DOUBLE MAP SUPPLEMENT: EARTHQUAKES

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COVER: A produce vendor in Ho Chi Minh City, Tran Kim Quy glows in a Hong Kong-made gown rented for her wedding day. Photograph by Karen Kasmauski.

Cover printed on recycled-content paper.

KEN LUBAS, *LOS ANGELES TIMES*

Earthquake! Thrown from their beds by a predawn quake, frantic Los Angeles residents stem a fire's spread by splashing a neighbor's house with water from a swimming pool. Costliest quake in U. S. history, the January 1994 temblor toppled freeways, shattered gas mains, and jolted the world of seismic research.

Califo

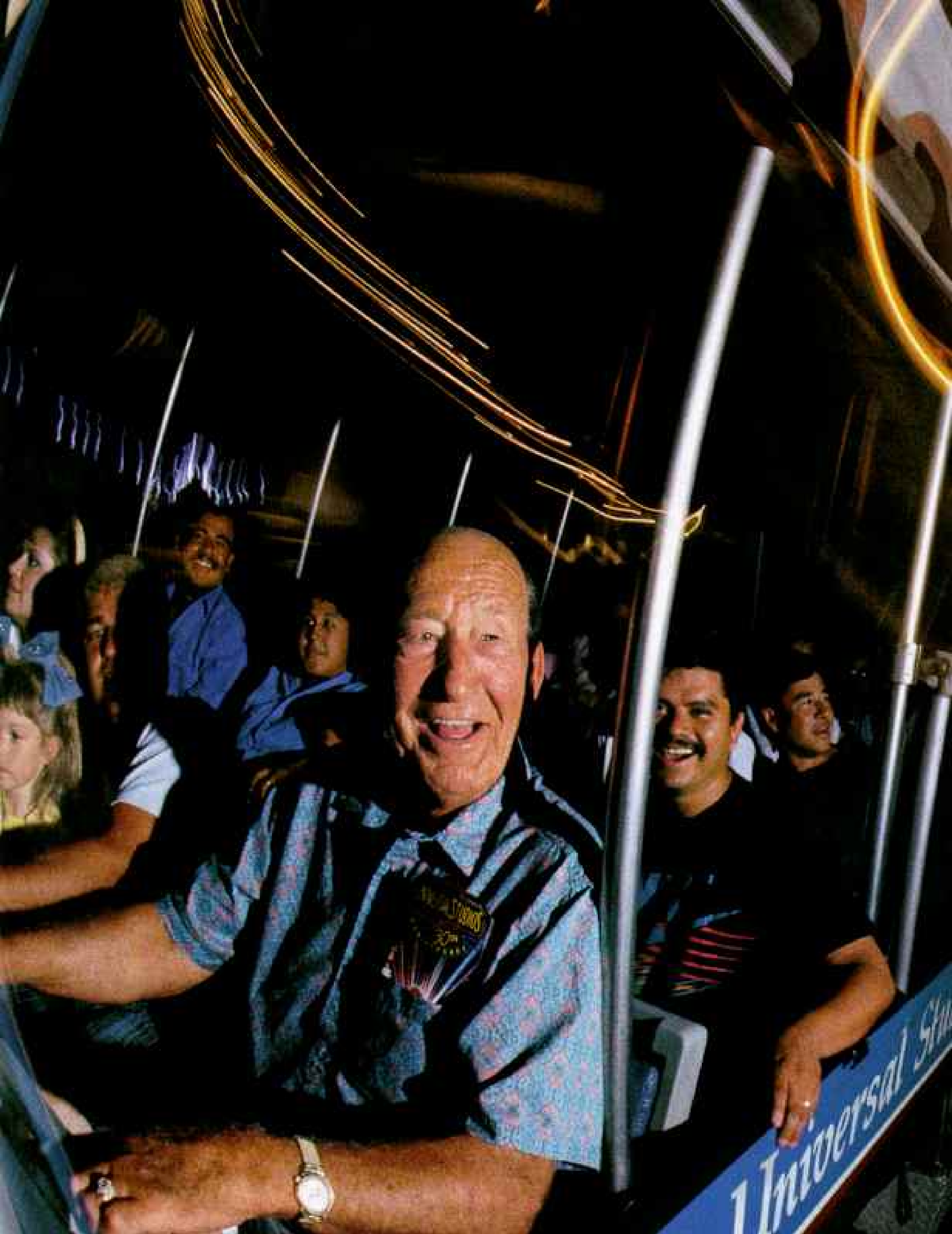
Living with rnia's Faults

By RICK GORE
SENIOR ASSISTANT EDITOR

Photographs by ROGER H. RESSMEYER

A newly formed ridge rips a scar across the Mojave Desert near the Emerson Fault, 105 miles east of Los Angeles. The ground here was nearly level until June 1992, when a major earthquake—named for the hamlet of Landers—

raised this half-mile-long block of rock five feet. At least six strong quakes rumbled under southern California between 1987 and 1994, a flurry that may herald even larger quakes in coming decades.



The shaking's just for laughs at Universal Studios Hollywood, a theme park 14 miles from Northridge—site of the 1994 quake's worst damage. Two hundred times a day a simulated quake rocks tramcars full of tourists and sends

an oil truck crashing onto a fabricated subway station. Park officials closed the ride for several days after the Northridge quake, but video stores stayed open—and reported a run on the 1974 thriller *Earthquake*.

AT 4:31 IN THE MORNING on January 17, 1994, the earth's crust snapped 11.4 miles beneath the community of Northridge in Los Angeles. An immense slab of rock began to thrust upward along an unknown buried fault, shifting the San Fernando Valley eight inches and releasing a surge of energy approaching in power the 1980 eruption of Mount St. Helens. At that moment, 15 miles south in Santa Monica, Rob Wirtz, a firefighter, was sound asleep in his station house. Within seconds a shock wave from Northridge knocked the wall phone above Wirtz's bed off its hook and onto his head. It was an unwelcome wake-up call, not only for Wirtz but for everyone in L.A.

The 38-year-old captain leaped up and into the trousers and boots he keeps at his bedside and ran toward the station's garage.

"Things were shaking so hard I could scarcely get my pants pulled up," he recalls. Reaching the garage, Wirtz saw a 38,000-pound fire engine bouncing up and down.

"I looked out the garage-door windows and saw the lights of L.A. blacking out," he says. "I knew something big-time was going on."

The Northridge earthquake—the most costly in the history of the United States—had struck. And L.A. residents were experiencing what geologists warn may be a new era of disastrous earthquakes throughout California.

Near the epicenter in Northridge, Rosemary Sato jolted upright in bed as tremors slammed through her house with the deafening sound of a sledgehammer. "Who has such wrath?" she recalls wondering as the quake blew open her front door, knocked down the wall around her house, and tossed furniture around like toys.

In a neighborhood west of downtown L.A., eight-year-old Carlos Bejarano woke up to the flashes of power transformers blowing outside his family's apartment.

"I thought monsters were flying into my room," he remembers.

Fate struck more violently at the three-story Northridge Meadows apartment complex. An early rising resident, Steve Langdon, was about to make coffee when his building lurched eight feet. The top two floors then crashed down onto his first-floor apartment.

"A wall fell on me," he says. "I couldn't move my head. I was pinned against a bed for five hours with a collapsed lung, five fractured ribs, and a broken collarbone."

Meanwhile, 16 other apartment residents died. Thirteen were crushed in bed by the joists of the upper floors. David and Cecilia Pressman, who had been married for 51 years, died embracing each other.

As aftershocks rumbled, L.A. residents assessed their losses. The magnitude 6.7 quake killed 60 people. It destroyed or left uninhabitable more than 3,000 homes. It toppled ten highway bridges, closing three major freeways. Its spasms demolished part of a huge shopping mall in Northridge and collapsed seven concrete parking structures. Damage estimates exceeded 20 billion dollars.

By comparison, the 1989 Loma Prieta quake in the San Francisco Bay area cost six billion dollars. Of all U. S. natural disasters, only Hurricane Andrew in 1992 cost more—about 30 billion dollars. Still, the city was lucky. Striking in the predawn hours, the quake claimed far fewer lives than if it had hit with rush-hour traffic on the freeways, children in school, and shopping malls crowded.

Crushed by falling carports, wrecked vehicles line a Los Angeles street behind quake-ravaged apartments. Next stop: the junkyard. A few miles away, a notation on the wall of a second-story apartment (right) marks the spot where first-floor residents David and Cecilia Pressman died in their bed. The elderly couple were killed, as were 14 of their neighbors at the Northridge Meadows complex, when the top two floors collapsed and flattened the first.

Photographer ROGER H. RESSMEYER's assignments for NATIONAL GEOGRAPHIC have ranged from astronomy to volcanoes to nuclear power. A former San Francisco resident, he moved to New York following the 1989 Loma Prieta quake.

JULIE MARKES, LOS ANGELES TIMES

IN THE DAYS OF THE AFTERMATH I fly into L.A. to begin a survey of California's seismic future. I want to explore how its people, from San Diego to Eureka, live with the faults beneath their state, especially after being shaken by two big urban earthquakes in the past five years.

Californians grow up with earthquakes, typically experiencing small quakes less than magnitude 5 or the rumblings of something larger off the coast or in the desert.

"The small ones can be fun—like riding a roller coaster," says Paula Stewart of Rio Dell. "They don't hurt anyone, and you don't have to pick up after them."

Recent big quakes have been giving them a different ride.

"The earth didn't roll through," says Ken Torbert of Ferndale, recalling the 7.2 Petrolia quake of 1992, which hit near Eureka. "It went up and down like a piston."

Now, with Northridge fresh on people's minds, I find tension everywhere. In a Laguna Beach coffee shop, for instance, I overhear two women making small talk.

"What a day," says one. "Like heaven. So clear and hot."

"It scares me," replies the other. "It's earthquake weather."

Scientists reject any correlation between heat waves and earthquakes. Weather aside, there's good reason for Californians to be concerned.

"Something unusual is happening," one of the state's leading geologists, Kerry Sieh of Caltech, tells me. "We've never seen so many destructive earthquakes so close together."

For one thing, he says, the notorious San Andreas Fault system, which bisects California from the Mexican border to the northern coast, may have entered a period of high activity. The San Andreas drives most of California's seismic turmoil. It is a complex network. The main fault—or fracture in the earth's crust—is a line of connecting fault segments running through the state. However, the system also includes a zone of parallel, branching faults as much as 100 miles across. This zone forms the boundary between two great blocks of earth's crust. One is the tectonic plate that carries the Pacific Ocean, along with much of coastal California; the other is the North American continent.

Pulled and pushed by forces deep within the planet, the Pacific plate is sliding northwest past North America at an average of about two inches a year—roughly the same rate as fingernails grow. But movement along the fault usually occurs in bursts. Along most of the fault, the colder, more rigid rocks near the earth's surface resist the plate motions. Eventually enough strain develops along a segment of the fault to overcome that resistance. Then, in geologic terms, that stretch of the fault "breaks," "fails," or "ruptures," and a segment of the crust riding the Pacific plate surges north, creating an earthquake. In the magnitude 7.7 San Francisco earthquake of 1906, which killed more than 3,000 people, a 270-mile-long segment of the San Andreas from south of San Juan Bautista to Cape Mendocino surged northward as much as 21 feet in a few seconds. Half a century earlier in 1857, during a similar but little known 7.8 quake, much of coastal southern California shifted north.

Such great earthquakes—in the range of 8—released about 30 times the energy of Northridge's 6.7 magnitude quake. They probably dramatically lowered stress along their segments of the San Andreas, and indeed for most

A Change of Scales

In recent years most seismologists have abandoned the familiar Richter scale for determining the size of large earthquakes, such as the quake that devastated Kobe, Japan, in January, taking some 5,000 lives. The Richter estimates the magnitude of a quake by using a seismograph to measure seismic waves, the form of energy released by disruptions of rock deep within the earth.

The scale was named for Charles Richter, a California seismologist who invented it in 1935 because he was tired of journalists asking him to compare the size of earthquakes. A three on the Richter feels like a large truck rumbling down the street. An eight is catastrophic.

Scientists now prefer a more precise scale, which measures total energy released by quakes. Known as the moment-magnitude scale, it is calculated in part by multiplying the area of the fault's rupture surface by the distance the earth moves along the fault.

This article uses the moment-magnitude scale, which adjusts famous quakes this way:

Earthquake	R	M
Chile, 1960	8.3	9.5
Alaska, 1964	8.4	9.2
New Madrid, 1812	8.7	8.1
Michoacán, 1985	8.1	8.1
San Francisco, 1906	8.3	7.7
Loma Prieta, 1989	7.1	7.0
Kobe, 1995	6.8	6.9
San Fernando, 1971	6.4	6.7
Northridge, 1994	6.4	6.7

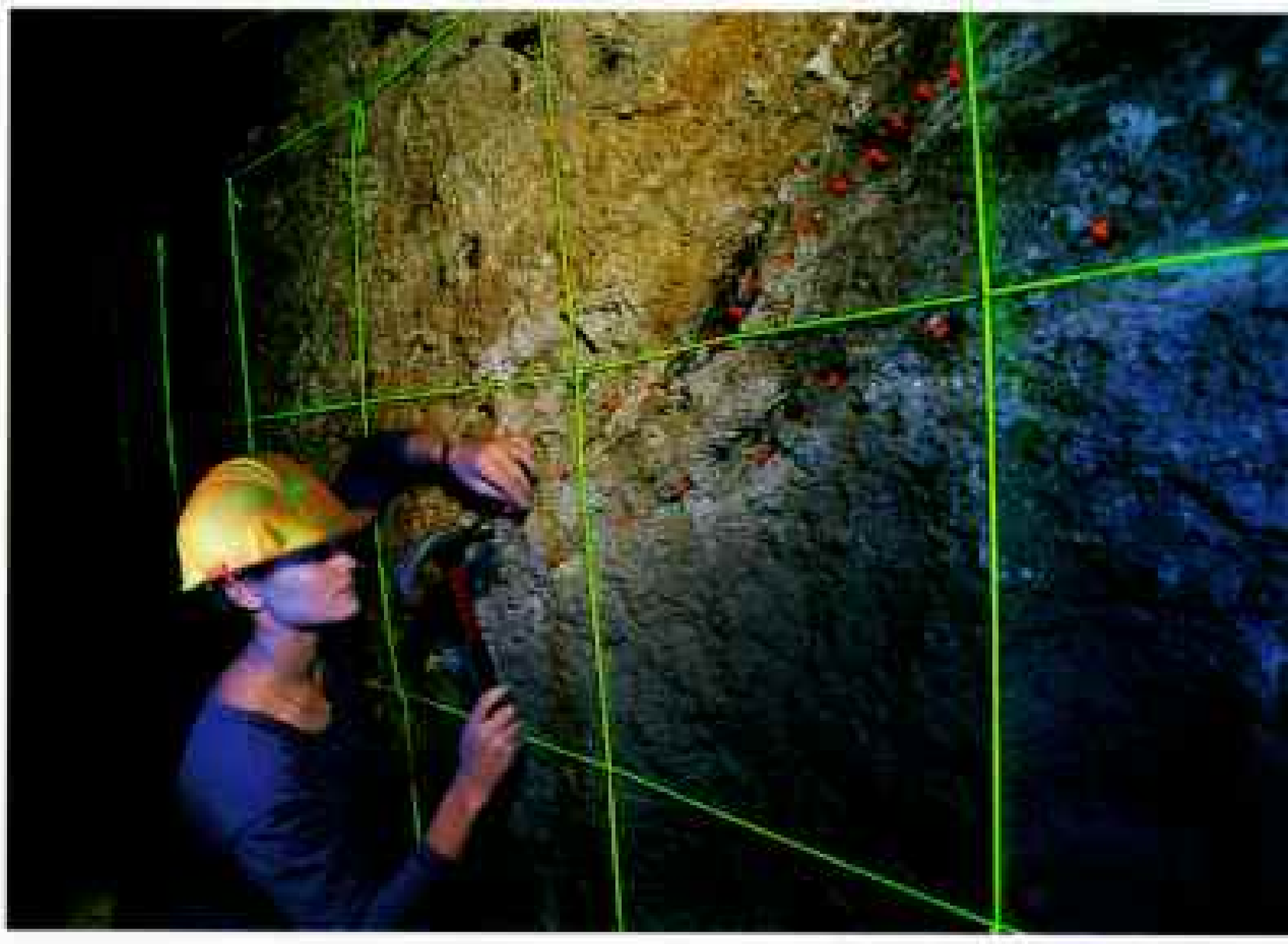
of this century Californians have experienced relatively few large earthquakes. That respite is probably over.

In the 75 years preceding the great San Francisco earthquake, notes Bob Simpson of the U. S. Geological Survey (USGS), 16 earthquakes with magnitudes greater than 6 struck the bay area. Then, for more than seven decades the area was hit by only one quake that large—a 6.5 in 1911. Now activity is increasing again in the region: Four quakes above magnitude 5.7 have hit since 1979. Likewise, southern California has been averaging one quake in that size range every year since 1986.

Moreover, the Northridge quake proved that southern California is particularly vulnerable to another, newly recognized seismic hazard—hidden faults. Called blind thrust faults, they move differently from the San Andreas, whose sides rip past each other horizontally, rupturing the ground with a visible scar. Blind thrust faults, by contrast, slope at shallow angles toward the surface. When they break, one side thrusts upward, and, as in the Northridge quake, the earth above them shudders with especially violent upward jolting. Blind thrust faults usually do not rupture the surface. Therefore, the only evidence of their existence may be mountain ranges that rise above them. During the Northridge quake, for instance, Oat Mountain, near its epicenter, was lifted up and northwest 18 inches. Yet the fault that created the havoc was unmapped, confirming a growing suspicion among geologists about the mountain-rimmed L.A. Basin.

"Northridge reminded us that there are unknown, obscure faults everywhere beneath L.A.," says Kerry Sieh. "We know now that just one of them can create a magnitude 6.7 quake. What if two or more break together? We would get a much larger earthquake—perhaps even a 7.5. We used to think the main danger to L.A. was a big one originating on the San Andreas Fault, which runs at least 30 miles from downtown. But the San Andreas is no longer the only source for a big one. We now have the enemy right beneath the city as well as on its margins."

Just one magnitude 7 quake under downtown L.A., says Ron Eguchi, a hazards-assessment specialist at the engineering firm EQE International, could kill 5,000 people in Los Angeles County if it struck during the day. Another 50,000 could be injured and 500,000 might be left homeless. Damage to buildings could run 50 billion dollars, with another 25 billion dollars in repairs to such regional infrastructure as roads and utility lines.



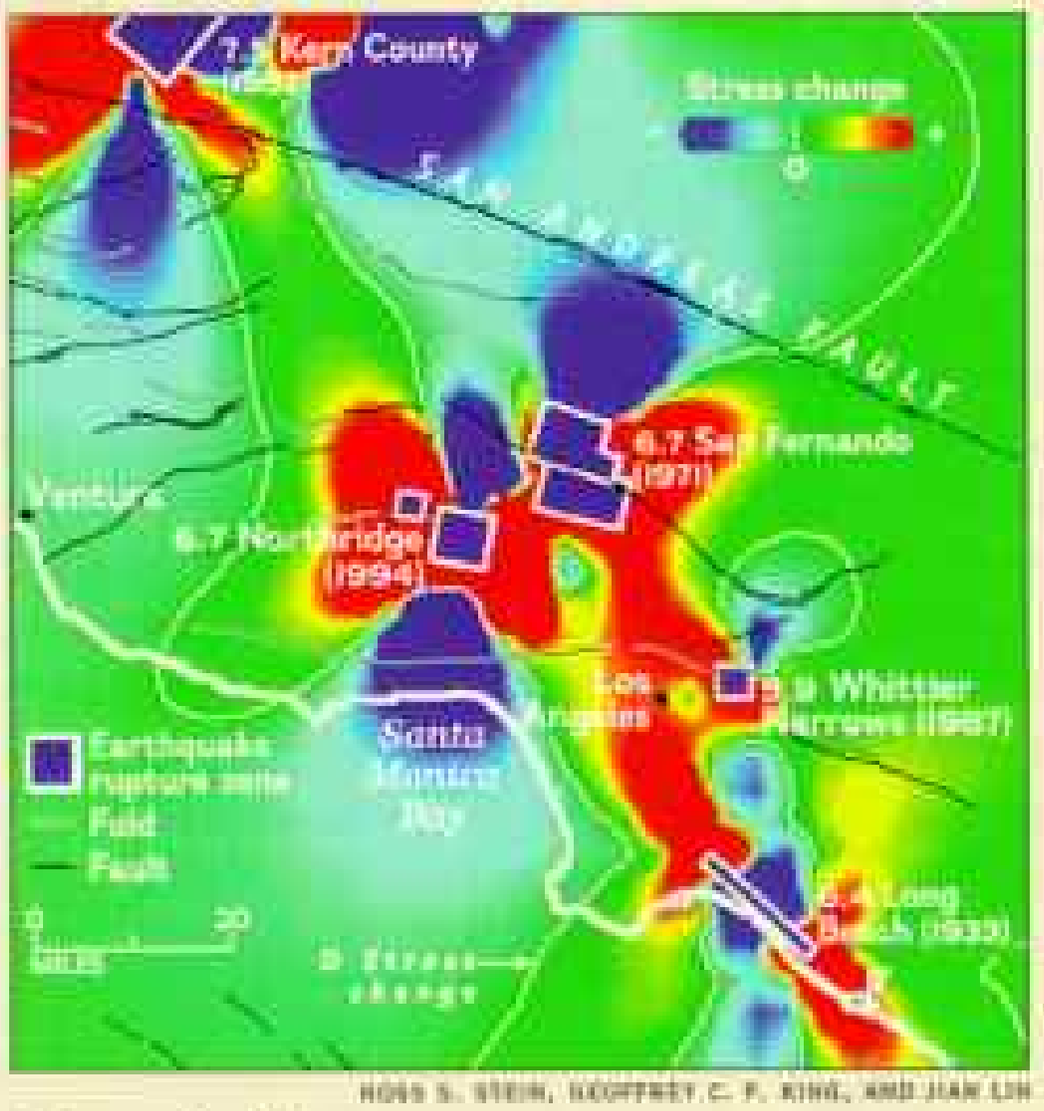
Working at night, Kimberly Thorup, a student at San Diego State University, marks a Mojave Desert fault with fluorescent nails. Ultraviolet light, which turns her reference grid green, highlights deposits of calcium carbonate left by water passing through small cracks along the fault. The position of the fault, indiscernible in sunlight, helps researchers measure its activity.

AS DAMAGING as blind thrust faults may be, the dominant quake maker remains the San Andreas system. The main fault begins about 90 miles northeast of San Diego. However, the system originates in Mexico as a series of faults coming out of the Gulf of California. One of these, the Imperial, *(Continued on page 16)*

The devils beneath the City of Angels

Residents of Los Angeles had long taken comfort in knowing that the San Andreas Fault skirts the city—veering some 30 miles north and east of downtown. They're complacent no more, shaken up by last year's Northridge quake in the city's San Fernando Valley. Measuring 6.7 on the moment-magnitude scale (see page 10), Northridge was the largest quake directly under a major U. S. city since the 1906 San Francisco disaster.

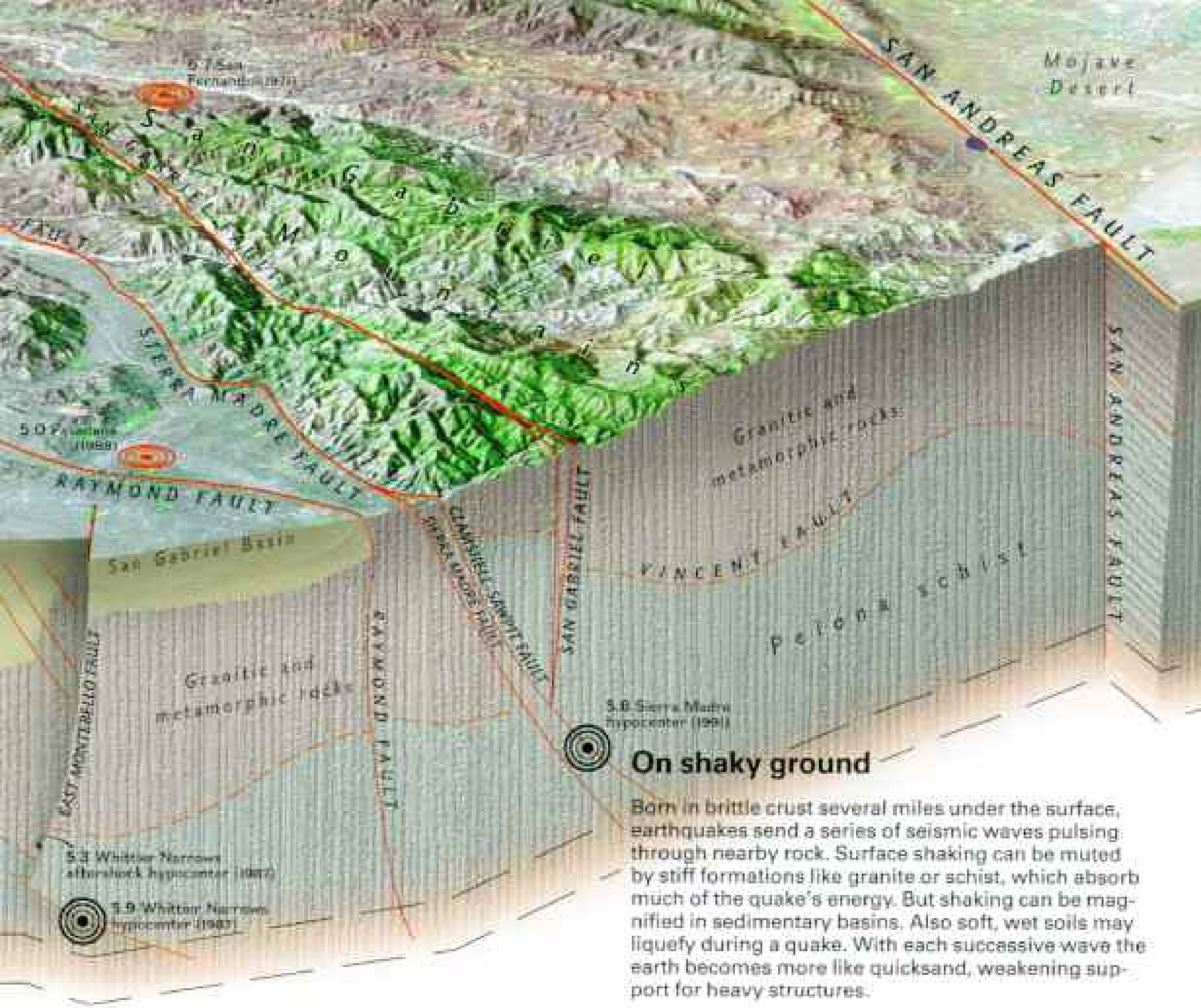
Geologists warn that scores of faults, each capable of magnitude 6.5 quakes, may slice through rock under Greater Los Angeles. Many are blind thrust faults, which usually do not break the surface of the earth—and so can elude geologists until a quake occurs. Both the Northridge quake and the Whittier Narrows quake of 1987 occurred on blind thrust faults.



ROSS S. STEIN, GEOFFREY C. P. KING, AND JIAN LIN

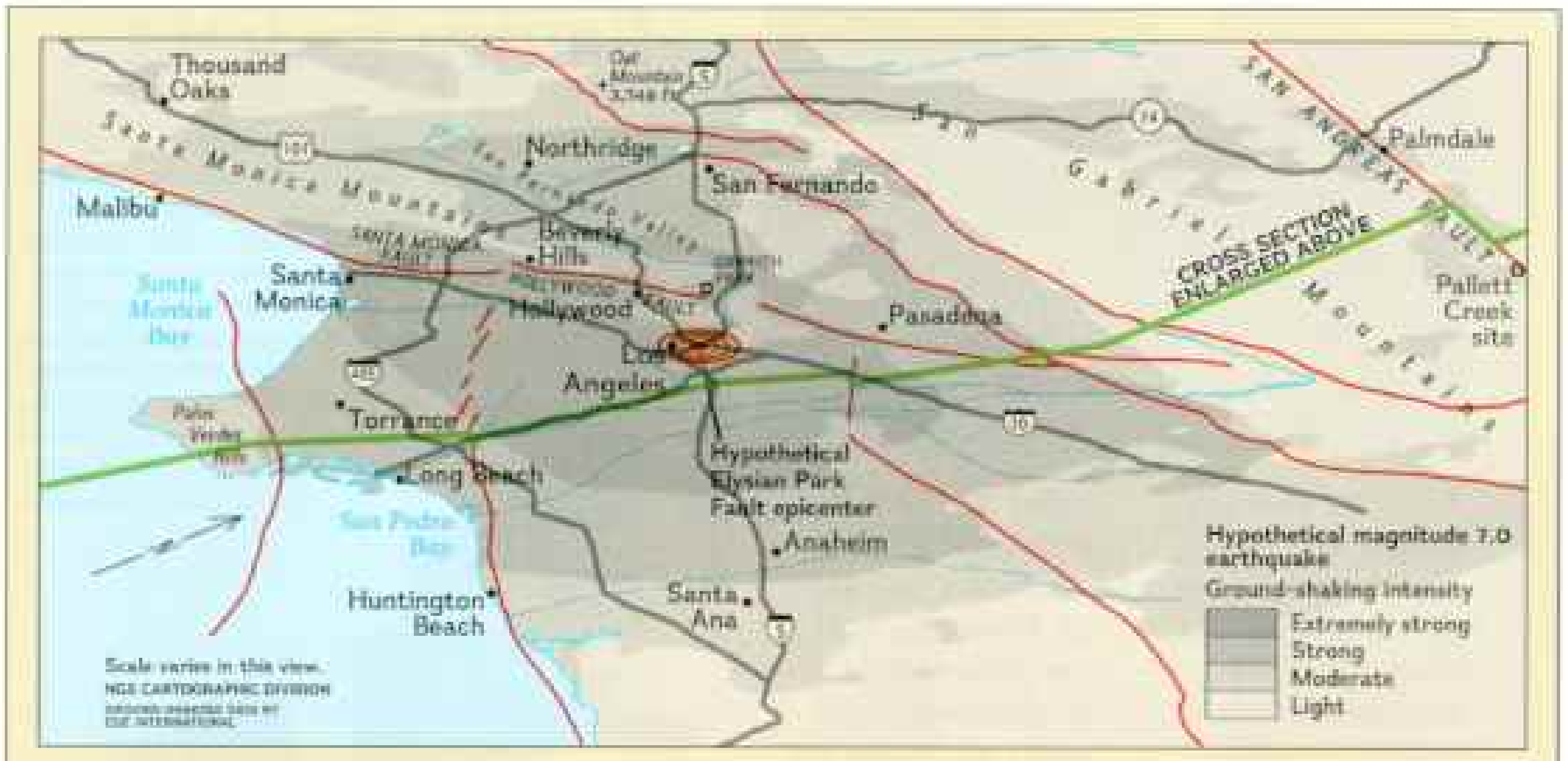
Stress buildup

In addition to relieving stress, quakes boost it in adjacent areas. A computer model calculates where stress has increased (red areas) as a result of large quakes since 1933 (purple boxes). The next temblors will occur where stress has risen.



On shaky ground

Born in brittle crust several miles under the surface, earthquakes send a series of seismic waves pulsing through nearby rock. Surface shaking can be muted by stiff formations like granite or schist, which absorb much of the quake's energy. But shaking can be magnified in sedimentary basins. Also soft, wet soils may liquefy during a quake. With each successive wave the earth becomes more like quicksand, weakening support for heavy structures.



A model for disaster

Twelve million people live in the L.A. area, where a quake three times as powerful as Northridge is likely to hit in the next 30 years. A model of ground shaking from such a quake on the Elysian Park Fault (above) shows a danger zone based on proximity to the fault, not to the epicenter—the surface point above where the quake starts. "You could be miles from the epicenter and still be on top of the quake if you're right on the fault," says the U. S. Geological Survey's Lucile Jones.

Faulty towers

Luminous at day's end, muscular skyscrapers spike above Los Angeles. Yet trouble may lurk within. A fractured column in an apartment complex near Northridge (left), while not common, points up the poor performance of steel in last year's quake. Smaller cracks occurred in and around welded connections in more than a hundred steel structures—raising fears of similar failures in the hidden framework of large downtown buildings.

A midsize steel skyscraper (figure 1, right) may be vulnerable to collapse in a major earthquake, if the timing of the building's motion is out of synch with the motion of the ground. Strong shaking can begin to move the lower floors, while the upper stories lag behind (2). If the ground movement shifts direction while the upper stories are still compensating (3), the building could in effect whiplash back (4) and collapse.

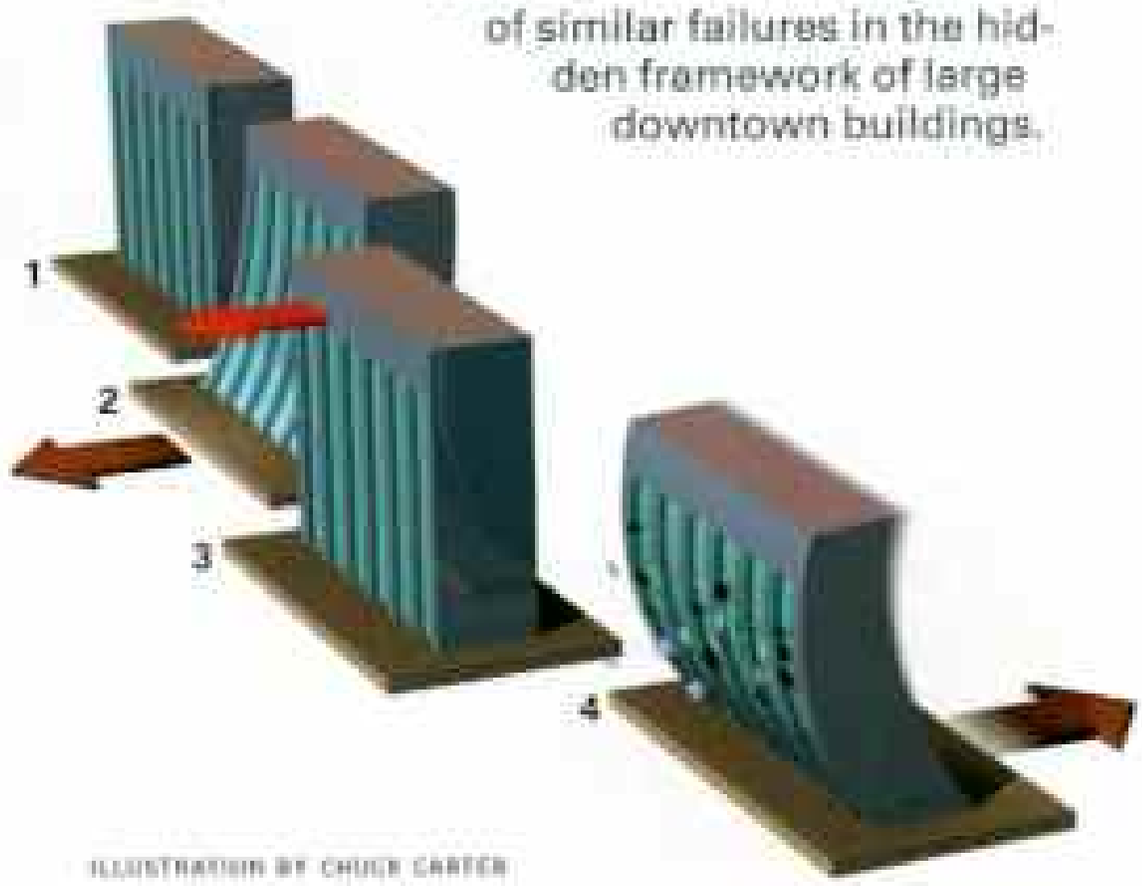
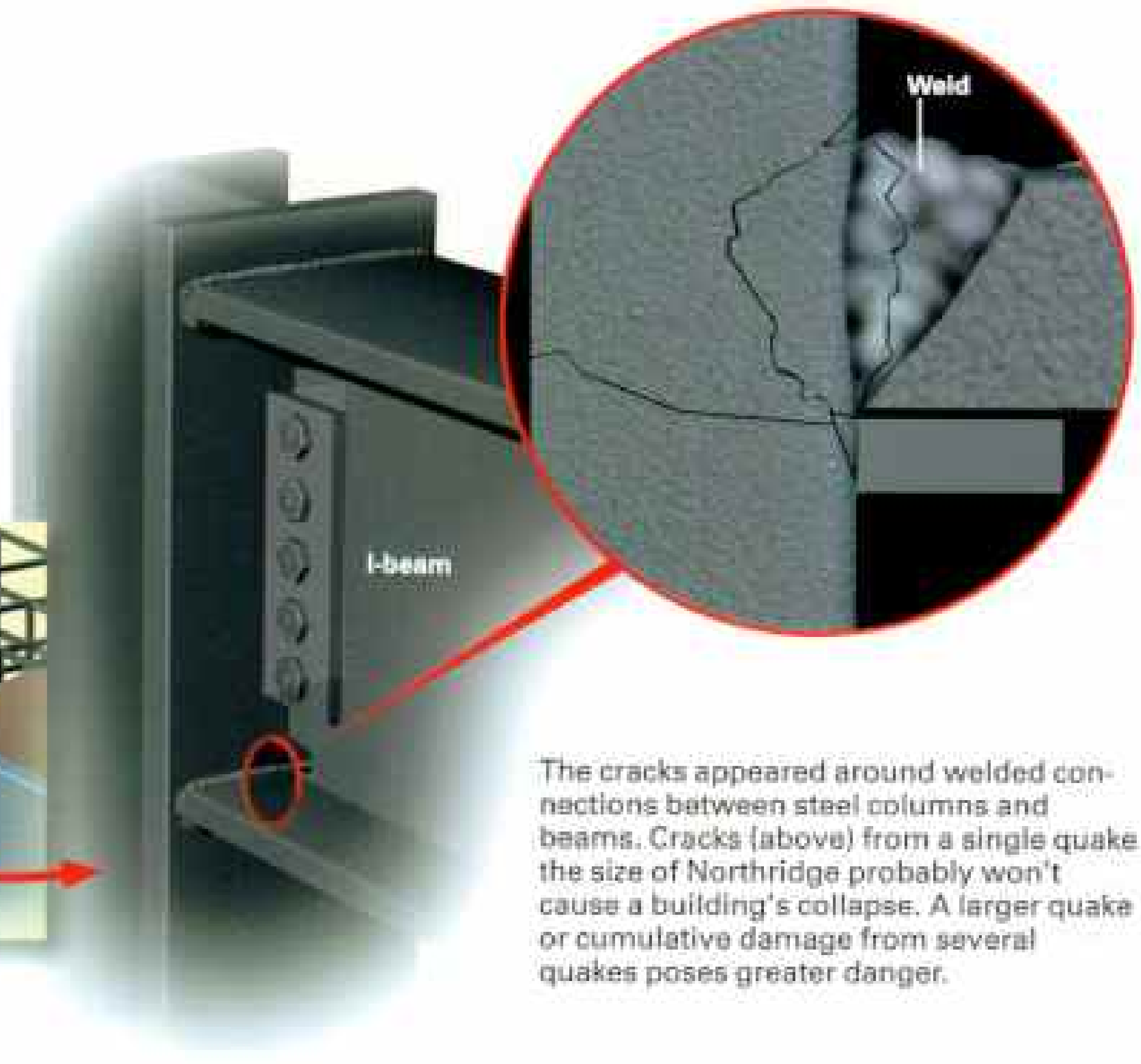


ILLUSTRATION BY CHUCK CARTER

Wounded welds

Safer than unreinforced concrete or brick in a quake, steel has been the material of choice for California builders. But some construction projects are on hold since Northridge, as engineers scramble to figure out why steel welds cracked so frequently.



The cracks appeared around welded connections between steel columns and beams. Cracks (above) from a single quake the size of Northridge probably won't cause a building's collapse. A larger quake or cumulative damage from several quakes poses greater danger.

feeds much of the Pacific plate's northward motion into the San Andreas.

Like many sediment-covered faults the Imperial is hard for untrained eyes to find. Tom Rockwell, a geologist at San Diego State University who specializes in southern California's faults, drives me into Mexico to see it. We find it crossing an east-west road outside the city of Mexicali. The only evidence, however, is an offset row of tamarisk trees along the road. Part of the row is 15 feet north of the other.

"Those trees were planted across the fault in a straight line," explains Rockwell. "But in 1940 a magnitude 7 earthquake moved all the trees west of the fault closer to California."

Across the border in the Imperial Valley farming town of Brawley, Millie Ralls, 80, remembers that moment well.

"It was a Saturday night," she recalls. "We'd come into town to get our groceries. We'd stopped in at Mel's Root Beer. Then, wham! My root-beer float went sailing down the counter. That quake just kept hitting us again and again. The Woodrow Hotel down the street collapsed. A drunk on the second floor didn't even know there'd been a quake. He just walked out the window into the street."

Few places in California get hammered by earthquakes as frequently as the fertile Imperial Valley, nicknamed America's Salad Bowl. More than a dozen major quakes have hit this century, the most recent in 1979 and 1987.

"We don't count 'em," says Ralls. "But you make a habit of looking at the clock every time you feel one."

"Fortunately, there's not a lot here to shake down," adds another longtime resident, George Wheeler. "You practically have to go out of the county to find an elevator."

California's push and pull

Uneasy border between the Pacific and North American plates—sliding past each other in northern and southern California but ramming into each other near L.A.—the San Andreas Fault stretches some 750 miles. The mighty fault, which spawns smaller ones, is framed by California's two most prolific earthquake zones: the Imperial Valley in the south and the Mendocino Triple Junction in the northwest.

At the north end of the Imperial Valley lies the Salton Sea, a tranquil saline lake whose peaceful appearance masks the seismic trouble brewing beneath it. Along its south coast we drive past small volcanic cones and steaming geothermal energy plants, indications of the heat being generated close to the surface.

"Just underground here," explains Rockwell, "the plate motions carried along the Imperial Fault are being shifted over to the San Andreas."

The San Andreas emerges full-blown on the northeast coast of the sea, beneath a tiny, fault-laced town of trailers and retirees called Bombay Beach. If the favorite scenario of many geologists is correct, Bombay Beach may become famous as the site that gave birth to the next big one.

"It's 12 months pregnant there," says Kerry Sieh, referring to the southernmost 60 miles of the fault.

Not until the late 1970s could scientists make such statements. Then, while still a graduate student, Sieh began applying a powerful new tool geologists were developing to look at a region's earthquake history. At a site called Pallett Creek, about 30 miles northeast of L.A., he began digging trenches across the San Andreas Fault.

Sieh takes me into one of his trenches. About ten feet deep, it is striated by dark layers of peat deposited during periods over the past 1,200 years in which Pallett Creek was a swamp. Because the peat contains carbon, radiocarbon dating has been able to determine the age of each layer to within a few decades.

"My feet are at A.D. 800, when Charlemagne ruled, and my head's up with Shakespeare," he says.

He points at one layer that abruptly breaks and drops a few inches.

"That offset was created by an earthquake about A.D. 1350," he says.

Such offsets let Sieh document past big ones along this segment of the San Andreas. The data were revolutionary. They helped inaugurate a new branch of geology called paleoseismology. Now scientists trench every fault

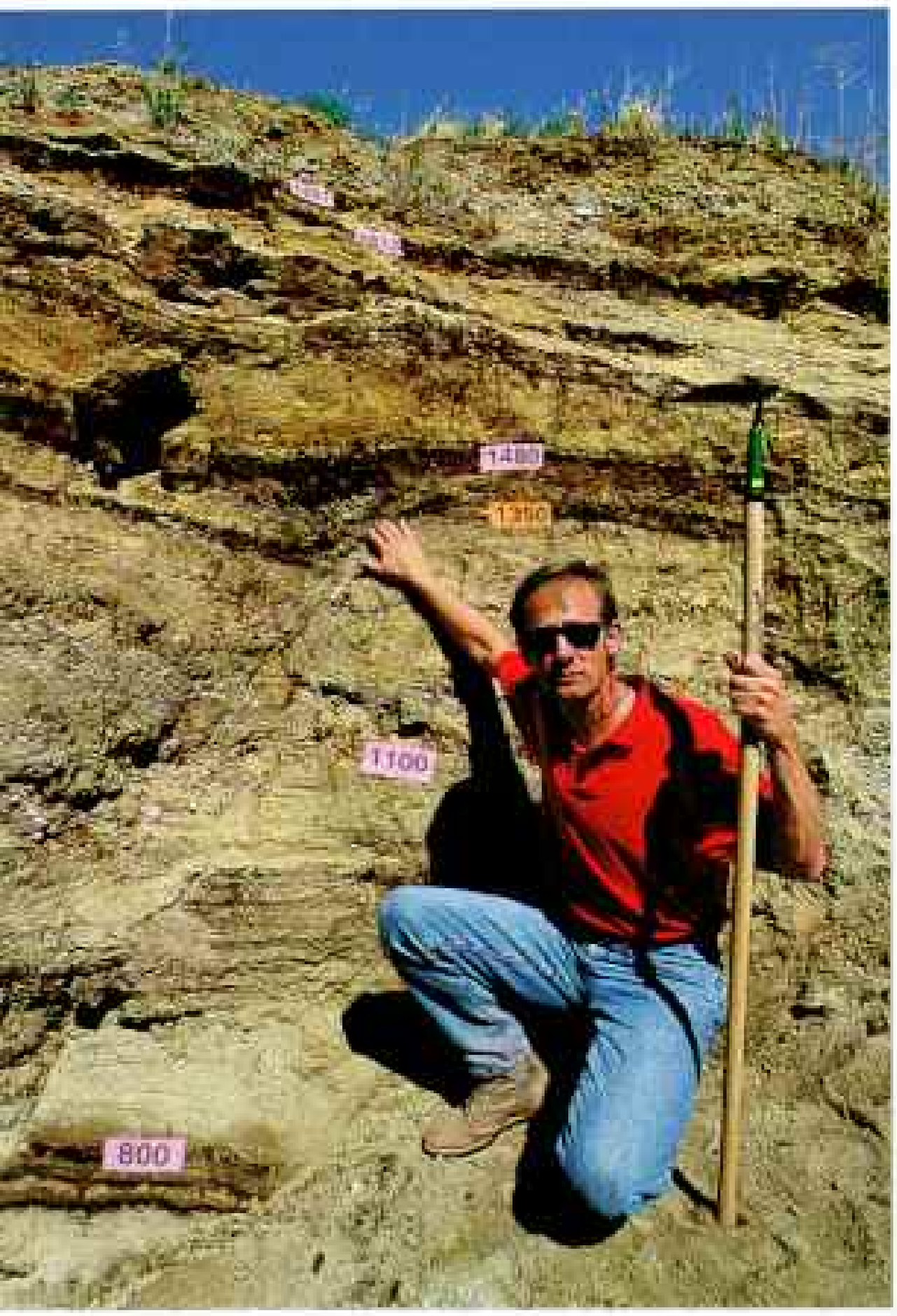
Die-offs of tide pool plants and animals helped geologist Gary Carver measure a four-foot uplift from the 1992 Petrolia quake. Carver expects more trouble a few miles away, where the Gorda plate subducts, or slides under, the western edge of the North American plate, pulling it down. The North American plate may move back up "sometime in the next hundred years"—causing a magnitude 8 or larger earthquake followed by a tsunami, or giant wave, rushing inshore "perhaps 30 feet above normal high tide."

they can, trying to understand how often faults generate earthquakes and the hazards they pose.

Some segments of the San Andreas seem primed to go. Sieh trenched the southernmost segment of the fault down near the Salton Sea. He found an alarming absence of earthquakes on that 60-mile segment, which runs past Palm Springs to the San Bernardino Mountains. "Our site there tells us we have major earthquakes on average every 220 years," he explains. "The last one was in 1680. That's why that segment seems past due."

New work by another team at a site 15 miles southeast of Pallett Creek, near the town of Wrightwood, underscores the threat along yet another stretch of the San Andreas.

"At Wrightwood we've found five major earthquakes since 1450," says the team's leader, Tom Fumal of USGS. "That averages one every hundred years. We think the fault is very close to failure. It's almost certainly going to happen in the lifetime of most people now living in southern California."



History is written in peat and sand at Pallett Creek, where geologist Kerry Sieh pinpoints quakes by dating broken rock layers in trenches dug across the San Andreas Fault. "Big earthquakes don't happen like clockwork," he says. "But it's clear that California has been unusually quiet for most of the 20th century."

JUST HOW BIG will that one be? The magnitude of an earthquake depends on the length of the rupture on the fault. If the system breaks from the Salton Sea through Palm Springs to the San Bernardino Mountains, for example, the quake would be about 7.4. If the rupture extended beyond Pallett Creek, the magnitude would grow to perhaps 7.9. Conceivably, the quake could exceed 8 if the rupture extended north into central California.

The fault probably cannot break along its entire 750-mile length, however. Near the town of Parkfield in central California, the rocks become less rigid, and for the next 90 miles the plates creep past each other without storing strain energy for a big quake. This stretch, known as the creep zone, buffers the northern and southern segments of the San Andreas from each other.

No matter where the southern San Andreas breaks, the city of San Bernardino, in the vast, densely populated suburban basin east of L.A., seems doomed to take the worst beating. This area is also threatened by the perhaps equally hazardous San Jacinto Fault, a splinter of the San Andreas that runs parallel to and about 25 miles west of the main fault.

"San Bernardino used to call itself City on the Move," says Kerry Sieh. "They never should have changed that motto."

"City on the Move? They should call it City of Liquefaction," says a local college student, improbably named Gavin Muck. "It's the worst place to build a city. It used to be a swamp."

Liquefaction is a devastating earthquake phenomenon that occurs where the water table is high and the soils are loose. The shaking turns the earth to quicksand, destroying its strength and amplifying the waves of energy shaking the ground.

Muck says most residents are aware of the hazard but "don't want to think about it."

Heading into L.A., I enter the newly recognized blind-thrust belt, where earthquake scenarios become as abundant as the boomtown dreams that built this brash metropolis.

"We've got six major fault systems in the metro area, excluding the San Andreas and San Jacinto," says Jim Dolan, an earthquake geologist at Caltech. "We're dividing those faults into potential sources for Northridge-size earthquakes. We've identified more than 50 so far."

"Our problem in Los Angeles is that we have this big kink in the plate boundary," says Lucile Jones of USGS in Pasadena. As the San Andreas approaches L.A., she explains, it takes a more westerly bend for about a hundred miles. That bend puts the North American plate in the path of most of southern California and Baja California, which are riding the Pacific plate north. Instead of grinding slowly past North America, southern California rocks collide with the continent around L.A. The collision contorts and squeezes the plate edges, building L.A.'s scenic mountain ranges higher and higher.

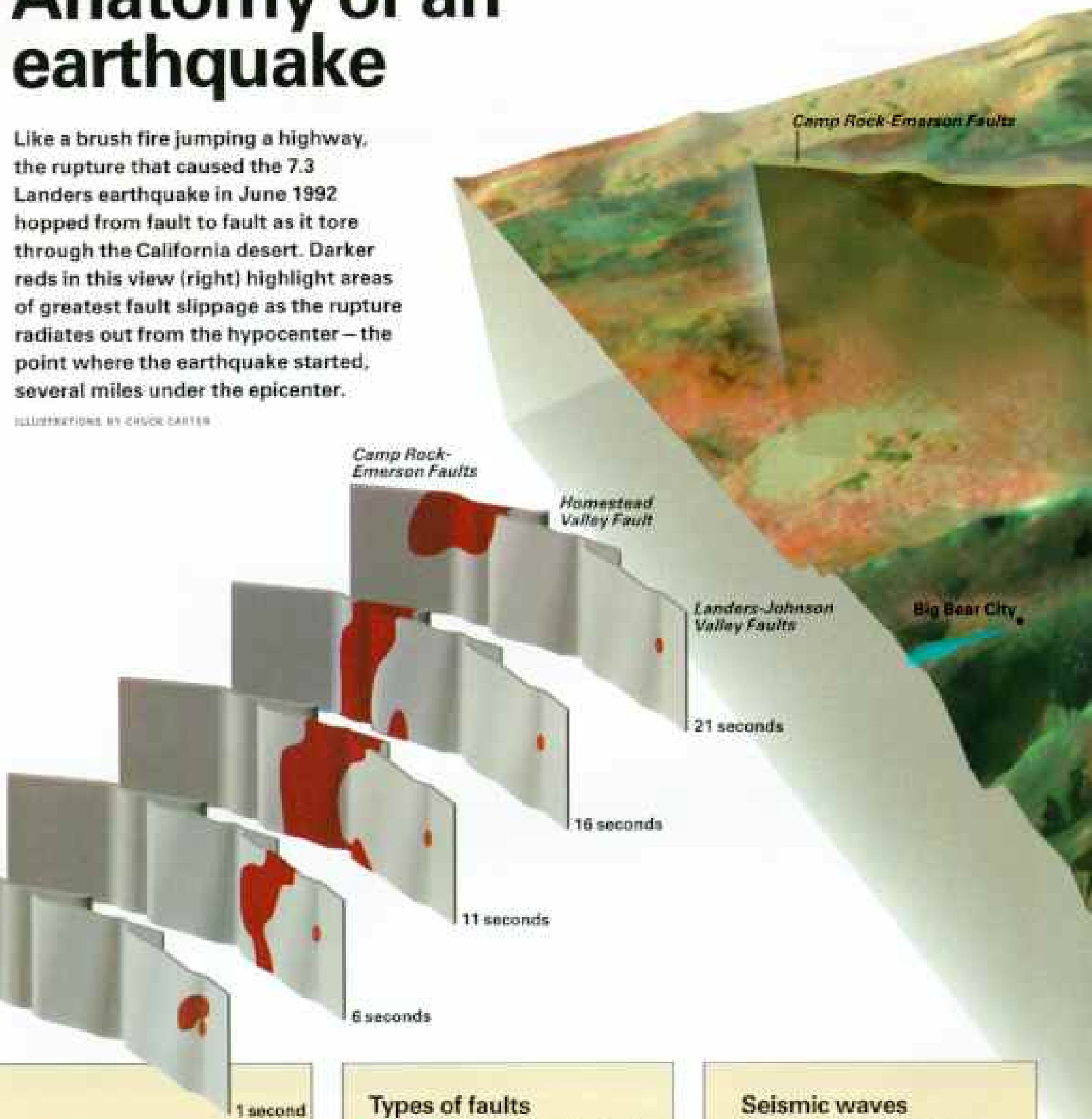
The collision is a fast one by geologic standards. The global positioning system (GPS), a network of navigation satellites, now lets geologists measure movements of the earth's crust with great precision. GPS data confirm that the Palos Verdes peninsula at the southern tip of L.A. is moving closer to Pasadena in the north by a third of an inch a year, squeezing the basin in between. Therefore, estimates Ross Stein of USGS, the L.A. Basin is losing about a quarter of an acre of land a year.

The San Andreas cuts a clean swath through rumpled hills in central California's Carrizo Plain. Here the Pacific plate, on the right, lurches northwest as much as 30 feet every few hundred years, grinding against the North American plate in a geologic tango known as strike-slip movement.

Anatomy of an earthquake

Like a brush fire jumping a highway, the rupture that caused the 7.3 Landers earthquake in June 1992 hopped from fault to fault as it tore through the California desert. Darker reds in this view (right) highlight areas of greatest fault slippage as the rupture radiates out from the hypocenter—the point where the earthquake started, several miles under the epicenter.

ILLUSTRATIONS BY CHUCK CARTER

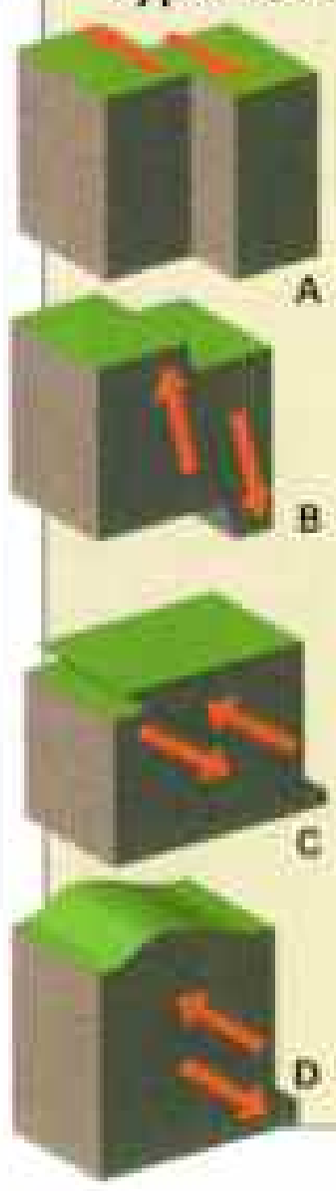


The quake's chronology

While other earthquakes have been known to "step over" to adjacent faults, the Landers quake was the first where researchers could track the slippage (above, in red). The rupture, which is plotted in five-second intervals, traveled 43 miles in 24 seconds.

BASED ON A MODEL BY DAVID J. WALD USGS, PASADENA

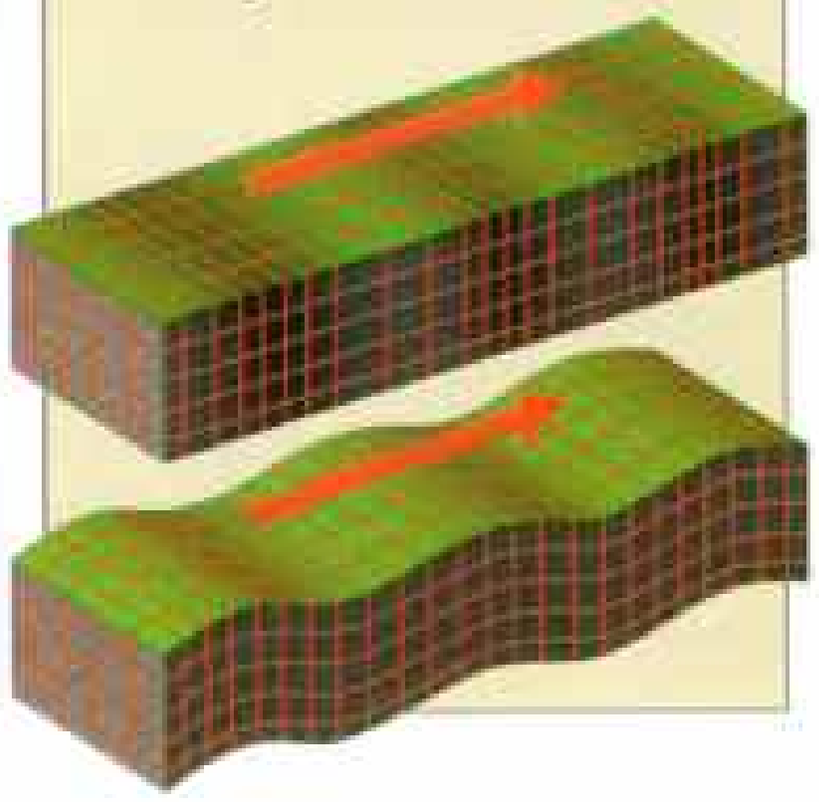
Types of faults

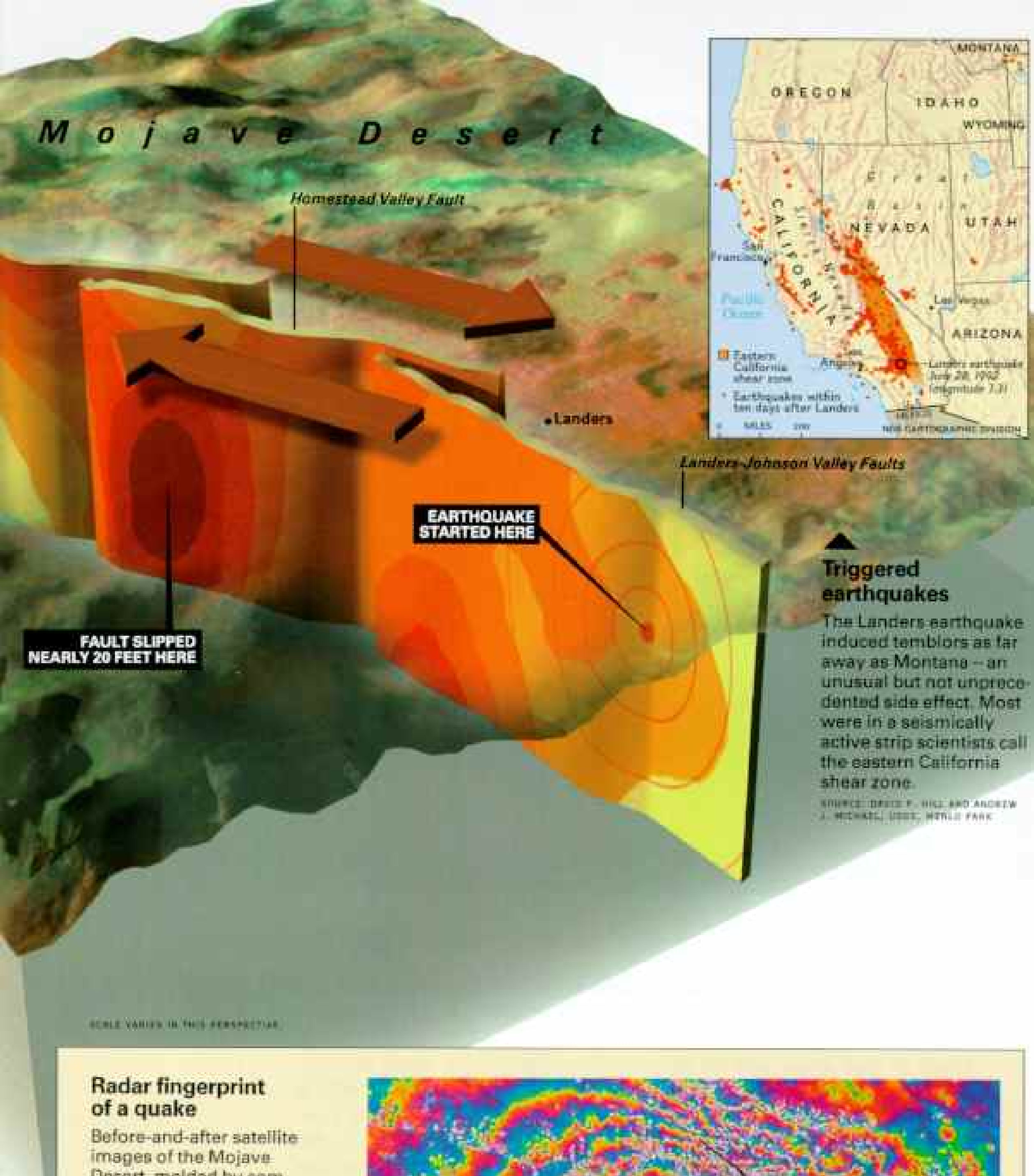


Strike-slip faults (A) form when slabs of rock slide horizontally past each other. Normal faults (B) occur when rock formations pull apart suddenly. Thrust faults (C) result when chunks of rock press together, forcing one side over the other. Blind thrusts (D) usually raise folded hills without breaking the surface.

Seismic waves

Earthquakes emit primary waves (top), which expand and contract the earth's crust. The more powerful secondary waves move more slowly, shaking the ground as they pass through the rock.





Triggered earthquakes

The Landers earthquake induced temblors as far away as Montana – an unusual but not unprecedented side effect. Most were in a seismically active strip scientists call the eastern California shear zone.

SOURCE: DAVID P. HILL AND ANDREW J. MICHAEL, USGS, MENLO PARK

SCALE VARIES IN THIS PERSPECTIVE

Radar fingerprint of a quake

Before-and-after satellite images of the Mojave Desert, melded by computer, create an interferogram—a map of the vertical movement of the earth's surface as a result of the Landers quake. Each swirling colored fringe represents one inch of ground movement. The closer the rings, the steeper the slope. The affected faults appear as a black line on a field of 3,700 square miles.

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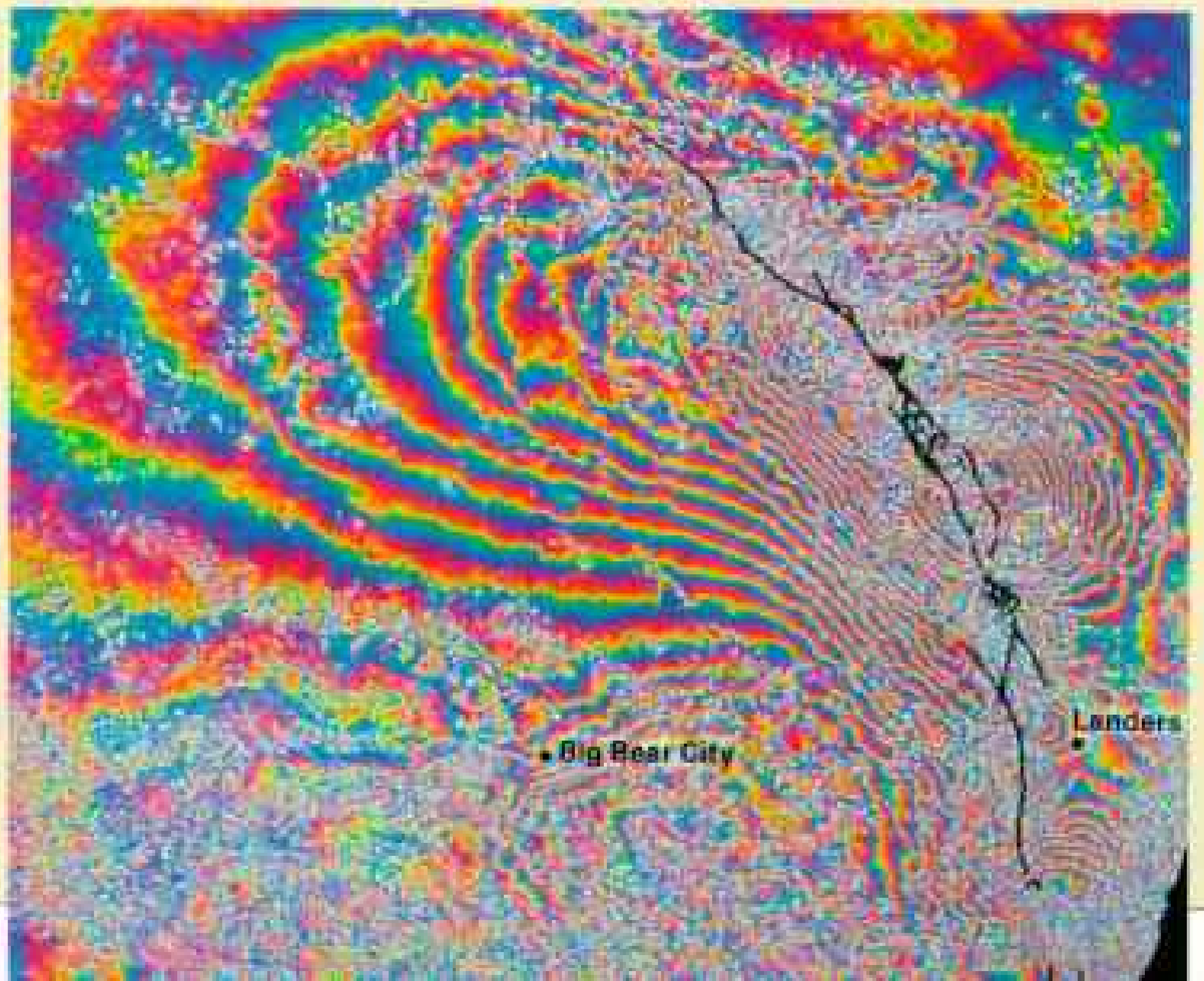


Given that rapid rate of collision, L.A. has not had enough earthquakes in historic times.

"We need 15 more Northridges to catch up with the strain that's built over the past 200 years," says Dolan. "Or else one big 7.5 event. It could be as high as an 8."

Much of that strain may be accumulating, Jones says, along a newly recognized hidden fault zone called the Elysian Park thrust-and-fold belt. It runs under the skyscrapers and crisscrossing freeways of downtown L.A.

From a mountaintop in Griffith Park, I gaze out with Jim Dolan at the glass towers of downtown L.A. On a mountain behind us rises the famous Hollywood sign. Below us Sunset Boulevard heads west toward Beverly Hills. The high-rise complex at Century City lies in the distance.

"This whole basin is a 25,000-foot-deep sea of sediments that have eroded off these mountains," he says. "Look at Century City. Those buildings are sitting on the tip of a buried mountain range. If you removed those sediments and stood at the bottom of the basin, it would be like looking up at the Himalaya."

We drive west along Sunset Boulevard, which is actually built along the Hollywood Fault. Until recently, this fault was considered inactive. Dolan, however, found that it breaks every few thousand years.

"If it broke, it would create an earthquake similar to Northridge," he says. "The Hollywood sign would go up and west a foot or two."

ROGER H. REESMEYER, STAR/LGAT

Heavy machinery was on the scene just hours after the Landers earthquake—when the Johnson Valley Fault did some unscheduled roadwork, shifting Reche Road ten feet as it ruptured underneath. Eighteen months later the Northridge quake raised Oat Mountain, overlooking the San Fernando Valley, by more than a foot and pushed parts of the valley three inches closer to downtown Los Angeles.

The Hollywood Fault also might fail in tandem with the adjacent Santa Monica Fault and the Elysian Park Fault system, generating a 7.5 disaster from east of downtown through Beverly Hills to Malibu.

Scientists can only speculate for now. More GPS receivers soon to be installed throughout the L.A. Basin will help them identify regions where stress may be building. But actually predicting earthquakes in L.A. remains a distant dream. What goes on beneath the surface of this city seems to grow ever more complex.

MEANWHILE, survivors of the Northridge experience are having difficulty blocking out the possibility of another big earthquake.

"I hate earthquakes!" says seven-year-old Ryan Campbell. "I've hated them ever since I was one week old and came home from the hospital. I want to live in England."

In fact, Ryan's anxiety began in 1992 when a 7.3 quake near the Mojave Desert town of Landers shook his home in L.A. After the Northridge quake, he refused to be alone. A clinical psychologist who specializes in earthquake trauma, Robert T. Scott, helped Ryan find ways to cope. For one thing, the boy took down pictures in his room that he feared would fall on him and replaced them with posters.

"The most damnable things are the aftershocks," says his father, Dale, a psychiatrist. "They get Ryan so rattled. Now he's so acutely attuned that even the garbage truck making the windows shake can panic him."

Meanwhile, Ani Shakhverdyan, eight, daughter of Armenian immigrants, is conquering her trauma with a magic sword.

"Our fear was so strong," says her mother, Hasmik. "We had to sleep in our cars for two nights. Even now, as we talk, my heart is beating fast and my hands are shaking."

Weeks after the quake, Ani would still cling to her parents, was terrified of the dark, and would not even go to the bathroom unattended. Levon Jernazian, a clinical psychologist, asked her to draw a picture of her fears. She drew a big rat. After telling her he was giving her an imaginary sword she could keep in her heart to use whenever she needed, he told her to cut the picture of the rat in pieces, burn it, and then stomp on its ashes. Ani did what he suggested, and her fears subsided.

Other reactions after the quake varied.

"Now many people are coping actively," says Cheri Adrian, a clinical psychologist specializing in trauma at the UCLA Medical Center. "They are buying earthquake emergency supplies, bolting down their belongings, making specific plans for what they would do and how they would contact their loved ones. This gives them a sense of control."

Many take their fears out on the city.

"L.A. is getting ridiculous," complains Paul Warner, a 30-year-old film director who woke up that January morning to bookcases falling on him. "Riots. Murders. Fires. Mud slides. This city is an apocalyptic zone. It's like an absurd comedy act. I'm getting out."

The earthquake, in fact, tipped the balance for many residents. Fed up with catastrophes and the state's dismal economy, thousands fled to other western states.

Most are staying. "I'm in the music industry. I can't run anywhere," says Ron Fair, a senior vice president with RCA Records on Sunset Boulevard. Fair recently bought the house owned by 1950s TV stars Ozzie and Harriet Nelson. The Hollywood Fault runs right through his living room. Even though the Northridge quake did 150,000 dollars' worth of damage,

he cites the estimates that the Hollywood Fault only breaks every few thousand years.

"I'll take my chances," he says.

Still, the cost of this earthquake—one insurance company lost 815 million dollars—creates fears about future catastrophes. It might have been worse. Stronger building codes, implemented after the 1971 San Fernando earthquake, prevented far greater damage to L.A.'s structures in the Northridge quake. Nevertheless, the tragic failure of the Northridge Meadows apartments underscores the need for better inspections.

Seismic braces loom behind a guard at Diablo Canyon nuclear power plant (facing page), located on the central California coast less than three miles from the offshore Hosgri Fault. A lightning rod for environmental protests since construction began in the late 1960s, the plant is still opposed by groups such as San Luis Obispo Mothers for Peace—who fear that a major quake could cause leaks from pipes or tanks that store radioactive materials. The Nuclear Regulatory Commission disagreed in a 1991 report, calling the plant "safe from all earthquake effects."

"AND THIS WASN'T THE BIG ONE—not even close," says attorney Joel Castro as we climb through the debris of the most devastated building in the Northridge Meadows complex. The odor of rotting food surrounds us as we step over the rubble of wallboard, insulation, fallen joists, and twisted window frames.

"We haven't found any building in this project in which the interior partition walls were connected to the floors and ceilings," continues Castro, who represents earthquake victims and their survivors in pending litigation. "Plywood shear walls, or support panels, would have held this building up—if there had been enough of them. Whole lengths of some were actually removed to put in utility panels."

Among many other defects, Castro points out joist hangers that are only half the size called for in the building's design.

"I'm not sure how much insurance the defendants have," he says, "but I'm pretty sure we'll get all of it."

Defense attorney Allen Tharpe expects a settlement. "We maintain," he says, "that the shaking was so strong this building would have collapsed even if it were built perfectly."

In fact, the shaking was surprisingly intense. In some places the ground accelerated with a motion exceeding one g—the force of gravity. Most buildings are designed for much less than that. So the first news was good: Most structures performed well.

The bad news began emerging a few days after the quake. In more than a hundred steel-frame buildings—a common type of construction in buildings five stories and higher for the past 25 years—inspectors uncovered cracks in critical welds, flanges, columns, and beams. Even though some tests done in the 1970s showed steel welds could be unreliable, engineers had embraced welding technology, applying it to hundreds of billions of dollars of high-rise construction, not just in California but in downtowns and suburban business centers across the country.

Now every structural engineer I talk with tells me that even though no steel-frame building collapsed during the quake, the welds and connections between their beams and columns must be strengthened.

"Confidence in steel-frame buildings has eroded," says Tom Sabol, a member of a panel of southern California structural engineers studying the problem.

Engineers are still debating how to fix the buildings. Strengthening one connection costs $5,000 to $50,000. A major high-rise with a thousand connections would thus face staggering retrofitting costs.

"Most of those buildings will not collapse in a big earthquake," Sabol emphasizes. "But it's a risk, and people occupying those buildings should be aware of the risk."

Many experts believe that California should rethink the goals of its building codes.

"The codes were designed to prevent life-threatening collapses," says

John Hall, an engineering professor at Caltech. "But now that we're discovering we have a lot more faults and increasing seismicity, it may make sense to spend a little more money and build stronger buildings. We don't want them so damaged we have to tear them down."

Earthquake anxiety diminishes as I leave the Los Angeles Basin and travel the San Andreas toward the San Francisco Bay area. Slicing its way through central California, the fault crosses dramatic but sparsely populated cattle country. Big earthquakes happen here, but not until the San

Andreas approaches the bay area does it threaten another populous region.

The bay area has still not recovered fully from the 7.0 Loma Prieta quake of 1989—or from the awareness that most of the region was actually spared from that quake's fury. Loma Prieta's epicenter was 70 miles south of San Francisco. Also, the rupture spread out in two directions. Parts of San Francisco and Oakland were shaken only six seconds. Had the earthquake's full energy been directed north, the shaking would have lasted twice as long.

The brunt of Loma Prieta was felt in Santa Cruz, which lost 40 percent of its downtown buildings. Today cappuccino bars, bookstores, and art galleries line the city's rebuilt main streets. But vacant lots still remind residents of what used to be.

Recovery has been slow and painful, says Neal Coonerty, owner of Bookshop Santa Cruz, which partly collapsed. For three years, while he struggled to find loans and rebuild, Coonerty operated out of a tent in a nearby parking lot.

Cars whiz past layers of sediment tortured over millennia by the San Andreas Fault, which lies only 200 yards beyond. State Highway 14's proximity to the fault points up the hazards of California's roadway web: Both the 1989 Loma

Prieta and last year's Northridge quakes buckled freeways, killing dozens of people. Engineers warn that many of the unreinforced concrete columns propping up overpasses may not withstand the state's next major quake.

"You get emotionally worn-out," Coonerty says. "And the feelings of that moment never leave you. It was so sudden. You never forget that at any second it could happen again."

Earthquake stress may have triggered another emotional aftershock.

"Ten days after the earthquake we had an all-time high in rape calls," says Melyssa Jo Kelly, coordinator of Santa Cruz's Commission for the Prevention of Violence Against Women. "And there was a 300 percent increase in reports of sexual assault and domestic violence. Both are crimes of power and control. I remember how completely powerless and out of control we all felt."

Santa Cruz is famous for its alternative lifestyles, and some residents comforted themselves with more spiritual tactics.

Kelly recalls falling apart after an aftershock. A young woman tried to console her: "Don't worry. This is just mother earth's way of giving birth to the New Age."

GEOLOGISTS have another explanation. Loma Prieta was triggered by horizontal and vertical thrust motion due to compression against a kink in the San Andreas Fault.

Thrust faults were the last thing bay area residents needed. They already had enough hazard with the San Andreas and several other faults that branch off it. Geologists now know that blind thrust faults lurk not only in the Santa Cruz Mountains, where Loma Prieta struck, but also to the east under San Jose and the Silicon Valley.

Still, the San Andreas and its affiliates dominate the hazard picture in the bay area.

"They aren't little puppies," says David Schwartz, a geologist at USGS in Menlo Park. "They are big biting dogs, and they each get unleashed every few hundred years."

The San Andreas runs up the San Francisco peninsula. But before it reaches the peninsula, it spins off side branches, the Calaveras and Hayward Faults, which cut through the cities of the populous east bay. Geologists divide the Hayward into northern and southern segments. Each segment ruptured in the 19th century. A fourth hazard, the Rodgers Creek Fault, bisects Sonoma County to the north but could direct a quake toward the bay area. Other worries include the poorly known San Gregorio Fault off the coast of the peninsula.

All those faults are loaded guns. USGS conservatively gives the bay area a 67 percent chance of being rocked by at least one 7 or higher quake from those faults in the next 30 years.

David Schwartz suggests that the odds are closer to 90 percent. No one would be surprised to see several big temblors within that period.

"Each one will be at least a 30-billion-dollar quake," estimates Bill Bakun of USGS.

The costs could go much higher. A repeat of the 1906 quake would today cost about 135 billion dollars.

Most scientists believe that a repeat of that quake, during which the San

City Hall gets a lift in Oakland, still mending from the Loma Prieta quake. Workers reinforce the building and install base isolators —giant rubber pads designed to dissipate a quake's energy. Aphrodite (circa 400 B.C.) warrants similar protection at the J. Paul Getty Museum in Malibu (facing page).

Andreas Fault ruptured well into northern California, is unlikely within the next century. They calculate that it takes 200 years for enough strain to build. Nevertheless, just the segment of the fault on the peninsula could unleash a major earthquake anytime. In fact Bob Simpson tells me the Loma Prieta quake could have added stress to the San Andreas north and south of its source.

"Those segments are more loaded now," adds Ross Stein. "Wouldn't that be cruel irony to the people of Santa Cruz, who think they've had their earthquake?"

The prime candidate for the next rupture, however, is the northern segment of the Hayward Fault, which cuts through Oakland and Berkeley. Most water, sewage, and power lines serving cities of the east bay cross the fault. Schools, hospitals, fire stations sit on its edges. Much of the housing in the area was built before stronger modern codes were established.

"People here have a false sense of what their homes will withstand," says Jerome Lenoir, owner of Quake Busters, an Oakland firm that reinforces houses to make them quake resistant.

Wood-frame homes can be made quite safe, he says, if they are bolted to their foundations and the walls strengthened with plywood.

Lenoir drives me up into the Oakland Hills, so ravaged by the fires of 1991. We pass an older brick home close to the fault.

"Unless they do some serious work, that house will be history," he says.

Farther uphill, in the area of the burn, the views of the bay below—the sailboats, the skyscrapers, the audacious bridges—grow spectacular. Construction crews crowd every street. Four-story houses that survived the fire perch on steep slopes. Scores of new ones near completion. Granted the view is grand, but considering the dangers, why would anyone move back here?

I ask the same question in San Francisco's bayside Marina district, which some geologists and structural engineers consider the most hazardous spot in the region. Built on an old marsh and filled in with rubble from the 1906 quake, the Marina's soil liquefied during the Loma Prieta earthquake. Many buildings collapsed, gas lines burst, and fires raged. Those devastated buildings have been replaced or seismically strengthened. No sign of disaster remains. Instead, youthful residents—the Marina is a mecca for single professionals in their 20s—jog past me or head for work in Jeeps and Porsches. Most are newcomers since the quake, and they pay some of the highest rents in the city. To live on the edge.

"Why did you move back here?" I ask Linda Lamb, a resident I meet in Bechelli's, a popular neighborhood coffee shop.

"This is my home. I wasn't ready to be pushed out," she says. "I survived the last one. I joined NERT [Neighborhood Emergency Response Team] and learned what to do. I'm not scared anymore. Also, it's similar to being in a plane crash. What are your chances of being in another?"

Here? At 90 percent in the next 30 years? Not bad.

One of the greatest hazards in San Francisco is its hundreds of older, unreinforced brick buildings. Chinatown, for example, is filled with these structures, which easily collapse. Unlike Los Angeles, which more than ten years ago began requiring that brick structures be strengthened, San Francisco and most other California communities have been slow to act. Poor people live in many of those buildings. Stricter rules would threaten their housing.

Officials are acting more urgently to retrofit the world-famous Golden Gate and San Francisco-Oakland Bay Bridges. Engineers warn that both must be extensively upgraded to safely withstand the big quakes expected. In the 1989 quake a small section of the Bay Bridge's upper deck collapsed onto the lower roadway, closing that vital artery for a month.

Much more destruction could occur in the more powerful shaking experts anticipate. The piers, which rest on timber pilings, could be damaged. Engineers say that while neither the Bay Bridge nor the Golden Gate is likely to collapse in their over-water sections, their approach ramps are vulnerable. Some trusses that support the roadways could also buckle.

"About 250,000 cars a day use the Bay Bridge. At any one time 4,000 people are on it," says Abolhassan Astaneh, a civil engineering professor at the University of California at Berkeley who led a recent detailed analysis of that structure.

Beyond the obvious life-safety questions, Astaneh says closing the bridge for a year or more would be economically devastating.

"The state's policy now is that major bridges should be completely functional after an earthquake," says Astaneh, noting that the Bay Bridge is "the most complex structure I have ever seen. Strengthening it is going to be a very big challenge."

Work on both bridges is scheduled to begin this year and take several years to complete. The cost will run more than 100 million dollars for the Golden Gate and 350 million dollars for the Bay Bridge.

Seismic hazards persist north of San Francisco, especially in the wine country of Sonoma County. The city of Santa Rosa was leveled by the 1906 quake, but today the Rodgers Creek Fault worries David Schwartz more.

"We think we see three big earthquakes in the past thousand years," says Schwartz at a trench his team has dug across the fault. "They occur on average every 230 years. We think the last one was about 1650. This fault can create at least a 7. There'll be a lot of wine on the ground."

Deck of cards adds a touch of whimsy to the $155 Execpak – an unsettling reminder that scarcity could follow a major quake. Safety officers at corporations and government offices buy their employees this survival kit or smaller ones, which fit neatly into desk drawers.

At the Kenwood Winery, one of nearly 150 in Sonoma County, I ask co-owner Mike Lee how he lives with the nearby fault.

"By hoping it won't happen," he says.

We enter a room filled with 12 huge stainless-steel tanks. "This is what really scares me," he says.

Each tank, he explains, holds more than 12,000 gallons, worth about $500,000 retail. Because he has no place else to store them, Lee has stacked 60-gallon wooden wine barrels along the walls, where they could easily fall and snap the valves that keep wine in the tanks.

Dennis Fagent, a structural engineer who helped Kenwood Winery retrofit its buildings, points out another problem: "The tanks are not designed to withstand earthquakes. In a big quake the steel tanks could buckle."

Thicker tanks might not buckle but would cost more, explains Lee's partner and sister, Elizabeth Sheela. Other wineries do not use them, and Kenwood cannot afford them either. The market is too competitive. "As always in business," she says, "it comes down to dollars."

NORTH OF SAN FRANCISCO BAY the San Andreas runs mostly offshore, and its affiliates grow hard to locate. By the time I reach Eureka the dynamics driving California's earthquakes have changed.

"San Andreas land is finished," says Gary Carver, a geologist at Humboldt State University. "You have entered Cascadia."

Cascadia, named for the Cascade Range, encompasses the entire coast of the Pacific Northwest. It begins at a point geologists call a triple junction. Here, just south of Cape Mendocino, three plates—the Pacific, the North American, and a small oceanic slab called the Gorda plate—converge. The Gorda is subducting, or diving, east beneath North America while being butted from the south by the encroaching San Andreas system. Geologists consider this spot one of the most seismically tortured in California.

ROGER H. WEDEMEYER, STARLIGHT

New apartments stand where others fell in the Loma Prieta quake (top). Careful construction is no guarantee of safety here in San Francisco's Marina district, built on unstable land reclaimed from the bay. Especially vulnerable are dwellings built over garages, which lack ground-floor walls.

The greatest hazards here are subduction earthquakes, generated as the Gorda plate thrusts beneath the coast. Subduction quakes are the largest on earth. The 9.2 magnitude Alaska earthquake of 1964 was a subduction quake. On April 25, 1992, a smaller one—a mere 7.2—hit the coast near the triple junction.

On that day Bob Shinn, a local general-store owner, was diving for abalone with his brother-in-law, Ric LeGendre.

"We'd just come onto the beach," recalls Shinn. "I'd pulled off my hood, when. . . ."

"The ground rushed up at us as if we were riding an elevator," finishes LeGendre. They take me to that same beach, where a cluster of rocks rises near the water's edge.

"It was like being on a bucking horse," says Shinn. "We were staggering around just trying to stay upright. Then I noticed that rock out there where I'd been swimming. It was about four feet higher out of the water. All the

Temblors created the hills that edge fog-mottled San Francisco Bay, spanned by the Golden Gate Bridge—unscathed, as yet, by earthquakes. Californians cite such sweeping vistas as reason enough to live with quake risks. And,

says geologist Pat Williams of Lawrence Berkeley Laboratory, the dangers are relative: "Many more people die every decade from severe storms and winter weather in the East and Midwest than from earthquakes here."

other rocks with mussels were way above water too. We took off. We thought we were going to have a tidal wave. But that water never did come back. All those mussels died off."

The two men had in fact ridden the coast skyward, witnesses to the process that has built mountains along the coast of California north of the triple junction: As the Gorda goes under, it jacks up the land above.

Although small by subduction-quake standards, this Petrolia earthquake—named for the town nearest its epicenter—traumatized residents of the sparsely populated region.

"I was upstairs at the computer when the rocking started," says Bonny Barnwell of Petrolia. "When the stereo flew past me, I panicked and went for the stairs. But our dresser jumped over and knocked me hard. It was probably a blessing. If I'd made it to the stairs, I think I'd have been thrown down them."

The quake triggered fires that burned down Petrolia's general store and post office. Some residents, says Barnwell, are still in emotional aftershock, easy to startle or subject to anxiety attacks. She herself broke a leg months after the quake in an accident she blames on a delayed stress reaction.

"This bed makes me feel secure," says Suzanne MacDonald in her San Francisco home. Her architect husband, Donald, built their bunker bed from heavy-duty plywood, supported by two-inch steel tubing, after the Loma Prieta earthquake. Says he: "This bed won't cave in."

Neither will California. Faced with dire news about active faults, Golden Staters strap their water heaters to the wall, bolt their homes to the foundation, pay high annual premiums for earthquake insurance—and hope for the best.

IN NEARBY FERNDALE, a touristic town of Victorian homes and bed-and-breakfasts, Dale Belvin recalls crawling out of a grocery store on his hands and knees as bricks fell around him. About 50 homes were thrown off their foundations. Although the town rebounded quickly, reports of earthquake damage devastated business for months.

"When I moved here 12 years ago from New York, I thought the earthquakes were all in Los Angeles," says local newspaper editor Elizabeth Poston McHarry. "Dumb me."

"The fact is we experience more earthquakes around the Eureka-Petrolia area than anywhere else in the state," says Gary Carver. "We feel a quake about once a month. There's a damaging one every three years on average."

The biggest concern, he says, is that "the Petrolia earthquake might be a precursor to a much more powerful subduction earthquake."

Until recently, scientists thought the Cascadia subduction zone was inactive. Now Carver is among several researchers finding evidence of huge subduction quakes in the recent past. In a saltwater marsh near Arcata he shows me stumps of trees that were killed and peat layers that formed from smothered vegetation after a major earthquake abruptly altered the tide line. Marshes in Washington and Oregon show similar evidence. Radiocarbon analyses date all this dead vegetation to about 1700. Does each site reflect the same monster quake? Striking along 400 miles of coastline, it would have been a magnitude 9 event. Or was there a series of smaller giants—8.3 or so—clustered over two or three decades? No one can say. Nor can they yet determine exactly how often big quakes recur.

"The estimates range from every 300 to 600 years," says Carver. "But the intervals aren't necessarily regular."

Since the last one apparently hit 300 years ago, how does he see the risk?

"Over the next 50 years, quite high."

So much uncertainty. I finish my journey feeling frustrated. Many critical questions will be answered only by earthquakes of the future. I have to hope they won't happen, yet I know they will, and I anticipate what they will teach us. Is the news too alarming? Consider the lives at stake if Californians don't heed what geologists are gleaning about the past.

As David Schwartz says: "My wife's a real estate agent. She hides me from her friends. We geologists may spread doom and gloom, but that's the way it is." □

Australia's arboreal ambassador is in trouble. The leveling of eucalyptus trees, koalas' prime habitat and food source, tops the list of threats to their numbers. Now Australians are rallying to the rescue.

KOALAS OUT ON A LIMB

By OLIVER PAYNE
NATIONAL GEOGRAPHIC SENIOR STAFF
Photographs by MIGUEL LUIS FAIRBANKS

THE ONE TIME I HELD A KOALA, snugging him close to my chest, I must admit that he had just the kind of effect on me I'd convinced myself I would resist. For a moment Dopey the tame koala became Julia my squeezable two-year-old. The association was visceral. Like her, he seemed soft and vulnerable, a coming together of circles, from ear and head to belly and behind.

Julia melted away when I looked into the koala's eyes, unresponsive amber beads with vertical slits for pupils. His nose, dramatically Roman, was satiny black, with splashes of pink skin beneath butterfly-wing-shaped nostrils. The mouth was a deep V, equipped with teeth that would give Dracula goose bumps. It curled down at the corners, making for a grouchy look, as if someone had just shaken him out of a deep sleep.

He smelled good, exuding the fragrance of eucalyptus, and looked dapper in a coat of luxuriant fur, white on the chest, light gray elsewhere. An orange-brown smudge on his chest marked secretions from his scent gland, a built-in dating kit. Male koalas rub their scent gland against trees to claim a patch; with guttural grunts that reverberate through the forest, they announce their presence.

Gingerly I took hold of a front paw and fingered the points on a set of gleaming black scimitars. No reaction. Dopey remained inert. Brief though it was, this Australian encounter satisfied me that the most

Driver's helper, two-year-old Pebbles rides home with foster parent Miriam Graham. Injured and orphaned when she and her mother were hit by a car, Pebbles' broken jaw prevents her from eating without help, and she is too young to be left unattended overnight at the koala

hospital in Port Macquarie, New South Wales. "Pebbles will be a permanent resident of the hospital," says Graham, a volunteer with the local caregivers, one of a dozen or so groups in Australia that tend ailing koalas. "She'll never be able to fend for herself in this mad world."

endearing thing about a koala is its gentleness.

Wrong! Koalas are more like shrunken grizzlies than teddy bears. Just listen to Keith Hayes, a land surveyor in Queensland who gives them a wide berth. "They're grumpy little buggers," he chortled. "If you get a real old grumpy bugger, a big one on the ground, and you're in his way, he'll sort of make this horrible growling noise and show his claws.

"Oh yes, they'll rip you to pieces. You just hope they don't turn on you and come in scratching. You'd look as though you'd been dragged behind a car for a hundred yards."

Phascolarctos (pouched bear) *cinereus* (ash-colored): Australian tree-dwelling marsupial; national icon, international heartthrob; nocturnal, odorous, somnolent. Preferred diet: eucalyptus leaves. Range: mainly the coastal forests of Queensland, New South Wales, and Victoria.

EASTERN AUSTRALIA left me with the strong impression that koaladom is buckling under human success. Convinced too that of all the oddities this continent has brought forth, none is more peculiar or influential—or contradictory—than the pseudo bear. Koalas grown in the wild are sometimes feisty, but in zoos they are downright cute. Koalas are bearers of very little brain, yet they have been revered for their wisdom. And though they live to sleep, Velcroed to a branch most of the day, koalas galvanize people.

Take Australians. The contrary marsupial is a superstar that radiates in their collective imagination. "The koala," confides Ros Kelly, formerly the environment minister, "is essential to how we see ourselves."

Too right! Koalas have slept their way deep into the Australian psyche—and woken up in the guise of mischievous Blinky Bill and debonair Bunyip Bluegum, beloved heroes of children's fiction. They're an affair of the spirit, as Aussie as kookaburras and convict ancestors.

What, then, explains a letter like this? "Dear Sir, I have cancelled my trip to Australia. I will re-book *only* after koalas are well protected." Dated July 6, 1992, this was one of more than 12,000 similar messages sent to Australia's ambassador to the United States as part of a campaign by an international animal rights organization to ensure the survival of the koala.

Between a grunt and a belch, a male koala's bellow can be heard a half mile away. Koalas reach maturity at two years, but males rarely mate successfully until they are three or four. About 35 days after conception in spring, a female gives birth to a single joey, nourishing it in her pouch for five months. SHIN YOSHINO, MPS/UNIPHOTO PRESS INTERNATIONAL

In 1992 the International Union for Conservation of Nature and Natural Resources listed 59 threatened Australian marsupials. Half came under the headings "endangered" and "vulnerable," and half, the koala among them, were judged "potentially vulnerable."

Recent research has added greatly to the store of knowledge about what koalas are like, but relatively little work has been done on the details of their habitat needs—how widely they range, for instance, and what particular eucalyptus trees they prefer. In the absence of irrefutable scientific evidence, debate about their status is emotionally charged. People readily invoke the term "koala politics" to explain often vituperative differences of opinion about how the animal is faring.

Many Australians I spoke with are in despair over what they regard as the unstoppable plundering of nature. (Indeed, opinion polls consistently rate the environment as one of the most compelling public concerns.) The intensity of their frustration owes much to the fact that in Australia nature has conjured so many forms of life, like the koala itself, that are wonderfully bizarre—and of course irreplaceable. It's a tragedy, these Australians say, that greed and institutional intransigence are squeezing the life out of their land.

I heard the message most forcefully from women. One embittered crusader went so far as to shrink the problem down to twin evils of her countrymen—chauvinism and alcohol consumption—uttering the words with a hopeless sigh.

Such assertions aside, there is no doubt that the clearing of forests has caused serious problems for koalas. They are dying out at alarming rates in places. As dwindling colonies become separated by houses, fields, golf courses, shopping centers, and the roads that serve them, inbreeding threatens to impoverish the genetic stock of the species.

Photographer MIGUEL LUIS FAIRBANKS was born in Guatemala and now lives in Santa Cruz, California. His byline appeared previously in the GEOGRAPHIC in "Maya Heartland Under Siege" (November 1992).

KOALAS ON THE RUN

Kill a koala, make a million! Promises of wealth from koala fur spurred a slaughter last century that continued until 1927, when public outcry stopped it. The clearing of eucalyptus forests for farms, logging operations, and urban development has further devastated the marsupials by shrinking their range. Today koalas claim treetops in disconnected stands in four states. Concentrated along coastal plains, they compete with people for prime real estate, particularly in southeastern Queensland—the fastest growing region in the commonwealth. There they struggle to survive in the midst of city dwellers and the trouble they bring: traffic, dogs, and obstacles that block a koala's path to the next tree.

Thus weakened, koalas could be susceptible to devastation by disease.

Another koala defender ventured that she could foresee the entire east coast stripped of all the old, native eucalyptus trees. Most people, she said, just don't care or are in denial about how bad the situation is.

Sue Dobson cares. When I met her, Dobson had been campaigning for four years to stop 22 houses from going up on the doorstep of the last healthy colony of koalas near metropolitan Sydney. Where houses go, she reasons, so go big killers: cars, dogs, and carelessness—someone forgets to stub out a cigarette, and these 70 or so koalas die in the flames. (There is also the inexplicable threat of arson. Last September three youths set a fire that almost obliterated the colony.) There are insidious enemies too, such as weeds that choke native plants and polluted runoff that poisons trees.

The subdivision remains unbuilt, in part because Dobson persuaded local union workers to refuse to provide electric and telephone service—possibly the world's longest running "green ban" for habitat conservation.

"The important thing," Dobson told me, "is that we're just ordinary people fighting to save the koala." She struck me as an extraordinary blend of courage and fear, a quality she explained. One day someone threw acid on her two dogs, scarring them badly. Another time a homemade bomb was lobbed onto her porch, where it failed to explode. After telling this story, Dobson leaned toward me and said in a hushed voice, as if she almost believed the coming thought, "If I get it next time, you'll know why."

YOU HAVE TO WONDER: Why do the lives of some Australians coalesce so powerfully around the koala? I ask Ken Walker, whom I meet in drowsy Bowraville in New South Wales, for his perspective. This soft-spoken elder of the Gumbaynggir tribe is one of only a few men initiated into the Dreamtime of his people and thereby entrusted with passing down the sacred creation myths.

That Ken also has koala Dreamings to share makes him an Australian treasure. Images of koalas are curiously scarce in Aboriginal paintings and rock carvings. A partial explanation may be that some tribes thought of the koala as the supreme totemic symbol, the

wisest of all beings, and painting it was forbidden. In Gumbaynggir lore, Ken tells me, koalas are seen as mischievous children with magical powers.

"See, the bear has special significance," he begins. "Our people were walking, then these two women got stirred up about something or other, and they made the sea, and all our people were trapped on an island. They had two koalas with them, so they stripped their stomachs—you know, the gut—and that formed a bridge back to the mainland. On the entrails of koalas, when they're dried and held up to the sun, you'll see footprints."

Ken Walker should know. When he was a boy, koala was on the menu, supplementing such staples as possum and pademelon (not a fruit but a small wallaby). What does koala taste like? Ken is dismissive. "The taste didn't come into it, as long as it filled the belly. I'd say a strong eucalypt taste."

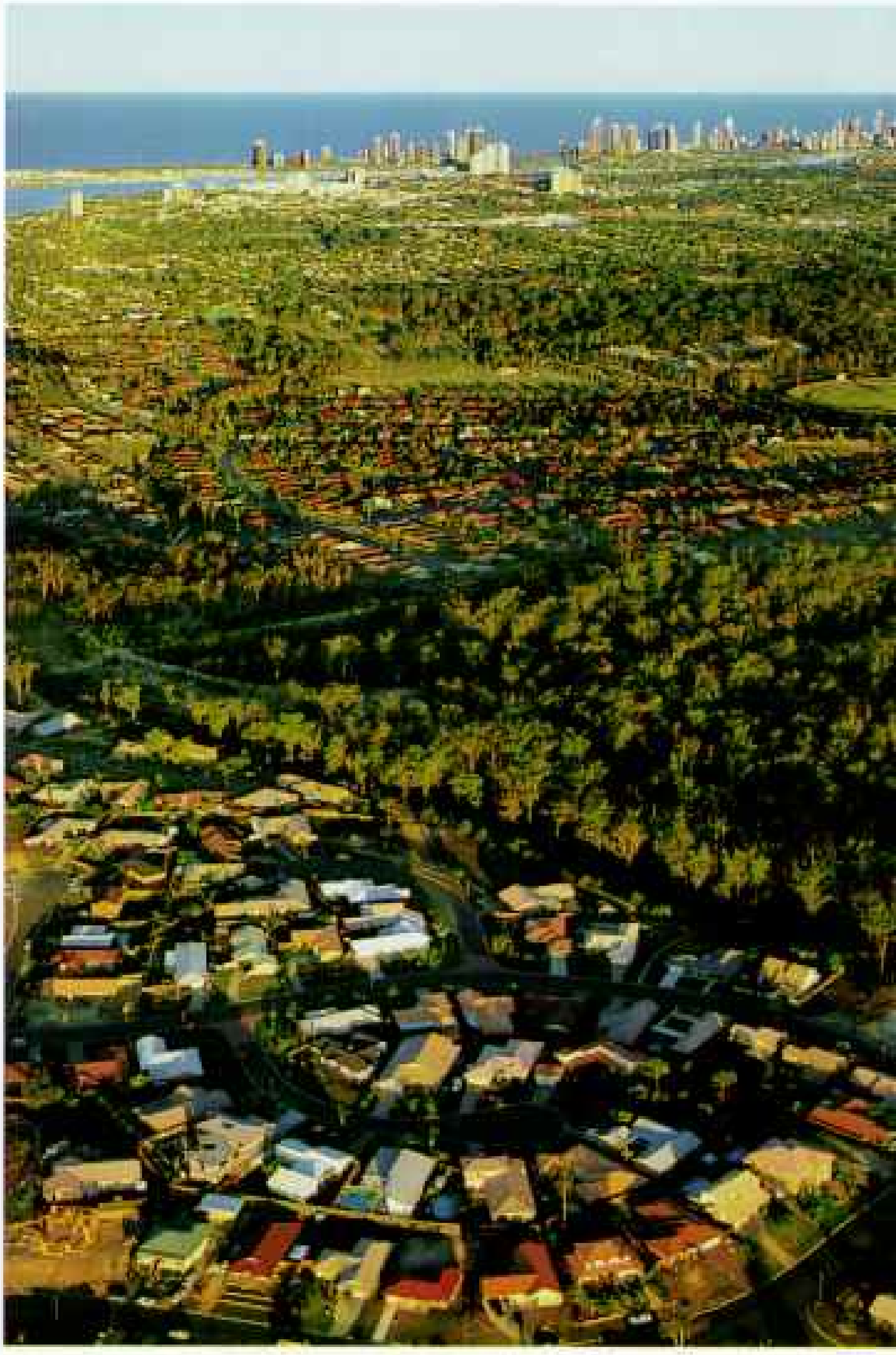
I try to imagine eating a plate of barbecued cough drops. "See," he says, "eucalypt was a healing aid. When you ate koala—zoom, you healed the insides."

Ken tells how at the agile age of six he began hunting koalas. "We just climbed the tree and knocked him down." One day he heard a haunting cry, the lament of a mother koala circling a tree from which her joey had been taken. In an instant Ken understood why some Aborigines believe koalas are the souls of dead children.

"When they started crying," Ken Walker says quietly, "I gave up hunting."

Aborigines thinned koala populations in the eastern forests, but the cries grew louder last century as European settlers discovered koala fur. Snaring and cyanide poisoning, unlike shooting, left pelts unmarred. In the late 1800s colonies in Victoria suffered huge losses, compounded by disease and bushfires. In Queensland the government periodically declared open season. The last one, in August 1927, yielded almost 600,000 skins, many of which were shipped to St. Louis, Missouri, a hub of the fur trade. This slaughter caused such outrage that within months the Australian government banned the export of koala pelts. By then in the state of South Australia there were no more cries to be heard.

Closing in on all sides, houses in Queensland's Gold Coast usurp koala habitat, leaving the animals a mere 80-acre enclave. Though some urban developers now connect green tracts with tree corridors to provide passage between them, conservationists doubt that koalas will use the pathways.



HUNTING FOR A KOALA in New South Wales these days can be tantalizing, especially when your radio receiver is beeping loud enough to shame a kookaburra. "I'm pretty sure we're right under her,"

Solitary tree dwellers, koalas rest as many as 20 hours a day. At night they rouse themselves to forage for eucalyptus leaves in their home ranges, which can vary from seven to 70 acres, depending on habitat quality. The total koala population is unknown. One guess puts their

numbers as high as 400,000; another, in 1993, as low as 40,000. "Our '93 figure sent out shock waves," says Steve Phillips of the Australian Koala Foundation. "We're talking about animals in a chronic state of decline."

said Rob Close, twisting the parallel prongs of his antenna as if hoping to snag the animal.

For several months Close, a senior lecturer in biology at the University of Western Sydney, had been radiotracking two koalas through O'Hare's Gorge, a primeval forested gash near the town of Wedderburn. "I realized that land-use decisions were being made without any knowledge," said Close, his voice barely audible above the chirping of the receiver and the snapping of twigs underfoot. Close was referring to the subdivision whose prevention is Sue Dobson's cause célèbre. Recording the habits of these koalas, he said, will help establish the range patterns and food preferences of the colony as a whole.

Also with us in the gorge, eyes up, neck crooked, squinting to resolve a fur ball out of the tangle of leaves and branches, was Keith Longhurst, retired truck driver and amateur naturalist. Keith knows his koalas and often speaks about them at service club functions. He was not surprised that on this sunny afternoon the receiver directed us to the shady side of the gorge.

"This is how they operate," he said. "They find a great big tree and sit with the bole between them and the sun, bums to the breeze, fast asleep."

If you're going to find a koala, Keith advised, "you've got to think like a koala."

That shouldn't be too challenging. If the shriveled brain were not well cushioned by membranous tissue, it would rattle around like the seed in a boab pod. "There's no other creature on earth with a brain so aberrant,"

Shooed down by a waving flag, a koala on Victoria's Raymond Island submits to a research roundup (left). Once bagged (below), it is fitted with a radio collar and checked for chlamydia, a bacterium that plagues koalas across Australia. Aggravated by stress, infection can cause conjunctivitis, urinary-tract disorders, sterility, and even death. "We don't see the outward signs of chlamydia on the island, but reproduction is very low," says veterinary pathologist Peter Mitchell. New addition to the colony, a pouch young is measured to determine its age (above).

A little pain is the price of research for a ward of Lone Pine Koala Sanctuary near Brisbane. Veterinarian Wendy Blanshard draws blood to test the koala's response to a vaccine for a respiratory disease. Such ailments are not usually fatal in captive koalas, which succumb most often to old age.

Jack Pettigrew of the University of Queensland had told me.

Pettigrew reckons the koalas have eaten themselves silly on eucalyptus leaves. "All their tissues reek of eucalyptus oil," he said disparagingly. "If you dissect one, its whole system is perfused with cineole." Cineole, an oily compound that gives eucalyptus its distinctive smell, is one of several toxics in the leaves koalas love. "They really are an intoxicated animal with an atrophied brain."

Arguably, the smartest thing about a koala is its gut, able to make something useful out of some of nature's most offensive greens. I discovered this from Steven Cork of the Commonwealth Scientific and Industrial Research Organization in Canberra. "Most people find eating muesli pretty hard work," Cork said. "Well, if you threw the muesli away and ate the cardboard box, that would be more like eating eucalyptus leaves."

To extract enough energy from this low-protein diet, koalas grind through one to three pounds of food a day, sniff-testing each leaf for suitability. Heavy artillery in the digestive arsenal is the cecum, an appendix as much as eight feet long. Here the tiniest leaf particles—material highest in protein, sugars, and fats—are trapped for up to eight days so every last bit of goodness can be exploited. Microorganisms in the cecum help break down the potentially fatal phenols. (On a diet of eucalyptus leaves you and I would quickly die from liver failure.)

And so for the better part of an afternoon Keith Longhurst did his best to think like a koala, while Rob Close moved from tree to tree, brandishing his radio antenna. Outwitted, we at last clambered back to the top of the gorge, and Keith filled me in on koala mothering.

Babies are born after a gestation of about 35 days. For the next five months they hunker down in the pouch, attached to a nipple. "Then, all of a sudden," he said, "when the mother reckons it's time for Herbie to come out, instead of defecating pellets, she starts excreting this pap. It's a real slimy green pap, and the baby licks it up hungrily for about a fortnight." At this Keith's voice rose to a falsetto: "You should see the bloody Rotary people when I tell 'em that; they just about throw up in their plates!" Keith rolled on. "The excreta gets into his gut—you know, he's got about 20 foot of gut in there, it's all over the place—and starts his stomach working so he can break down the stuff that's poisonous. Then the pap turns back to pills, and he's out, mate, and he's eating gum leaves."

"MAGIC, KOALAS, AREN'T THEY?" On another sun-washed spring afternoon I visited Summer Hill Primary School in Sydney to hear Dan Lunney address the students. Lunney, head of survey and research at the New South Wales National Parks and Wildlife Service, is an authority on

koalas in the wild. He presented his evidence with the flair of a courtroom lawyer.

"That's what the Bega Valley would have looked like in 1830," he said, showing a slide of eucalyptus forest in the southeastern part of the state. He clicked to a slide of rich pastureland. "That's what it looks like today. What a spot! Green. Lush. But it's been stripped. It's dairy country now, and everyone eats Bega cheese. Well, the price of a cheese is a koala."

In 1986, as part of the National Koala Survey, Lunney's group sent questionnaires to households throughout New South Wales. When they combined the results with his historical research, the conclusion was clear: Loss of habitat is *the* big problem for koalas.

There are more than 600 species of eucalyptus trees in Australia. The koalas thrive in 10 to 15 of them, trees that reach at least 30 feet and have a fairly thick canopy. These do best in low, flat areas with the richest soil—the very places where farmers and graziers cleared holdings and pioneer towns sprang up to supply them. Well over two-thirds of the kinds of forests Ken Walker hunted koalas in have already been destroyed.

Australia is a land so rich in plants and animals that it is recognized as one of 12 "megadiversity" nations. It is the only one of those 12 wealthy enough to belong in the First World. Yet habitat degradation has led 20 Australian mammal species—10 of them marsupials—to extinction in modern times. That's about half the modern world total for mammal extinctions, a record no other country can match.

If I awoke tomorrow as a marsupial, I'd

rather be a koala than a burrowing bettong or a northern hairy-nosed wombat, both a whisker away from extinction. (There is no tomorrow for such pouched eccentricities as the crescent nailtail wallaby, Tasmanian tiger, or pig-footed bandicoot.)

But even as a koala, I'd be very anxious. *Phascolarctos cinereus* slipped through the net of the federal Endangered Species Protection Act of 1992, because it is not yet listed as endangered throughout its range. Widespread local extinctions—as in New South Wales, where the koala was put on the endangered list three years ago—are warnings for the species as a whole.

NO ONE KNOWS how many koalas remain; as I learned, they can be extraordinarily cryptic. South Australia contains a few hundred descendants of reintroduced animals. Victoria? Who can say? Perhaps 10,000—or add another zero if you like. Estimates for New South Wales run as low as a few thousand. In Queensland the numbers are even fuzzier.

"There could be anywhere from a hundred thousand to half a million koalas," Greg Gordon of the Queensland National Parks and Wildlife Service disclosed uncomfortably. "I don't doubt that they have conservation problems, but we have trouble finding funds for the most endangered animals, let alone the koala. It has relatively good status."

Not so, parried his colleague Steve Phillips, a zoologist who has quit the park service to work for the Australian Koala Foundation. His best guess: 25,000 to 50,000. Phillips argues that Queensland should put the koala on the endangered list immediately, in hope of preventing the kind of population slide that has already occurred in New South Wales.

Gloomy experts claim a nationwide population as low as 40,000. This does not imply that koalas are in imminent danger of extinction (Australians would *never* let that happen, I hear again and again), but Dan Lunney, like Steve Phillips, is worried by their rapid decline in many areas.

"If they did become extinct, would it affect other animals?" It was question time at Summer Hill School, and Lunney paused to frame an answer for 11-year-old Kingston Soo.

"Take the koalas away, and nobody wants to sing about saving insects. So a whole raft of animals depend upon the koala as a flagship species, as an umbrella species, as a symbol of the bush. And symbolism is extremely important when you're trying to save something."

Call it koala power—the mysterious force that possesses Australians and sends them headstrong into battle. Sue Dobson has succumbed to it. So have Chris Allen and Tony Norton.

A forbidden pat on a koala's head will draw a mild reprimand from employees of the Australian Wildlife Park in Sydney. New South Wales has specific laws limiting the handling of koalas, which, some experts say, become stressed from being held. Adding just the right touch, Japanese tourists plant saplings in the park (right) on the first Save the Koala tour. Leafy branches will be harvested as food for the colony of more than 60 koalas.

It was 9:30 p.m., breakfast time for koalas, when Chris, Tony, and I began laboring up a diabolical 2,000-foot escarpment in the southeastern corner of New South Wales. Not far below, Devils Creek tumbled by. This part of Tantawangalo State Forest is hot property: The venerable eucalyptus trees are irresistible to loggers, but koalas sleep in them.

Chris, an angular, companionable fellow who lives nearby on a small cooperative farm, carried his spotlight for the Tantawangalo Catchment Protection Association (TCPA)—local citizens who banded together a decade ago to keep area rivers clean and now double as a police squad for koalas. In his olive-green inverted flowerpot rain hat and Driza-Bone coat, he melted into the forest.

"The first koala we saw, most of us were just crying," Chris said. That koala, a mother found with her joey in November 1990, marked a turning point in what had become an ugly dispute between forest defenders and logging interests. Until then State Forests of New South Wales, the agency in charge of public forests, had flatly denied that koalas existed here. The agency had quotas to fill (paramount was supplying the Japanese-owned woodchip mill near Eden), and the presence of this threatened species could disrupt operations.

As we climbed, I saw a reassuring beam from one of two other TCPA survey teams. Each was doing two 500-yard transects; any evidence of koalas or other rare wildlife was to be noted. Every 30 yards we stopped, and it was lights out for five minutes.

"That way you get a better feel for the

Suiting up on behalf of koalas, protesters hit Sydney's streets. Last year conservationists won a three-year moratorium against logging in some state forests of New South Wales. The reprieve will give researchers time to study koala populations there.

forest," said Tony, a forest ecologist and marsupial expert from Australian National University in Canberra. Pivoting slowly, he shone his spotlight on every tree, from the ground up, in a circle of about 50 yards radius. Chris and I stood behind, straining to identify a koala. The three of us also combed the ground for droppings, next best thing to finding the animal itself. (Rumor has it that the little green pellets are good for your health: Drop some in water and breathe in the eucalyptus vapors to clear your sinuses. Let me know if it works.)

"Wombat!" Tony sang out. I glimpsed a beer barrel wrapped in a doormat hurrying off into the darkness. No koalas that night, but at least I could notch up their ground-hugging closest relative. The oldest fossils of primitive koalas date back more than 20 million years, but no one knows when or why the wombat-like forebears moved into the trees. Koalas and wombats share more than the lack of a tail. The texture of their footpads is alike, as is the shape of their toes, and they both have a single pair of teats in the pouch.

IT WAS NEARLY MIDNIGHT when we got back to the TCPA campsite. Tea appeared from a billycan as deep as a magician's hat, and I lingered by the fire, pondering the Fundamental Law of Tantawangalo Koalas: Every timber industry claim (C) has its counterclaim (CC).

C: Koalas have been sighted throughout the region; controlled logging poses no threat. CC: The estimated few hundred koalas in the southeastern forests may be a genetically distinct population and therefore crucial to the survival of the species. The accidental loss of a single animal is unacceptable.

C: Setting forest aside for koalas puts loggers out of work. CC: Overcutting, mechanization, and weak markets do that. Ecotourism creates jobs.

C: Koalas prefer logged areas, because leaves in young "regeneration" forests are more tender. CC: Unsupportable. Large, old trees are food staples that give more shade and are more likely to survive fires and droughts.

C: Logging is now prohibited in half the region's million acres of state forests, parks, and reserves. CC: Most of the parks and reserves do not embrace the areas of greatest biological diversity and are unsuitable for koalas.

Sunup, and the eucalyptus forest revealed itself. Isobel Crawford, a botanist from Canberra, pointed out a smooth-bark tree whose delicate leaves, red-tipped with spring growth, contrasted with the gray edifice of its trunk. "Monkey gum," she said. Early settlers called koalas monkeys, and the name given to a favorite food tree stuck.

"One of the most striking things about old-growth forests," Isobel said, "is the diversity of structure and ages." The half dozen or so eucalyptus species around our camp varied

from saplings to monarchs over a hundred feet tall. If old trees go, Isobel said, they'll take with them not only koalas but also birds, fungi, and who knows how many insects.

Chris Allen agreed. "There's much more than koalas at stake, but they are a prime indicator of the biodiversity of our forests."

That biodiversity now has a reprieve. In mid-1994 State Forests accepted a three-year moratorium on logging in and around Tantawangalo, allowing further research on the habitat needs of the elusive koalas of southeastern New South Wales.

IF ONE RODEO RIDER takes ten seconds to rope a 300-pound steer, what does it take for two koala cowboys to rope a 30-pound pseudo bear? No less dexterity than you need to thread a needle with a frayed piece of cotton—and it's just as exasperating.

I've come to French Island off the coast of Victoria. Our posse is led by Mick Douglas, a seasoned koala roper, and four other professionals from Victoria's Department of Conservation and Natural Resources. Wearing overalls and leather gloves, they want no flesh exposed. Their goal: to catch and tag 30 koalas, which will be released on the mainland.

Out on this windy speck it's impossible *not* to find koalas. With some 2,000 animals, French Island is Koala City, Australia. All are descended from a small group, possibly only two, introduced in the late 1800s. A few human families also make their home here, raising cattle and sheep—and contemplating the population explosion.

"They're bloody sexy," a state government biologist had told me. Actually, the island's koalas could double in number every three years, largely because of the absence of predators and disease. Most years nearly all females give birth, which is why rangers remove surplus animals. Otherwise, the koalas would strip the trees and starve.

Translocating koalas does raise questions. When you randomly pluck an individual—say a dominant male—from its group, what effect does the loss have on the remaining koalas? And what happens when that individual is plunked down in an unfamiliar forest, especially if that forest is already home to koalas?

More than 5,000 koalas have been moved off French Island since the 1920s, replenishing mainland colonies devastated by hunting. On the family tree of Victoria's koalas, which can be twice the size of their cousins in Queensland, nearly all animals trace back to the original French Islanders. This sameness, scientists insist, reinforces the need to preserve the genetic stock of every colony—however small—in the other states.

Lassoing a koala, Mick Douglas demonstrates, requires a noosed rope on a long pole to coax the animal down. You maneuver the noose over twitching ears and call in the flag waver. A red flag means one thing to a bull, quite another to a koala. Flap it, and a terrible squawk-screech ensues. Waaa-oww! WAA-OW! How DARE you wake me up! The indignant koala backs straight down the tree. You hope. More likely it comes to a fork and tries to shinny up the other branch. Often it loses its grip and drops out of the tree.

"Don't worry," says John Emmins reassuringly, "they bounce pretty well." A ranger then holds down the koala, and Emmins, an immunologist at Monash University in Melbourne, takes a blood sample. Emmins is here to test two beliefs: That these isolated koalas are free from chlamydia, a bacterium that causes conjunctivitis and urogenital tract infections, and that they are severely inbred. His findings: Antibodies to chlamydia were present in some animals, and "the French Island koalas are about as inbred as the folks in the movie *Deliverance*. Even so," Emmins says, "they are the largest, strongest koalas I have come across."

By noon our koalas are in full bounce, and the blood is coming nicely. Hard work, is it? "Ah yes," John replies. "Gets the adrenaline flowing, just trying to keep your fingers out of the way of all the pointy bits." When it comes time to board the ferry for the mainland, Mick Douglas has crateloads full of grumpiness, and I have an understanding of what it takes to keep up with the world's sexiest koalas.

I discussed the problem with Roger Martin, a biologist at Monash. In 1989 Martin drafted Victoria's koala-management plan. "We have too many," he said bluntly. "I don't think we can continue to translocate them."

What to do?

"You have to adopt fairly severe management regimes. Just as some places in America are culling their deer populations, we. . . ."

Cull koalas, eh?

"That's ridiculous!" Such eruptions of opinion are in character for Debbie Tabart, once described by admirers as "a lava flow

All fangs and no bite, a dog is stopped by a fence outside a koala hospital. While dogs, dingoes, foxes, and raptors cause some koala deaths, automobiles are the most lethal predators. Of some 4,000 koalas reported killed yearly, 2,500 are destroyed by cars in urban areas. To curb deaths, citizens groups are working to stop plans for a new highway linking Brisbane to Gold Coast.

Swimming pools can be deadly traps for koalas, which deviate little from a straight-line trek to the next food tree. To aid escape, many pool owners insert backspliced ropes that are easy to grasp.

—red-hot and relentless." Tabart, who has a purple roof on her house and a pet donkey called Winston, leads the charge at the Australian Koala Foundation (AKF) in downtown Brisbane. "The problem," she insisted, "isn't too many koalas; it's not enough habitat."

WITH KOALAS, it seems, the talk always comes back to trees. The subject also profoundly disturbs Tricia Caswell, head of the Melbourne-based Australian Conservation Foundation. She cited a 1992 government report, which estimates that every year 200,000 acres of trees are cleared on private lands in this country that's as big as the contiguous U. S. but with one-fourteenth the people. As Caswell put it, "There's a terrible lack of will and lack of understanding about ecosystems. Australia's still a frontier. We're not even holding the line."

Shrinkage of forest continues apace on farms, as financially strapped graziers open up more land for pasture and more trees succumb to dieback. An Australia-wide catastrophe, dieback results from poor land management,

A treetop roadway carries Amy the koala on her regular passage through a Port Macquarie neighborhood. An estimated 80 percent of koala habitat is on privately owned land, much of it in urban areas. The residents who named Amy continue to watch out for her safety.

"My family is privileged to share an environment with these animals," says neighbor Kay Garven. "We plant trees in our garden just for Amy." Many communities in eastern Australia are following the same plan, replacing trees lost to indiscriminate cutting.

which exacerbates the effects of natural stresses such as fire and drought, causing water tables to rise and salt to invade the topsoil.

Clearing for residential development has slowed in economically sluggish Victoria but not along the stunning coastline from Port Stephens to Brisbane and beyond. Here billboards shout LAND FOR SALE! Pockets of rich coastal forest hold the largest surviving koala colonies in Australia, yet the trees are falling fast. One Saturday afternoon in Coffs Harbour I watched bulldozers tearing up a strip of eucalyptus trees that happened to be the last link for koalas moving between two fragments of prime forest habitat.

At first, most money raised by the nonprofit AKF went to biological research, but Tabart has broadened the focus. The foundation has embarked on a computer-derived atlas of koala habitat. "It's fundamental," she said. "It puts the horse in front of the cart."

What she meant was that protecting koalas requires first establishing—tree by tree—the precise limits of their core areas and interconnecting eucalyptus corridors. Governments need this information if they are to create enlightened master plans for towns and regions.

Tabart hopes the maps will help change the way land is used. "It's political will," she said, "that's all that's missing."

NOT ENTIRELY. Sue Dobson reports that the government of New South Wales, spurred by information from Rob Close's radiotracking program, has acquired the disputed housing site near Wedderburn. Also, following a devastating bushfire last year, the state's park service worked with the coastal shire of Port Stephens to frame a community-based management program for the surviving koalas. It could serve as a model for a statewide plan. And in southeastern Queensland—a last stronghold of koalas in the wild—Redland Shire recently set a new direction by acquiring part of Point Halloran peninsula to safeguard a koala colony. The shire, like the neighboring city of Brisbane, imposes an annual environmental levy on its 94,000 residents; it is using the fund to buy other critical habitat in its 212-square-mile jurisdiction.

Meanwhile green has colored the thinking of some land developers—Allan Hutchison in suburban Brisbane, for one. Hutchison never tires of pushing the message that his way of designing communities saves money as well as

Straddling a branch of eucalyptus, a koala naps in the safety of a zoo. Much remains to be learned about the animals and what they need to thrive again in the wild, but Australians seem determined to do just that. Says folksinger John Williamson: "If we lost the koala, it would be a shameful thing."

nature: Let terrain and watercourses dictate the plan, preserve vegetation corridors, keep roads to a minimum. "If little Willy can get to school without crossing a road," he said, "it's going to be safe for the koalas."

Last year the Queensland government trumpeted its adoption of the Koala Coast Protection Plan, with the goal of preserving some 7,500 acres of prime habitat by the end of the century. (Strangely, this same government also seems to favor cutting a multilane highway right through the proposed sanctuary.) To many wildlife experts, piecemeal protection of individual species is conservation quackery. Some argue that the commonwealth, not the states, should designate and administer national parks and that the nation's parks should be redefined and expanded to conserve areas truly representative of the fullness of Australia.

Whether or not that ever happens, there remains the problem of depleted farmland. One federally funded program aims to plant a billion trees nationwide in this decade. (Tricia Caswell reckons it would take 15 billion trees to restore just the Murray-Darling Basin.)

Taking their cue from state conservation agencies, farmers around Gunnedah in New South Wales have begun a "bear care" program. They are planting native eucalyptus trees, which consume 60 or more gallons of water a day, to lower the water table, thereby returning salt-encrusted pasture to fertility. Dan Lunney of the New South Wales park service applauds this idea. "Save the soil, save the farmers, and save the koalas," he said. "A magic combination."

Clearly magic will not guarantee the survival of the koala and the multitude that shelters under its symbolic umbrella. Ken Walker, the Aborigine elder who responded to the cry of a koala, wants to believe that a real commitment to end the destructive imbalance between people and nature is at hand.

"The people of the earth," he said, "are starting to wake up. They've taken enough away." □

The New

Now officially Ho Chi Minh City, the former capital of

By
TRACY DAHLBY

Photographs by
KAREN
KASMAUSKI

"Whatever works" makes a suitable toast these days in Ho Chi Minh City. At Reunification Hall civic leaders warmly welcome Japan's Mitsubishi Bank—yet another free-market player in the liberated economy of the former Saigon. From offices to street corners, this once war-torn city is open for business again.

Saigon

South Vietnam reclaims its freewheeling soul.

Going with the new flow, citizens rush to work along Phan Dinh Phung Boulevard on a steamy monsoon morning. *Cyclos*—three-wheeled pedicabs—and motorbikes outnumber vans and cars, but probably not for long. With the loosening of state controls and the end of the United

States-led trade embargo, entrepreneurs are pouring money and merchandise into Vietnam's largest urban center.

"Ho Chi Minh City will grow, grow, grow," says American John Mims, the manager of the new Pepsi-Cola franchise. "This is one of the last frontiers in the business world."

The end of the line for Saigon and South Vietnam came in late April 1975. As communist troops shelled the city, U. S. helicopters evacuated thousands of loyalists, some from a downtown rooftop (left). On April 30 the North Vietnamese overran Saigon, naming their trophy Ho Chi Minh City for their late revered leader. Today the city is a tourist draw. Young women in traditional *ao dai* welcome a cruise liner and its invasion force of 750 Westerners.

BETTMANN (LEFT)

"YOU DON'T MIND the motorbike, do you?" asked Gerry Herman, pretty much as an afterthought, before inching us into the swirling, darting chaos at the intersection of Le Loi and Nguyen Hue Boulevards, where, in the tropical night, motorbikes flew in all directions.

"Not at all," I lied, knuckles clasped to jellied knees. In a flash we had whipped around the redbrick edifice of Notre Dame Cathedral, as if fired from a slingshot, and were speeding under a canopy of towering tamarind trees.

When Gerry, an affable old hand of the new Saigon, had offered to show me around, I jumped at the chance. Later I was told that there were more than a million motorbikes plying city streets, an explosive increase since 1991. Anybody who got near one, I decided, ought to have his head examined.

But it wasn't my mental health I was worried about as we streaked past palm-studded villas, which ticked by behind wrought-iron fences like choppy scenes from a silent movie. Farther on, families hunkered down in community video parlors that glowed like snug electronic caves, young lovers hugged the shadows, and peddlers hawked tourist T-shirts proclaiming, with presumed irony, "Apocalypse Now."

"This is the ultimate video game!" yelled Gerry, as he expertly navigated a sea of taillights and headlamps. I was just working up the courage to share his enthusiasm when we fishtailed slightly and—*thwack!*—I felt a hand slap my shoulder. Turning, I found myself staring into the ambiguous grin of a scooter-borne teenager.

For a fleeting moment I felt uneasy. Like many Americans making their first trip to a

city that had once served as the capital of our country's failed efforts to bring American-style democracy to Vietnam, I had harbored qualms about just how I might be received.

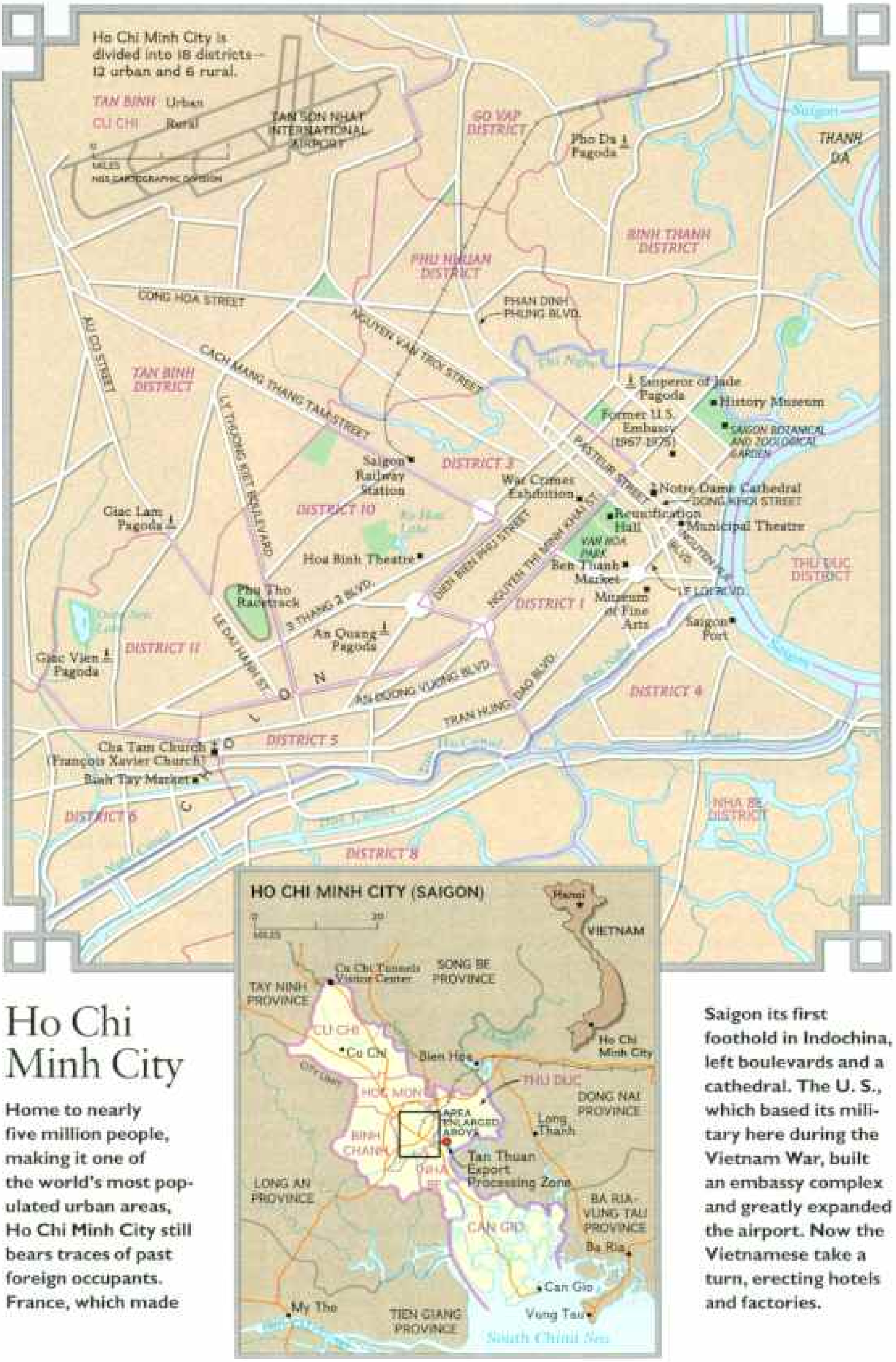
I needn't have worried. The youngster flashed me a luminous smile and the thumbs-up sign.

"There is great affection for America here," Gerry told me later over a mercifully stationary dinner, "in spite of, or maybe because of, the wartime trauma we shared." Indeed, as my own travels would confirm, foreigners, and particularly Americans, were symbols of the resurgence of light and color in a city that had a decade earlier hovered on the edge of darkness. President Bill Clinton had lifted America's 19-year-old economic embargo of Vietnam six months before. All Saigon, it seemed, was speeding toward the light.

"I came here for a week as a tourist and was amazed at the energy and drive," said Gerry. Flying to nearby Singapore, where he was working at the time, Gerry sank his life savings into computer equipment and returned to help a Saigon company set up Vietnam's first state-of-the-art graphic-design studio. Three months later the firm won the advertising account for Vietnam Airlines, the national flag carrier.

That kind of promise had begun to lure back growing numbers of exiled Vietnamese too. "Money, brains, hard work," said Gerry. "That's the fuel that's going to help this place catch fire."

During the month I spent there, Saigon's energy proved contagious all right, and a little overwhelming. The city reminded me, coconut palms and tropical heat aside, of tales my grandmother once told me of the Klondike gold rush—a roistering, boom-or-bust place,



Ho Chi Minh City

Home to nearly five million people, making it one of the world's most populated urban areas, Ho Chi Minh City still bears traces of past foreign occupants. France, which made Saigon its first foothold in Indochina, left boulevards and a cathedral. The U. S., which based its military here during the Vietnam War, built an embassy complex and greatly expanded the airport. Now the Vietnamese take a turn, erecting hotels and factories.

A tide of ferryboat traffic flows on the Saigon River. The city grew up along its banks, from a 17th-century trading post to today's hustling metropolis. Despite postwar privations, the onetime capital of South Vietnam rules the reunified nation's financial and commercial life.

flashing with cash, gaudiness, and intermittent brutality. In a sleek mid-city showroom, for instance, a Mercedes-Benz sedan retailed for $420,000 U. S. (list price plus 200 percent import duty). The dealer lamented that some people "don't even have a bicycle." Only blocks away, amputees scuttled by on jury-rigged skateboards.

For all its contradictions, Ho Chi Minh City—that's the official name for the place even its officials still call Saigon—is Vietnam's biggest attraction. Situated at the southernmost joint in the country's long, beckoning finger, the city and its environs account for a third of Vietnam's 15-billion-dollar economy. Under the government's policy of *doi moi*, or economic renovation, the region has drawn in much of the ten billion dollars foreign investors have earmarked for electric power stations, hotels, golf courses, and factories that will make, among other things, cement, feather pillows, and sewing-machine needles.

Yet escaping the past won't be easy. Twenty years after its "liberation," Ho Chi Minh City remains the captive of a struggling economy. The country's communist rulers in Hanoi are embarked on a tricky bid to steer toward the open market under cumbersome communist discipline. Daily life, meanwhile, is shaded by resentments between victor and vanquished, north and south. City dwellers speak, with a wink or a frown, of the reemergence of the "Old Saigon"—shorthand for a troubling surge in drug trafficking and prostitution.

Whichever way the country goes, however, Ho Chi Minh City is likely to provide its driving force.

TRACY DAHLBY has reported on Asia for many years but made his first trip to Ho Chi Minh City for this article. He most recently wrote about Kyushu (January 1994) for the magazine. Washington-based photographer KAREN KASMAUSKI is a frequent contributor, also with a special interest in Asia; her last story was on viruses (July 1994).

"We used to be called the Pearl of the Orient," said Harvard-educated economist Nguyen Xuan Oanh. The sobriquet was conferred on the city after its capture in 1859 by French invaders, who later turned the languorous port into the cosmopolitan capital of French Cochin China. After the communist victory over American-supported South Vietnam in 1975, said Oanh, "we were foolish enough to think we could isolate ourselves from the world, and we lost our glitter."

Now the economic dynamism that had turned neighboring Bangkok, Singapore, and Hong Kong into veritable gold mines, Oanh said, has fueled an "obsession of catching up with the Joneses. The people of Saigon think of nothing but how to move the city ahead."

I SAW THAT URGE in action when I wended my way through the pocket-size machine shops and storefronts of the city's gritty Binh Thanh District to Thanh Da, a wedge-shaped island at an elbow bend in the Saigon River. There I visited the Nguyen Dinh scissors works, where owner Nguyen Manh Tuan steered me through a jungle of stamping machines and drill presses to a mound of old military-truck suspensions. "Top-quality steel," he said triumphantly, kicking one of the slats. "Left behind by your army!"

A former lieutenant colonel in the South Vietnamese Army, Tuan, now 58, was captured in combat in March 1975 and spent 18 months in a communist reeducation camp. After his release, he said, he was "homeless, penniless, jobless." Then lightning struck: Why not, thought Tuan, turn the wastage of war into something useful, like quality, hand-ground scissors?

Today Tuan, a genial man with a level gaze and a salt-and-pepper mustache, has sold his scissors, with their snappy orange-plastic handles, in 14 countries around the world and become a star of the government's export-promotion campaign. He has also provided hundreds of jobs for Army of the Republic of Vietnam (ARVN) veterans and their family members, who still have trouble finding steady work.

"But I am not a real capitalist yet," insisted Tuan, elevating his eyebrows toward seven tumbledown wooden sheds that were as much artifact as factory. Steel fence posts that had once helped ring villages in barbed wire in the U.S.-backed "strategic hamlet" program now supported a thatched roof over the workers' canteen. Homemade grinding machines were pieced together from old howitzer shells. "I can make one for $50," he said proudly.

But ingenuity will carry private enterprise only so far, as Tuan well understood. "My dream," he said, "is to form a joint venture with an American company. They have the technology and capital. We have the cheap, highly intelligent labor force." I couldn't help but like this inventive man with the tungsten constitution. But how was he able to put his painful past behind him?

"I knew I must forget the past if I wanted to survive," he said. "Any military man knows that the best way to win a victory is to persuade the people who are against you to think like you and respect you."

Cutting through the debris of history has been critical to improving Vietnam's relations

U. S. Air Force veteran Vern Pall revisits Nam for some friendly fire, testing an AK-47 at the Cu Chi Tunnels, a former hideout of Vietcong guerrillas. A soldier accepts an American dollar for each shot. "Every vet should try to return," says Pall, who flew troops into Vietnam. "It was so grim before. They should see it on this better day."

Something that hasn't changed is the worship of Uncle Ho. The face that launched a thousand battles—communist leader Ho Chi Minh's (below)—makes an appearance at a school rally.


ĐỘI THIẾU NIÊN TIỀN PHONG HỒ CHÍ MINH
LIÊN ĐỘI

Looking for handouts of hope, children scarred by the streets gather at Thao Dan Shelter. The private facility provides sleeping space and meals for dozens of street children, most of them orphans or runaways. Called *bui doi*, or dust of life, Ho Chi Minh City's homeless youth drift through the streets

selling newspapers and lottery tickets, shining shoes, and begging. "Their numbers are growing.

The government no longer pays for health care or schooling," says Judy Ladinsky of the U. S. Committee for Scientific Cooperation with Vietnam. "We're seeing the dark side of economic reform."

with the United States. I discovered this one morning at the War Crimes Exhibition (formerly the Museum of *American* War Crimes) when I found myself in a deserted courtyard with the rusting relics of war: an M48 tank and a large yellow bulldozer allegedly used by the Seabees to raze villages. A guillotine purportedly belonging to the U. S.-sponsored regime of former President Ngo Dinh Diem bore the cheery legend, "The blade only weighs fifty kilos!" But why were there so few Vietnamese visitors, I wondered?

One reason, as an amiable government guide later explained, was that half the city's residents had been born after 1975 and, for them, subsequent clashes with China and Cambodia had made sharper impressions. A thousand years of fending off overzealous neighbors and colonialists had taught the Vietnamese to be realistic, he said.

EQUALLY IMPORTANT is the city's frenzied dash for dong (Vietnam's official currency) and dollars (its preferred one), which leaves little time for dwelling on the past. That was the case the morning I met Hank Nguyen, who was visiting Manhattan (*Ma nhat tan*, to Vietnamese), the hamburger and pizza restaurant his in-laws had just opened across the square from Notre Dame Cathedral.

Hank smiled as we watched trendy young Saigonese crowd the counter for a taste of a burger with fries (90 cents) or nachos with jalapeño peppers (60 cents). Hank, who served as a consultant to the restaurant, said he was grateful for the opportunity to return from the U. S. to his native city and show people "what a real hamburger is like."

The city was also feeding on other American dreams. "The story went around here," said Hank, "that in the States they have machines on the street where you put in a plastic card and get all the money you want." What it left out, said Nguyen, who built up a chain of Houston seafood restaurants after fleeing Saigon in 1975, was the hard work and sacrifice it took to get the money in there in the first place.

Other Americans I met found a few of Saigon's cash-based values less than appetizing. Everywhere you went, they said, somebody expected "rich" foreigners to redistribute their wealth in the form of tips, inflated prices, even bribes. "Cowboy capitalists," as the more freebooting Vietnamese-American entrepreneurs are called, get the blame for promoting this "fast buckism." Many older Vietnamese complain that it tempts the twentysomething generation into a moral vacuum of motorbikes, Hong Kong movies, American fashions, and rock-and-roll.

The problem, said Duong Quynh Hoa, a former top communist official and now a leading physician in Ho Chi Minh City, was that the country's revolutionary old guard had failed to provide clear national goals. "Vietnamese leaders are trying to build a market economy on a socialist infrastructure with capitalist management," said the Paris-educated Hoa with a jaunty laugh. "Impossible!"

The city was grappling with its contradictions one bright Sunday morning when I strolled down storied Dong Khoi Street toward the Saigon River. On the left, a tasteful new nightspot called the Q-Bar had tucked itself into the alabaster underside of the

A patch of sidewalk is space enough to open a small business in Cholon, the city's large Chinese district. A single corner hosts a manicurist, cigarette vendor, and bicycle repairman. Traditionally the Chinese have dominated the city's economy. Great numbers fled after the "American war," though signs show that Chinese money is again fueling the system.

For all the teeming streets, parts of Ho Chi Minh City are spaciously rural. One metropolitan farmer zips to market with a load of captive pigs.

95-year-old Municipal Theatre and become the watering hole of choice for business expatriates. Farther down, workmen had caged a gracious French-era hotel in rickety bamboo scaffolds in the dubious quest of making it more "modern." New bookstores, bistros, and souvenir shops were slowly restoring joie de vivre to what was once the most fashionable promenade in all Indochina.

Until 1954, when French colonial rule ended, Dong Khoi, then the Rue Catinat, was the haunt of *boulevardiers*, spies, French police inspectors, and willowy Annamese beauties and the site of terrorist café bombings, which Graham Greene immortalized in his novel *The Quiet American*.

TODAY A PEACEFUL WALKABOUT on Dong Khoi can quickly turn into a gantlet run, as roving squads of preteen street hawkers thrust forward unwanted chewing gum, cigarette lighters, or suspicious looking "antique" coins before they spot easier tourist marks and leave you alone.

The scene here was genuinely chaotic when, on April 30, 1975, Ca Van Tran ran for the harbor and a barge leaving port before the city fell to the communists. "You wouldn't have believed it," Ca, a Virginia-based restaurateur who runs a program for the handicapped in Vietnam, told me one evening. "People were trying to escape. Some committed suicide." The streets shook when a nearby ammunition dump exploded, he recalled, and—again—when a helicopter pilot, hoping to rescue his family, crash-landed in an intersection.

That tumultuous past provides Ca and others with a favorite Saigon guessing game: How long it will take the city to recapture its former elegance and verve—10, 20, 30 years?

Who wins that bet may depend heavily on how successful the Ho Chi Minh City People's Committee, the city council, proves at wooing foreign capital and technology and at slicing through the bureaucratic red tape that can induce vertigo in overseas investors.

Case in point: the 11-story glass-and-marble building at 162 Pasteur Street that Australian developer Bob Blackmore erected over the ocher-and-white majesty of the old French colonial law courts. The darkish monolith, a skyscraper by Saigon standards, was already up when local newspapers began calling it the "disgusting building," and key members of the People's Committee came up with a modest proposal to deal with what they saw as a blot on the city's historic downtown business district: Remove the top five floors.

"It was perhaps not the best way to inspire confidence among foreign investors," said one laconic Asian observer.

"Most people want economic reform," said Blackmore philosophically. "Their hearts are in it. It's just the system that's chaotic."

Not surprisingly, environmental pollution is closing in on Saigon's native charm, as I witnessed late one afternoon when I hired a slow-rolling *cyclo*, or pedicab, and watched the sun go down over the Saigon River. As ivory bled into mauve at the horizon, I was struck by the spectacle of so many lives being lived so publicly in such close proximity: Children

Supplying demand, a grocery store stocks imported items for a new, free-spending business class.

"Buy Vietnam" is the marketing strategy of scissors maker Nguyen Manh Tuan, who lectures his son on quality control (below). A former officer in the South Vietnamese Army, Tuan opened a factory using steel from leftover U. S. military vehicles.

frolicked alongside the busy roadway while ancient DeSoto buses rumbled by, belching grimy exhaust. Nearby, housewives tossed rotted fruit and vegetables into a canal that was already choked with plastic bottles.

Greater Ho Chi Minh City, including outlying farming and industrial areas, now claims roughly six million people. The city is woefully short of water and sewage-treatment plants. With economic prosperity, its million-plus motorbikes are almost sure to transform themselves into cars. What happens then?

The government's answer is to create a "triangle" of development designed to link the swampy Tan Thuan area southeast of the city center, where an export-processing zone is fitfully taking shape, with two farther flung points—the industrial suburb of Bien Hoa to the north, formerly a massive U. S. air base, and Vung Tau, a corroded resort town on the South China Sea, which is slated to become a major ocean port.

Not a few Saigonese worry that such ambitious plans will inevitably shove their picturesque city the way of Bangkok, Thailand's sprawling, overbuilt, traffic-snarled capital. "Traditionally, there was harmony among man, earth, and heaven in Vietnam," internationally acclaimed architect Ngo Viet Thu told me as I sat in his European-style drawing room watching mosquitoes buzz confusedly in the breeze from an electric fan. Today, he added, the challenge is to create a city "modern in its conception, traditional in its expression, and human in its scale."

That could be a tall order, however. Back on Pasteur Street, for example, the controversy over the "disgusting building" reached a sort of uneasy equilibrium when the People's Committee conceded that the building could be made less disgusting, perhaps, not by shrinking it but by decorating its exterior.

With what? I asked Blackmore. "That," he said dolefully, "is the burning question."

While the TV shouts triumph from a World Cup soccer match, a more somber mood settles over the features of a former "boat person" as he poses for identity papers. Newly arrived from a camp in the Philippines, he is a participant in a United Nations program to persuade refugees who have been denied political asylum to return to Vietnam. After 1975 more than a million people deserted the country, mostly by boat. The warming economic climate now tempts many to return.

For many Ho Chi Minh City residents, survival still tops the list of life's priorities. The government's commitment to "openness" has sluiced the flow of people leaving the countryside to seek their fortunes in the big city, where, at $810, the average annual income is more than four times as high. What many find instead, however, is difficulty getting work or adjusting to urban life, which leads to splintered families and growing numbers of *bui doi*, as homeless youth are called—the "dust of life."

Sitting on a bench in Van Hoa Park—one of the legacies of French design that still grace the city, with its roller-skating rink and leafy, serpentine walkways—I struck up a conversation with Nguyen Van Loc, a quiet teenager with a shrewd pixie's face. He told me he'd been living on the city's streets for four years. Loc didn't know where he'd been born, what happened to his real parents, or how he ended up in a hellish foster family.

"They beat me every day," he said, "so I left. I went to work in an auto garage, but they beat me too. So I became a street boy."

Many of the city's thousands of street children sell lottery tickets to eke out a living, and some become entangled in petty crimes, drugs, and prostitution.

Loc told me he had managed to avoid the

deadlier pitfalls of street life, including heroin addiction.

But when I asked him what he wanted out of life, he looked shell-shocked for a moment. Then a tentative grin flickered at the corners of his mouth.

"I'd just like to have an occupation where I can support myself," he said. "And, well, maybe a motorbike . . . a Honda."

OTHERS HAVE VISIONS of growing markets. Since the U. S. embargo was lifted, IBM, PepsiCo, Coca-Cola, and Mobil Oil have set up representative offices in Saigon, and dozens of other large American companies have also embarked on "market entry" campaigns of military daring. Within hours of President Clinton's announcement, for example, an infamous "cola war" broke out. Vying for the taste buds and purses of the Vietnamese, Pepsi sent trucks into Saigon neighborhoods to hand out free samples. Coca-Cola shot back by airing television commercials and sponsoring pop concerts. This made me wonder: If the city that fell to communism 20 years ago was becoming a Madison Avenue-style beachhead, what had the "war of liberation" been all about?

Tran Van Giau tried to set me straight. *"Bienvenue, monsieur!"* said the 83-year-old former revolutionary when I visited him behind the gates of his villa. Giau had served the communists' great hero Ho Chi Minh for many years as a top agent and propagandist and told me bluntly that Karl Marx never said people had to be poor.

I'd give him that, but what would Ho or Marx make of cowboy capitalism or the rise in drug abuse and prostitution? "When economic development is so quick, there are bound to be side effects," Giau acknowledged. Then he

Taking the town by motorbike, Sunday-night cowboys blaze a trail at the meeting of Le Loi and Nguyen Hue Boulevards. The weekend ritual of cruising celebrates what youths call *song tu do*, or living freely.

For American GIs, the intersection rivaled Times Square. They jammed the area visiting girlie

shows, buying souvenirs, and often getting crazy—anything to forget the war.

These days the downtown—an area still called Saigon—stands out as an oasis of light. With electricity erratic or even nonexistent, much of the city at night sinks intermittently into a darkness broken by cooking fires.

added, "But poverty is always more threatening to society than wealth.

"When the Americans left, the economy was booming," he said. "Then our mistakes nearly killed it." Thanks to doi moi, the reform policy, the economy is now back on its feet.

Still, wasn't he bothered by the billboards for credit cards, hair tonic, and video recorders that wallpapered the streets? Or the city's proliferating discos?

The old revolutionary stared at me. He didn't know about me, but, he said, "even I used to go dancing when I was 18!"

CERTAIN NEIGHBORHOODS will not yield lightly to buoyant new rhythms, however. That was evident the afternoon I took a cyclo to District 4, the place one Vietnamese friend called, with only some exaggeration, the neighborhood of the "five no's"—"no sewers, no water, no electricity, no jobs, no hope." Many of those who live there once fought on or worked for the losing side in the "American war."

The sun was burning down as my driver pedaled across a bridge, where emerald green palm fronds drooped over a fetid canal, and plunged down a trail of broken pavement. Suddenly a wild-eyed young man in a soiled green shirt rushed our cyclo, arms flailing in anger. "He wanted to know what country you from," said my driver, unconvincingly, after fending him off with a few brisk shouts. No wonder few outsiders ever ventured here.

As we burrowed deeper into the heart of the district, with its collapsing wooden shanties and septic ditches, the streets closed to little more than a cyclo's width, bringing us within a fingertip of the daily round. A toothless old man leaned from his window to say "Harro," with a friendly flap of his hand. A sad-faced young mother in flower-print pajamas cradled her baby under bunched mosquito netting in the cool darkness of a metal-roofed shack, as an unseen boom box crooned a tinny rendition of an old Everly Brothers song:

When I feel blue in the night
And I need you to hold me tight
Whenever I want you
All I have to do is dream, dream,
dream, dream. . . .

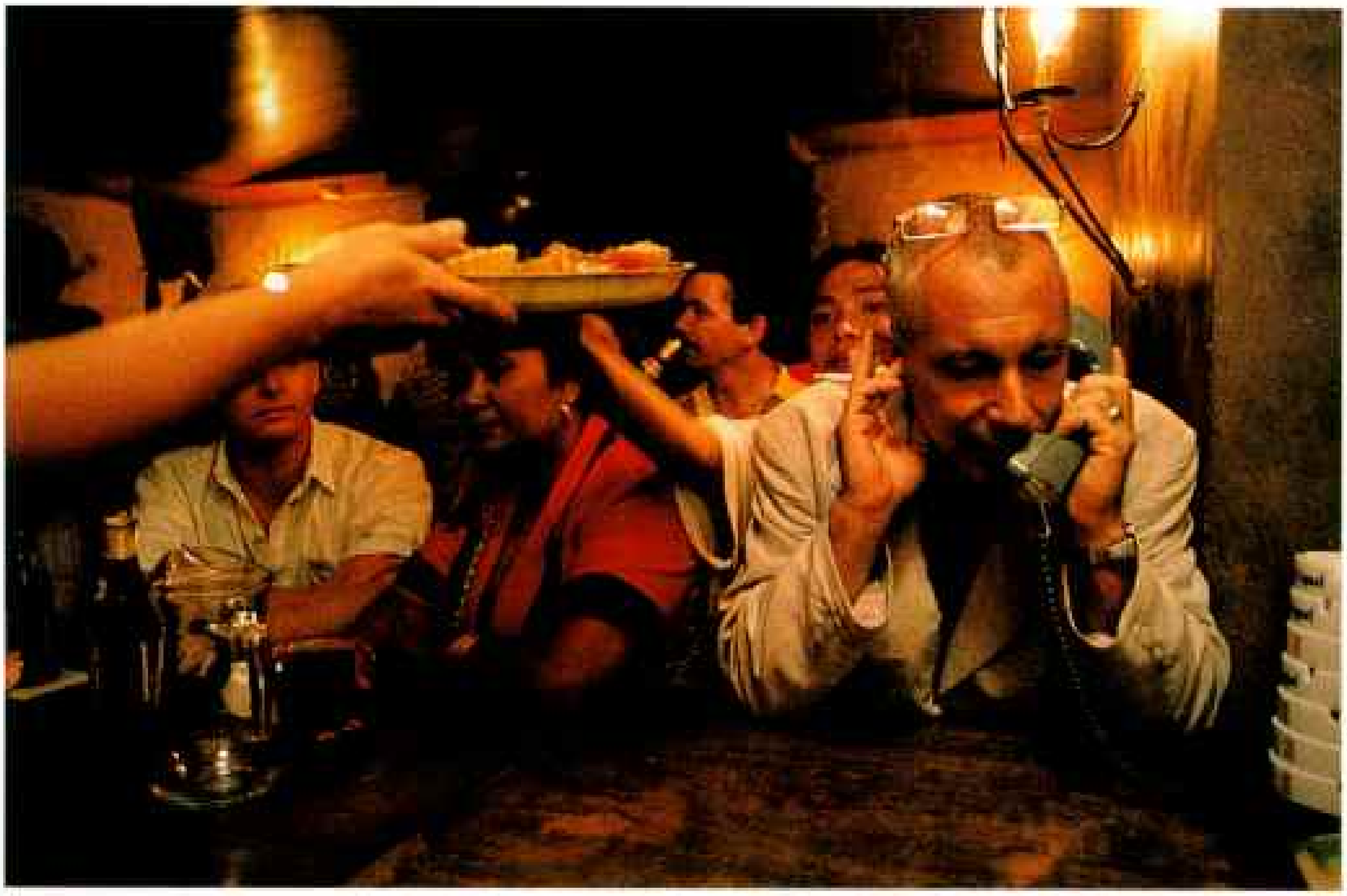
Nearby I stopped to talk to a middle-aged resident with rheumy eyes and a thin mustache, who proffered a snapshot, grainy with age, showing a rakish young soldier in combat fatigues. "Airborne," he said proudly, his backbone stiffening at the memory of his role in a long-gone army.

One area of Ho Chi Minh City where doi moi has turned dreams into profitable reality is Cholon, the city's Chinatown. As my cyclo driver navigated tree-lined An Duong Vuong Boulevard, I watched the buttery light of late afternoon fall on the perspiring faces of shopkeepers assiduously stacking electronic goods in boxes marked Sony, Sanyo, and Goldstar. Wrinkled crones policed display cases featuring American cigarettes and videocassettes —typical of the contraband that routinely flows from Thailand into Vietnam across its porous land border with Cambodia 35 miles away.

In darker times Cholon witnessed searing events. We rolled past Cha Tam Church, to which beleaguered Ngo Dinh Diem fled before

Glitz and kitsch lure customers into the jaws of a floating restaurant on the Saigon River. On most nights its tables ring with toasts welcoming back overseas Vietnamese.

Over at the Q-Bar, former New Yorker David Jacobson may as well hang up since the crowd, mostly European and American expatriates, has come to make noise at the hip club's second anniversary bash. "Places open every week," says Jacobson. "For nightlife in a communist country, this is paradise."



being assassinated in a November 1963 coup d'état. Several blocks away, near the An Quang Pagoda, was the place where, in 1968, South Vietnam's police chief, Nguyen Ngoc Loan, fired a revolver bullet through the head of a suspected Vietcong guerrilla. Images of the curbside execution exploded onto television screens back in the U. S., fueling the growing antiwar movement.

Yet Cholon's greatest travails began after the communist victory, when the neighborhood's merchants became the target of a withering anti-Chinese pogrom and many of the city's most talented entrepreneurs fled the country, taking their money with them. "Now," said Tran Tuan Tai, chairman of Cholon's large Viet Hoa Bank, "people are coming back and bringing their friends." Indeed, Cholon has once again emerged, bigger than ever, as a rallying point for Chinese capital, with investors from Taiwan and Hong Kong, followed by Singapore and Malaysia, far and away the biggest players in the local economy.

Yet in Ho Chi Minh City, it always seemed, no sooner had I found another compelling reason to believe in the city's rebirth than an incident of some sort undermined that impression.

Near Dong Khoi Street one evening I was sitting with friends in a bar (this one proclaimed itself the First American Vietnam Veteran Owned Bar in Vietnam) sipping a tall 7UP when a violent commotion erupted outside. About a dozen young Vietnamese filled the picture window like extras in a B movie. They brandished bottles and shouted angrily, stopping just beyond our view. Minutes later they sauntered back, nonchalantly adjusting their hair and clothes. In the brawl—which was rumored to have had political overtones—a young man had been left lying on the pavement in a pool of blood. Later, word came: The man had died en route to a local hospital.

SUCH GLIMPSES of Saigon's darker side, and my growing feel for the city, made me wonder how it would ever overcome its roller-coaster history.

"Resentments simmer below the surface here like undercurrents in the sea," a Vietnamese friend told me when I shared a quiet cup of coffee with him. A student of north-south relations for many years, he spoke on condition that I not use his name.

When the northerners took control, he said, "they were so afraid southerners had been contaminated by Western culture" that they purged even the hard-core communists from positions of power. Many Saigonese—Vietcong and ARVN alike—have remained bitter. Now, he said, even older feuds between the Buddhists and Catholics, long frozen by communist discipline, could heat up again.

Hanoi had done many good things under doi moi, he said, but now faced a dilemma. Saigon's innate entrepreneurial flair, hence its greater appeal to foreign investors, would, he and many others believed, widen the economic gap between south and north and could, in the worst case, stir secessionist sentiments.

If the authorities were suddenly to loosen political controls, he said, there could be bloodshed. "If they go too fast in economic growth, there'll be more smuggling, prostitution, bullying, and economic discrepancies. If it's too slow, foreign investors will pull out."

Turning her back on the material world, 19-year-old Tran Thi Thu, her head freshly shaved, begins life as a Buddhist nun at Pho Da Pagoda. Earlier that day, before she cut her hair and buried it beneath a tree, Thu received the blessings of a dear aunt (top).

For a time the communists restricted religious training and sent monks and nuns to reeducation camps. Today the appeal of the holy life seems strong, especially among the poor. Monks and nuns receive schooling and never go hungry.

Time is short, labor is not as a brigade of female workers prepares for the January 1995 opening of the Vietnam International Golf Club. A joint venture of Taiwanese and Vietnamese investors, the exclusive club—one of only three licensed in the vicinity of Ho Chi Minh City—capitalizes on the

Asian businessman's lust for golf, an activity once viewed in Vietnam as unsuitably bourgeois.

Environmentalists almost shut down the 36-hole club with protests that the developers were straying into a protected forest reserve. It took a ruling by Vietnam's premier to stay the course.

To honor his father's wishes, Quang Thuan Le (left), who fled to Canada in 1979, returns briefly to take a Vietnamese bride.

Dressed in a Western-style gown, another bride, Tran Kim Quy (right), follows wedding-day tradition and visits her husband's family's house, where her grandmother-in-law keeps a sharp eye out. For richer for poorer, for communist for capitalist, family ties endure in Ho Chi Minh City.

So Saigon's "open door" could swing shut again? I asked.

"The economy will go forward," he said, but it could be a bumpy ride. Vietnam could have a hard time adjusting to today's peaceful invasion. "Now all kinds of people are coming in, not as enemies but as investors. How can we handle all these cultures?"

I KNEW. Or rather, I had stumbled into one possible answer when I visited the outlying Cu Chi Tunnels, a famous labyrinth of Vietcong guerrilla caves (embellished since the war, critics say) that the government now uses to channel in tourist dollars. After the obligatory duckwalk through steamy subterranean chutes and crawl spaces (included in the three-dollar admission price), the next stop was the rifle range and the dubious opportunity, declined by me, of shelling out a dollar a cartridge to blast away with GI-issue M16s or the more tourist-popular Soviet-made AK-47.

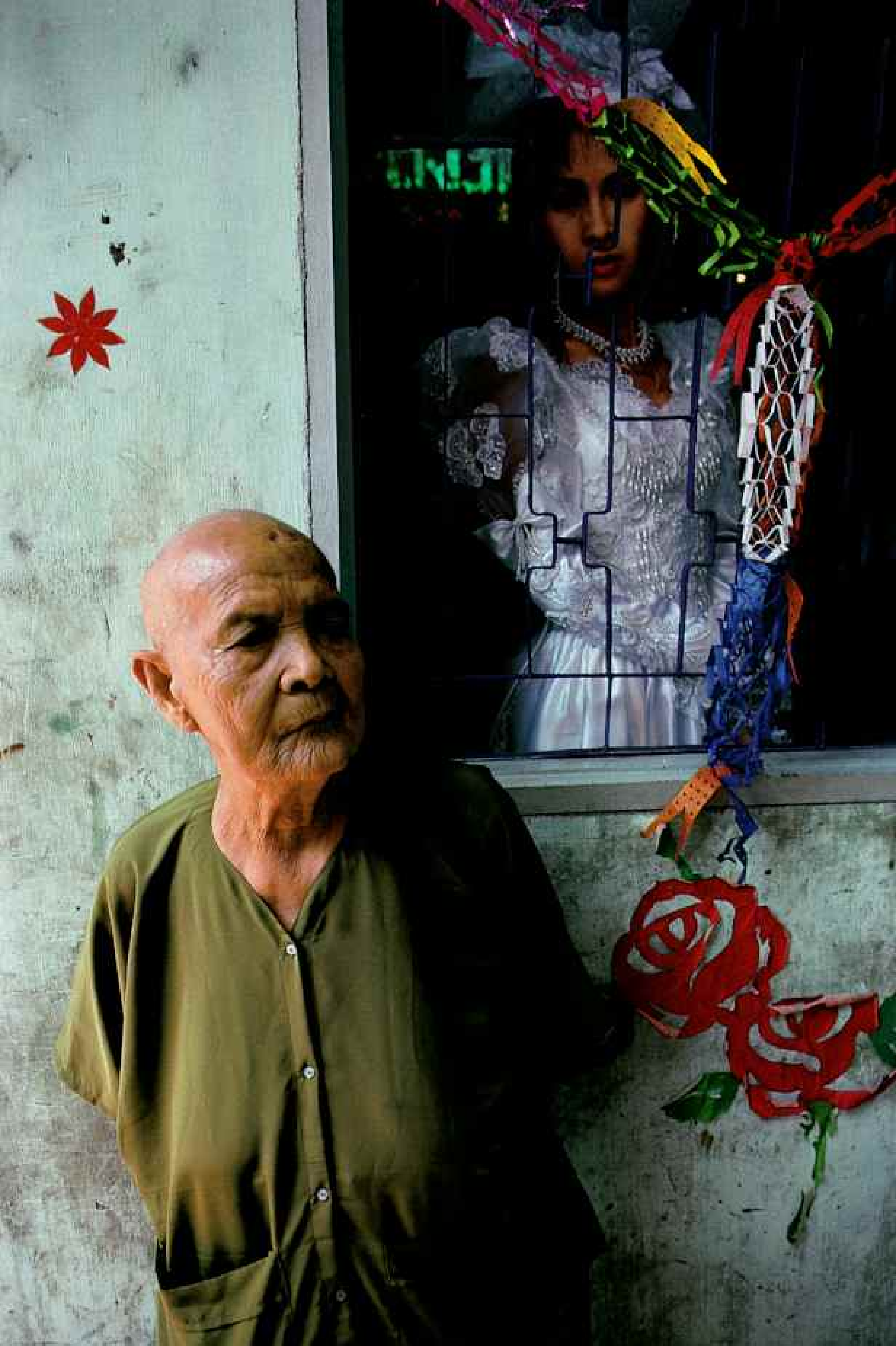
It was there that I met Dat Tat Do and watched him heft a bulky Russian model, take careful aim at a paper water buffalo downrange, and squeeze the trigger. My ears ringing from the blast, I asked him how he'd done.

"Didn't hit a thing," he said, his baseball hat worn back-to-front in the L.A. street style. But Dat had his eyes on a loftier target. Just graduated from UCLA with a degree in actuarial mathematics, he had come to Saigon looking for a job with a big American firm. He hadn't found one yet, but he wasn't worried. "Jobs are tight in the States, even for college grads," he said. "People take more risks here, and that's exciting."

Born in Saigon in 1971, he vividly remembers his excitement the day his mother pulled him from grade school on the promise of a "long vacation." That began a harrowing odyssey on the high seas in a leaky fishing boat; it was punctuated by his grandmother's death, and it ended when a U. S. military transport flew surviving family members to a strange place called Ca-li—California.

Now, 14 years later, Dat had returned to Saigon to lay claim to his future as an American pioneer as well as to the heritage he left behind. That puzzled many of the young Vietnamese he had come to know. "Their whole thing is to get to America. When I tell them that *this* is the land of opportunity, they don't see it," he said, shaking his head. "But they will learn."

I couldn't help thinking that it was people like Dat who, if anyone could, would bind Vietnam and America, past and present, and in so doing bring Ho Chi Minh City closer to its dreams. □



The Brindisi Bronzes

CLASSICAL CASTOFFS RECLAIMED FROM THE SEA

Corrosion from centuries in salt water (below) has peeled "skin" from a bronze head with copper lips (right). The beard and pensive face suggest that the image could be an ancient Greek philosopher.

PROVINCIAL ARCHAEOLOGICAL MUSEUM, BRINDISI

How could fragments of statues found together off Italy's coast vary so greatly in age? They may be the first evidence of bronze being shipped for recycling in ancient times.

Text and photographs by O. LOUIS MAZZATENTA

Near day's end on July 19, 1992, Major Luigi Robusto, *carabinieri* commander for the province of Brindisi, cautiously descended 50 feet into the Adriatic Sea, twice as deep as he had dived before. While admiring the beauty of a starfish, he saw greenish toes protruding from the sandy floor.

"Not here too!" he thought, for in the line of duty Robusto has seen many corpses. "I brushed the first three toes with my hand. They were rough and hard. I knew the foot was not human."

The site was secured against theft, and a fisherman casting his net nearby was firmly discouraged, though he would not have been the first to haul up statuary. A first-century B.C. votive relief (top) found at the Roman port of Ostia shows fishermen lifting a Greek sculpture of Hercules in their nets—a scene scholars believe depicts an actual event.

Claudio Mocchegiani Carpano, the director of Italy's Technical Service for Underwater Archaeology, coordinated the excavation, conducted by a private marine cooperative. A team of archaeologists and technicians uncovered an array of bronze heads, arms, feet, and fingers (painting, facing page).

The discoveries captured the attention of all Italy. Archaeologists were taken by the number of objects and the diversity of their ages, ranging from fourth century B.C. to third century A.D. But where had they come from, and where were they going?

"We like to think the bronzes were being carried into Brindisi," says Giuseppe Andreassi, archaeological superintendent of Apulia, who believes that the boat was caught in a storm sometime between the third and sixth centuries A.D. Its bronze cargo may have come from eastern provinces, where Romans collected worn statues from public areas for reuse.

"This discovery is the first tangible proof of commerce in the recycling of ancient bronzes," asserts Francesco Nicosia, archaeological superintendent of Tuscany.

The manufacture of bronze mirrors in Brindisi and the reuse of scrap copper are mentioned in the first-century A.D. writings of Pliny the Elder, a Roman historian. So it may be that the cargo's destination was a foundry where bronzes were melted for recasting into such objects as swords and armor.

As for the boat itself, no conclusive remains have been uncovered. Items found nearby—a lead used for depth sounding, a ring for attaching sails to a mast, and copper nails (above left)—could have belonged to other ships.

SURVEYING THE BROKEN BRONZES

Some scholars believe that sailors jettisoned bronze cargo to lighten their boat during a storm.

Centuries later divers measure, draw, and photograph the bronze objects. Combined with satellite data, their records will make an accurate survey. The diver at far right guides a sorbona, a device that sucks sand from buried artifacts.

The Roman port of Brindisi was the terminus of the Appian Way and gateway to the east.

Main area of finds: 1 female head; 2 nude torso (pages 98-9); 3 statue of man wearing toga (page 95); 4 foot, first artifact found (page 92); 5 small hand; 6 forearm and hand missing some fingers; 7 forearm and hand with extended finger; 8 head, Hellenistic prince (pages 92, 98-9); 9 half head (page 93); 10 giant arm (pages 94-5); 11 head fragment

PAINTING BY GREG HARLIN

ANCIENT BRONZE body parts fill a table in a makeshift morgue. The male head at center was quickly named the Hellenistic prince for its resemblance to a well-known statue in

the National Roman Museum. The foot at lower left was the first item found. Amphorae fragments (not shown) discovered at the site may help date the sinking of the bronzes.

R. LAMBOGLIA UNDERWATER RESEARCH GROUP, PROVINCIAL ARCHAEOLOGICAL MUSEUM TABONE AND FACING PAGE)

Desiderio Camassa thought he must be uncovering a bronze leg as he cleared sand from a new discovery. But as he gingerly examined the piece, he saw the bend of a colossal elbow. However huge the arm, it was fragile, and divers filled a balloon with air from a scuba mouthpiece to gently raise it to the surface (left). Measuring 56 inches, the arm (below) must have belonged to a statue about 12 feet tall.

To make a thorough search, six teams of two divers descended daily, each team working a one-hour shift. They conducted their investigation by sweeping handheld metal detectors over the seafloor. Whenever the audio tone of the detector sounded, a diver would mark the spot with a white cork float and return later to excavate it.

Artifacts were often found within hollows in the rocky bottom, which was covered with as much as two feet of sand. All told, an area about the size of a tennis court was excavated.

Some objects were covered with layers of growth that had to be cut away with a knife. "The dead algae is soft like a carpet, but difficult to cut," says diver Giovanni Lattanzi, who works without gloves because "it improves your sensing ability."

It's also risky, as Lattanzi found out when he sliced open a finger. He examined the wound at a depth where no red is visible and found it "strange" to see himself "bleeding green blood."

Divers treated the bronzes much more carefully. The Augustan-era sculpture of a life-size male in a toga (above) was secured on a foam-covered wooden frame to cushion its rescue. A gaping fracture in its side and a thin, almost demineralized body gave evidence of bronze high in lead, an alloy common in ancient Roman sculpture. Careful inspection showed that the statue's head had been cast separately and soldered in place.

To extend the search, especially for the wreck of the missing boat, a navy hydrographic vessel employed a proton magnetometer—a powerful metal detector—and side-scan sonar, which gives three-dimensional readings. Some suspicious profiles were recorded, and more work may be done, possibly with a submarine robot.

Removed for restoration, the stone right eye of the philosopher (top) had been encased in thin copper sheets fashioned into eyelashes.

Centuries of encrustation have not obliterated the grace of a female hand (above), which was once adorned with two rings. Corrosion transformed another hand (above right), reducing it to a blackened claw. The bronze has been eaten away by marine salts, so that only a remnant of good bronze at the tip of the thumb survives.

In 1972 divers raised a gigantic foot (right) from about the same location, although precise geographic coordinates were not taken. This bronze, of the late Roman imperial era, is consistent with the recent discoveries and may even have been part of the same cargo.

Head and torso of the Hellenistic prince (right) are united by computer in an approximate reconstruction that suggests the two pieces were once one. Fractures above the right elbow, visible in an X ray (below), may have been made with the intent of breaking the arm apart. The sculpture shows signs of deliberate breaking where the left arm had been soldered to the shoulder.

Remnants of the original clay core were removed from inside the prince's head by Erzsebet Lantos (top left), a necessity

ARCHAEOLOGICAL SUPERINTENDENCY, FLORENCE

because the clay is laden with sea salts, which would have continued to damage the bronze. Under fiber-optic light Renzo Giachetti (left) uses a scalpel to scrape minute deposits from the back of the torso.

Restoration revealed that the sculptor had finished his creation carefully, patching small defects created by air bubbles trapped in the original casting.

Both Lantos and Giachetti work toward conserving the bronze while remaining faithful to the original. "You are preserving his story," said Lantos, "wrinkles and all."

Tiny shells spangle the profile of a young Roman woman of the second century A.D. (left). She may be Faustina, wife of the emperor and Stoic philosopher Marcus Aurelius, according to Angela Marinazzo, director of the Provincial Archaeological Museum in Brindisi.

"She is my favorite," says Marinazzo. "We had been working late washing the pieces as they were coming in. Someone said all we're missing is a young girl. The next day Faustina showed up."

Her hair is pulled tightly back into a style Italians call *melone* because it resembles a cantaloupe. Reliefs on coins of the young Empress Faustina show her with this coiffure.

What may be the portrait of a young and still serene Tiberius (above), who reigned during the time of Christ, has been badly blackened by sulfur produced by algae. At its worst, the reaction destroys the fine detail of the bronze caster's art.

The fragile Brindisi bronzes are a windfall for archaeologists and art historians alike. "There are so few bronzes from classical times," says Carol Mattusch of George Mason University in Fairfax, Virginia.

"Pliny mentions that Athens had 3,000 bronze statues. This collection gives us a wonderful sense of what it must have been like to stroll through a city in ancient times." □

On the Edge of

Earth and Sky

Standing fast on a cliff above Montana's Flathead River,
a female mountain goat, or nanny, in Glacier National Park
searches the rock for salt. Master of one of the world's highest,
steepest ecological niches, *Oreamnos americanus* pushes
the limits of its precarious world.

By DOUGLAS H. CHADWICK

Photographs by SUMIO HARADA

DEEP IN MONTANA'S BACKCOUNTRY, near the crest of the Continental Divide, a solitary female mountain goat, or nanny, moves steadily along a cliff face. It must be the scale of these walls, with thousands of vertical feet to them, that makes her white figure seem especially alone.

Cut off by a fault partway across, the nanny stops to survey the pitch below. She leaps—and is gone. From my vantage point, it looks as if she has jumped straight into the chasm. Scrambling, skidding, and finally crawling on my belly, I go to peer down the precipice. There is nothing for 400 feet but snowflakes spinning in air currents. Looking more closely, I can make out scuff marks. The nanny had ricocheted off a sidewall onto a ledge about 15 feet down, then leaped to another eight feet below that. I found her later, calmly pawing through the snow to reach dried grasses.

Cloaked in a double coat—dense fur topped by eight-inch guard hairs—an old nanny in Canada's Banff National Park shrugs off the cold. A greater threat is deep snow, which buries the grasses, lichens, and other forage that sustain herds in winter.

No other large North American animal can match the mountain goat in climbing ability. The goats themselves seem to know that. As long as there is a steep wall nearby for escape, they will actually approach predators—the better to keep them in view. I've grown used to their frost-colored heads and black, inquisitive eyes peering around rocks as they follow my progress through their sheer-sided home.

How do the goats come by such a mastery of this skyline of rock and snow? Thick fur, specialized hoofs, and extraordinary strength and balance carry them a long way. So does a penchant for dueling and a strong yearlong bond between mothers and their young.

DOUGLAS H. CHADWICK wrote about mountain goats in the August 1978 GEOGRAPHIC and in his book, *A Beast the Color of Winter*. Japanese photographer SUMIO HARADA has focused on these elusive climbers since 1987.

But it's their high spirits that have always drawn me toward these hard-living creatures, which thrive in a realm of ice, stone, and danger, at the very limits of what seems plausible for life on earth.

Their natural range encompasses the high country of the Rockies and coastal mountain chains from southern Alaska to southern Idaho. On this edge of earth and sky, temperatures can reach 50°F below zero, food is buried by snow, and one misstep may mean death. These peaks hold no more than an estimated 50,000 to 100,000 of the animals; you could find as many white-tailed deer in a couple of Pennsylvania counties.

For almost a quarter century now, I've roamed among these shaggy mountaineers. I studied them full-time in the Montana wilderness from 1971 to 1978. Not much was known about the creatures back then, so month after month I tracked certain herds, came

Lured down by summer vegetation, a band of nannies and kids grazes along a melting glacier in Alaska's Kenai Fjords National Park. Their ancestors crossed the Bering land bridge from Asia at least 100,000 years ago; Ice Age predators and competitors forced the newcomers to take to the heights to survive.

With her back against the wall, a nanny beds down, relatively safe from predators and falling debris. Some 50,000 to 100,000 goats range from Alaska to Idaho. Several thousand have been introduced elsewhere for hunting.

to recognize individual animals, and noted the most subtle details of their behavior. I learned, for instance, that they flick their tongues in and out and raise their tails when they're afraid, and that they stare each other down until one goat is forced to look away.

To be with them, I often hiked many miles a day across avalanche-scoured slopes in frostbite temperatures. Although mountain weather kept me tentbound for long spells, my hours of goat observation eventually added up into the thousands, and I slowly discovered new dimensions in an animal so few had understood before.

A breakthrough came in 1975 when, after years of scrambling around cliffs to view the goats from a distance, I found a herd in Glacier National Park that let me live in its midst, accepting me like an eccentric member of the family. One goat even stepped over me while I lay snoozing in a flower-filled meadow. Another, the largest

male, or billy, I ever met, gored me in the knee when I walked too close to him. Whenever I saw him after that, I crouched and moved aside, the way subordinate goats do, to avoid another skewering.

Then I knew I had begun to learn more about the animals and myself than I had dared hope. The goats are true survivors, with great confidence and toughness. By surviving in the same high, wild places, I discovered new levels of resilience and courage in myself.

These animals are perhaps the best mountaineers that ever were. They do not have hoofs that act like suction cups on solid rock, as many folks believe. But they do have a soft, padded sole and two flexible toes for extra traction. Combined with relatively short legs, deep forequarters humped with muscle, and a narrow body for edging along cliffs, the hoofs help the wild climbers defy gravity.

Because the goats have chosen such an inhospitable niche, few people ever see them. If they do, it is usually on a summer day, when the skies are fair and the way is strewed with miniature alpine wildflowers. On such an afternoon I pushed on toward one of those knife-edge ridges that is the first to greet the sun each day and the last to let it go. I paused in a cliffside notch and noticed a piece of goat fur snagged on the sidewall. Easing around a leftover drift, I almost walked into a band of nannies with their kids and a few older juveniles spread out above a turquoise meltwater lake.

The kids were busy trying to climb everything handy, including their patient mothers, bedded on the grass. A couple of the little goats chased after marmots, whose whistling calls echoed between the crags. One kid began to wander toward a cliff edge. Its mother bolted over to nuzzle the baby, gently herding it back toward safety, as she had done countless times since its birth in late May or early June. Other kids popped high into the air, as if some internal spring had suddenly been released. Every once *(Continued on page 114)*

Bellying up for a shot of salt, goats come from miles around to ingest a solution of various mineral salts seeping from a cliff known as Walton Goat Lick in Glacier National Park. Some even brave the raging Middle Fork of the Flathead (right) to get there to replenish nutrients lost during winter. Their first few days at Walton, goats do little but lick, in four- to six-hour bursts.

Ornery by nature, adult goats keep a wary distance from one another and frequently clash over the tastiest spots. Males, or billies, tend to prevail. Subordinate to nannies in the day-to-day social hierarchy, billies—like the pair above, shedding winter fur—assert vigorous control over mineral rights.

Sparring partners, a pair of evenly matched adults take their fight over salt to the river's edge. The billy at left stages a rush threat, while the nanny dodges and lowers her rump, target of most horn attacks. Horn-to-horn combat is rare among these thin-skulled, dagger-wielding creatures. Instead an array of threats, feints, and body blows minimizes death among rivals.

in a while an older goat seemed inspired to join in, leaping, twisting, tossing its horns—dancing at the top of the world.

On these late summer afternoons among glissading goats, it seems the warm light might stretch on forever. But the days are already shortening. The time comes when a voice inside me starts whispering that maybe I ought to turn and climb down.

Down to where the October sun slants across the countryside, making the tamaracks glow like candles among the dark spruce. The spires above me have snagged another wave of snow clouds moving in from the west. Already the snow is calf deep, and the waterfalls have frozen in place.

Yet the goats are moving onto even steeper cliffs, because those collect the least amount of snow. Glimpsed through veils of falling white flakes, the climbers look like plump snowballs. They have been feeding for longer periods than usual, gobbling grasses and late blooming wildflowers like purple aster and penstemon for about six hours a day, to prepare for lean times to come. Their new coats have grown in, clean and fluffy, only partly covered by the long guard hairs that give each goat an extra layer of insulation.

Built for balance—with short legs, heavy shoulders, and spreadable, padded hoofs—a billy in Banff studies his next move. In winter goats often climb to ground too steep or windswept to hold snow, where forage is likely to be exposed.

I spend hours plodding through deepening drifts, looking for goats but finding only the tracks of a grizzly probably headed for its winter den. Sometimes, when the goats are as elusive as ghosts and the north winds come rasping by in the early darkness and it gets so cold I can no longer work my fingers to take notes, I wonder why any sane person would spend his time this way.

But a couple of weeks later I come back and am reminded why: This time the mountains are a dazzling geometry of white planes beneath a perfect sky. It is the beginning of the mating season, and I soon come across some billies, whose bright new coats are now matted and stained from pawing in rutting pits, the bed sites where males urinate and scrape the ground as a way to proclaim their presence through scent.

The billies have stopped eating and spend nearly all their time searching for bands of females. When a male does find a nanny in

these early weeks of the rut, he simply stands at a distance and stares as if he is moonstruck—hammered to a standstill by love. Mountain goat courtship is extremely slow and cautious, and for good reason: The belligerent nannies are not used to tolerating any animals near them except their offspring. I have seen nannies viciously stab overeager young suitors in the face, neck, and shoulders, piercing their skin with stiletto-sharp horns.

After several weeks the nannies' resistance wanes, and they allow the billies to approach and nuzzle their backs and flanks. By Thanksgiving some even rush after males to get on with breeding.

The same sorts of battles I see during rutting season continue throughout the year. Each goat has its own personal space, a kind of imaginary bubble that extends about ten feet around it. If another goat violates that sphere, the defender will threaten or even

Born to romp—and leap, twist, skip, prance, and climb on mom—a pair of two-month-old kids gambol down a talus slope behind a nanny in Glacier National Park. Since twins are rare, the two are probably just playmates. High spirits and wandering attention can be fatal for young goats. Fortunately, nannies dote on their offspring, tending them from the downhill side to block falls and keeping watch for eagles, wolverines, grizzlies, and other predators.

attack the trespasser. Yet the goats seldom come to blows. Most clashes are resolved by body language—stiff postures combined with feints and bluff charges, thus sparing needless bloodshed.

Big goats can usually force smaller ones aside by stamping their hoofs, flourishing their horns, or simply staring at an opponent. But sometimes, especially when the foes are evenly matched, a battle is unavoidable. One frigid morning I watched two large nannies quarrel over a bed site. Each arched her back and lowered her horns. The pair began to circle each other, head to tail, each hooking her horns toward the other's rump while swinging her own rear away. Faster and faster they circled. Then one nanny lost her nerve and bolted from the duel, getting a sharp jab in the rump from her rival.

This constant fighting is among the most distinctive features of mountain goat life—and the most puzzling, particularly since so

many contests play out on cliffs where caution ought to rule. I eventually realized that the brash encounters serve an important purpose: By keeping goats dispersed in small bands, the battles allow a herd to avoid competition for a limited food supply that lies scattered in snow-covered patches through the long winter.

When spring finally arrives in the goats' world, it is no more than a drop of water sliding off an icicle, a hint of warmth where your fingers grip a sunlit rock, a faint scent of moist earth rising on a thermal along with a pair of returning eagles.

Even with all the goats' skill and endurance, three out of every four kids may have died if the winter has been especially long and bitter. At least half the yearlings are likely to have vanished along with them, having exhausted their limited energy reserves. In addition, enough broken white bodies lie beneath goat wintering areas that the tracks of scavenging wolverines and grizzlies just out of hibernation often led me there. Some of the carcasses come from climbing accidents and cliffside quarrels. But most are the work of avalanches, which shake the high country and pour down across cliffs week after week.

Winter won't give up its long reign without burying every trace of new green beneath a few late blizzards. But eventually the cold melts away into a thousand bright waterfalls.

About the time the avalanche lilies begin to flower, pregnant nannies are giving birth to a new generation of mountaineers. By the newborns' second day of life, they are already clambering up rocks, jumping, spinning in circles, and jabbing at imaginary foes.

My herd in Glacier Park loved to join in this springtime play. Full of high spirits, young and old alike would make whirling leaps and toss their horns in mid-flight, like rodeo bulls just out of the chute. One day I joined the goats as they boogied downhill in a wild spray of snow. In imitation of their dancing, I leaped higher and higher, twisting and turning, feeling more free with each bound. Peaks and glaciers spun past on all sides while swollen rivers glistened and swirled far below. Winter was over. It was time to celebrate.

Easing into courtship, a billy licks a female to signal interest while creeping from the rear, in a crouch, to avoid her temper and sharp horns. After mating, males tend females for a day or two, then resume their largely solitary ways.

Like a little snowstorm on hoofs, a billy in Glacier National Park skitters down a snowfield in late summer. Will his habitat remain as finely balanced? Goats gaze down on a backcountry increasingly crossed by humans in search of big game, oil and gas, or one precious glimpse of the mountain goat. □

Earth Day

25 YEARS

Rejoicing at grass roots, Mary Lyn Ray epitomizes a generation of activists who answered the call of Earth Day, April 22, 1970, when millions rallied to the cause of the environment. Ray, for one, is rousing her neighbors to keep their corner of New Hampshire green.

By FRANK GRAHAM, JR.

Photographs by RANDY OLSON

Earth Day 25

It was to have been a teach-in. The National Environmental Teach-In, the organizers called it, hoping to capture the spirit if not the politics of those earlier "sit-ins" of the fractious 1960s. Instead, what emerged on April 22, 1970, was Earth Day, the greatest nationwide street demonstration the United States had witnessed since the tumultuous close of World War II.

Twenty million Americans turned out that day to hear politicians and philosophers pledge allegiance to the planet by deploring its polluted condition. Congress stood in recess, its lawmakers out on the ecological stump. Senator Edward Kennedy, ex-Harvard, stumped at Yale; Senator Barry Goldwater at Adelphi University in Garden City, New York. Margaret Mead, the anthropologist, predicted that the energy required to roll back environmental degradation might well match that of the industrial revolution. John V. Lindsay, the mayor of New York City, proclaimed it a day to remember: "This is the first time," he said, "I've walked down Fifth Avenue without getting booed. . . ."

NEW YORK CITY, APRIL 22, 1970. JASON LAURE, MCGUFFIN CAMP & ASSOCIATES

A few speakers feared that the enthusiasm of that day might soon fade away. They needn't have worried. There have been Earth Days each April 22 ever since, and now it is time for another, the 25th. A silver anniversary for this sometimes uncertain notion that we the people are a part of the earth, not apart from it, and that (to borrow from the mountain philosopher John Muir) "when we try to pick out anything by itself, we find it hitched to everything else in the universe."

The original event, 1970, had been the brainchild of Senator Gaylord Nelson of Wisconsin, a longtime battler for clean water and a man regarded by many conservationists as one of the few voices of conscience on Capitol Hill. At the time, Nelson was troubled that the environment remained, as he called it, a "non-issue in the politics of our country" even after all the ecological alarms and disasters of the 1960s. The parching of the Everglades. Blackened beaches from the oil-rig blowouts off Santa Barbara. The perils of pesticides. The smog in Los Angeles. The sewage afloat in Chesapeake Bay.

But these *were* issues to more folks than Gaylord Nelson suspected. And as inquiries from town and gown began to swamp the senator's staff, Nelson was obliged to hire Denis Hayes (right), a 25-year-old Harvard Law School student, to take over the operation. With Hayes aboard, the planned festivities evolved into Earth Day, and Environment with an uppercase E was off and running, though not without its fair share of detractors.

From the left came insinuations that Earth Day was a scam to deflect the nation's attention from the war in Vietnam. On the right it was said that the event was a communist plot—the April 22 date that Nelson had selected to avoid a conflict with college exams and spring vacations happened to coincide with the 100th anniversary of Lenin's birth.

The events of that day were as varied as the expectations of the participants. There were trail hikes and talkathons, prayer vigils and publicity stunts. In Washington, D. C.,

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FRANK GRAHAM, JR., is a field editor for *Audubon* and author of more than a dozen books on the environment. RANDY OLSON, Newspaper Photographer of the Year in 1992, captured images of northern California (July 1993) and U. S. national parks (October 1994) for the GEOGRAPHIC.

demonstrators poured oil on a sidewalk in front of the Department of the Interior to protest its policies on offshore drilling. At Boston's Logan International Airport, 200 people posed as pallbearers for the United States' planned but never-to-be-built supersonic jetliner.

The gimmicks grabbed the headlines, but for most of the people who turned out for the ubiquitous street fairs and pep rallies, Earth Day One was about as confrontational as a bouquet of tulips. But it wasn't a lark either, or a "springtime skipalong," as one of the national newsweeklies suggested. By year's end, even some skeptics began to concede that the fallout from Earth Day would be writ on the face of America for years to come.

At first the most noticeable changes appeared in the law books. Three months before Earth Day, President Richard Nixon had signed the National Environmental Policy Act, requiring review and analysis of public projects. An amended—and tougher—Clean Air Act cleared Congress that year, to be followed by a Clean Water Act, a Marine Mammal Protection Act, an Endangered Species Act, a Safe Drinking Water Act, and a Toxic Substances Control Act, among scores of new federal and state statutes.

And inevitably, as the environmental community scored one victory after another on the regulatory and legislative fronts, a few Americans would come to resent what Earth Day had wrought, perceiving the regulations as infringements on their property rights and decrying the laws as pernicious attacks on liberty and the pursuit of happiness.

But the most surprising legacy of that landmark occasion 25 years ago is neither the backlash nor the passage of statutes, but rather the emerging prominence of grassroots advocates acting as unaffiliated individuals or in small groups to educate a community, save a special place, or squash a project harmful to the commonweal.

The message on April 22, 1970, was that the planet's plight demands an urgent response from each of us. For a quarter century that message has endured to influence the way thousands of Americans now live their lives. Here are brief profiles of seven of them.

DENIS AND SAIL BUTLER HAYES ON LAKE WASHINGTON, OUTSIDE SEATTLE.

Mountain greenery near South Danbury, New Hampshire, will remain intact thanks to Mary Lyn Ray, community spirit, and conservation easements, a legal tool that gives tax relief to landowners who agree to limit development.

The heart of Mary Lyn Ray's world is a cluster of green-and-gold valleys ringed by the blue-tinted mountains of central New Hampshire. It is a good piece of country for a woman like Ray, a writer of children's books and a land saver with a strong sense of place.

Unlike most over-40 activists in the environmental movement, Ray sat out Earth Day the first time around. "It just sort of passed me by," she recalls. "I remember thinking, 'How encouraging that so many people care.' "

By 1987, however, Ray had something of her own to care about. More than 150 acres of open fields and woodlands adjoining her home in South Danbury was at risk of being developed into small house lots. And if that happened, it would mark the beginning of the end for the values and traditions vested in the land. She decided to acquire the property herself to protect it.

With help from the nonprofit Society for the Protection of New Hampshire Forests, Ray contrived to purchase the land by using underlying gravel deposits as collateral for a bank loan. When the deposits proved too shallow to meet payments on the loan, Ray sold off her collection of art and antiques and learned to live on the edge of bankruptcy. And, convinced that the land should be preserved beyond her lifetime, she arranged for a conservation easement that precluded development.

That was only for starters. Having limited the use of her own land, Ray felt she could ask her neighbors to think about placing easements on *their* property. By late last year her persistence had helped bring permanent protection to more than 5,000 acres of forest and farmland on Ragged Mountain and the surrounding hills.

"When Mary Lyn sets her sights on something," says Paul Bofinger, president of the Forest Society, "you can see the fire in her eyes. She's bet the farm more than once to make good things happen. We're awful lucky to have her on our side."

MARY LYN RAY IN HER SOUTH DANBURY HOME

JUDY HANCOCK ON THE SUWANNEE RIVER, GEORGIA

Right now Judith Hancock is afloat in Okefenokee National Wildlife Refuge. But you might find her, too, at the wheel of a pickup truck on a back-country road in Osceola National Forest, near Lake City, Florida, checking out potential threats to wildlife and its habitat. "I hope this one's got a bottom," she says as she accelerates the truck across a mudhole filled by recent rains. An earthy plume oozes over the windshield.

Then, pounding the steering wheel with an open palm, Hancock inquires of a rattled passenger, "Still with me?"

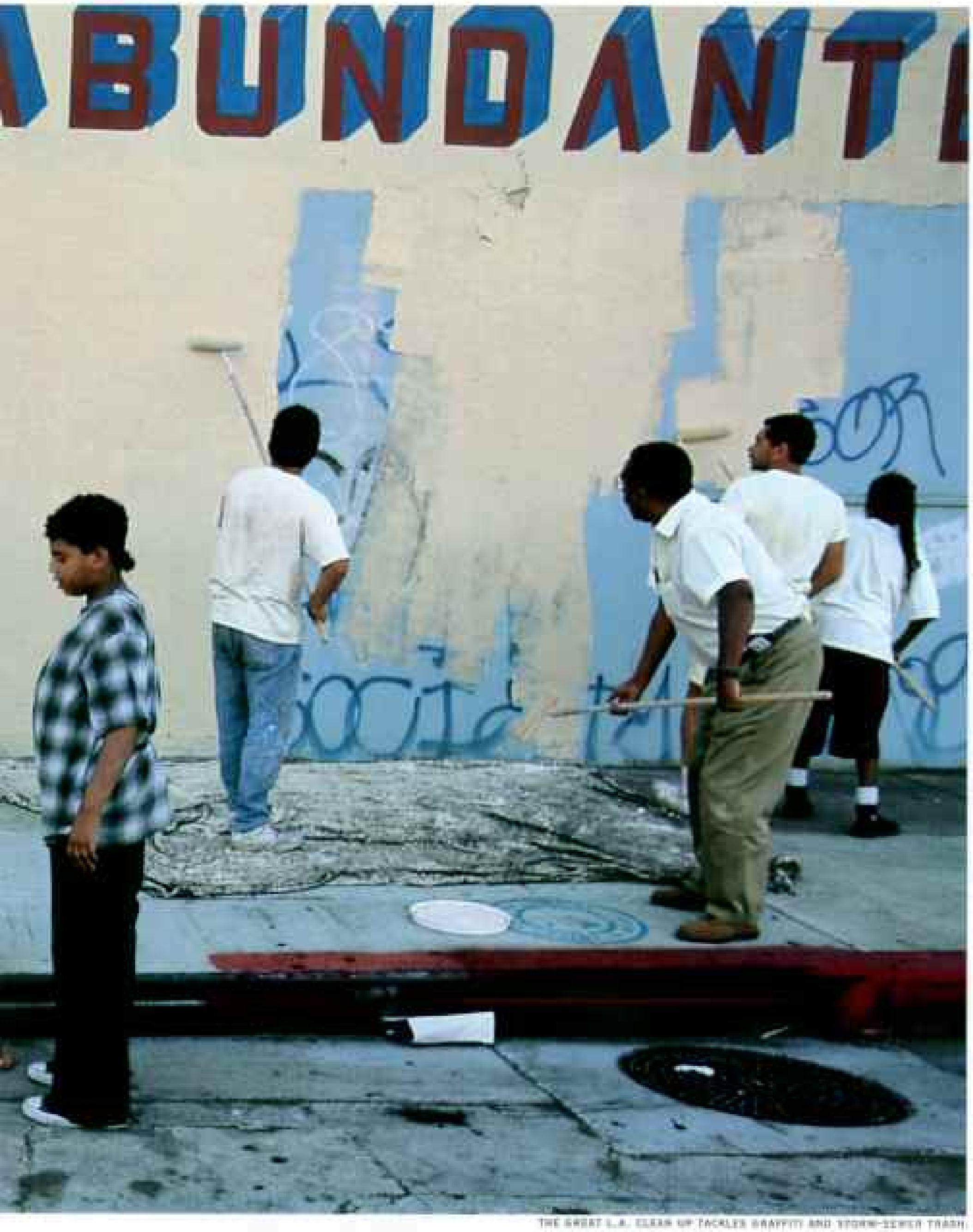
The intensity of Hancock's approach to mudholes mirrors her passion for her unremunerated work. In the Osceola she contended with the U. S. Forest Service over timber plans she considered unfriendly to the endangered red-cockaded woodpecker and the wood stork.

The Earth Day idea was a decade old when Hancock first came to the environmental wars, and the first battle she fought was right here in the national forest, where a consortium of companies had applied for permits to mine phosphate. Hancock was familiar enough with wetland ecology to know that the mining and processing of phosphate rock along the headwaters of rivers can have a devastating effect on them, introducing sediment, excess nutrients, and toxic chemicals to the water. So she joined a citizens campaign to block the miners. The citizens prevailed. Based partly on information supplied by the group, Congress enacted a bill in 1984 prohibiting phosphate mining in the national forest.

Now Judy Hancock leaves the cab of her truck to plunge down a trail through wet woods along the Suwannee River. She pauses to admire large golden silk spiders and a canebrake rattlesnake, and before the day's done, she's picked up enough chiggers to keep a hound scratching for a week.

Every day is Earth Day for Father Peter Kreitler, a 52-year-old Episcopal priest in Los Angeles, California. Tall and outgoing, with a tidy white beard and the confident, resonant voice of a preacher, Kreitler serves as a kind of diocesan minister to the environment, touring the grittier parts of the city in a relentless war against visual pollution. He knows there are far greater problems to solve in the vast sprawl of Los Angeles, but at the same time he believes that solutions have to start somewhere, even if they're small.

"When people lose respect for themselves and their surroundings," he says, "everything else breaks down. Gangs mark out their territories with graffiti, and litter piles up in the streets. We want to turn those things around." Kreitler founded Earth Service, Inc., which fights blight by helping neighborhood groups organize to paint over wall graffiti and haul trash out of vacant lots. Much of the group's



THE GREAT L.A. CLEAN UP TACKLES GRAFFITI AND STORM-SEWER TRASH.

effort is aimed at involving young people in recycling and the planting of trees.

El Padre, as he is identified by the letters on his license plate, was ordained in 1970, just five days after the first Earth Day. He did not participate in the event himself, but he remembers reading about it and being impressed by the number of people who expressed their concern. Later that year he began addressing environmental issues regularly from the pulpit, to the extent that some parishioners would soon be joking about "Father Peter's Save the Whales sermons."

So far Kreitler has been frustrated by the reactions to his environmental ministry from some of his colleagues of the cloth. A couple of years ago he called on several pastors to persuade them to correct such sources of wasted energy as incandescent bulbs. "I didn't get much of a response," Kreitler laments. "When the churches say, 'Let there be light,' they really mean it."

PETROGLYPH OF SNAKE

RINCONADA CANYON IN PETROGLYPH NATIONAL MONUMENT, NEW MEXICO

Isaac Eastvold made his pact with the petroglyphs before Earth Day was conceived. His vow was to keep them from harm's way. The petroglyphs are those drawings carved in stone centuries ago by the ancestors of the Pueblo Indians. Though the art is scattered widely throughout the cliffs and canyons of the American Southwest, one of the greatest remaining petroglyph concentrations lies along the West Mesa escarpment on the outskirts of Albuquerque, New Mexico—right in the path of intense development.

Eastvold, bearded and often stirred to lyricism, has devoted at least half his 54 years to the study and protection of Indian rock art. Profoundly moved by the spiritual images, he first roamed the California desert, photographing petroglyphs for the Bureau of Land Management. Then, in 1985, he and his wife, Sharon, moved to Albuquerque and turned their attention to the rock-art treasures that lay just across the Rio Grande.

"When we got here," Eastvold recalls, "the petroglyphs were under terrific pressure. Vandals were using them for target practice. Big boulders with petroglyphs on

ISAAC SAVEVOLD IN HIS ELEMENT

them were being carted into the city for residential landscaping. In some areas development was being permitted right up to the rocks."

Eastvold proposed that the petroglyphs be protected in a national monument. Then, assuming the presidency of a new group called Friends of the Albuquerque Petroglyphs, he spearheaded an effort to enlist the support of New Mexico's congressional delegation and forge a consensus among competing city and state interests.

In 1990 his dream came true: Congress established 7,200-acre Petroglyph National Monument under the joint management of the city, the state, and the National Park Service. But the fragile consensus evaporated when the city of Albuquerque proposed building two huge roads through the fledgling monument. Eastvold and Pueblo leaders, who consider the park a major religious site, supported alternative routes recommended by the Park Service, but the city has recently granted subdivision permits blocking those routes.

"One developer threatened to run me out of town and ruin my reputation," Eastvold said. "When I pointed out that this is a place of worship for Native Americans, he laughed in my face and scorned their beliefs as a 'Stone Age religion.' He couldn't understand that the land around the petroglyphs is as vital to their meaning as the great cathedrals are to the paintings they hold."

On occasion Eastvold walks in the monument with Phillip Lauriano, a spiritual leader of the nearby Sandia Pueblo. Lauriano recalls first visiting the petroglyphs with his grandfather nearly 70 years ago. He explains to Eastvold that prayers here "go beyond the great divide to a reservoir of strength and power." The men walk together through a sea of wildflowers—evening primroses, mallows, sunflowers. Hover flies, gemlike and volatile, float in front of the blossoms. Wind rustles the bunchgrass.

"Wind in the grass," says Eastvold, "is the voice of the desert."

Margaret Miller is telling her husband, Paul, that it's time to go over to Dillon's Super Store and check on the bins. "Mrs. Recycling," they call her in Wichita, Kansas. "I got into recycling," Margaret explains, "because I thought it would be most enlightening for the person who wouldn't ordinarily become involved in environmental issues. It's visible. It gets people thinking."

Miller first came to the attention of Kansans when she took on one of the state's electric utilities by opposing its big Wolf Creek nuclear power plant (she lost) and then organized a consumers coalition seeking representation before the state board that sets utility rates (she won).

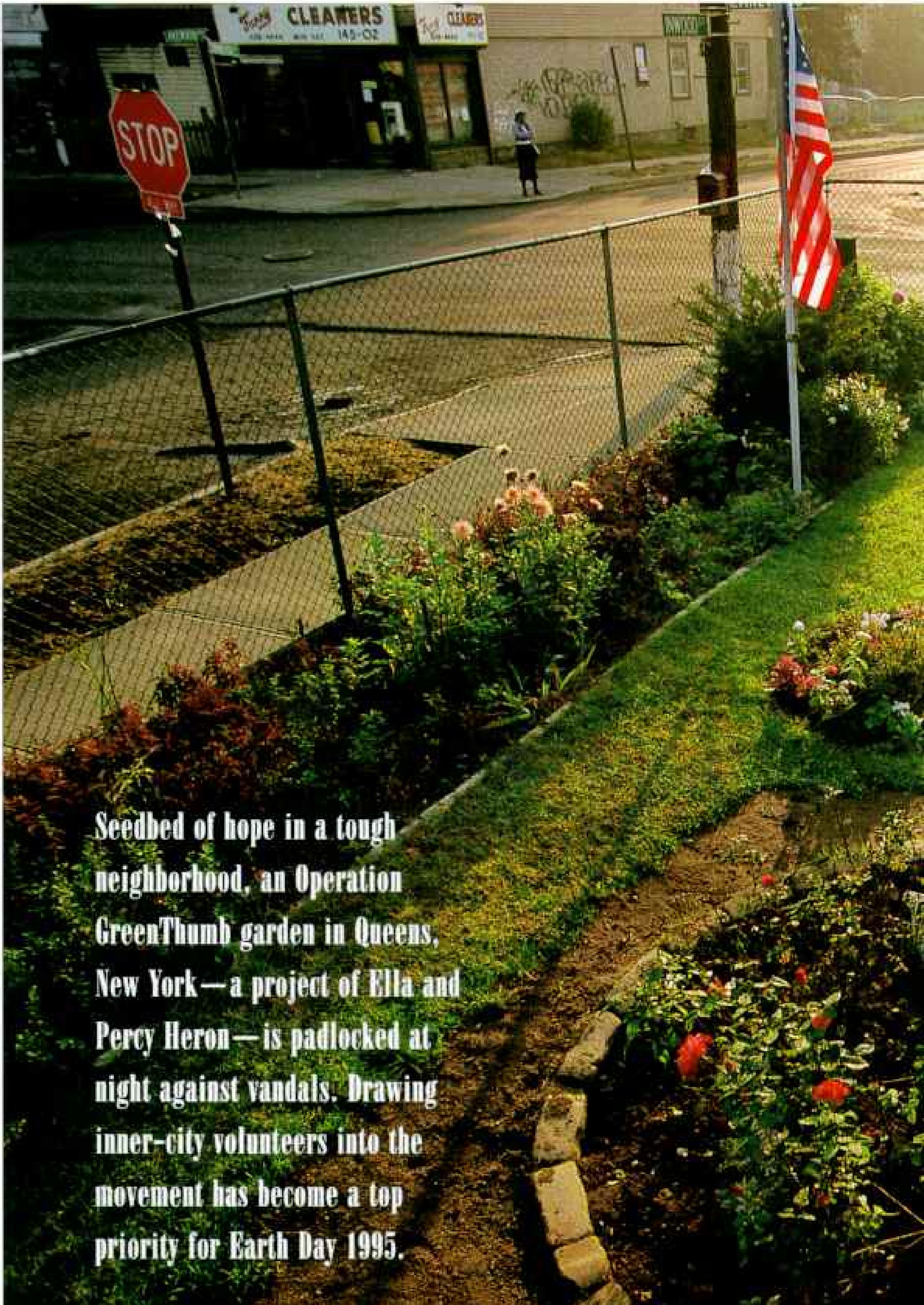
In 1989 Miller and two friends asked the Wichita City Council to help them set up a recycling program. "They laughed at us," Miller recalls. "They said people here would never go for it. So we established our own collection in a few parking lots. At the end of 18 months it was taking a fleet of trucks to handle all the waste." Now both the city and the state have pitched in, and local governments throughout Kansas coordinate the collection, reduction, and recycling of waste.

A key to Miller's success is her willingness to cooperate with the business community. "Margaret Miller pioneered recycling in Kansas," says Eric Evenson, manager of a new Weyerhaeuser Company plant in Wichita. The plant sorts and bales recyclable office papers and other "secondary" fibers for reprocessing. Evenson also credits Miller with educating the public on how to separate wastes—"and that's a job we could never have done by ourselves."

But the job never ends. Over in the parking lot at Dillon's Super Store, Miller spots a newcomer to the system. "Look at that woman," she says in a low voice. "She's going to put those colored bottles in with the clear ones."

Miller approaches. The miscreant is about to get educated.

MARGARET AND PAUL MILLER AT WEYERHAEUSER RECYCLING PLANT, WICHITA, KANSAS



Seedbed of hope in a tough neighborhood, an Operation GreenThumb garden in Queens, New York—a project of Ella and Percy Heron—is padlocked at night against vandals. Drawing inner-city volunteers into the movement has become a top priority for Earth Day 1995.

INWOOD MEAT MARKET
IMM

ELLA AND PERCY HERON HARVEST VIRGINIA PEANUTS AND A PERFECT MOMENT (1984)

Percy and Ella Heron's community garden sits at the corner of Inwood Street and Lakewood Avenue in the South Jamaica section of Queens, not far from the great airports of New York City. The garden is enclosed by a high chain-link fence. The gate is padlocked when the garden is not in use. The neighborhood of single-family houses on narrow lots has seen better days, though hardly anyone but the Herons has lived here long enough to remember them.

Percy and Ella Heron moved in here, two houses from the corner, in 1949. Together they and their neighbors tend the community garden, nurturing not only plants in the earth but also ideas in the minds of a younger generation. "We teach the neighborhood children about the soil," says Ella. "We teach about water and where it comes from and why it has to be clean."

Once there had been a house at the corner. Then the house burned, and the city condemned it and tore what remained to the ground. Vacant, the lot attracted garbage and litter until the Herons stepped in, appealed to the city's Department of General Services, and, with its blessing, slowly turned the place into a community garden, one of some 700 now flourishing in New York under the auspices of the department's Operation GreenThumb.

In season, the garden sparkles with roses, azaleas, hydrangeas, daisies, asters, tulips, and daffodils. There are planter boxes with peanuts and okra and tomatoes. Children come to the garden after school to help the Herons with their chores. This is how the ideas get planted.

Now it is time for Earth Day again. It will be, as always, a very special day at the community garden. Last October Ella and Percy Heron and some of their young friends got down on their hands and knees and planted tulip bulbs around the edge of a bed of roses. And what Ella told the kids was, "Don't you forget to come back here on April 22. These tulips might be fixing to bloom for that day." □

ON EARTH DAY'S 25TH ANNIVERSARY, WE ALL NEED TO LEND A HAND, PAW, FIN, HOOF, AND WING.

This April 22, it's important to remember that together we can make a difference in the lives of all creatures, great and small. Every year, millions of people all over the world show their commitment by participating in everything from walkathons to cleanups. Below are some of the things we're doing at Chrysler Corporation, as well as a few simple ways you can help too.

For starters, we're doing our part by recycling. Every year Chrysler Corporation recycles thousands of tons of wooden pallets, cardboard, and paper. Even our vehicles are 75 percent recyclable.

Our engineers are also working to reduce emissions and improve air quality. Even though today's gas engines burn cleaner and more efficiently than ever, we're looking at alternative fuels like methanol-gasoline mixtures, natural gas, and electricity to power our vehicles in the future.

But you don't have to wait for technology to have a "green" machine. Keep your air and fuel filters clean for better mileage, performance, and a cleaner exhaust. Maintain recommended tire pressures to increase fuel efficiency. And combine errands, since short trips use more gas per mile than a long trip.

As you can see, there's a lot we can do. So let's all lend a hand to save our planet. . . not just on Earth Day, but every day.

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To get the most out of technology, you need a vision for how it can improve learning in your school. You need a plan to turn that vision into reality. And, you need help and advice.

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—Dr. Sheila Cory

Director of Instructional Technology and Media, Chapel Hill, North Carolina

This is the technology plan Sheila's team created. Along the way, they used Apple's Teaching, Learning and Technology, a multimedia kit that guides you through the entire planning process–from choosing the right technology, to implementing it, to evaluating its overall effectiveness in your school.

Apple Systems Engineer Dave Slaton. Sheila says that Dave "went above and beyond our expectations in helping us plan our network. He studied our blueprints, outlined options—he even lent me books from his own library."

At Apple, we realize that putting technology in a school can be a very detailed and, often, a very demanding process. Even experienced computer coordinators find that they may need a little help every now and then.

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As Though A Class Of First Graders Wasn't Wild Enough Already.

You might think a roomful of 6-year-olds would be difficult to keep under control. But at Winn Brook Elementary of Belmont, Massachusetts, the first graders are perfectly well behaved. It's the classroom itself that's wild.

With help from their teacher, Donna LaRoche, the students at Winn Brook have transformed their class into a lifelike rain forest habitat. Complete with vines and waterfalls and scary creatures that are half-jaguar, half-kid.

Ms. LaRoche believes "constructivist" lessons such as this help create "a community of joyful learners." Not to mention a community of South American jaguar fans.

For planting seeds of inspiration in the minds of those who, someday, may help the rain forests grow, we at State Farm are pleased to present the Good Neighbor Award to Donna LaRoche, along with $5,000 to her school.

STATE FARM INSURANCE

Good Neighbor Award

STATE FARM INSURANCE COMPANIES
Home Offices: Bloomington, Illinois

The Good Neighbor Award was developed in cooperation with the National Council for Geographic Education.

THE PRESIDENT'S REPORT ON THE

Education Foundation

ANNIE GRIFFITHS BELT

Taking Root: Grants for Teachers

Valuable lessons in geography can be found anywhere—if you're willing to get your hands dirty. Lola Wheeler of Louisville, Kentucky (above, at right), encourages her Seneca High School students to do just that as they probe the remains of a plantation house. Her clever down-and-dirty approach was one of 26 projects funded by our Education Foundation's Teacher Grant Program.

"The Briscoe family has owned this land since the 1700s; the house burned down around 1840," says Lola. "By plotting landforms and available water sources, my students are trying to discover why the Briscoe family chose this particular area.

"They'll also study the growth and decline of the area population."

Best of all, Lola's archaeological digs on the plantation site have lit the fires of curiosity in her students.

"Some of my seniors are so into this they've asked if they can come back to help out next year."

PHIL SCHERMEISTER

Ideas poured in after the foundation put out the call for teachers' grant proposals last year. I'm not talking about vast sums of money—the amounts ranged from $435 to just over $1,200—but the results have been priceless.

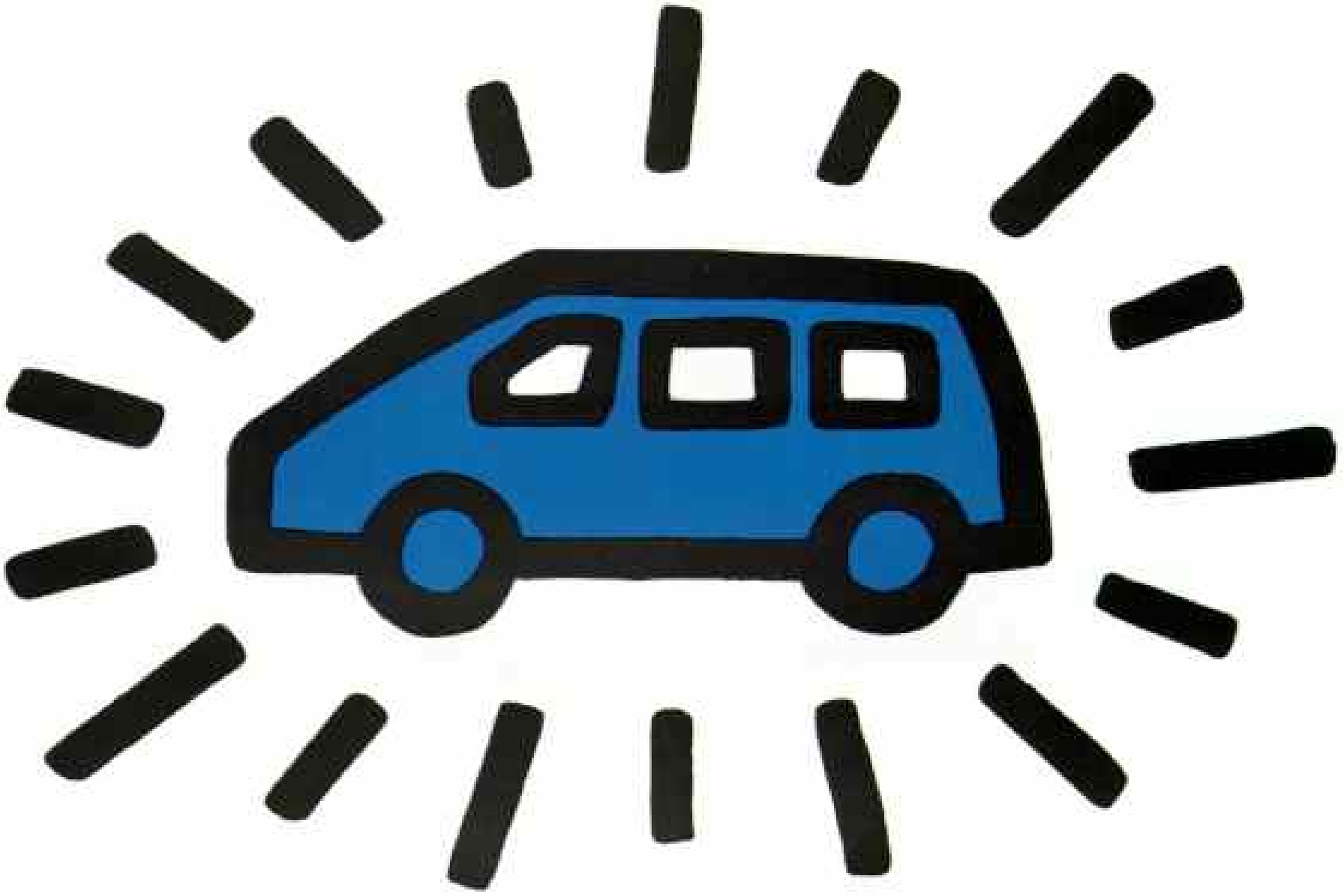
At Janesville Union School in northern California, seventh graders helped their first-grade counterparts use surveying devices to measure ponderosa pines (left). "Our students are also planting trees to restore an overgrazed area," says grant recipient Julie McKee.

In Bloomington, Illinois, a teacher grant helped create a lesson plan that used aerial photography. High schoolers in Gonzales, Texas, traveled from their coastal plain home to the state's hill country. Conway, Arkansas, elementary school students visited an Ozark folk festival.

Then there's Jane Fallon of Moscow, Idaho. She is the first recipient of the Wendy Rogers Memorial grant, named for a cherished member of our education staff. Jane's three-day Geography Camp—during which kids dug fossils, studied aquatic life, and learned compass skills—is now a permanent part of her school district's sixth-grade curriculum. Not a bad return on $984!

Gilbert M. Grosvenor

Introducing Odyssey.



Why does a mini-van have to have that heavy sliding door? It doesn't. We gave ours four doors and power windows.

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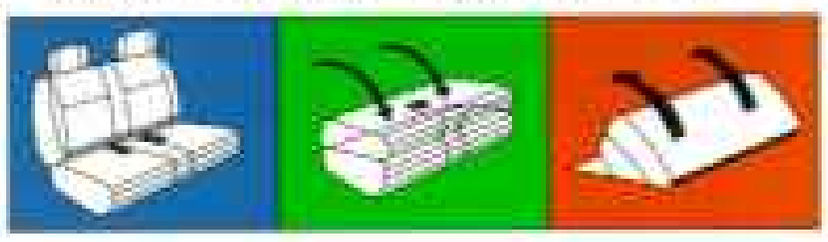

Dual A/C allows back seat drivers to control their own comfort level.

Dual A/C allows front seat drivers to control their own comfort level.

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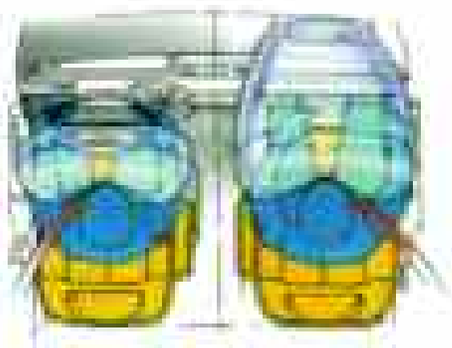

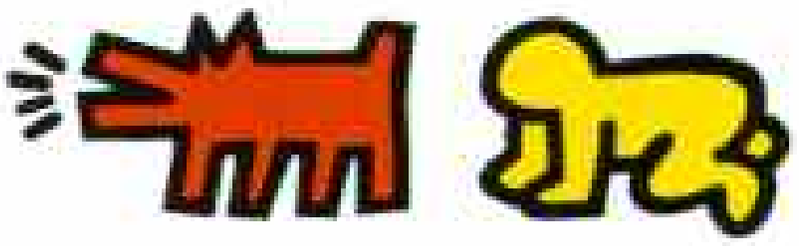

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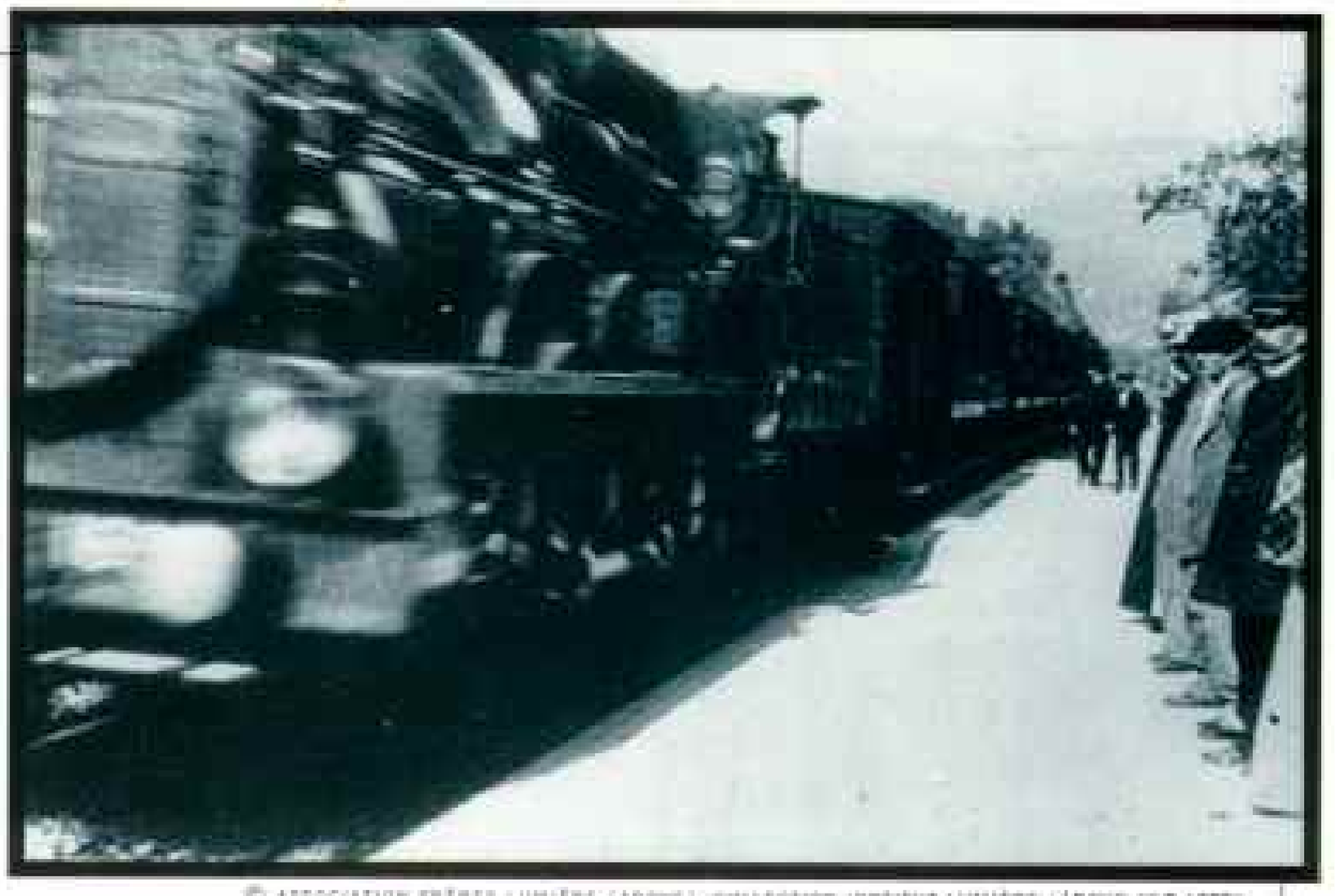
** All may not be available in all states.

Geographica

A Century Ago the Age of Cinema Began



The steam locomotive huffed into the station and slowed to a stop, but many of those watching reared back in fear. No cause for alarm: The train moved on film.

That brief moment of movement on a screen—and the reaction from onlookers—was a highlight of 1895, the year "the movies" were born. The train scene was one of several *documentaires* shot outdoors by Auguste and Louis Lumière (above) with their *cinématographe*, a lightweight camera, printer, and projector all in one. Inside the device a claw propelled a perforated strip of 35-mm celluloid film past a projector lamp at a speed of 16 frames a second.

The Lumières first staged a program of their films in a café basement at 14 Boulevard des Capucines in Paris on December 28, 1895. Their subjects included workers leaving a factory, parents feeding their baby, and—in an early comedy—a gardener being doused by a garden hose. The 33 viewers had long been credited as the first paying audience for a motion-picture program. But recently film historians learned that other inventors in the U. S. and Germany had shown films even earlier that year. Among them were C. Francis Jenkins and Thomas Armat, who projected films with a device called a phantoscope at the Cotton States Exposition in Atlanta. Those scenes were originally made by Thomas A. Edison's firm to be seen through a peephole, one viewer at a time.

During 1995 France is celebrating the cinema's centenary with conferences and gala film showings, many at the Institut Lumière, based at the Lumière chateau in Lyon. The 1895 Paris event drew far less notice, but a journalist there took the long view: "With this new invention, death will be no longer absolute, final. The people we have seen on the screen will be with us, moving and alive after their deaths."

© ASSOCIATION FRÈRES LUMIÈRE (ABOVE); COLLECTION INSTITUT LUMIÈRE (ABOVE AND LEFT)

BRUCE LYON

Coot Parents Favor Most Vivid Chicks

Billiard-ball bright, the crown plumage of newborn American coots defies logic: This strong coloration, which vanishes after three weeks, should attract predators. But that very brightness may hold a key to coot survival.

Canadian researchers trimmed the orange plumage of half the chicks in 21 broods, each made up of four to seven chicks that hatched during a seven-to-ten-day period. Parents fed the brightly colored chicks and ignored the darker, trimmed birds in the same brood, the researchers found.

Other broods in which every chick had plumage trimmed fared just as well as those in which the plumage was left alone. Only when colorful and dark chicks shared a nest did parents show a preference.

One-third to one-half of all coot chicks die of starvation. "Parents can't feed them all, so they exert a choice," says Bruce Lyon of the University of Calgary, who directed the study. Lyon and his colleagues believe that parental choice may have influenced the evolution of the chicks' unusual coloration. "Over time," says Lyon, "it paid to be bright."

National Geographic, April 1995

For a brochure call 1-800-950-2438.

Even in the caring, sharing '90s, you can still use a little personal space.

After all the time you've spent raising your sensitivity to the needs of others, you could probably use some time for yourself. Fortunately, the all new Monte Carlo is here. It's a very personal space, designed for a very personal fit. It's a place where the only relationship that matters is the one between your driving instincts and a car engineered to follow them unerringly. Where you can relax undisturbed in the comfort of an ergonomically designed driver's seat, within an impeccably designed cabin. Of course, you could decide to share all this with someone special. But that's completely up to you.

The New Monte Carlo

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Geographica

STEVE BRIMMER

Rare Cranes Are Taking To the Mails

Two endangered cranes are now flying around the world—on postage stamps issued by the United States and China last October 9, World Post Day.

The whooping crane of North America and Asia's black-necked crane appear on the first joint stamp issue of the two nations. Chinese artist Zhan Gengxi painted the birds for stamps designed by Clarence Lee, a Chinese American.

"We decided to feature cranes because they symbolize peace and friendship in China, and we both have endangered crane species," says Terry McCaffrey of the U. S. Postal Service.

After a half century of conservation efforts in North America, whooping cranes have risen from a low of about 20 birds to 260 or so. Perhaps 6,000 black-necked cranes remain, most on the Tibetan Plateau, where changing agricultural practices are reducing the available amount of barley, the birds' favored grain, says George Archibald of the International Crane Foundation (GEOGRAPHIC, May 1994).

Stumps Tell a Tale of Long, Severe Drought

Californians who felt relief when a six-year drought ended in 1993 may have new reason to worry.

State planners, who rely on runoff from the Sierra Nevada for much of the water they send south, have traditionally based their worst-case scenario on a drought of seven years—the longest in 140 years of recorded measurements. But new evidence shows that at least twice in the distant past so little snow fell in the Sierra that droughts lasting several decades resulted. Lakes, rivers, and swamps dried up, and trees took root in the dry beds, growing to great heights before precipitation finally returned.

In the West Walker River (below), stumps of long-dead pines provide clues to past climate. Geographer Scott Stine of California State University at Hayward carbon-dated the outermost wood of such trees from the eastern and western slopes of the Sierra. Then he counted rings to see how long the trees had lived. All dated from one of two periods: 892 to 1112, or 1209 to 1350. "I get the same message from all these trees: Early droughts were more severe and prolonged than anything we've seen recently," says Stine, who urges state planners to prepare for dry spells lasting far beyond seven years.

Though those earlier droughts were unusually long, the past century has been abnormal too. Despite having two harsh droughts, it has been among the wettest in 4,000 years, Stine says.

Prehistoric King of the Seas—in Motion

More than 500 million years ago a marine creature up to six feet long with grasping claws cruised for prey, outmatching every other living thing. But just how it cruised remains a question for experts studying the dizzying variety of animal life that evolved during the Cambrian explosion (GEOGRAPHIC, October 1993).

Derek Briggs, of the University of Bristol in England, believes that *Anomalocaris* moved flaps, or "wings," in the wavelike fashion

NHK, DISCOVERY CHANNEL, TELE-IMAGE, ABS

of a squid or a manta ray. But a Chinese-Swedish team excavating fossils in China thinks that the creature could also swim like a bony fish, its body undulating, its tail providing steering and stability.

Briggs guided Japanese modelmakers in creating a battery-powered, remote-controlled model (above), two feet long, which was used in a television documentary.

SCOTT STINE

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THE BEST TIRES IN THE WORLD HAVE GOODYEAR WRITTEN ALL OVER THEM.

Tiny Loans a Big Boost to "Micro-entrepreneurs"

Until recently Raimundo Manuel Cortes, who lives outside Buenos Aires, Argentina, was a member of the working poor, with little hope of running a successful business of his own. Then a loan of $500 enabled him to purchase large supplies of wicker and turn his basketmaking operation into a growing enterprise.

The money came from Emprender, or "beginnings," a group affiliated with Massachusetts-based ACCION International, one of several dozen organizations encouraging micro-enterprises in the developing world. ACCION provides more than 200 million dollars a year in loans as low as $50, mostly in Latin America. Since 1991 ACCION has even made loans to needy U. S. entrepreneurs. In Bangladesh the Grameen Bank makes loans, averaging $100, largely to women, who start their own small businesses as weavers, peanut fryers, bookbinders, or vendors. Opportunity International, based in Illinois, oversees a global lending network that recently began helping East Europeans move toward capitalism.

"Micro-borrowers" scrupulously repay their loans, thus qualifying for larger ones. Business success has given Raimundo Cortes, working with his father, José (above), pride and a chance at a better life. And Cortes and his wife have been able to buy their first automobile.

DIEGO GOLDBERG, FOTOMA

The Stowaway Beetle That Ate Wall Street

When a New York securities firm found its vaults infested with creepy, crawly things, it called in an exterminator, who consulted Louis Sorkin, an entomologist at the American Museum of Natural History. Sorkin found, to his amazement, that the invader was a little-known North American beetle, *Micromalthus debilis*, which had arrived years earlier in the chestnut, oak, and other hardwood used to construct the vaults. It has since appeared in the vaults of jewelry stores, banks, and other businesses.

"The builders unwittingly used infested wood," Sorkin says. "The walls acted as incubators. It's dark and warm, and humidity is high—all conducive to beetle growth."

Though the rare insect was first identified in the 19th century, its presence in great numbers in New York permits Sorkin and his colleagues to make detailed studies. They found that its legs are attached to its body in a way that permits great range of motion and that males have an unusual glandlike structure that may produce a pheromone to attract females.

"We'd never have enough specimens if they didn't make vaults the way they did," he says.

RICHARD THOMPSON

Marsupial Fossil Hints At North American Origin

A tiny jaw from a mouse-size marsupial in the badlands of central Utah has added fuel to the debate over where the pouched mammals originated. The jaw was dug out of one-hundred-million-year-old siltstone, making

STEVEN FUMPHREY

this marsupial the oldest yet known anywhere. Richard Cifelli of the Oklahoma Museum of Natural History named it *Kokopellia juddi* for the flute-playing prankster of the ancient Anasazi and for a local naturalist, Jon Judd.

"The period about a hundred million years ago is terra incognita," says Cifelli, whose work is supported by the National Geographic Society. "Now we know marsupials, or something like them, lived then in North America; today only the opossum survives." Some experts place the homeland of marsupials—their ranks include kangaroos, koalas, and wombats—in South America, Australia, or even Asia.

—Boris Weintraub

National Geographic, April 1995

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The 1995 Chevrolet Lumina Minivan.

In a world where most of us feel robbed of security, at least you can take comfort knowing one thing out there offers more peace of mind than ever before. The Lumina Minivan. Not only does Lumina give you a driver's-side air bag and anti-lock brakes standard, it offers you an available traction control system. This feature automatically controls wheel spin. So as weather and road conditions change, the confidence you have in your handling of them doesn't. Lumina also has convenient built-in child seats available. So that's one less thing you have to worry about. But perhaps the best thing about this security system is that you don't have to remember a special access code to gain entry. All you have to remember is to see your Chevrolet dealer. Lumina. It looks different because it is different.

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TOM SEAVER

Gardener, Baseball Hall-of-Famer

Gardening is an important part of my life. I'm often out in my garden by seven.

I love the smell in the air, the early morning light.

My wife Nancy gave me a bronze plaque.

It says "He who plants a garden plants happiness." That's the way I feel.

I use Miracle-Gro to make everything in my garden look its best.

I learned that secret back when I was a rookie gardener.

Tom Seaver

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Today, she's going home with the game ball.

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Forum

Animals at Play

Among the GEOGRAPHIC's achievements over the years has been its dispassionate presentation of the natural world, a point I recalled as I read the stricture levied against "Lions of Darkness" in the December 1994 Forum, only a few pages before the delightful photographs of "Animals at Play." I hope the magazine will not be influenced by the imposition of human prejudices on the natural world. Animals in the wild are fascinating and beautiful whether they volley old tires, tug each other's tails, or devour one another in the African night.

ADAM N. MCKEOWN
Arlington, Virginia

The article was amusing. However, it was also scary. You say that play is necessary for the physical and social development of young animals, including man. Today millions of children spend endless hours watching television and playing video games instead of playing with one another. How are they going to learn to deal with a world that is becoming more complicated all the time?

TED HOGG
Aurora, Illinois

Stuart L. Brown's observations support the importance of social activities. He cites the childhood experience of Charles Whitman, who went on a shooting spree in Austin. But a postmortem showed Whitman had a brain tumor. Neurosurgeon Vernon Mark suggests that the violent activity exhibited by Whitman may have been related to the tumor.

PATRICK SULLIVAN
Yardley, Pennsylvania

Whitman did have a small brain tumor, but the panel of experts assembled by Texas governor John Connally could not establish a clear relationship between the tumor and Whitman's actions.

I have both a B.S. and an M.S. in recreation and park administration, and I'll never forget the professor who in an Introduction to Recreation course told us the capacity to play was one of the things separating man from the lower animals. Through years of watching wildlife in action, I have come to realize that he had never spent any time in the wild observing animals. I hope he reads the article.

STEVE WESTON
Little Rock, Arkansas

A stream runs through our neighborhood, fed by a lake spillway and a storm sewer. When the rains come, narrow banks behind our neighbor's lot create a whitewater stretch that attracts mallards from the local lake. The males enter just below the sewer outlet and ride the fast waters for about a hundred feet. Where the stream widens and the action slows, the thrill seekers walk or fly back to the head and ride again. The females sit on the bank and appear to watch with limited interest.

JEAN KIEFFER
Mason, Ohio

As a dog-behavior counselor, I know play is vital for proper development in dogs: Games of keep away, chase, and tug-of-war not only develop physical abilities but also help the animals attain social status by establishing superior mental and physical skills. Furthermore, play, while it often mimics aggression, is one form of defense used to diffuse potential confrontations. In 1963 Konrad Lorenz published *On Aggression* and suggested, as does Stuart Brown, that ritualized play in humans, namely sports, serves an identical purpose. I see a large number of problem dogs whose behavior clearly developed through either improper games or lack of games.

PHYLLIS DELVIN
Richland, Washington

America's Poet: Walt Whitman

How wonderful, giving space to Walt Whitman—not only America's greatest poet but also a liberating poetic force worldwide. How sad it seemed that author Joel Swerdlow openly confessed his lack of understanding of Whitman's poems. Then I saw the justice; Mr. Swerdlow is precisely one of the people Walt was writing for.

HARALD WYNDHAM
Pocatello, Idaho

Twenty years ago *Cosmic Consciousness*, by Richard Maurice Bucke, introduced me to the interior adventure of Walt Whitman. Bucke also wrote a biography of his friend. I finally found a copy; the aged, leatherbound book arrived yesterday along with the December GEOGRAPHIC. Bucke's book tells about the poet in the words of people who knew him personally. I was equally thrilled to see your touching portrayal. NATIONAL GEOGRAPHIC has discovered the geography of the soul.

MICHAEL SHYNE
Alamogordo, New Mexico

I vividly recall asking my grandmother's cousin, Mary White, who lived not far from Whitman in Camden, New Jersey, what her impressions of the old man were. She replied that she often saw him shuffling along the street in such disarray that "one wanted to thrust a nickel into his palm." Ironically his impressive tomb is in probably the nicest part of Camden, hardly America's most seductive city.

ROBERT H. NEWALL
Hampden, Maine

FOR A BRIEF MOMENT, WE'D LIKE TO LET FORD WINDSTAR REST ON ITS LAURELS.

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AUTOMOBILE MAGAZINE

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While the experts are busy giving us high praise, we're busy raising the standard even higher, offering new features for '95. Further proof that the future belongs to Windstar.

*Of leading minivans.

Ford

THE NEW WINDSTAR

For years I tried to read Whitman with no success. Reading your article, I was reminded that when Zen masters were asked to describe their experience of enlightenment, they would answer with something like "chopping wood and carrying water from the well," meaning that bliss is found in very ordinary things. Then it dawned on me that Whitman was speaking Zen. Now I understand and appreciate.

EDWARD C. STELLA
Seattle, Washington

This fine essay should send many of us to our library shelves to reencounter one of the greatest of our voices. We who are choral musicians are able to deliver Whitman's verse in excelsis through performances of Ralph Vaughan Williams's *A Sea Symphony*, which uses a number of the sea poems, and *Dona Nobis Pacem*, uniting some of the Civil War verses with profoundly moving music.

JUDITH A. BERNDT
Milwaukee Symphony Chorus
Bayside, Wisconsin

I feel I have discovered something wonderful that has been right under my nose all along. I'm not much of a reader, so putting the few but enticing words on beautiful photographs drew me in to find poetry written in "plain English."

DOROTHY HAGE
Thousand Oaks, California

Canada's Railroad

Canada is at a crossroads, our future in question. In this time of need for leadership and understanding, your dramatic account of this country's steel spine provided a subtle reminder of the importance of those qualities that so pervaded the efforts of our founders. Although our national identity has always been elusive, I fear that more than a railroad will be necessary to hold together what dreams forged so long ago. But then again, the dream does run deep, and far, and wide.

CHRISTOPHER MCLAUGHLIN
Guelph, Ontario

As a rail buff and reader of three rail magazines, may I say that writer Michael Parfit did a great job. Made me feel as if I were in the engine of that train with him.

RICHARD A. STROM
Richton Park, Illinois

To complete the Canadian Pacific, the Canadian government under Prime Minister Sir John A. MacDonald brought in thousands of Chinese laborers from Guangdong Province. The Chinese worked on the most hazardous sections of the line, namely up the Fraser River Canyon in British Columbia and through the Rocky Mountains. Hundreds of Chinese bodies littered these stretches. When recruited, the Chinese were given the understanding that their return passage would be paid. However, the authorities reneged; they were cut loose and left to fend for themselves in a foreign and hostile land. There were no safety nets in those days. The Chinese not only endured, they overcame all handicaps and flourished.

RICHARD A. MAH
Nanaimo, British Columbia

Wreck of the *Alabama*

Max Guérout's article on the Confederate steamship makes no mention of Comdr. James Dunwoody Bulloch, CSN, without whom there would have been no *Alabama*. Serving as Confederate naval agent in England, Bulloch contracted for the ship's construction, provided its basic design, procured its crew and armament, and managed its escape from England before turning command over to Captain Semmes. Bulloch was anticipating command himself, but Confederate Navy Secretary Stephen Mallory considered Bulloch's work indispensable, and he was ordered to remain in England, securing ships for the Confederacy.

NORMAN C. DELANEY
Corpus Christi, Texas

In the south wall of Easton Royal Church in Wiltshire, England, is a marble tablet to the memory of Dr. David Herbert Llewellyn, the acting surgeon of the *Alabama*. A stained-glass memorial in the east window provides a reminder of the sacrifice of the 26-year-old physician. He assisted the wounded into the only undamaged boats and refused to join them for fear of causing a capsizing. He took his chances in the cold waters of the Channel, telling no one he could not swim.

GREGG S. CLEMMER
Germantown, Maryland

The visit of the C.S.S. *Alabama* to the Cape of Good Hope in 1863 is echoed in a traditional South African song, "Daar kom die *Alibama*" ("There comes the *Alabama*"), which is often learned by Afrikaner children at their mother's knee.

JOHANN HAHN
Yorkton, Saskatchewan

Geographica

The report on anticancer drugs from the sea quotes George R. Pettit of Arizona State University as having never seen an invertebrate with cancer. The Registry of Tumors in Lower Animals at the National Museum of Natural History has more than 300 documented cases of malignant tumors in invertebrates. One population of hardshell clams, *Mercenaria* sp., has a 68 percent incidence of ovarian cancer in the females, one of the highest occurrences in any animal population. Investigations continue, to determine the causes.

NORMAN J. BLAKE
University of South Florida
St. Petersburg, Florida

Letters for FORUM should be sent to National Geographic Magazine, Box 37448, Washington, D. C. 20013-7448, or by fax to 202-828-5460, or via the America Online computer network to ngsforum@aol.com. Include full name, address, and daytime telephone. Letters selected may be edited for clarity and space.

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Earth's largest land carnivore has a choice of weapons: jaws, claws — and sheer size.

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THE SAVAGE PACK.
The art of the ambush. The chase and the kill. It's teamwork with a deadly purpose as wild dogs hunt their prey.

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Sokoke Scops Owl *(Otus ireneae)* **Size:** Length, 17 cm. **Weight:** Approx. 50g **Habitat:** Lowland forest in coastal Kenya and northern Tanzania **Surviving number:** Estimated at 1,000 pairs. Photographed by Stan Koo

WILDLIFE AS CANON SEES IT

Marking the first time a juvenile Sokoke scops owl has ever been seen, a tiny owl sits with its parents safely hidden amid tangled thickets. The adults, in color phases of rufous and gray, hunt leaf-eating insects at nightfall. In Kenya's Arabuko-Sokoke Forest, the scops owl and numerous rare and endemic birds exist in what ornithologists consider to be one of Africa's most valuable forest habitats. To save endangered species, it is vital to protect their habitats and understand the role of each species within the earth's ecosystems. As a global corporation committed to social and environmental concerns, we hope to foster a greater awareness of our common obligation to ensure that the earth's life-sustaining ecology survives intact for future generations.

NATIONAL GEOGRAPHIC MAGAZINE

PRIME SEATS ARE STILL AVAILABLE FOR THE SPORTING EVENT OF THE YEAR.

INTRODUCING THE NEW FORD TAURUS SE

It's the Taurus with a decidedly sporty edge. Taurus SE's cast aluminum wheels, new clear lens headlamps and available spoiler make a serious statement of style.

Inside, the SE has a long list of driver-friendly touches. Even air conditioning comes standard. And, of course, Taurus SE also gives you the added safety of standard dual air bags* and available anti-lock brakes.

But the SE's news doesn't end there. There's a refined powertrain that delivers an especially smooth performance from the computer-controlled V-6 engine. And when it comes to value, Taurus performs equally as well, as a better value than its leading competition.**

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Help is only a toll-free call away if you or your family should have a flat tire, get locked out or run out of gas.

The new Taurus SE. Sit back, relax and enjoy the sporting event of the season.

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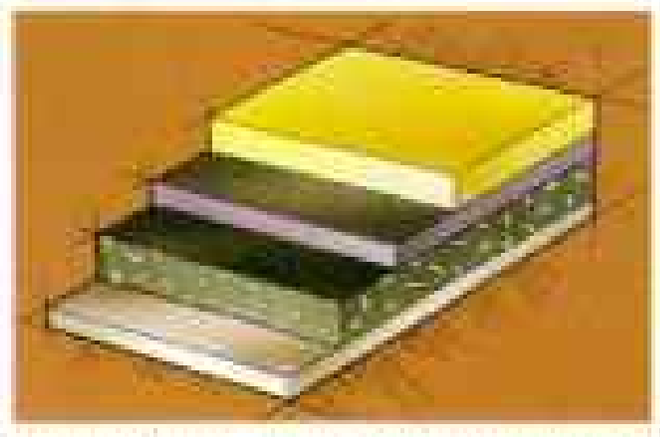

Sound-dampening asphalt and steel sheets are sandwiched together to help minimize vibration and noise.

Today, Corolla is busy making NEW promises. With TECHNOLOGICAL systems that range from ADVANCED safety features to sound-dampening materials that REDUCE interior noise levels to a quiet hush.

The 1995 Toyota Corolla. It's the promise of something new, backed up by a HERITAGE of promises kept.

And RECOGNIZED around the world as the BENCHMARK of QUALITY.

*Both driver and front-passenger air bags are standard.**

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*To help avoid serious injury, always wear your seatbelt. Driver and front-passenger air bags are a supplemental restraint only.

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Heavy Isn't Healthy.

Excess weight can be associated with certain health conditions

You can help your dog lose weight with Purina® Fit & Trim®. It's specially formulated with 15% fewer calories, 33% less fat and 33% less sodium than the leading dry dog food.

Plus, the extra fiber may help keep your dog from feeling hungry while he's trimming down. And dogs will think Purina Fit & Trim tastes great, too.

To give your dog the Purina Fit & Trim Rib Check, put your thumbs on his backbone and both hands on his rib cage. If you can't easily feel his ribs, your dog probably needs to shed a few pounds.

And remember, for the health of your dog, please visit your veterinarian regularly.

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On Television

LÜ ZHI

In the Bamboo Forest With Wild Pandas

Fourteen months old and still growing strong, a panda cub (left) thrives on bamboo leaves and shoots in the Qin Ling mountains of central China. Observed from the time she was just days old, when she weighed only four ounces, Xi Wang, meaning Hope, stars in a new National Geographic Special. "Secrets of the Wild Panda" provides a rare look at panda behavior in the animals' own environment.

Two Chinese scientists, Pan Wenshi and Lü Zhi, have closely studied the giant pandas of the Qin Ling for a decade. Their pioneering work has revealed that a panda mother will stay with her cub, never eating, for as long as 25 days after it is born. Then she may leave her young for hours while she feeds to regain strength. This natural behavior, when observed previously, was thought to be abandonment.

Perhaps 1,200 giant pandas remain in all of China, where they are threatened by logging, poaching, and genetic isolation. Pan Wenshi and Lü Zhi race against the clock to learn more about these elusive animals. Why, they wonder, do panda young, so fragile in captivity, thrive in the wild?

"Secrets of the Wild Panda," Special on NBC, March 29, 8 p.m. ET.

Crossing Continents in a Time Machine

"Vimy 1, cleared to land," radioed the control tower. "Welcome back to Darwin after all these years."

With those words, the dream of Peter McMillan, an American, and Lang Kidby, an Australian, was won: to re-create a 1919 flight from England to Australia that showed the feasibility of round-the-world air travel. Their journey is chronicled in EXPLORER's "The Greatest Flight" (and in next month's GEOGRAPHIC).

BOSS SMITH (LEFT); JAMES L. STANFIELD

Resurrecting original blueprints, McMillan and Kidby built a World War I-era Vickers Vimy biplane bomber (above) with open cockpit and cotton-covered wings, fitting it with modern engines and navigation gear. McMillan describes the joy of cruising over the Taj Mahal at a stately 75 miles an hour and the terror of a crash landing in Sumatra.

Rough landings also challenged the original crew (left). "The Greatest Flight" interweaves the stories of the 1919 and 1994 adventures, separated by 75 years but united in a common spirit of daring.

"The Greatest Flight" airs April 30 at 9 p.m. ET on EXPLORER, TBS Superstation.

"We've got three trucks and we're never had

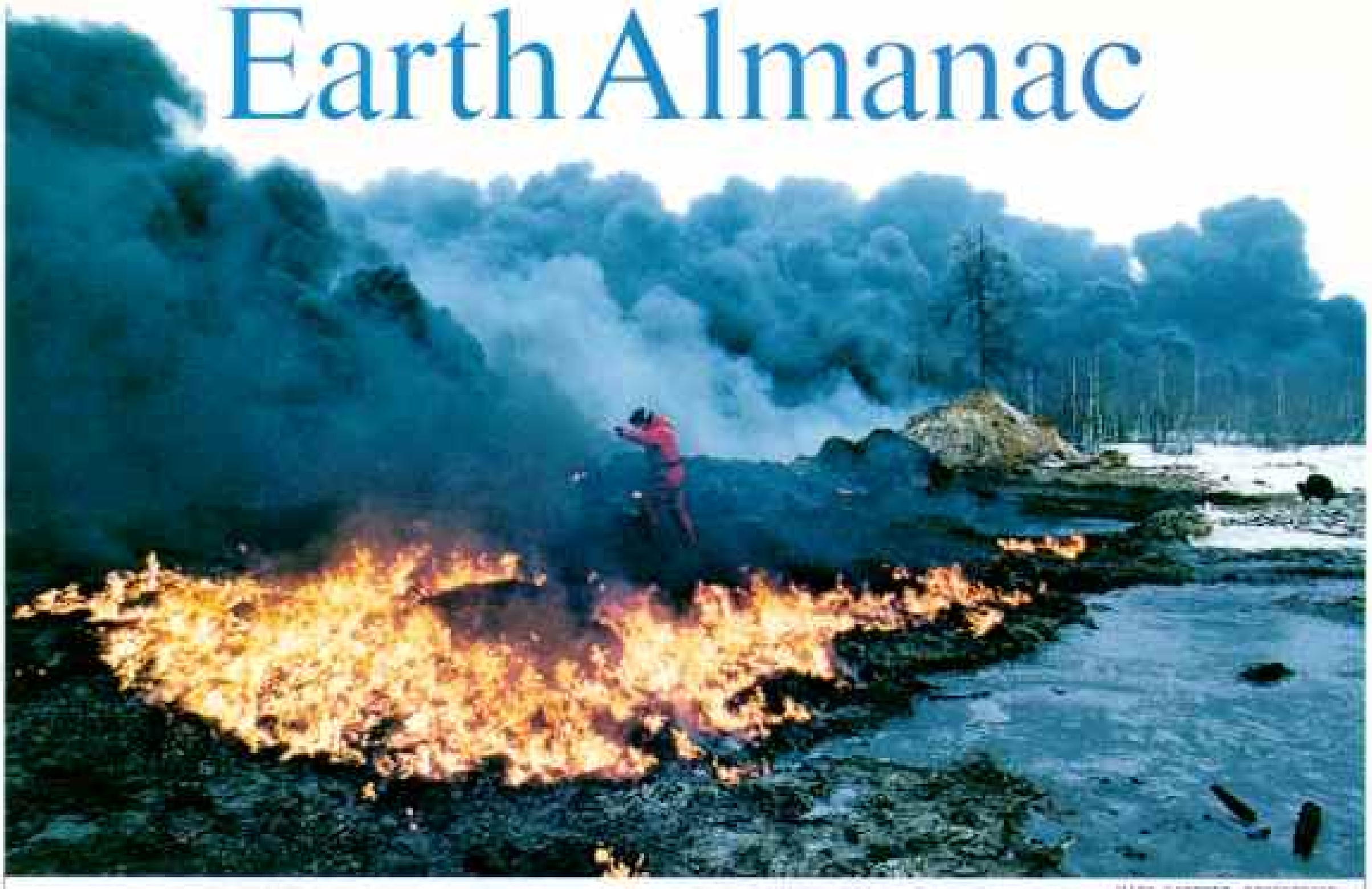
People and nature can live in harmony, according to John Sawhill, President of The Nature Conservancy. For instance, bison at the Conservancy's Tallgrass Prairie Preserve in Oklahoma share miles of pristine grassland with tourists and scientists. To protect and preserve the land, The Nature Conservancy gets corporations, landowners and private

and 300 bison,

a single traffic jam.

citizens to work together to help. The goal: safeguarding the environment without destroying jobs or businesses. That's a goal General Motors shares. So we're supplying funds, talent and even the GMC Trucks used to maintain Tallgrass. John says, "The Conservancy gets results you can walk around on." And the results are truly spectacular.

Earth Almanac



MARK HARMEL, GREENPEACE

Will Russian Spring Bring a Tide of Spilled Oil?

Twenty years old, corroded and leaking like a sieve, a 26-inch pipeline from the Russian Arctic to a refinery near Usinsk has released a torrent of oil since last summer. The spill may have reached 25 million gallons—more than twice that of the *Exxon Valdez* disaster—according to United Nations observers and Russian authorities. Officials in the area had originally put the spill at four million gallons.

Greenpeace biologist Paul Horsman (above) examined part of the problem in November—a burning lake of oil. It came from a leak near a bypass built during repairs of an earlier leak. To get rid of the oil, workers simply set it afire, releasing harmful gases. "They're also using homemade booms—logs, rope, and wire—and primitive skimmers on rivers," says Horsman. "But working conditions are horrendous—minus 40°F." At that temperature oil becomes nearly solid and easier to contain. But even if workers can brave the cold, equipment freezes.

Now, during spring thaw, melting ice and oil will flow into the Pechora River and its tributaries, threatening waterfowl arriving to nest. "Any equipment the Russians try to use will be crushed by moving ice," says Glen Doughty of Alaska Clean Seas, an oil-spill cleanup firm. Despite the threat of more accidents, the Russians continue to operate the pipeline, since its oil, mostly for export, brings hard currency.

Another Rare Bird of the Old-Growth Forest

A seabird that nests in the forest is a rarity. Numbering 160,000 to 300,000, marbled murrelets are considered threatened in both Canada and the U. S. outside Alaska. Their need for protection adds to concerns about logging of old-growth forests. Like the northern spotted owl, the murrelet nests in ancient trees such as coast redwoods, Douglas fir, or Sitka spruce from central California to Alaska.

"The murrelets are so secretive that only 65 nests have been discovered," says Oregon State University biologist Kim Nelson. Most simply lay their eggs on thick moss growing on large limbs—like this murrelet in California—and return to the same area each year. Two years ago environmentalists filed suit against a California logging firm that was allegedly destroying murrelet habitat; a decision is pending. On Vancouver Island murrelet nests were found amid a logging operation near Clayoquot Sound, helping persuade the government to set aside land for the birds.

JAMES P. BLAIR

National Geographic, April 1995

If your doctor says you've got symptomatic benign prostate enlargement, help can be in the palm of your hand.

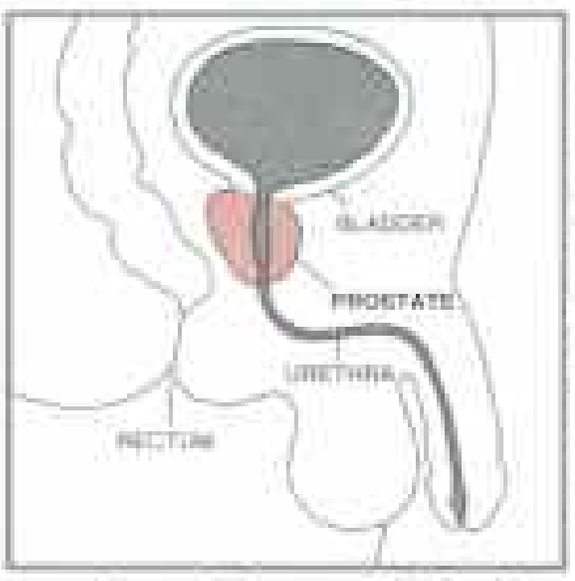
Many men mistakenly believe that an enlarged prostate is treated the same way for all men. But today there are more options than ever. By speaking frankly about your symptoms, you and your doctor can decide what is appropriate for you.

Is this you?	Yes	No
Do you get up more than once or twice a night to urinate?	☐	☐
Do you often have sudden, uncontrollable urges to urinate?	☐	☐
Do you have a hesitant or slow urine stream?	☐	☐
Do you have a frequent need to urinate?	☐	☐

If you answered yes to even one question, tell your doctor. Your symptoms may be caused by a condition called benign prostate enlargement (BPH). But remember, only a doctor can evaluate your symptoms and their possible causes. *While BPH is not cancer and does not lead to cancer, the two conditions can exist at the same time.*

Symptomatic BPH can be treated in several ways. In addition to surgery and monitoring the condition with regular checkups, now your doctor has oral prescription medicines. One oral medicine is PROSCAR, the only medicine for the treatment of symptomatic BPH that can shrink the prostate.

PROSCAR works by blocking a hormone that can cause the prostate to enlarge. *But it is important to know: PROSCAR doesn't work for everyone. Although the prostate may shrink, there may not be an improvement in urinary symptoms. However, in clinical studies with PROSCAR, some men have seen an improvement in their urinary symptoms after 2 weeks. Others have found that PROSCAR took up to several months to help them.* Because all men are different, you and your doctor will need to determine how PROSCAR is working for you.



The prostate surrounds part of the urethra, the tube that carries urine from the bladder. As the prostate enlarges, it can squeeze the urethra and cause urinary problems.

Today you don't have to live with the discomfort of symptomatic BPH. Ask your family doctor or a urologist if PROSCAR is right for you. **For free information that will help you discuss your symptoms with your doctor, call 1-800-770-4825.**

For the treatment of symptomatic BPH

PROSCAR® 5mg
(FINASTERIDE)

The only medicine that can shrink the prostate.

MERCK

Please see the patient information on the next page.

PATIENT INFORMATION ABOUT PROSCAR® (Pra-ha-car)
Generic name: finasteride (fin-AS-tur-eyed)

PROSCAR is for the treatment of symptomatic benign prostatic hyperplasia and for use by men only.
Your doctor may prescribe PROSCAR if you have a medical condition called benign prostatic hyperplasia or BPH. This occurs only in men.

Please read this information, as well as the leaflet which accompanies your medication, before you start taking PROSCAR. Also, read the leaflet each time you renew your prescription, just in case anything has changed. Remember, this leaflet does not take the place of careful discussions with your doctor. You and your doctor should discuss PROSCAR when you start taking your medication and at regular checkups.

What is BPH?
BPH is an enlargement of the prostate gland. After age 50, most men develop enlarged prostates. The prostate is located below the bladder. As the prostate enlarges, it may slowly restrict the flow of urine. This can lead to symptoms such as:

- a weak or interrupted urinary stream
- a feeling that you cannot empty your bladder completely
- a feeling of delay or hesitation when you start to urinate
- a need to urinate often, especially at night
- a feeling that you must urinate right away

Treatment options for BPH
There are three main treatment options for BPH:

- **Program of monitoring or "Watchful Waiting".** If a man has an enlarged prostate gland and no symptoms or if his symptoms do not bother him, he and his doctor may decide on a program of monitoring which would include regular checkups, instead of medication or surgery.
- **Medication.** Your doctor may prescribe PROSCAR for BPH. See **"What PROSCAR does"** below.
- **Surgery.** Some patients may need surgery. Your doctor can describe several different surgical procedures for BPH. Which procedure is best depends on your symptoms and medical condition.

What PROSCAR does
PROSCAR lowers levels of a key hormone called DHT (dihydrotestosterone), which is a major cause of prostate growth. Lowering DHT leads to shrinkage of the enlarged prostate gland in most men. This can lead to gradual improvement in urine flow and symptoms over the next several months. However, since each case of BPH is different, you should know that:

- Even though the prostate shrinks, you may NOT see an improvement in urine flow or symptoms.
- You may need to take PROSCAR for six (6) months or more to see whether it helps you.
- Even though you take PROSCAR and it may help you, it is not known whether PROSCAR reduces the need for surgery.

What you need to know while taking PROSCAR

- **You must see your doctor regularly.** While taking PROSCAR, you must have regular checkups. Follow your doctor's advice about when to have these checkups.
- **About side effects.** Like all prescription drugs, PROSCAR may cause side effects. Side effects due to PROSCAR may include impotence (or inability to have an erection) and less desire for sex. Each of these side effects occurred in less than 4% of patients in clinical studies. In some cases side effects went away while the patient continued to take PROSCAR.

  Some men taking PROSCAR may have a decrease in the amount of semen released during sex. This decrease does not appear to interfere with normal sexual function. Rarely, some men have reported breast swelling and/or tenderness or allergic reactions such as lip swelling and rash.

You should discuss side effects with your doctor before taking PROSCAR® (Finasteride) and anytime you think you are having a side effect.

- **Checking for prostate cancer.** Your doctor has prescribed PROSCAR for symptomatic BPH and not for cancer—but a man can have BPH and prostate cancer at the same time. Doctors usually recommend that men be checked for prostate cancer once a year when they turn 50 (or 40 if a family member has had prostate cancer). These checks should continue while you take PROSCAR. PROSCAR is not a treatment for prostate cancer.
- **About prostate specific antigen (PSA).** Your doctor may have done a blood test called PSA. PROSCAR can alter PSA values. For more information, talk to your doctor.
- **A warning about PROSCAR and pregnancy.**

  PROSCAR is for use by MEN only.

  PROSCAR is generally well tolerated in men. However, women who are pregnant, or women who could become pregnant, should avoid the active ingredient in PROSCAR.

  If the active ingredient is absorbed by a woman who is pregnant with a male baby, it may cause the male baby to be born with abnormalities of the sex organs. Therefore, any woman who is pregnant or who could become pregnant must not come into direct contact with the active ingredient in PROSCAR.

Two of the ways in which a woman might absorb the active ingredient in PROSCAR are:

Sexual contact. Your semen may contain a small amount of the active ingredient of the drug. If your partner is pregnant, or if you and your partner decide to have a baby, you must stop taking PROSCAR and talk to your doctor. If your partner could become pregnant, proper use of a condom can reduce the risk of exposing her to your semen (discuss this further with your doctor).

Handling broken tablets. Women who are pregnant or who could become pregnant must not handle broken tablets of PROSCAR. PROSCAR tablets are coated to prevent contact with the active ingredient during normal handling. If this coating is broken, the tablets should not be handled by women who are pregnant or who could become pregnant.

If a woman who is pregnant comes into contact with the active ingredient in PROSCAR, a doctor should be consulted.

Remember, these warnings apply only if the woman exposed to PROSCAR is pregnant or could become pregnant.

How to take PROSCAR
Follow your doctor's advice about how to take PROSCAR. You must take it every day. You may take it with or between meals. To avoid forgetting to take PROSCAR, it may be helpful to take it the same time every day.

Do not share PROSCAR with anyone else; it was prescribed only for you.

Keep PROSCAR and all medicines out of the reach of children.

FOR MORE INFORMATION ABOUT PROSCAR AND BPH, TALK WITH YOUR DOCTOR. IN ADDITION, TALK TO YOUR PHARMACIST OR OTHER HEALTH CARE PROVIDER.

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Your contribution could make a world of difference.

Photo collage of winning photographs from the 1991 – 1992 competition.

Enter the UNEP International Photographic Competition on the Environment 1994-1995

— in the 50th anniversary year of the United Nations —

The United Nations Environment Programme invites you to submit photographs on the theme, "Focus on Your World". This is UNEP's second international photographic competition, made possible once again by the support of Canon Inc. The competition seeks to draw attention to global environmental problems and includes a new category for photographs by children.

The prizes will be awarded in New York in October 1995 to coincide with the 50th anniversary of the United Nations. Winning photographs will be exhibited internationally, and the most suitable entries will also be preserved in a photographic library administered by UNEP on behalf of the United Nations.

Send us your photographs. Show us you care about the Earth.

ENTRY PERIOD

From September 21, 1994 through April 30, 1995.

PRIZES TO BE AWARDED

1. **Professional Division:**
   Gold Prize (one entrant): diploma, US$20,000
   Silver Prize (one entrant): diploma, US$10,000
   Bronze Prize (three entrants): diploma, US$5,000
   Honorary Mention (twenty entrants): diploma
2. **Amateur Division:**
   Gold Prize (one entrant): diploma, US$10,000
   Silver Prize (one entrant): diploma, US$5,000
   Bronze Prize (three entrants): diploma, US$2,000
   Honorary Mention (fifty entrants): diploma
3. **Children's Division:**
   Gold Prize (one entrant): diploma, US$1,000
   Silver Prize (one entrant): diploma, US$500
   Bronze Prize (three entrants): diploma, US$200
   Honorary Mention (twenty entrants): diploma
4. **The UNEP Executive Director's Special Prize**
5. **The Canon Special Prize**

Canon products will be presented as supplementary prizes to all the above prizewinners. Payment of subsequent taxation on prizes is not the organizers' responsibility.

AWARD CEREMONY

All winners will be announced at the award ceremony held in New York in October 1995. Gold Prize winners will be invited to attend the award ceremony at the organizers' expense. (The Children's Division Gold Prize winner will be accompanied by a parent or guardian.) Special Prize winners will also be invited.

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International Photographic Competition on the Environment 1994-1995

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For further details, call: 1-800-670-4321

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Navy Downsizes Its Dolphins

Since the 1960s the U. S. Navy has maintained an elite team of bottlenose dolphins for both research and hazardous duty such as locating mines underwater. Until recently about a hundred dolphins lived at Navy facilities in Hawaii and in San Diego, where trainer Lauryn Crosthwaite exercises one of her troops.

But Defense Department cuts have reached even the dolphin squad, and to save money, the Navy is looking for new homes for 25 to 30 animals. So far about 20 have been moved to aquariums and sanctuaries, including Sugarloaf Dolphin Sanctuary in the Florida Keys. Its director, Lloyd Good III, plans to apply for a permit to free his five Navy dolphins after extensive conditioning designed to help them survive in the wild—a controversial experiment.

Navy spokesman Tom LaPuzza cites many hurdles. The former captives must learn to catch their own fish and be accepted by a wild dolphin school. "Their reliance on humans will have to be completely broken," he notes. Another cause for concern: possible transmission of diseases between the released and wild dolphins.

SCOTT LINNETT, SAN DIEGO UNION-TRIBUNE

High, Wild Valley Named 500th Refuge

It all began in 1903 when Florida's three-and-a-half-acre Pelican Island became the first national wildlife refuge. The movement reached a milestone last October when the U. S. Fish and Wildlife Service dedicated the 500th refuge—a Canada-like slice of West Virginia called Canaan Valley.

From valley wetlands 3,200 feet above sea level to mountain ridges nearly 1,000 feet higher, plants and animals typical of more northern ecosystems thrive. Canaan Valley snows are pocked with snowshoe hare prints. "We have cotton grass, a plant more common in Canada and Alaska," says refuge manager Gail Baker.

The valley also sustains the threatened Cheat Mountain salamander and the endangered Virginia northern flying squirrel. The service hopes the refuge will grow from its current 155 acres to some 20,000 acres with purchases from willing sellers.

CHRISTOPHER WILLETTE, CHARLESTON GAZETTE

Pearls of the Sea: Defensive Gems

Round, lustrous objects growing on coral reefs often intrigue divers. They look like giant pearls, but they're really plants called sea pearls. Found throughout Caribbean waters to depths of nearly 300 feet, the globes of these green algae are single cells

CHARLENE HUGHES

that can exceed an inch in diameter—making them among the largest cells in the world.

Though not fit for a pirate's chest, sea pearls, *Ventricaria ventricosa*, have their own intrinsic value.

"They display remarkable regenerative qualities," says John W. La Claire II, a botanist at the University of Texas at Austin. If a pearl is punctured by a fish, it breaks into hundreds of tiny spheres that eventually grow into new sea pearls. "So the plant turns a wound into a means of asexual reproduction," he explains.

—JOHN L. ELLIOT

National Geographic, April 1995

In the time it takes to read this headline,

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On Assignment

"I do get a little anxious now in California parking garages," admits Senior Assistant Editor RICK GORE, who inspected this quake-toppled structure at California State University's Northridge campus while reporting for this issue. Rick arrived after the shock waves of the January 1994 temblor had subsided. "I actually kept hoping I'd experience at least an aftershock in Los Angeles, but I never did," he says. "I was in a small quake once in Indonesia. A big one is different. When I interviewed people who had been through the Northridge quake, the terror was still in their eyes and voices."

Rick grew up in Fort Lauderdale, Florida, the son of a newspaper editor. "As a boy, the last thing I wanted to be was a journalist," Rick says. "I started at Northwestern University in premed, then I fell in love with my English classes. I guess the need to write runs in my family."

ROGER H. RESSMEYER

A shooting gallery stocked with automatic weapons and live ammunition was not photographer KAREN KASMAUSKI's idea of fun during her Saigon assignment. But she looked down the sights after "shooting" (with her camera) the Cu Chi Tunnels, a former Vietcong stronghold. The army still controls the tunnels—as a tourist attraction—and charges a dollar a shot for a turn with an AK-47, surplus from the war. "Target practice is a big moneymaker," reports Karen. "Visitors can win Vietcong-style scarves or hats."

MARCIA KELVIE

Seeing the country for the first time was very emotional for Karen, whose father served in Saigon in 1972, when she was a teenager. "My dad, Steve Kasmauski, was a chief petty officer, and he ordinarily took pictures wherever he was stationed during his 35 years in the Navy. When I received this assignment and asked to see his old photos of Vietnam, he realized he'd never taken any. He told me, 'I guess I didn't want to remember.'"

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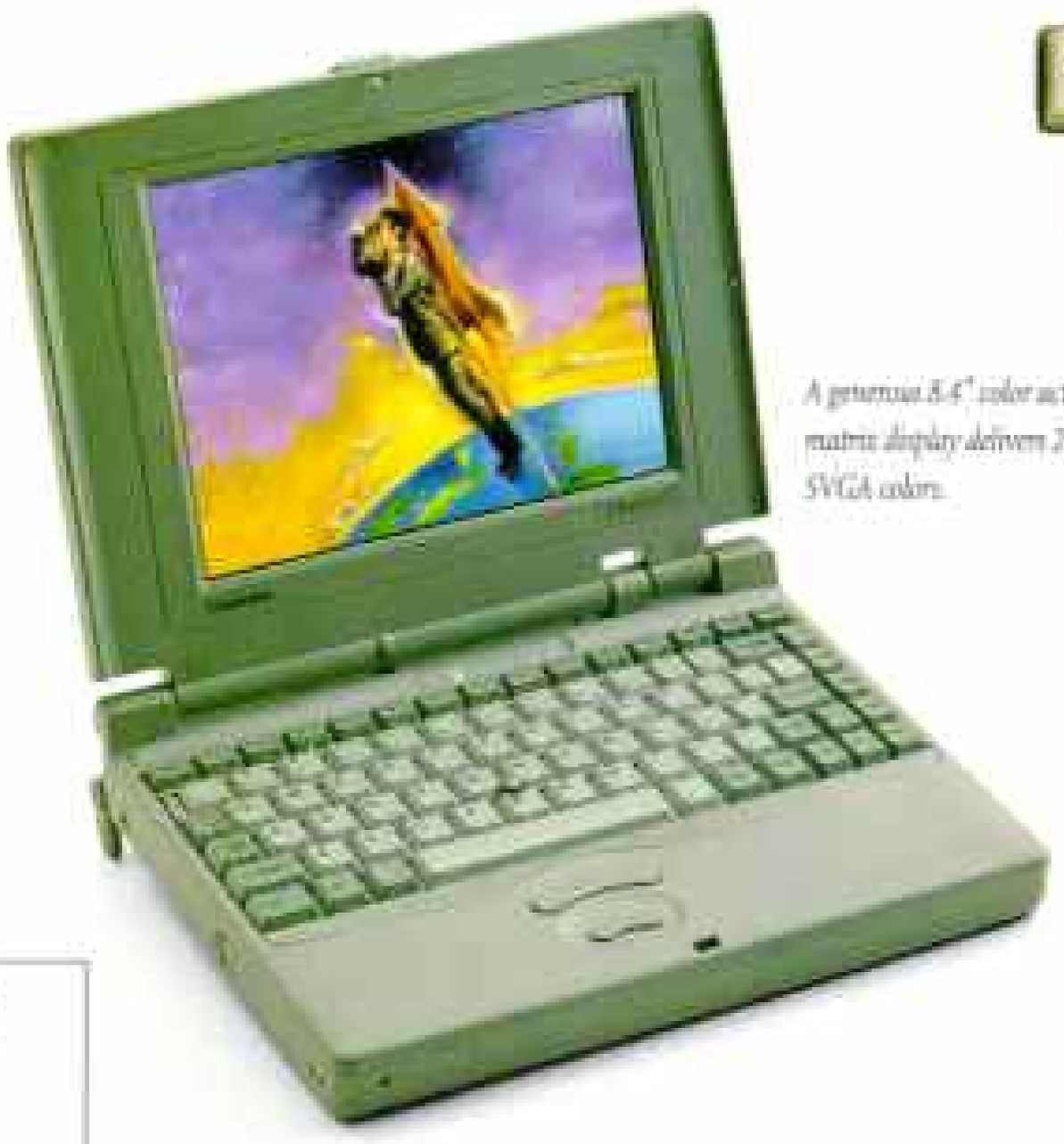

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