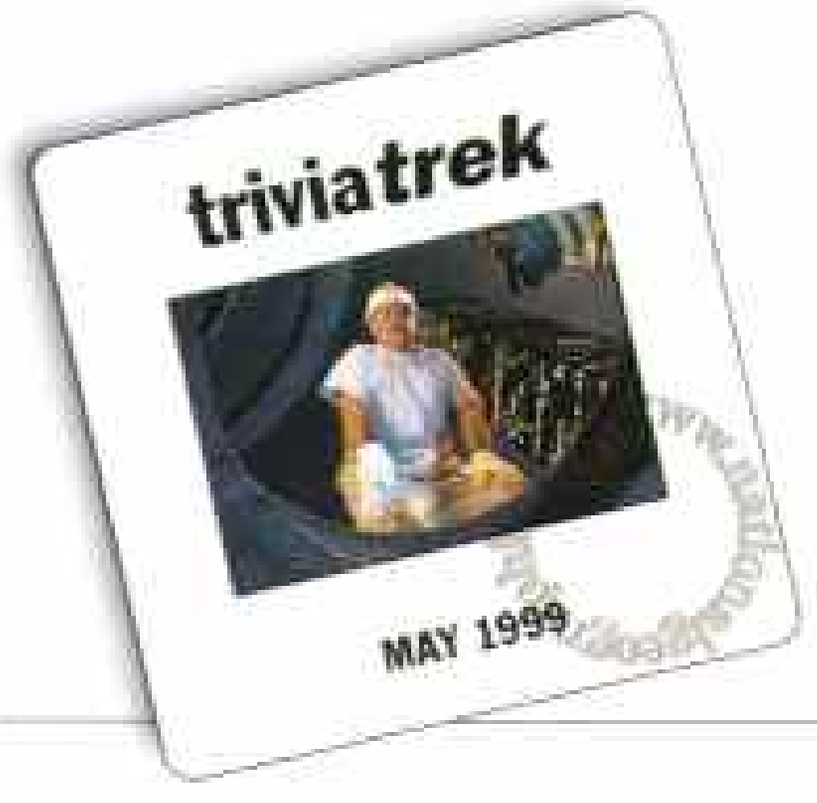

■ TRIVIA TREK

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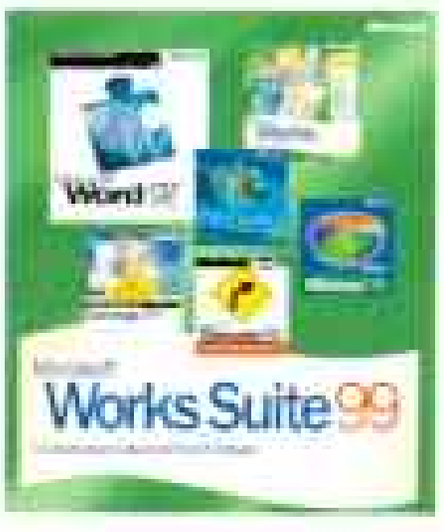

NATIONAL GEOGRAPHIC

*On*Assignment

RASHID SHEKHBANDI

■ CASPIAN SEA

Facing a Sea Change

While shooting Azerbaijani sailors in a chemical weapons defense drill, Reza (above, with camera) recalls, "Their commander said to me, 'Do you want me to bring out some real chemicals?'" Reza swiftly declined. The Iranian-born photographer grew up vacationing on the Caspian's southern shores but has lived in exile in Paris for 18 years. "In Persian there is a word, *darya*, which translates as 'sea' but also means something that is complex and multifaceted. The Caspian is, in both senses of the word, darya."

■ ANTS AND PLANTS

An Eye for the Smallest Detail

"I have no taste for pursuing an ape for ten years and only seeing it once. I can always find my critters," says Berkeley, California–based photographer Mark W. Moffett. In French Guiana he tracked tiny quarry on the tangles of an epiphyte (right). For this three-part story—the first installment was published in February—Mark traveled "to every continent except one, and I only missed Antarctica because there aren't any ants there."

MARK W. MOFFETT

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