NATIONAL GEOGRAPHIC

From the Editor

IT SEEMS ALMOST CRIMINAL, a lot of people think, to rip anything out of a NATIONAL GEOGRAPHIC magazine. But I hope everybody will make an exception this month and detach the blue-and-red 3-D glasses inserted in the front of this issue.

It was an unprecedented publishing effort to include these glasses in all 9.5 million copies of this month's magazine, but I'm convinced they're the only way to do justice to our coverage of two remarkable feats of human adventure: the Mars Pathfinder probe and the R.M.S. *Titanic* exploration.

CLOCKWISE FROM LOWER LEFT: RANDY KIRK, BRUCE MCELFRESH (PARTLY OBSCURED), BARBARA MCCONNELL, BILL NAIR, BILL ALLEN, BY NATIONAL GEOGRAPHIC PHOTOGRAPHER MARK THIESSEN

For all the memories 3-D glasses conjure of campy Hollywood scare flicks, in this case the use of depth perception is no gimmick. Three-dimensional image technology was fundamental to the success of both these voyages of discovery.

In order to guide the rover called Sojourner among the rocks that studded the Pathfinder landing site, Jet Propulsion Laboratory scientists needed to know precisely how much space there was between them—information that could be provided only through a stereoscopic view.

Likewise, because *Titanic* is barely accessible, and then for only short periods of time, 3-D imagery enables experts who have never been able to board a minisub to study the wreck in greater detail.

And OK, I'll admit it. The 3-D Mars pictures were just plain thrilling when I sat down with several staffers to look at them in our layout room (above). With us was Randy Kirk of the U.S. Geological Survey, just one of the experts who helped gather, select, and process the images. Thanks to them and to our own *Titanic* team, we all can join in the excitement of exploration from 119 million miles in space to 12,500 feet beneath the North Atlantic.

Bill Allen

RETURN TO Mars

By WILLIAM R. NEWCOTT
NATIONAL GEOGRAPHIC SENIOR STAFF

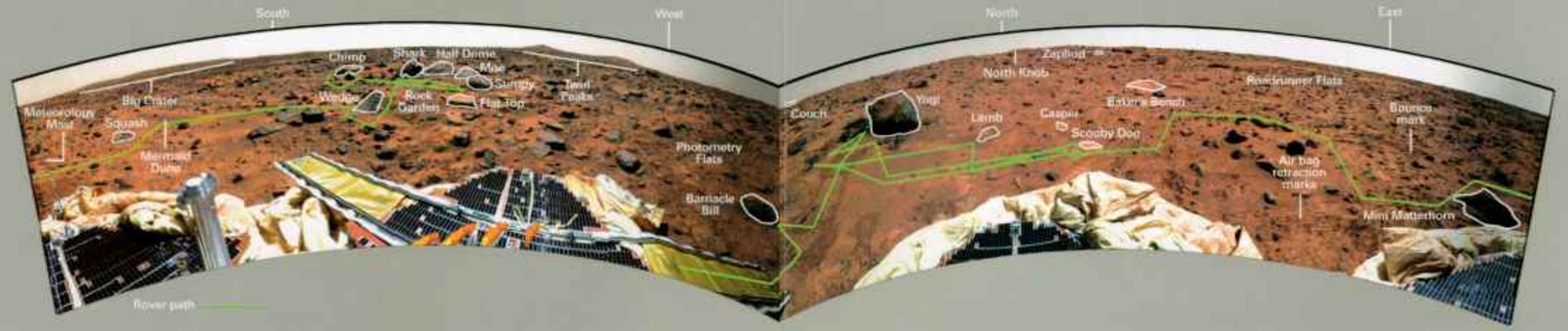
Images by NASA/
JET PROPULSION LABORATORY

Making tracks, the six-wheeled, 23-pound rover named Sojourner took its first tentative spin on planet Mars on July 5, 1997, one day after its mother ship, Mars Pathfinder, landed on a rocky plain in the planet's northern hemisphere. Seven months and 119 million miles from Earth, humankind's first Martian outpost in 21 years revealed a dusty, boulder-strewn world sculpted by wind and cataclysmic floods. For a Martian-eye view of the red planet, use the 3-D glasses found in the front of this issue to view stereo images taken by the lander's camera, indicated by the glasses icon.

Welcome to the red planet

"Well, we wanted rocks," says Pathfinder project scientist Matthew Golombek, "and we got rocks." If you were seated in a swivel chair with your head five feet above ground, this is the panorama that would unfold before you at the Ares Vallis landing site. The 360-degree image begins and ends in the middle of a solar panel that bears, at extreme left, a slim meteorology mast. The rover, which made the trip from Earth atop the second panel from the left, has been remotely driven down a ramp and has already begun the first ever analysis of rocks on another planet. Sojourner made the circular track nearest the lander while investigating a rock called Barnacle Bill. Visiting a rock called Yogi, the rover made a second circle, digging away soil as fine as flour and revealing a hard white material. Its composition appears to match that of Scooby Doo, a substance that the rover's spiked wheels could not scratch.

Rumpled under the panels are deflated air bags, which had ballooned into a protective cocoon around Pathfinder just ten seconds before its bouncing touchdown. To ensure ideal lighting for this panorama, one of four made by the lander's camera, the image was taken in segments over a three-day period. Reds have been made slightly redder and rocks more gray to enhance the contrast between rocks and soil. Its second day on Mars the lander was named the Carl Sagan Memorial Station for the late astronomer.



METEOROLOGY MAST Martian winds can reach a hundred miles an hour, but in nearly three months the breezes measured by Pathfinder's wind sensors never topped 20 miles an hour.

BIG CRATER Many of the dark, angular rocks near the lander may have been ejected when a meteorite crashed into Mars, creating this 4,900-foot-wide crater more than a mile away.

ROCK GARDEN Left in a catastrophic ancient flood, these rocks were a prime target for Sojourner.

BARNACLE BILL The first of eight rocks studied by Sojourner's alpha-proton x-ray spectrometer, Barnacle Bill is high in silicon, as is the continental crust of Earth.

YOGI About six feet away from Barnacle Bill, Yogi may be a similar type of rock but is covered with far more dust. Its perch and round shape suggest that a flood put it here.

SCOOBY DOO Like the material that Sojourner uncovered in front of Yogi, Scooby Doo appears to be composed of chemically cemented drift.

ROADRUNNER FLATS One of many dune structures visible from Pathfinder, but never visited by the rover, it is more reflective than any dune seen before on Mars.

MINI MATTERHORN The lander nearly toppled when its deflated air bags snagged on this boulder while retracting. Even if it had tipped, the lander was capable of righting itself.


Imager for Mars Pathfinder (IMP); a multifilter stereoscopic camera
Magnetic Properties Experiment (MPE)
Near-field magnetic target
Ramp
Low-gain antenna
High-gain antenna
MPE
MPE
Radar altimeter
Atmospheric Structure Instrument/ Meteorology mast
Solar panel
Retracted air bags

Distant hills

Just half a mile away and about 150 feet tall, the Twin Peaks west of Pathfinder were unreachable by the short-distance Sojourner. Nevertheless, the hills, as well as a nearby impact crater, were important signposts: Jet Propulsion Laboratory (JPL) geologist Tim Parker consulted decades-old images from the Viking 1 orbiter to triangulate

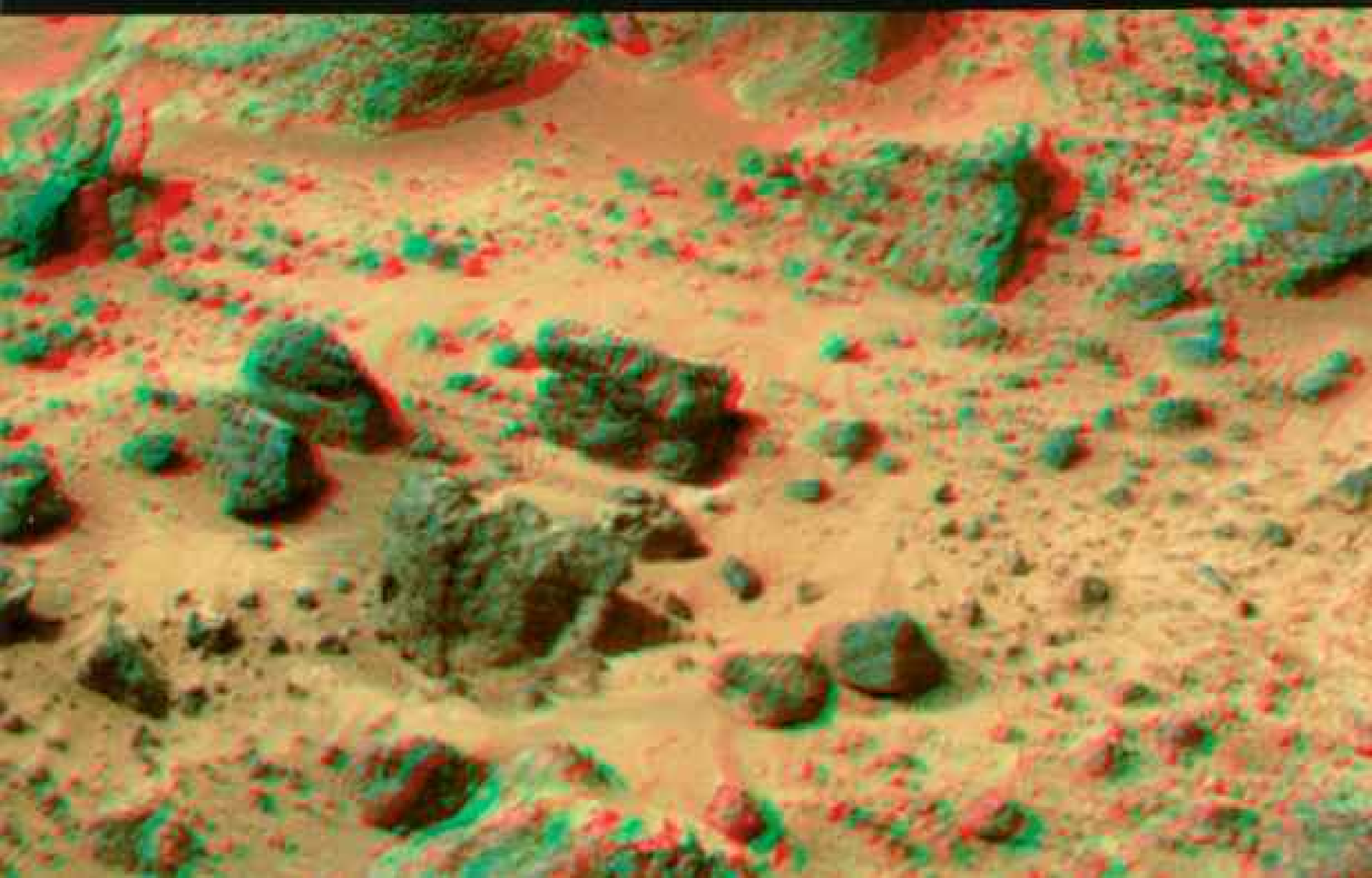


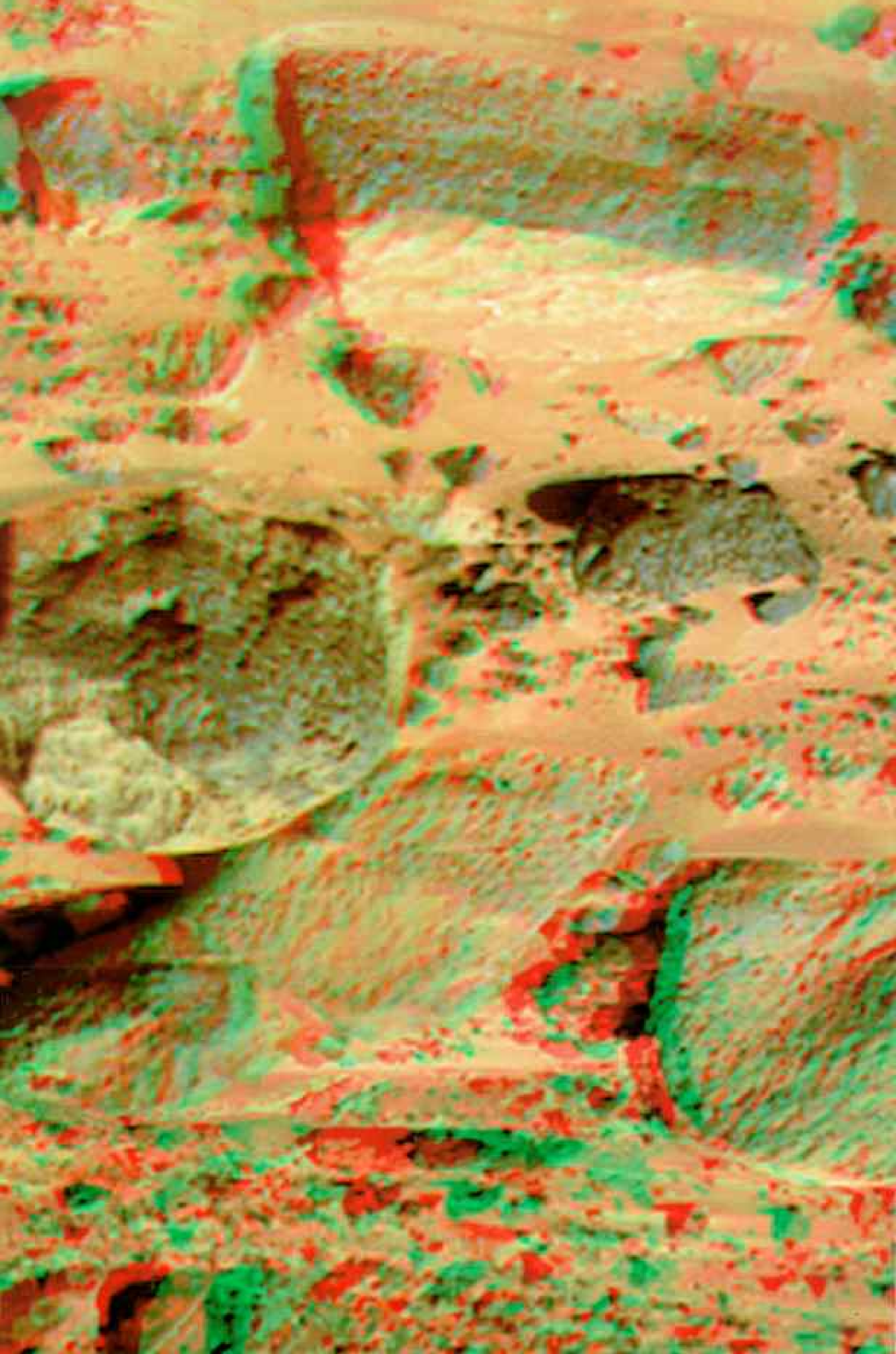
IMAGE PROCESSING BY TIM PARKER, JPL (BOTH)

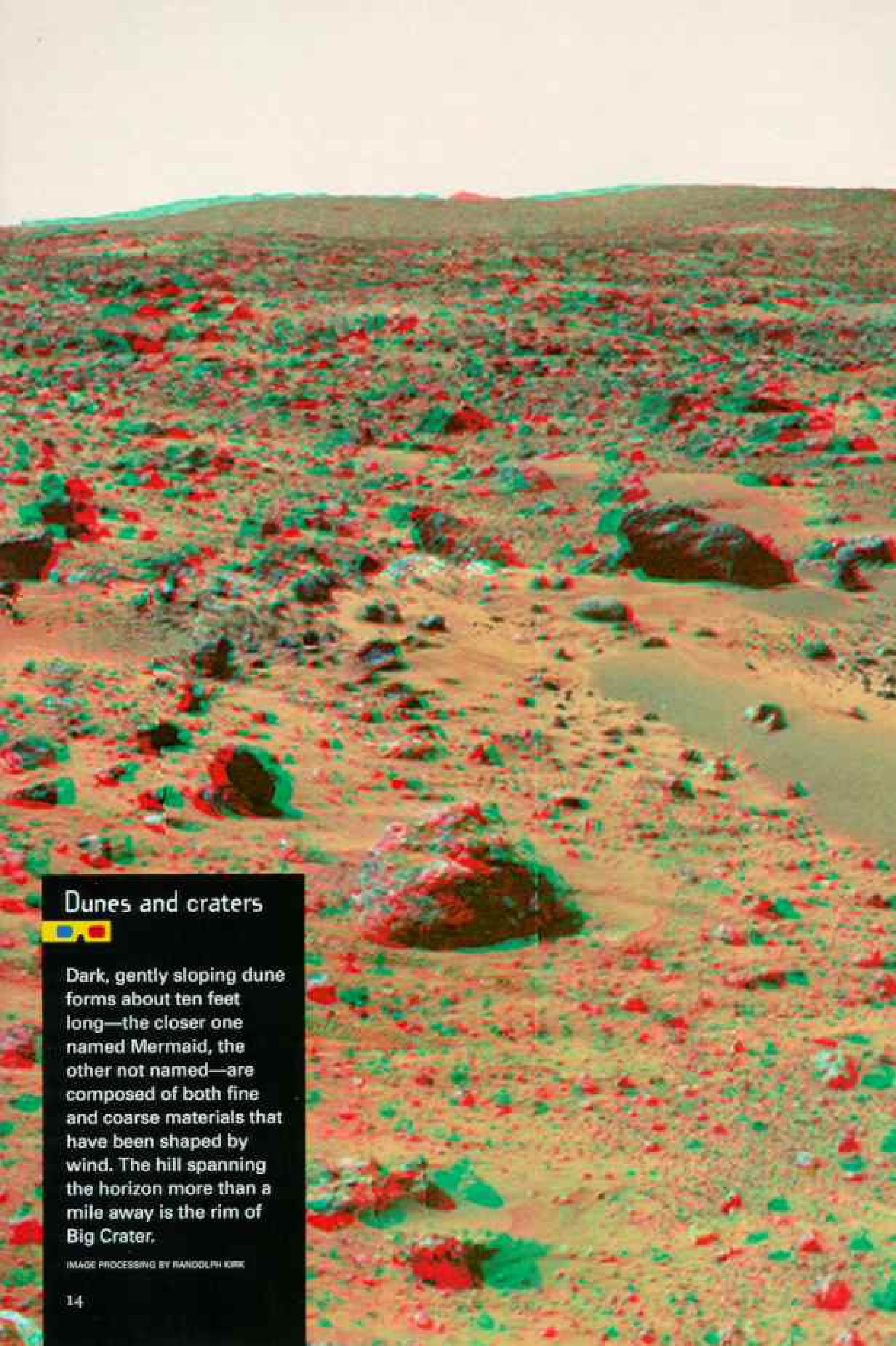
the landmarks and within hours pinpointed Pathfinder's whereabouts. The lander was equipped with a stereo camera so scientists could view the surface—like the area in front of the Rock Garden (below)—in three dimensions to understand the topography and navigate the rover.

In the Rock Garden

On the edge of a shallow swale, a lineup of rocks named, from left, Shark, Half Dome, Moe, and Stimpy dominates the Rock Garden. Those angled to the northwest indicate the direction of flow of a massive flood two billion or more years ago, which also carried rounded Stimpy here.

IMAGE PROCESSING BY TIM PARKER





Dunes and craters

Dark, gently sloping dune forms about ten feet long—the closer one named Mermaid, the other not named—are composed of both fine and coarse materials that have been shaped by wind. The hill spanning the horizon more than a mile away is the rim of Big Crater.

IMAGE PROCESSING BY RANDOLPH KIRK

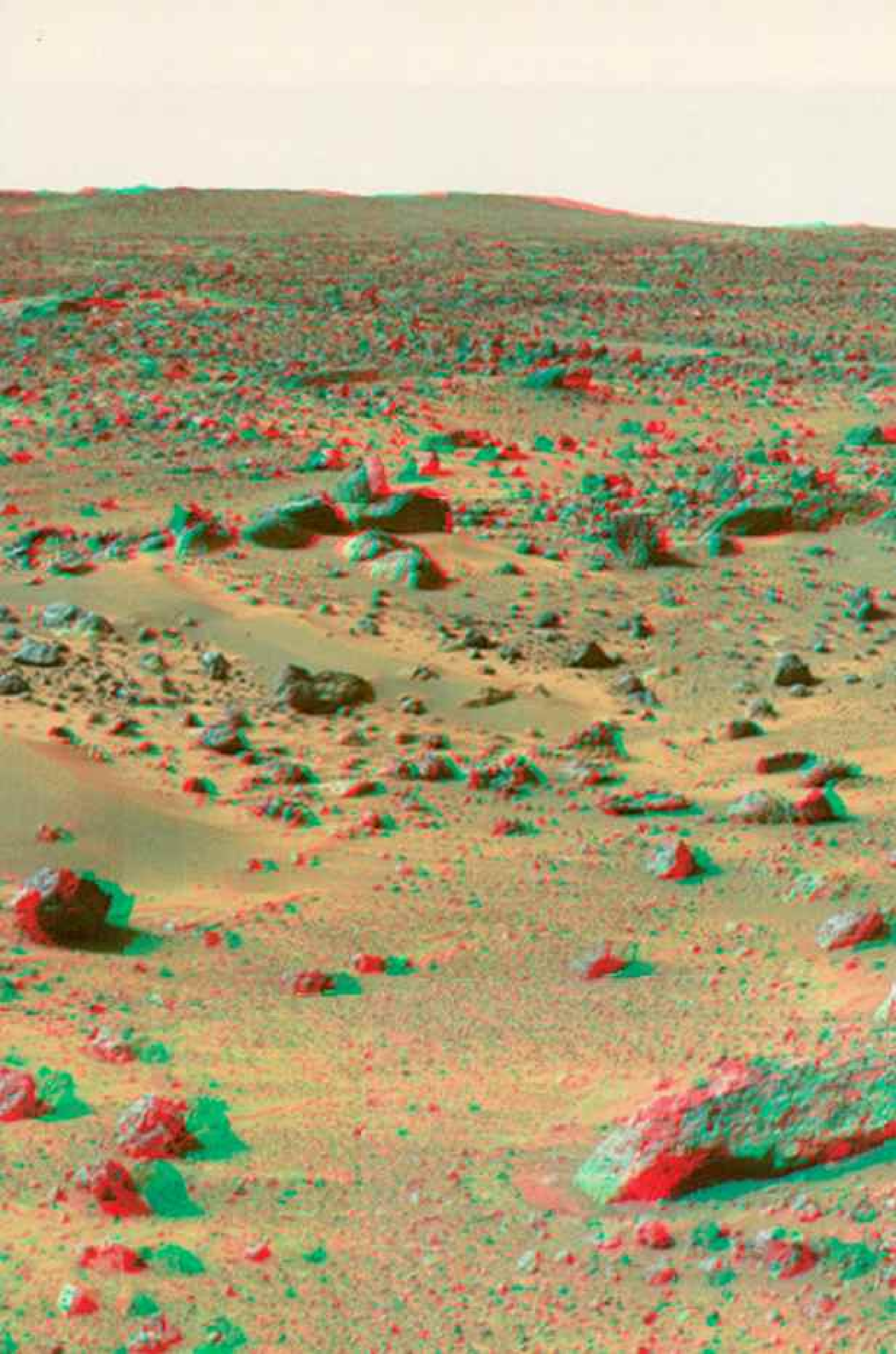


IMAGE PROCESSING BY MARK LEMMON, UNIVERSITY OF ARIZONA, TUCSON (ABOVE AND RIGHT); MARK LEMMON AND JUSTIN MAKI, JPL (BELOW)

Blue sky at night . . .

The setting sun tints the sky blue (above) as light is scattered by particles of airborne red dust. Similarly, scattering by tiny water-ice particles lends a blue hue to wispy high-altitude clouds passing overhead near dawn (right). Gray clouds (below), colored by icy dust particles, give an overcast morning an Earthly quality—on a clear day the Martian sky is butterscotch.

THE MIDSUMMER SUN was high in a clear yellow-brown sky. The morning's filmy blue clouds had dissipated, and the temperature was 8°F—way up from last night's low of minus 100°. A breeze wafted from the west at about eight miles an hour.

A perfect afternoon for a drive on Mars.

Gingerly pushing a joystick, I watched the computer screen as the six-wheeled rover named Sojourner eased away from the Mars Pathfinder lander, which had carried it to this rocky Martian plain 119 million miles from Earth. The two-foot-long vehicle rolled along a Mars landscape replicated from images beamed back to Earth after Pathfinder's landing on July 4, 1997.

I was not, of course, commanding the real rover. By the time I sat down at this computer terminal at the Jet Propulsion Laboratory (JPL) in Pasadena, California, Pathfinder had been out of contact for weeks. But if the lander had still been alive, I could have been plotting real rover maneuvers at this computer.

An intriguing collection of rocks lay a few yards to the left of the rover, but a pair of good-size stones seemed to block my path. Luckily I was wearing liquid-crystal 3-D glasses that enabled me to see depth on the flat computer monitor. There would be just enough room for me to squeeze Sojourner through—I thought.

"Um, you may have a problem there," said a charitable Brian Cooper, who designed this virtual-reality computer program for the Jet Propulsion Laboratory and served as the primary designated driver for the actual rover's three-month mission. From this very console in his JPL office, the bearded, shirt-sleeved Cooper plotted the moves of the interplanetary dune buggy.

Fortunately for the U.S. space program, my navigational mishap happened off-line. As opposed to my blunderings (somehow I found a way to make the virtual rover rise into the air and fly off into the distance, growing ever tinier as it disappeared over the Martian horizon), Cooper found routes around barriers, stopped to spin the rover's wheels so scientists could study the soils stirred up, and cozied up to rocks for closer looks.

"Don't feel too bad," Cooper told me. "We spent so much time in one area that I nicknamed it the Bermuda Triangle."

With the goggles and video-game graphics, this all seemed like entirely too much fun for real science. In fact, from the beginning there was a vague sense of goofy abandon to the Pathfinder project. The spacecraft was designed, built, and launched in three years. The mission's total cost ran 265 million dollars, one-fourteenth the amount of the last successful Mars missions, Viking 1 and 2, in 1976. The rover was so cute that a copy became one of the most popular Hot Wheels toys ever produced. Even the landing was offbeat: At 1,165 feet above the surface, after being slowed by the atmosphere and a parachute, the lander sprouted multiple air bags, cushioning itself inside a huge beach ball. It bounced more than 15 times across the Martian surface before rolling to rest on a gentle slope.

The air bags were deflated and cranked back around the lander, which then unfolded its petal-like shields to reveal the payload: the Imager for Mars Pathfinder (IMP), a stereoscopic camera with 24 filters; the Atmospheric Structure Instrument/Meteorology (ASI/MET)

package to record daily weather; and the rover itself, with cameras on the front and back and an alpha-proton x-ray spectrometer (APXS) to analyze the makeup of Mars rocks and soil.

That may seem like an ambitious lineup, and those devices did come up with some remarkable discoveries. But at its inception the main aim of the entire Pathfinder mission was simply to get something—anything—safely on Mars.

"This was primarily an entry, descent, landing demonstration," said Matthew Golombek, the project scientist whose wide-eyed smile and unbridled enthusiasm endeared him to TV viewers as Pathfinder's spokesman. "After we had the thing on the surface, whatever we did was pretty much considered gravy."

From his windowless little office on the JPL campus, Golombek oversaw the Pathfinder science mission. "They probably let me have the job thinking I wouldn't cause them too much trouble," he smiled. "But I thought it would be silly just to send a red brick to Mars. I figured we should try to learn something new."

The learning began even before the landing. During the descent the spacecraft recorded information about the planet's atmosphere. Finally on the ground in a region called Ares Vallis, the IMP camera showed rocks—large and small, angular and rounded, dark and bright—stretching to the horizon. To Golombek the landscape was gratifyingly familiar.

"I spent two and a half years worrying about the landing site," he said. "We knew from old Viking images that there were areas of Mars that looked like they had been formed by catastrophic floods. On Earth places like that are where you can get a variety of rocks, so that was where we wanted to go."

As 3-D images of the surface were processed, it became clear that some kind of trough lay just beyond a nearby ridge. Set on the trough's edge like books on a shelf was a collection of angled rocks. The consensus grew that what carved the trough and deposited many of the rocks at Pathfinder's landing site was a flood whose volume may have equaled that of all the Great Lakes.

And when the rover ventured off the lander, it saw rocks that are possibly conglomerates, a type of rock that forms over millennia as water rounds pebbles and cobbles and deposits them in a matrix of sand and clay. "That means there was once liquid water on Mars," said Golombek. "It suggests a very different climate, perhaps one where life could have developed. That raises the questions: If life developed, what happened to it . . . and if not, why not?"

FROM THE EARLIEST TIMES humans knew there was something different about the bright red heavenly body that marched across the night sky out of step with the steady progression of the stars. The ancient Sumerians, Greeks, and Romans associated it with their god of war, unaware that its blood-red color was merely evidence of a world covered with iron oxide dust.

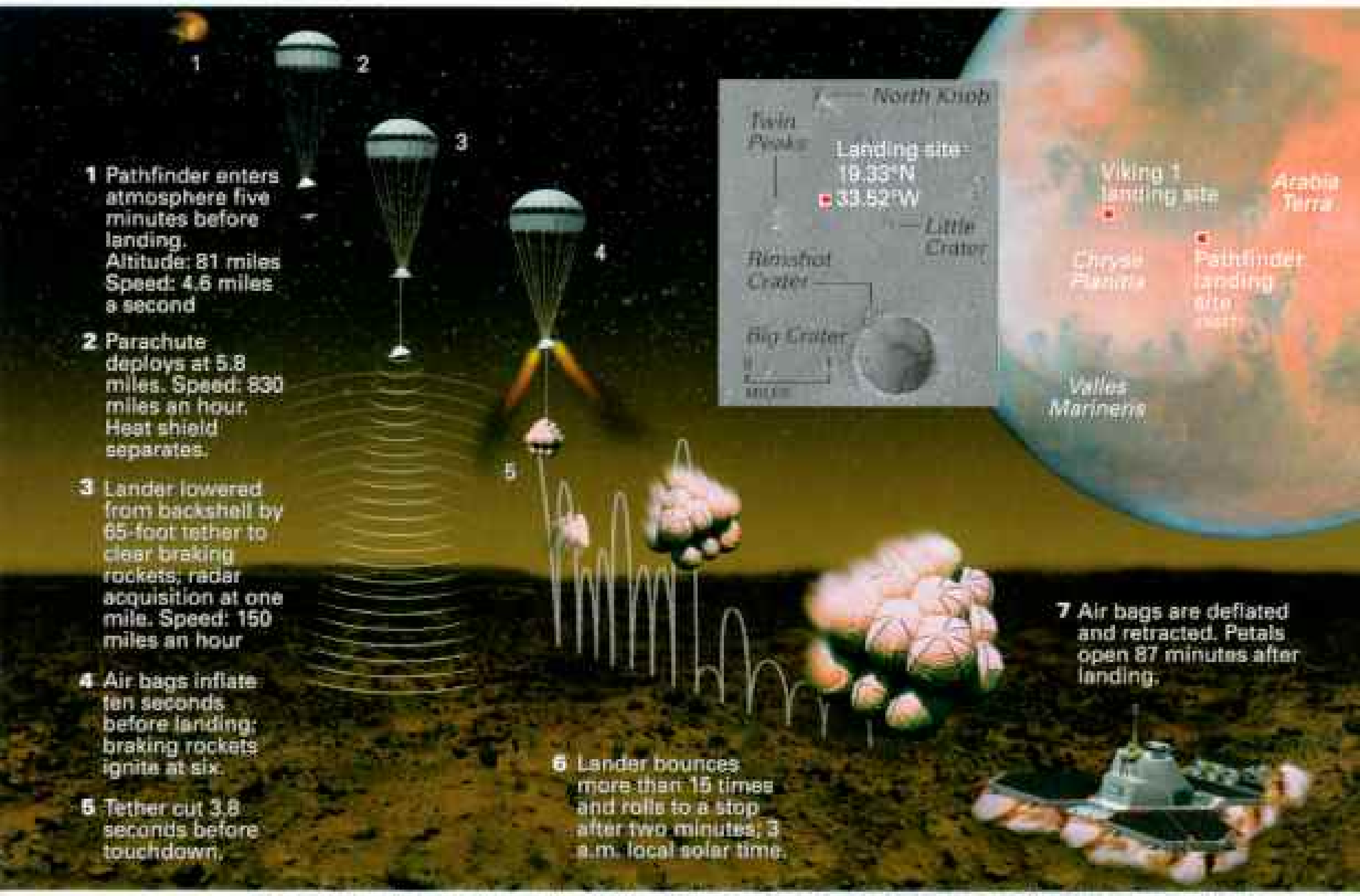
In the late 1800s an Italian astronomer named Giovanni Schiaparelli mapped what he described as *canali* on the Martian surface. The word can mean either natural channels or artificial canals, and Percival Lowell, a Boston millionaire and astronomy enthusiast, seized on the more tantalizing translation. He decided he would see those Martian canals for himself. And he spared no expense.

Lowell called the Arizona mesa on which he established his observatory Mars Hill. Back in 1894 it was in the middle of nowhere. Today it's a five-minute drive from where old Route 66 passes through Flagstaff. Stroll up a pathway—past the domed mausoleum where Mr. Lowell's remains lie—and you're at the door of the wooden cylindrical building that houses the 24-inch refracting telescope he brought to the site by train.

Lowell spent years squinting through the telescope, drawing the intricate patterns he saw—or imagined he saw—on the Martian surface. The canals, he said, stretched from the cold ice caps to regions closer to the equator. It was clear to Lowell that Mars was a drying, dying planet and that its ingenious inhabitants had created the canals in a last-ditch attempt to survive.

It was, needless to say, one of the great wrong guesses in astronomical history. But Lowell helped propel a century of Mars studies—along with classic science-fiction books and movies that planted the seed of Martian curiosity in the young minds of more than a few future scientists.

Science fiction aside, Mars is in many ways remarkably like Earth. A day on Mars lasts 24 hours, 37 minutes. The Earth's axis tilts at



ART BY SEAN TOLEY; HUBBLE SPACE TELESCOPE IMAGE OF MARS, STEVEN LEE, UNIVERSITY OF COLORADO, BOULDER; INSET MALIN SPACE SCIENCE SYSTEMS/NASA

BOUNCING INTO HISTORY, Pathfinder makes its unorthodox arrival on Mars. Air bags were ideal for the rocky landing spot—near the mouth of the Ares Vallis flood channel—seen in a 1998 Mars Global Surveyor image (inset).

23.43 degrees; Mars's tilts at 25.19 degrees. Both planets have observable seasons, with warm summers that melt their polar ice caps. Clouds drift across the face of each. Mars is half again as far from the sun as Earth, yet while polar nights are nearly minus 200°F, summer days south of the equator can get as hot as 80°.

Although the diameter of Mars is little more than half that of Earth, its major geological features dwarf those on our planet. The Martian volcano Olympus Mons rises 75,000 feet, two and a half times the height of Everest. And the Valles Marineris canyon, which would stretch from San Francisco to New York, is the longest such valley known in the solar system.

The more Earthlings learned about Mars, the less it remained an astronomical curiosity. Mars was a place to go.

BUT YOU WOULDN'T WANT to live there. As Elton John sang in the 1970s, "Mars ain't the kind of place to raise your kids / In fact it's cold as hell." Dusty, pockmarked, dead: This was the view of Mars sent back to Earth by the Mariner flyby missions of the 1960s. The black-and-white images showed a planet that looked positively moonlike. Impact craters were everywhere. Then in the early 1970s the Mariner 9 orbiter showed intriguing evidence of volcanism and dry riverlike flood channels. Two 1976 landers, Viking 1 and 2, looked for life on Mars by scooping up and testing soil samples, which yielded no organic material.

For nearly two decades after the Vikings, Mars remained unvisited by the United States. (The Soviet spacecraft Phobos 2 orbited the planet for a month in 1989.) A grand return was planned with the Mars Observer probe, which bristled with experiments, sensors, and cameras. A week before its planned arrival in August 1993 a scientist showed me a single black-and-white image of Mars taken by Observer to test the equipment.

"If anything happens to that spaceship,"

MEN FOR MARS share a jubilant hug when confirmation of Pathfinder's successful landing was beamed to Earth July 4, 1997. Chief engineer Rob Manning, facing camera, will continue his role in all robotic Mars exploration—a task that will extend through the next decade. NASA plans at least four more missions, all of them with landers.

BILL INGALLS, NASA

I told him, "this will be the most expensive eight-by-ten glossy ever taken." We laughed. Days later Observer fell silent.

The Mars Observer debacle came at the end of an era: The age of spending a decade or more developing, building, and launching a space probe was over. NASA's chief, Dan Goldin, summarized the future of space exploration in three words: "Faster, better, cheaper."

NASA announced that spare parts for Observer would be assembled on a new craft called Mars Global Surveyor. It would be launched as soon as possible, the first in a series of Mars orbiters, landers, and rovers that included Pathfinder.

With its three-year deadline and strict budget, the design and assembly of Pathfinder was unlike any space project before it. In the old days a device as critical and complex as the IMP camera would have been built entirely by a government contractor. But now, to save money, the final assembly and testing was done by scientists, engineers, and graduate students at the University of Arizona Lunar and Planetary Laboratory in Tucson.

"In the past, large teams were common on this kind of project," said Peter Smith, the imaging team leader who conceived the camera at the University of Arizona, helped build it, and then supervised its operation on Mars. "This had no more than 20 employees. Traditionally with contractors the cost of the camera would have run in the tens of millions of dollars. Ours cost less than six million."

Tall, bearded, and obviously more comfortable in knit polo shirts than anything else, Smith recalled the hectic last days of building the camera in December 1995.

"The motors for pointing the camera arrived here at the university on December 20, and the camera was due at JPL December 29. That was the Christmas from hell, but we worked very long hours and got the thing packaged at 4 a.m. on the 29th.

"Before sending the camera to JPL, my colleagues Chris Shinohara and Bob Marcialis and I put it on my dining room table and toasted it with warm beer, the only thing we could find at five in the morning. That was real team spirit."

The Global Surveyor orbiter was launched first, in November 1996. Pathfinder was hurled into space a month later, on a trajectory that brought it to Mars two months sooner. The media sensation Pathfinder caused was unlike that of any space program since Apollo. In the first month of surface operations the JPL Mars Pathfinder Internet site registered an unprecedented 566 million hits.

IN A JPL CONFERENCE ROOM a blowup of the Martian panorama surrounding the Pathfinder lander stretched nearly wall to wall. Almost obliterating the image were over a hundred yellow adhesive Post-its bearing the whimsical descriptive names that scientists had given Martian rocks. Names like Barnacle Bill, Yogi, and Couch.

"It seemed like a better idea than just assigning them numbers," said the young scientist showing me around. "But they were careful not to give them the names of any real people. Too much danger of jealousy."

At that moment my eye caught sight of a rock named Moe, so named, it appeared, for its

shaggy "haircut." A momentary lapse, I supposed. And so it came to pass that the only feature the mission named for a person honors the memory of Moe Howard, the eye-poking, skillet-wielding leader of the Three Stooges.

Each day during the mission Brian Cooper, the rover driver, sat at his computer screen and mapped out Sojourner's route, a trail the rover followed at a blistering two feet a minute. Cooper couldn't simply rev it up and drive it around like a kid with a remote-control car though. Each new route had to be painstakingly planned and tested by the rover team. That's why Cooper had to develop a computer program that enabled him to envision the rover in the Mars landscape. He rehearsed the day's intended route at JPL, then sent the set of commands, the radio signals taking some ten minutes to reach Mars. He gave the rover way points, then let it head for the destination on its own, using five lasers and two cameras for range finding and to see what was in its path.

"The cameras and lasers worked as an avoidance system," he said. "Even if I told the rover to go off a cliff, it wouldn't do it."

Cooper watched me fumble with his baby. Finally, a confession. "I think this is the most fun job on the whole project," he said. "I've had a blast."

Cooper's most delicate procedure was to maneuver close enough to rocks for the rover's APXS sensor, at the end of a short movable arm, to be pressed against them.

"We found rocks very high in silicon, which indicates that some crustal materials are like the continental crust on Earth," said Matthew Golombek, the project scientist.

LOOK FAMILIAR? Take away the blue skies and the distant water and this rocky plain in Iceland could be Martian. Boulders and smaller sediments here were deposited in a flood, as were the sediments in Ares Vallis. Pathfinder team members visited similar floodplains in Washington State to predict what they would find at their landing site.

MIKE MALIN, MALIN SPACE SCIENCE SYSTEMS

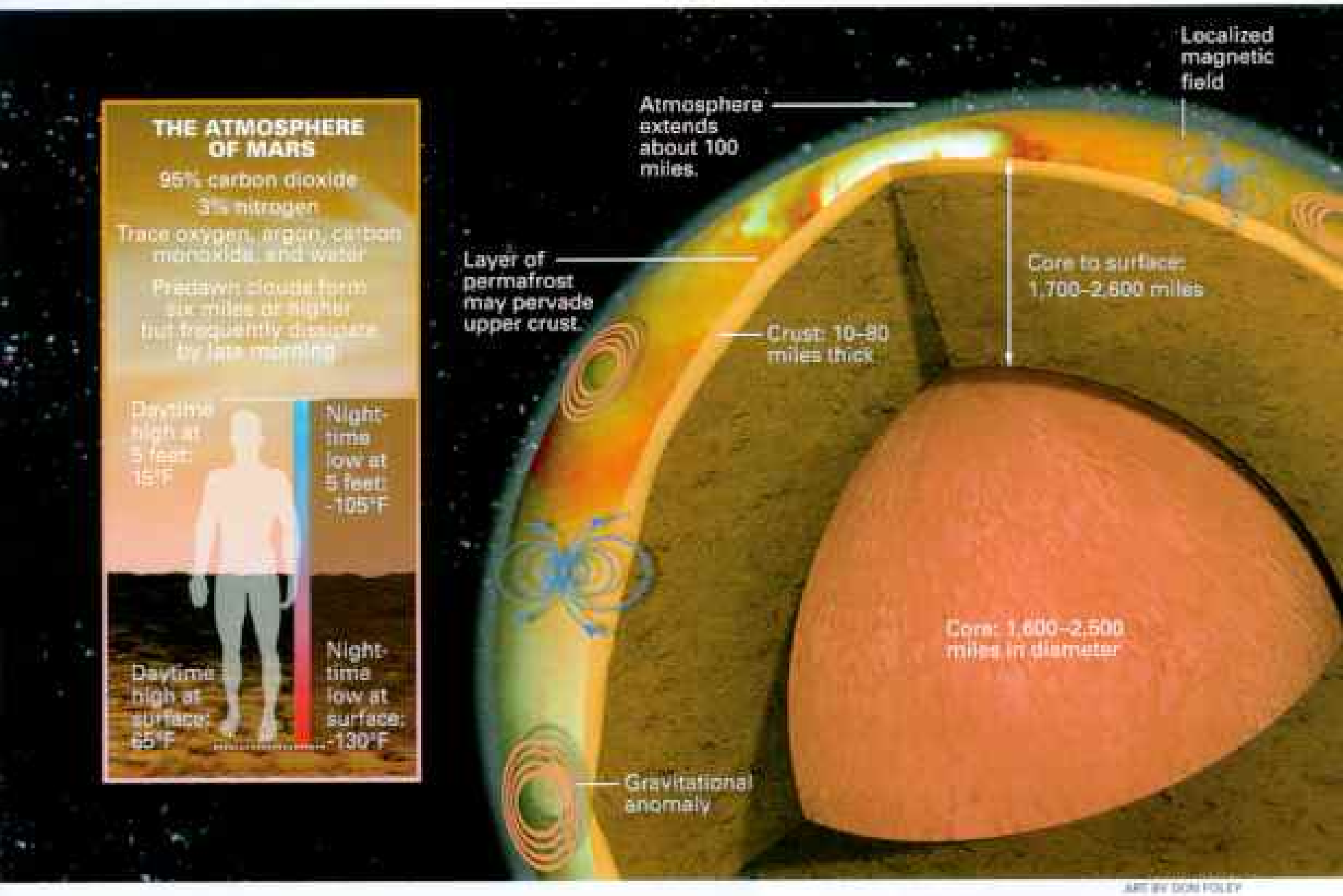
THE PATHFINDER LANDER transmitted its last data on September 27. Though twice revived by JPL scientists, it sent no further information. Wild Martian temperature changes probably caused a wire to snap or a soldering point to crack. The solar-powered rover, however, may still be rolling around, using its laser eyes to dodge rocks as it circles the lander like an orphaned pup. More likely, the rover has at some point sensed itself in a precarious position and placed itself on hold, waiting for instructions that will never come.

By September 27 the rover had covered about 110 yards of terrain and taken 16 APXS readings of Mars rocks and soil. The lander and rover sent back more than 17,000 images. Almost daily weather recordings tracked temperature, air pressure, and wind speed and direction, including several small, swirling dust devils passing right over the lander. "In short," said Golombek, "we have explored about 240 square yards of Mars."

Like most Pathfinder scientists, Golombek keeps coming back to the mounting evidence that Mars, like present-day Earth, once had bodies of water lapping against the now dry landscape.

Even in its dryness Mars betrays a watery past. All around Pathfinder were windblown dune forms. Rocks visible from the lander had been sculpted by wind, a phenomenon that requires airborne sand as an abrasive. On Earth you need running water to make sand.

And there were more signs of water on Mars. One of the experiments added to the Pathfinder payload was a series of magnets on the



ART BY DON FOLEY

MORNING ON MARS brings wild temperature change. As the sun warms the surface, heat rises in eddies. Measurements made using the lander's radio communications system show that Mars has a metallic core. The Mars Global Surveyor detected no global magnetic field but rather many localized fields and gravitational anomalies.

lander. As the weeks on Mars wore on, the IMP camera saw dust collecting around the magnets. The patterns confirmed that the particles, just two microns across, were highly magnetic—interpreted as evidence that iron in the crust was once leached out by groundwater.

Soon after Pathfinder's last transmission, Mars Global Surveyor began sending back remarkably high-resolution images of the Martian surface. As it orbits Mars, Global Surveyor is using the atmosphere to slow itself down until it attains an ideal operating orbit in March 1999. Meanwhile, its near-spy-satellite-quality camera has revealed that the walls of Valles Marineris have sharply defined layers, like the Grand Canyon. The orbiter's laser altimeter, which measures the distance from the satellite to the planet's surface, appears to show that the north polar cap rises much higher than previously thought, in places almost a mile above the relatively flat, sandy plains that surround it. The laser altimeter also shows a vast flat region covering much of Mars's northern hemisphere—possibly an extinct seabed or ancient mudflat.

Said Golombek, "It just seems that everywhere you look on Mars, you see water. At least the evidence of it."

So where did it go? The prevailing view holds that most of Mars's water is frozen—at the poles, underground, or on the planet's northern plains. But life cannot exist without liquid water. No water . . . no Martian life.

DAN MCCLEESE got hooked on Mars early. As a 16-year-old in San Diego, his high school science project was to try to grow slime mold in a simulated Mars environment. Young McCleese had a man at a local garage weld together a chamber into which he pumped carbon dioxide and traces of oxygen. The temperature was kept

low by immersing the chamber in a refrigerant bath. A vacuum pump lowered the air pressure, and an ultraviolet lamp simulated sun-rays unfiltered by a thick atmosphere.

"I killed the slime mold," he reports 30 years later.

Despite that, McCleese is the chief scientist for JPL's Mars Exploration Program, setting the strategy for an ambitious series of Mars missions that began with Pathfinder and Mars Global Surveyor.

"We'll be going back every 26 months, each time Mars is at its optimum position with respect to Earth," he said. Pairs of spacecraft—one with an orbiter, the other with a lander—will be launched on separate rockets to the red planet. Besides carrying their own scientific equipment, the orbiters will act as relay stations transmitting data back to Earth from the landers.

- Late 1998–early '99: Mars Climate Orbiter will carry cameras and equipment to study the atmosphere and the surface. Mars Polar Lander will settle near Mars's southern ice cap—thought to be frozen water and carbon dioxide—and take samples with a robotic arm. Two small probes will be dropped into the ground to search for water. No rover will be included.
- March 1999: Mars Global Surveyor will attain a circular orbit over Mars's poles. Capable of imaging objects the size of a large desk, it will map the Martian surface. Other instruments will continue to study Mars's localized magnetic fields. A laser altimeter will measure, to an accuracy within a meter, seasonal changes in the height of the ice caps.
- 2001: The new millennium begins with the launch of a new orbiter and a lander, ideally with a rover payload. Considerably hardier than the fragile Sojourner, the 2001 rover will collect rocks and soil samples and cache them. Scientists will select the landing site based on high-definition data collected by Mars Global Surveyor and Mars Climate Orbiter.
- 2003: As in the 2001 mission, this lander will be sent to an area with rocks most likely to bear evidence of past life on Mars. Again, the rover will collect and cache rocks and soil samples.
- 2005: The first round-trip mission to collect rocks. Using technology not yet developed, a lander will head for the most promising of the previous landing sites. Its rover will collect the rocks and soil samples cached by an old rover. Samples will be brought back to Earth in 2008 for detailed study.

"I plan to be here through all the planned missions and for subsequent sample-return missions as well," said McCleese. "We really don't believe a single sampling will tell us everything we need to know about Mars."

Already completing his camera for Mars Polar Lander, Peter Smith both revels in his work and longs for something more. Wearing a pair of blue-and-red 3-D glasses, he studied a stereo panorama of Mars mounted on a wall of the JPL auditorium.

"If I have a regret, it's that we lost Pathfinder just before the Martian dust storm season," he said. "I tell you, I would have loved to see a big old cloud of dust roiling up from that horizon. It would have been like the Dust Bowl, only a whole lot bigger, covering the entire planet."

And, presumably, louder. Perhaps we'll find out in 1999, when Mars Polar Lander settles in near the South Pole—with a microphone on board.

Smith stepped closer to the mural for a look at the panorama's most distinctive features, two hills he named Twin Peaks.

"They're a half mile away, and we couldn't get there with the rover. But our next-generation rover will be able to drive beyond the horizon, leaving the lander behind.

"We can't afford to launch a heavy rover that can drive hundreds of miles, however, so the irony is that when you go to Mars cheaper and faster, it actually takes longer to really explore it. I'd love to see a Mars program that would get humans there in our lifetime."

In a fit of optimism, then President George Bush suggested that the U.S. should land humans on Mars by 2019, the 50th anniversary of Neil Armstrong's first step on the moon. As the years pass, that possibility seems to dwindle. But just imagine the year 2008. The sample mission comes back with a rock that bears evidence of fossil remains.

There may have been life on Mars. The only way to know for sure would be to go look.

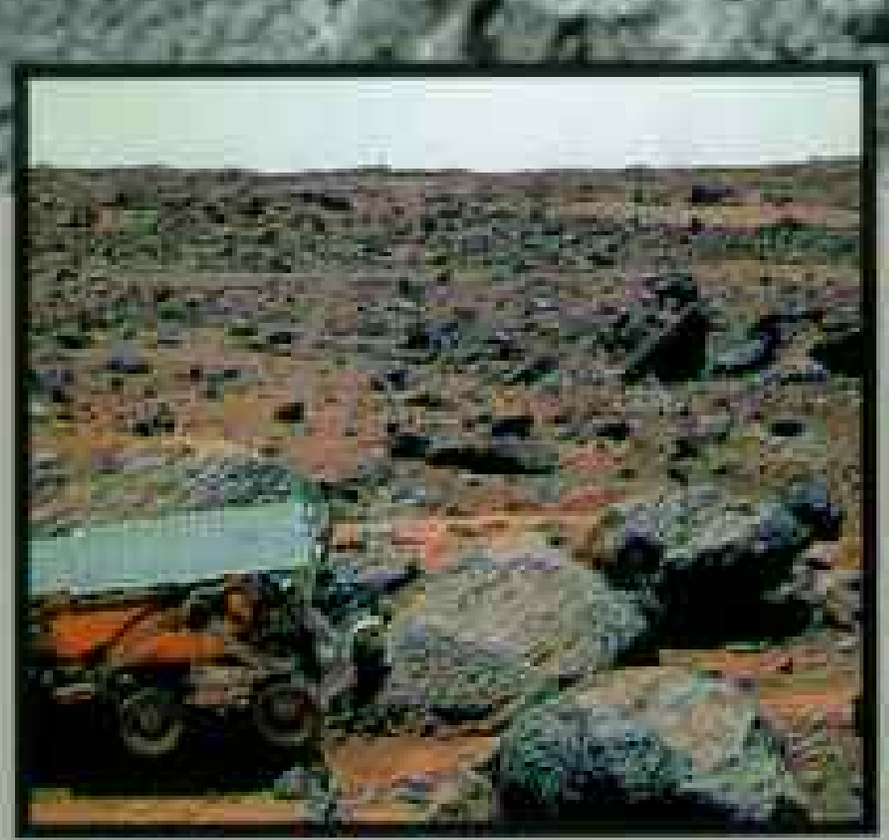
We'd still have eleven years. We got to the moon in less than ten.

Learn more about the Mars Pathfinder mission at *www.nationalgeographic.com/features/98/mars*.

Sojourner goes six wheeling

Think of a microwave oven and you've pictured the size of the rover named for abolitionist Sojourner Truth. Two feet long and a foot tall, it was designed to give "ground truth" on its Mars sojourn, surface data to be used for interpreting information gathered by subsequent Mars orbiters. It captured close-up images of the terrain and a view of the lander itself (top). A 25-million-dollar interplanetary geologist with stereo vision and an alpha proton x-ray spectrometer (APXS) to analyze rocks and soil, Sojourner was designed to surmount obstacles seven inches tall. Encountering an eleven-inch-tall rock called Wedge, the rover (below, from rear) sensed trouble and stopped to await instructions from Earth. It was facing the camera when it ended a day on Mermaid Dune (right).

IMAGE PROCESSING BY NASA/JPL/MSSS



CHECKING OUT CHIMP, the rover cozied up to the whimsically named rock, perhaps volcanic, to photograph its cracked, pitted face (above). A dark crust seems to cover much of its surface. At Moe (far left and left), Sojourner saw flutes that indicate wind erosion and extended its APXS sensor to try to determine chemical makeup. Data are still being analyzed, but the rocks at the landing site generally show elevated silicon levels, suggesting an unexpectedly Earthlike composition.

LOOKING OVER A RIDGE beyond the Rock Garden, Sojourner saw dune forms (above) out of sight of the lander's camera. About half a foot high and a yard long, they are crescent-shaped, or barchanoid, dunes, common on both Earth and Mars. Their horns point downwind and here show prevailing winds from the northeast.

From its low perspective, the rover could see the balancing act of three-foot-wide Yogi (below), the largest boulder it studied, probably deposited in

this position by a flood.

Five-inch-high Flat Top (below) has elongated pits either of volcanic origin or caused by weathering. The top is coated with dust, which in mild Martian winds also accumulated on the lander and rover.

After the trip on which it saw the barchanoid dune forms, Sojourner was to circle back around the lander, then take readings with its APXS of the dust particles that had been drawn to the lander's ramp magnets. But the lander, which relayed all rover findings, sent its last data transmission on September 27. JPL twice revived contact but learned nothing. Intermittent attempts were made until March, when the Pathfinder Mission was officially declared over. ▯

Deep in Borneo, a male orangutan we call Jari Manis feeds on wild ginger stems as he keeps an eye on a female he's been shadowing. My team of assistants and I track the elusive apes from dawn to dusk, when they bed down in a nest in the trees (following pages). Mixing modern science with old-fashioned fieldwork, we are breaking new ground in understanding how wild orangutans have adapted to their rain forest home.

ORANG

IN THE WILD

ORANGS

By CHERYL KNOTT

Photographs by TIM LAMAN

A fistful of mother's skin and hair keeps one-year-old Bekti aloft as she rides on Beth, who is hurtling herself through the forest. It will likely be almost seven years before Bekti will have a younger sibling, one of the intriguing aspects of orangutans that has lured me to Borneo to study their reproductive cycles and social patterns.

In darkness, submerged in water up to my neck, I was plunging through a flooded creek, a creek that I had easily jumped over that morning. My husband, Tim, was wading along just a few feet ahead of me, while balancing a backpack full of camera gear on his head. He turned and said, "Are we in Borneo, or what?"

We were slogging our way back from a full day of following a wild orangutan as she searched for food on the rain-drenched mountain slopes of Indonesia's Gunung Palung National Park, near the west coast of Borneo (map, page 38). We had made a research site there our home. Tim was continuing his studies on the animal and plant life high in the rain forest canopy, and I had begun my investigation of wild orangutans. For several months we had been following an adult female we had named Beth, and she was now well past the stage of vocalizing and dropping branches on us, behavior typical of orangutans when they first encounter people. These large red apes can be surprisingly difficult to find and follow. Like fat-bellied acrobats, they seem to traverse the canopy effortlessly, leaving researchers such as me to crash through the undergrowth trying to keep a constant eye on them (below).

RESEARCH PROJECT

Supported in part by your Society

The year before, we had made the trip upriver to the research site in the middle of an unusually severe dry season. The water was too low to use a boat with a motor, so we had to drag our dugout canoes, burdened with more than a year's worth of research supplies, across the sandy river bottom. As we penetrated farther and farther into the forest, a steady stream of white and pink flowers floated down to greet us as if we were in a ticker tape parade. The flowers heralded a so-called mast fruiting—an event in Southeast Asia rain forests when a large proportion of trees bear fruit at the same time. The mast provides a boon for orangutans, like Roman (right), who gorge themselves on high-calorie fruits.

The sun's last rays turn mist into a flaming yellow blanket, tucking the rain

forest in for the night (right). Lush and teeming with life, this botanical wonder leads many to think of it as a virtual Garden of Eden that produces an unceasing cornucopia of succulent fruits. In reality, though, fruit abundance varies greatly even if temperature varies little.

Periods of high fruit production happen only at odd intervals in Borneo, about once every four to seven years, although smaller fruit peaks occur every year. Being there during a mast fruiting proved ideal for studying how changes in food abundance influence orangutan reproduction and behavior.

Unlike chimpanzees, for example, orangutans do not live in groups. Adult males travel alone, and mothers are usually accompanied only by an infant and sometimes by an older juvenile. This is partly because the fruits that the animals prefer are widely dispersed and can't support large gatherings of the apes.

But orangutans are not wholly unsociable. During the mast we've seen as many as eight individuals feeding together in the huge dipterocarp trees that dominate the rain forest. Clearly orangutans get together when the food supply permits.

I spend countless hours sitting on soggy ground observing the animals. One day I watch Roman eat one after another of the pineapple-size durian fruits. Hearing a rustle, I turn and see Rob, a subadult male, throw together a nest in a tree behind me and dive in. Rob lacks the cheek pads and throat sac of fully mature males like Roman and doesn't announce his presence with long, bellowing calls. He eyes Roman and the durian tree. When Roman has eaten his fill, he quits the tree, ignoring Rob as the smaller ape approaches to feed. After gorging on durians, Rob pauses at a small *Baccaurea* tree to grab a handful of its glossy red fruit (right).

When he leaves, one of my assistants shimmies up the tree to take some fruit for us to weigh and dry out. I pick up some loose durians that Roman and Rob have knocked down. Later in the laboratory I'll be able to figure out how many calories they have consumed today.

I spread plastic sheets beneath animals sleeping in their tree nests to collect urine to analyze for hormones and signs of disease. In bringing such scientific techniques into the forest, my goal is to gain a deeper understanding of orangutans without intruding on their life in the wild.

In 1997 Harvard University anthropologist Cheryl Knott and her husband, Harvard biologist Tim Laman, received the first annual Chairman's Award from the Society's Committee for Research and Exploration.

Boom or Bust

The research site in Gunung Palung National Park covers eight square miles of rain forest, and a grid of trails (dashed lines) permits quick access to the varied habitats occupied by orangutans. My dedicated team of Indonesian and Western assistants and I have logged more than 15,000 hours observing the apes. Their movements are highly influenced by the presence of ripe fruit. Depicted on the map are the paths of five orangutans observed during sample periods, with dots marking the places where each slept at night. During the mast fruiting, orangutans were found mostly in the alluvial terraces and lowland hills, where dipterocarp seeds, durians, and other fruits were abundant. During fruit-poor periods the apes often ranged more widely between habitats while searching for food. Recording such travel helps us develop a clearer picture of the complicated orangutan social system and the way each animal's home range relates to others. This approach has, for example, led to the finding that as many as six adult males may range independently over a given area at the same time—a surprising degree of territory overlap.

Alluvial terrace forest
Rich soils support large dipterocarps and the highest density of vines and strangler fig trees, as well as a lush herbaceous layer at ground level. This constitutes the richest habitat for orangutans within the research site, especially during the mast.

Peat swamp
In flat, poorly drained areas with sandy soil, organic material builds up on the forest floor, and tannins tint the water red. This forest is host to important orangutan fruit trees, such as *Palaquium leiocarpum* (foreground) with its stiltlike roots.

High-fruit period: An orangutan's diet during a mast fruiting is higher in calories than at other times. My research has shown that this is due to a higher carbohydrate and lower fiber content.

Low-fruit period: When high-calorie fruit is not readily available, orangutans rely on less nutritious but relatively plentiful foods, such as leaves, figs, ginger stems, and the inner layer of bark. Low-fruit periods can last for months.

Lowland forest

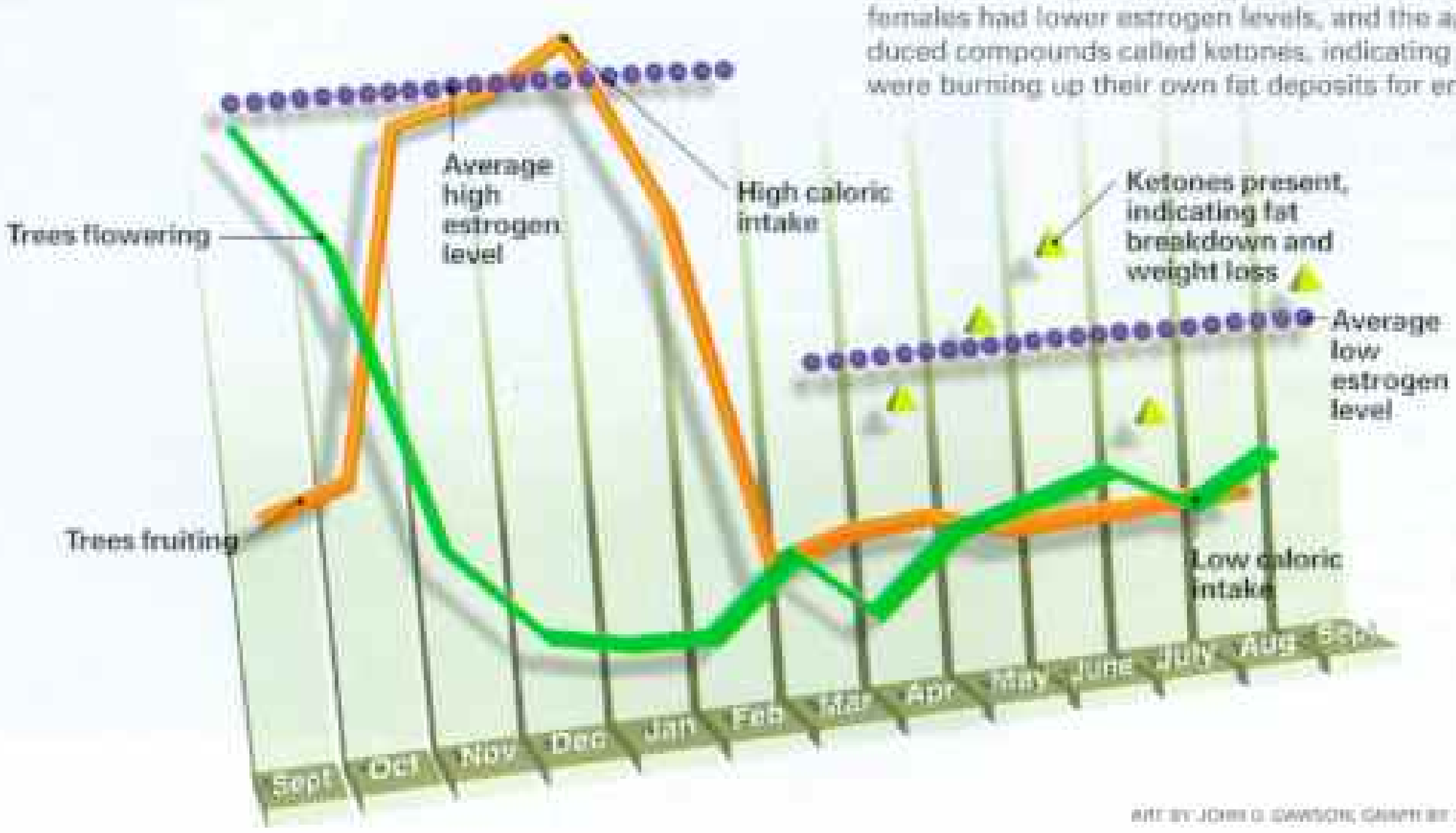
On soils derived from sandstone, the forest is dominated by large dipterocarp trees above a relatively open understory. Orangutans ascend the steep slopes found here in their quest for a wide variety of fruits. The animals also range higher on the mountain, where the terrain makes them difficult to follow.

Freshwater swamp

Found in flat, low-lying plains close to streams around the base of the mountain, this type of habitat has clear flowing water. Trees such as *Neesia* provide seeds that are among the richest sources of calories for orangutans. For observers, the spiny rattan plants and swampy ground offer challenging obstacles.

NATIONAL GEOGRAPHIC MAPS

In 1994-95, graphed below, a rich mast fruiting was followed by a period of severe fruit shortage. During the mast, orangutans consumed many more calories, females had higher estrogen levels, and mating was frequent. During the shortage, caloric intake dropped, females had lower estrogen levels, and the apes produced compounds called ketones, indicating that they were burning up their own fat deposits for energy.



ART BY JOHN D. DAWSON; GRAPH BY DOUG STERN

When Times Are Lean

Doing a little jungle gymnastics, young Misha hangs by one arm (facing page), peeling ribbons of bark from the tree as her mother, the upside-down Marissa, does the same.

After several months of superhigh fruit production the forest now offers slim pickings, and orangutans scramble to find enough to eat. Males sometimes journey to the forest floor (though females rarely do); Jari Manis descends to the ground to suck termites from their nest (right).

Though they now have to turn to low-quality fruit and vegetation such as bark, leaves, or the celery-like *Pandanus* that Beth (above) has broken off, they make do.

Such periods of abundance and scarcity have helped shape orangutan evolution. As with humans, orangutans store fat when food is abundant. By measuring the by-products in their urine, I've found that during periods of scarcity they produce ketones —telling me that they are burning up their fat deposits. The extra calories they stored when fruit was plentiful are now helping them survive.

Cruising through his treetop world, Roman approaches a fruit tree. At 200 pounds, adult male orangutans are the largest of canopy animals. About the same weight with all his camera gear, Tim has had to develop his own tree climbing techniques to photograph orangutans eye to eye.

Conflict Between Males

When we came upon Rocky (left) on the forest floor one day, we saw new gashes on his right shoulder. His wounds could have been made only by another male's canine teeth, like those displayed by Rob (above), in the infrequent but sometimes deadly fights between males. Several weeks later when I was following Rob, I came upon Rocky again. He had become severely emaciated and was in no shape for an encounter with Rob. The two grappled and rolled on the ground until Rob finally left, leaving Rocky even further exhausted.

The next morning we found Rocky curled in a ball on his side, his matted hair giving little cover to his protruding ribs. Around midday he managed to shuffle over to a small tree, where he grabbed a handful of fruit and collapsed again, slowly chewing without lifting his head from the ground (below). Sadly, I knew that he didn't have long to live.

CHERYL KNOTT

With a last burst of energy, Rocky tried to cross a fallen log bridging a stream. Halfway across he faltered and, turning around to go back, collapsed. As an afternoon downpour thundered out a final farewell, Rocky died.

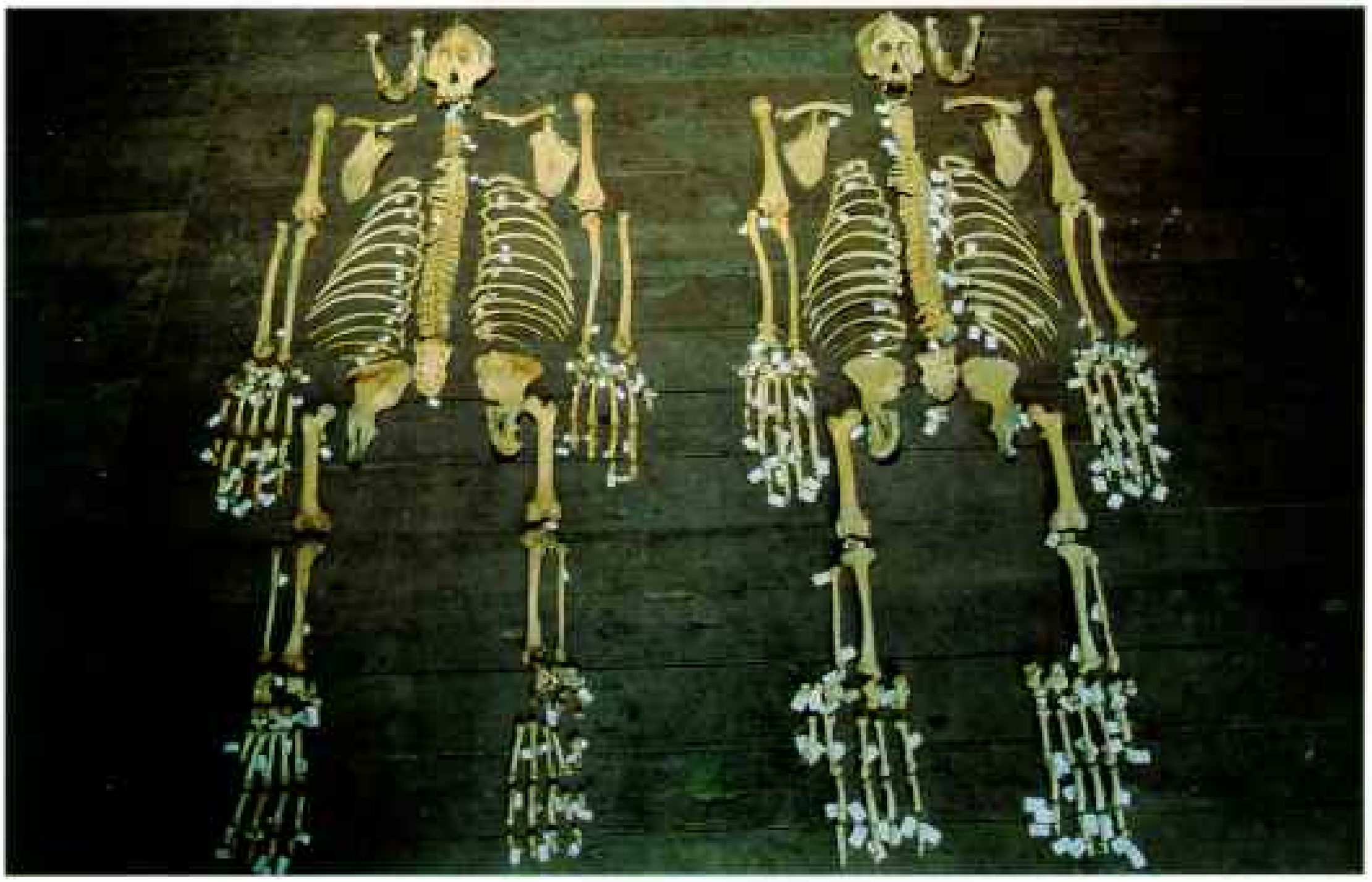
CHERYL KNOTT

We placed Rocky's body on a crude wood-and-wire frame and hoisted him up for his last trip into the canopy. I hoped that this would keep scavengers, like Borneo's bearded pigs, from scattering his bones, which I wanted to study for signs of disease and injury. Two weeks later we were amazed to see Rocky's clean white skeleton laid out on a bed of stringy red hair (right). Later I finished the job that the insects had started (bottom left).

So far as I know, such an orangutan death had never before been seen in the wild. Given the apes' low population densities and long lives, the probability of witnessing a death is extremely low. Even so, Rocky's remains were joined a few months later by those of another adult male (bottom right, at right), found in a streambed.

These rare finds were most likely the result of an increase in male conflicts arising from the influx of orangutans drawn to feast on the abundant fruit. We had seen as many as six large—and mutually intolerant—adult males ranging within a small region. Here was natural selection at work: Countless contests between adult males during orangutan evolution likely contributed to males being twice the size of females.

The battle between males to mate has reproductive payoffs but is not without cost. Testing urine samples, I have detected significant signs of infection resulting from wounds that can, as in Rocky's case, lead to death.



Field Data

When the apes turn in early, our open stilt house (above) provides a retreat to review the day's data. At dawn I am back on the forest floor, collecting urine (left) from an orangutan just awakening in her nest above. I can test the urine on site for signs of menstruation, infection, and weight loss (bottom left).

I save some samples for later genetic analysis, so I can learn who is fathering offspring and how the animals are related. I'll also analyze the hormones in the urine back at the lab.

By measuring hormones for the first time in wild orangutans, I've found that estrogen levels increase when nutritional status improves. Pregnant Beth (right) conceived her baby Bekti during the mast fruiting, when estrogen levels were high.

Growing Up Slowly

"Misha's got a rat!" I yell to Tim in my astonishment. The young ape bites off the rat's head and swings it by the tail like a stuffed toy (above).

Orangutans rarely eat meat, and in this case Misha seems motivated more by curiosity than by appetite. She also occupies herself with the orangutan version of playing house (below), making a simple nest and practicing the skills of independent living she'll need when Marissa, her mother, one day turns her attention to a newborn.

The pioneering work of Biruté Galdikas suggests that orangutans bear offspring only once every eight years on average—an extremely long interval among mammals.

After a mother gives birth, her baby will cling to her for several years, rarely venturing away from her side, and continue to nurse for about six years. A juvenile sibling may stay with its mother for a few years, as does Emy (right, at bottom) with mother Ely and her infant.

Emy is learning how to fend for herself since, unlike human mothers, orangutans normally do not provide food for their offspring beyond lactation.

One of my research goals is to try to determine why these periods of juvenile dependency last so long.

Now more than a year old, Bekti gently reaches over to grasp Beth's hand. I can only hope that when Bekti grows up and leaves her mother, enough rain forest will still be standing to sustain her and her future offspring—for untold orangutan generations to come. □

New York's

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32 CHINESE CONSOLIDATED BENEVOLENT ASS'

Yearning to breathe free, a new wave of Chinese immigrants

Chinatown

pours into Manhattan seeking liberty and a fresh start.

Drums beat. Cymbals crash. Flags wave. The dance begins.

On the prowl during a Chinese New Year parade, a yellow lion with white "hair" (symbolizing the wisdom of old age) confronts a youthful rival. "To look like lions," says a middle-aged resident, "they should wear black kung fu pants, not dungarees!"

By **Joel L. Swerdlow**
ASSISTANT EDITOR
Photographs by **Chien-Chi Chang**

GUESTS TAP CHOPSTICKS on teacups as the young couple lean closer to kiss. The bride, Feng Jheng, is 21 and sews garments in a sweatshop. The groom, Tian-Li Li, is 28 and head cook in a restaurant. Her fingers rest on his shoulder. The crowd, totaling nearly 200, cheers as their lips touch.

Cheers also come from three other wedding celebrations in the Silver Palace, one of the largest restaurants in New York City's Chinatown. Waiters push trolleys of shrimp, noodles, and meatballs past tables with plates of oranges and watermelon seeds. The rug, tablecloths, wall hangings, napkins, streamers, bride's dress, and groom's boutonniere are red, a symbol of luck in Chinese tradition.

All the newlywed couples celebrating today are recent immigrants—eight men and women out of a quarter million Chinese now living or working in Manhattan's Chinatown. With thousands more living nearby in Queens and Brooklyn, Chinese constitute more than 3 percent of New York City's population and are one of the city's fastest growing ethnic groups—the largest concentration of expatriate Chinese outside Southeast Asia. About 12,000 arrive here legally each year. Just as many may come in illegally.

I have come to Chinatown to get a sense of a place that seems like a foreign country, full of energy and exotic language. With the exception of groups from tour buses around Mott Street, traditionally the center of Chinatown, almost everyone is speaking Chinese. Signs are in Chinese, and newsstands sell only Chinese-language newspapers. People crowd around pushcarts selling fried taro root and scallion pancakes. Roasted pigs and ducks hang glistening in restaurant windows.

Most residents live in crowded tenements. But Chinatown also has a few high-rise apartments, occupied mostly by middle-class and retired people, and blocks of renovated town houses with three-story atriums.

Until the 1980s, when China began to ease emigration restrictions, Chinatown covered about a dozen blocks in lower Manhattan dominated by restaurants and curio shops (map, page 64). Today it sprawls halfway across Manhattan, occupying approximately six times its original area and, in the process, swallowing large sections of some older neighborhoods around it. To the north Little Italy has shrunk to a few shops and two blocks of restaurants.

Chinatown has rolled over the edge of the Lower East Side, traditionally the immigrant beachhead and the home of European Jews. The head of a yeshiva, a Jewish school, pleads with me not to refer to her block as Chinatown. I look around. Everyone else on the sidewalk is Chinese. A man selling kosher pickles nearby laments, "The Chinese are buying everything," and he didn't mean pickles.

I pause to wonder what sense my grandparents—Osias and Ethel Katz—would have made of it all. They came to the Lower East Side from Eastern Europe around the turn of the century, met through a matchmaker, and were married in a social hall that is now a Chinese apartment building.

"Does Chinatown have matchmakers?" I ask Zan Ng, who came here in 1975 from China's southeast coast. We are walking along East Broadway, one of Chinatown's main thoroughfares. Newcomers call East Broadway "Little Fuzhou," after the capital of Fujian, the province from which many of them emigrated.

"There's a matchmaker," Zan says, pointing to a sign in a third-floor window. Most of the newcomers here are single males. Indeed, some villages in Fujian Province have lost more than half their population to the United States and are now virtually devoid of working-age men.

At a sidewalk food stand Zan introduces me to lotus roots and sweet pancakes with peanut filler. "This is Fuzhounese food," he says. "If we were on a street that had people from northern

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Freelance photographer CHIEN-CHI CHANG, a native of Taiwan, now works out of Baltimore, Maryland. This is his first story for the magazine.

SWEARING IN He who takes the oath as president of the Chinese Consolidated Benevolent Association becomes the unofficial leader of a community that isn't consolidated at all. But despite their regional and ideological differences, most residents of Chinatown can gaze at a portrait of Sun Yat-sen and see a hero who helped dethrone China's last emperor.

China, we'd be seeing sweet rice cakes, dumplings, and steamed buns."

Zan was born in rural Fujian Province and dropped out of school at age seven. At 18 he entered the U.S. without proper papers and was jailed briefly but then released. Zan got his first job in a restaurant washing dishes. He taught himself to read Chinese and to speak and read English. Now he owns an advertising agency, a telemarketing firm, and several other businesses, employing more than 200 people.

"How did you do it?" I ask as Zan fields calls on his cell phone. We are sitting in a restaurant on East Broadway, snacking on duck tongue.

"How did I make it here? Hard work, saving, and keeping an eye out for opportunity," he says. "That's how you do it. Then something comes along." He reminds me that Chinatown has more banks per block than any other section of New York City and that these banks often have lines of people waiting to make deposits. "The banks are open on Sundays too," he says.

For the newcomer from China who wants to rise above poverty, it seems to me that the necessary first step is to learn English. On a door in a small shopping arcade I see a sign advertising English lessons. I knock and go in. A man greets me. He's surprised to see a Caucasian but motions toward a seat and offers me tea.

We are alone in a windowless room with a desk, a chalkboard, 12 classroom seats, a sink, and a hot plate. The man says he is 57 years old and was a professor of English at a major

TIGHT QUARTERS

Of the thousands of legal and illegal Chinese immigrants who arrive in New York City each year, many come from mainland China's Fujian Province and settle along East Broadway in "Little Fuzhou" (right). Signs of the time—for a marriage broker, a florist, a real estate agent, a driving school—reflect a local Chinese population that has quadrupled in the past 30 years.

Chinese university. In 1989 he helped dissident students at Tiananmen Square communicate with Western journalists. After the killings there, he came to the U.S. He does some translating for courts and immigration hearings, teaches English classes here, and sleeps on a cot behind a curtain. He says he is ashamed of how he lives and asks that I keep his name secret. So I call him Teacher. He invites me to meet some of his friends that evening at a dance hall.

The dance hall is up three flights of stairs above some shops. On the dance floor the 20-or-so regulars fox-trot under swirling lights as Hong Kong soap opera music blasts from speakers. Most of the dancers seem to be Teacher's age. They live in Brooklyn or Queens. Some are accountants or beauty technicians. A few are unemployed. They come to Chinatown to escape loneliness, to meet other Chinese people, to eat the best Chinese food, to remind themselves of where they came from. "It's fine to be young and in Chinatown," one tells me. "But if you're not young, life here is too hard. You have to work too long for too little money."

The next afternoon I meet five students in Teacher's "restaurant English" class.

The students repeat "A, E, I, O, U" and do drills: "We, he, be, me, she; bike, like, big, pig." I sit in the back thinking this should be easy, until Teacher, perhaps reading my mind, asks me to repeat some Chinese words. My mouth becomes knotted. I try again. Nothing comes out. The students smile sympathetically.

FOR A CENTURY and a half this part of lower Manhattan has functioned as a catchment for successive waves of poor immigrants, including Irish, Germans, Italians, East European Jews. Each enclave dissolved as second and third generations seized the opportunities that education afforded them and then moved on to better neighborhoods, greener suburbs, or distant cities. But lower Manhattan, with its inexpensive housing, remained, ready to absorb the next wave.

The Chinese of Chinatown fit this pattern but might also break it. Most of them are Cantonese speakers who have lived here for several generations. China also harbors a supply of potential emigrants that appears virtually unlimited. And they will keep coming as long as the most common jobs in Chinatown, restaurant and garment workers, require neither a command of the English language nor, as far as the boss is concerned, proof of legal status.

To a greater degree *(Continued on page 71)*


福建旅行社
福州婚姻介紹
福州小食
紐約第一駕駛學校
ONE WAY
MARKET
MANHATTAN BR
州天天男女髮型

Trying to fit in

Upon arrival in New York many immigrants can afford to live only in dilapidated, cockroach-infested boardinghouses like this one a few floors above Bowery. For $150 a month, a tenant gets his own bunk bed in a tiny room he shares with perhaps three others. Many of the men—and they are all men—make room for a TV, their window on America. Down the hall are two showers, four toilets, and three sinks that serve several functions for 100-plus residents. Nevertheless, says Paul Lee, a local merchant: "You want to meet a billion people who'd like to live in the United States? Go to China. At least here we have toilets that flush."

Keeping an American dream alive on Bowery

Trying to deal himself a better hand, this 50-year-old man bid his family in Fujian Province good-bye ten years ago and left for the U.S. Today he remodels Chinese restaurants. "I dream of bringing my wife and children over here," he says, "and opening my own restaurant."

STEAMED UP

Low-paying restaurant jobs sustain large numbers of immigrants. Many of them work grueling hours, stopping to grab a bite to eat when time permits. Their strong work ethic is fueled by a hunger to escape poverty and, for many, by a crippling load of debt. To reach the U.S., some recent arrivals promised as much as $35,000 to smugglers, called snakeheads, who don't hesitate to use intimidation and violence to exact payment in full.

(Continued from page 64) than for their European predecessors in these tenements, assimilation is difficult for the Chinese. "No matter what we achieve and where we live, people still see us as Chinese," one businessman tells me. Their ethnic pride is rooted in a continuous culture 4,000 years old. Except for the past few hundred years, China was the world's most technologically advanced culture. Everyone I meet, even Chinatown's poorest, uses the same word for white people. It means "barbarian."

Cultural pride is evident in Chinese Americans who live among non-Chinese neighbors throughout the metropolitan area but come back to Chinatown on weekends to give their children what they call "a Chinese experience."

"It's like going back to mom's house," one woman explains. "It's nostalgic. You go even if you don't need anything, and you always pick up something that reminds you of home."

Chinatown also attracts young adults who don't speak Chinese but feel drawn for reasons they can hardly articulate. "Only a Chinese person can cut my hair," says a young Chinese American who lives in Connecticut but whose barber works in Chinatown. Residents of Chinatown describe these visitors as ABCs—American-born Chinese—or as bananas, yellow on the outside and white on the inside.

The ABCs often sound defensive. "It's not a crime to be Chinese and not speak Chinese," one young woman shouts at a street vendor who's frustrated that she speaks only English.

To keep their sense of the mother culture strong, some ABC parents send their children to Chinese-language, or "Saturday," schools in Chinatown. Others bring their children to Chinatown's public schools from other parts of New York. One afternoon I wait with parents as they pick up their kids after school. They are middle-class professionals. "We never lived in Chinatown," one mother tells me. "I just want my daughter to know what it's like to be in an environment with Chinese people."

CHINESE IS THE NATIVE LANGUAGE of photographer Chien-Chi Chang. He is from Taiwan and has been living in Chinatown with illegal immigrants for about six weeks. I ask if I can visit where he sleeps. He is apologetic but firm: This might jeopardize the trust he has earned. I can come only when he has finished taking photographs.

Late one evening, more than a month later, Chien-Chi takes me to a large building on Bowery, one of Chinatown's busiest streets. On the second floor we pass the locked doors of a Buddhist shrine. "You will not be reincarnated for 10,000 years if you steal from the temple," warns a sign in handwritten Chinese.

On the fourth floor, where Chien-Chi has been living, the smell of urine mixes with the odor of food cooking. Plywood partitions separate sleeping platforms stacked as in a submarine. Exposed lightbulbs dangle from the ceiling. The walls are covered with hooks for hanging clothes and photographs of families.

One man tells me, via Chien-Chi, that he is happy to have a construction job in New Jersey. It pays ten dollars an hour, most of which he sends to his family in China. In a 40-hour week he earns more than the average yearly income of a person in his home village.

"What if you're hurt?" I ask, thinking that he'll laugh at my American softness. After all, he's young and looks quite strong.

The man lifts up his sleeve and shows me where an accident at work broke his wrist. He received no medical care. He pulls up his pants leg. Open sores from a work-related accident cover one ankle. He says it always hurts.

"When I'm here, my heart is in China," he tells me. He has a telephone in his cubicle which he uses to call his family in Fujian; his monthly telephone bill can total more than his monthly bill for food.

Despite their discomfort and longing for home, the men crowding around us still see America as a place of hope, the "golden mountain" where dreams come true. When I talk about how hard life must be and ask why they don't return to China, they protest. "I know I can succeed, so there's no need to go back," one man assures me. "This is much better," says another man. "In my village there is no work."

LOOKING AHEAD If their parents have their way, Lily, Mary, and Amy Lam will not grow up to become garment workers like their mother. Though many needle-and-thread workers toil in union shops (below), they remain hesitant about demanding their legal rights, largely out of fear of losing their jobs and benefits.

To disappoint their families back home would be to lose face, a concern fundamental to Chinese culture. But many of these men have a special reason not to return home empty-handed. They have paid smugglers—whom the Chinese call snakeheads—about $35,000 for their trip to the U.S. The smuggled men borrowed this money from family and friends and must pay it back. One of Chien-Chi's friends, who refuses to meet me, has just smuggled his wife in, raising their debt to about $70,000.

Revenues from smuggling Chinese to America—most of them end up in New York City—now run as high as 600 million dollars a year. Many snakeheads engaged in this traffic are also involved in drugs, counterfeit credit cards, and food stamp fraud.

"We've successfully broken most of the old-style, family-oriented crime organizations traditionally associated with Chinatown," a federal prosecutor told me. "But now we have these new international crime syndicates. Cracking them is much harder." With major centers in New York, Los Angeles, Atlanta, Chicago, and San Francisco, the new syndicates enjoy ties to crime families in Taiwan and China.

According to law enforcement officials, most smuggled immigrants come from Fujian Province. Their journey begins with a down payment; the snakeheads demand around $1,500. Then there is the trip, usually by freighter, which can take four months and include stays in Latin America, Russia, or other jurisdictions with lax visa requirements. Officials say physical abuse, disease, and inadequate food or water kill some of these people the snakeheads call customers. Customers often enter the U.S. across the Canadian or Mexican borders.

Once in New York, customers telephone their families in China. The family then pays the balance to local "snaketails." Treatment of people for whom payment is not quickly made follows the same pattern: They are locked in a basement, handcuffed and beaten, sometimes raped. A customer's finger may be crushed or cut off as he sobs into the telephone: *Sell the house. Sell anything. Do anything. Make the payment or I'll be killed.* Often there is disbelief at the other end of the line. If one has arrived safely in America, surely the hardest part is

Fat, fresh, and ready to fry

Presented with two hogs, a Chinese chef might prepare shredded pork with garlic sauce or roast pork with broccoli. But don't call these dishes "Chinese food," because there is no such thing. There are only regional cuisines: Cantonese, Fujianese, Sichuan—or American.

over. An increasing number of customers are being forced into indentured servitude because financial resources in their home villages have become depleted.

Prosecution of snakeheads is difficult because they inspire so much fear and because many in the Chinese community have little sympathy for the victims, who agreed to pay the snakeheads' fee. Economics is also a factor. Peter Kwong, chairman of the Asian American Studies Program at Hunter College in New York City, has lived in or near Chinatown for 15 years. His new book, *Forbidden Workers*, argues that the traffic in, and abuse of, illegal immigrants is tolerated in part because the American economy welcomes cheap labor.

"It's a global economy," a federal official told me, explaining why he's not too surprised by conditions in Chinatown. "We can buy things made in sweatshops in China or in sweatshops here. It's all the same." Other officials insist that working conditions here, even in illegal sweatshops, are far better than in China.

TO FIND A GARMENT SHOP is easy. You look for steam from presses escaping through vents, and chances are it's a sweatshop. Accompanied by Adeline Chung, my interpreter, I climb three flights of stairs and open a metal door. Inside are brick walls, clothes with designer labels piled on the wood floor, and sewing machines under long fluorescent lights. Clouds of thread particles hang in the air.

My grandfather worked in a sweatshop, but my grandmother refused to because fire killed so many workers. The danger persists. Despite a huge amount of flammable material and "No Smoking" signs (in English only), I can see that several workers are smoking. Boxes block the fire escape. Suddenly, a supervisor appears and angrily orders us to leave.

FAMILY TIES They wanted a small wedding but ended up with 800 guests and a 12-course banquet. "Out of respect for our families," explains Persephone Chan. "They say more guests means more happiness."

Over the next week, through interpreters, I talk with dozens of garment workers. Many say they're satisfied. One woman claims she earns more than $30,000 a year. "We don't tell the government," she says, "so we also get food stamps." But most describe a life my grandfather would have found familiar: pains in the back, legs, and arms; long hours growing longer. "What about the eight-hour workday?" I ask. "I'd be happy with ten or twelve," one woman replies.

Many, or perhaps most, garment workers also are paid far below the legally mandated minimum wage of $5.15 an hour. Sometimes employers refuse to pay their workers on a regular basis.

On a street filled with garment shops two men sit on stools, talking. One is missing several fingers. "How did you lose them?" I ask.

"Cutting cloth."

"Did you get workers' compensation?"

The man laughs. "They gave me $50 a finger," he says. "Now I have no job."

DURING MY LAST TRIP to New York City, I visit Feng Jheng and Tian-Li Li. Six months have passed since their wedding. Now they live in the Bronx, where they own a restaurant. The neighborhood is working class, mostly black and Hispanic.

For breakfast on a Sunday morning, Feng suggests we meet at McDonald's—for them a welcome novelty. They tell me how a bank loan allowed them to purchase their new restaurant from a fellow Chinese.

Their days are long; the small, four-table restaurant is open every night until after eleven. I tell them how much their challenges resemble what my grandparents must have faced and read to them from a book my grandfather studied to learn about his new country: "You have come with . . . hopes and ambitions. . . . You have before you many disappointments."

"That's for sure," Tian-Li says.

"You have also before you," the book continues, "the possibility of the success of which you have dreamed. . . . In America we are all immigrants."

Later that day, as we drive from the Bronx into Chinatown so that Tian-Li can pick up supplies for his restaurant, he tells me of his dream. He and other immigrants plan to buy a farm to grow Chinese fruits—litchi and longan—in American soil, for sale in Chinatown. Tian-Li has already scouted for real estate in southern New Jersey. Two of his cousins, who work on a New Jersey farm, told him about the latest developments in farm machinery and plant genetics.

"I won't be doing this restaurant business for long," Tian-Li says. "In about a year and a half I'll have saved enough money to pay my share of the land and rent the machinery."

Everything about Tian-Li tells me that—yes—he'll have that farm. Saying good-bye, I tell him that the next time we meet, my children will be climbing his longan trees. □

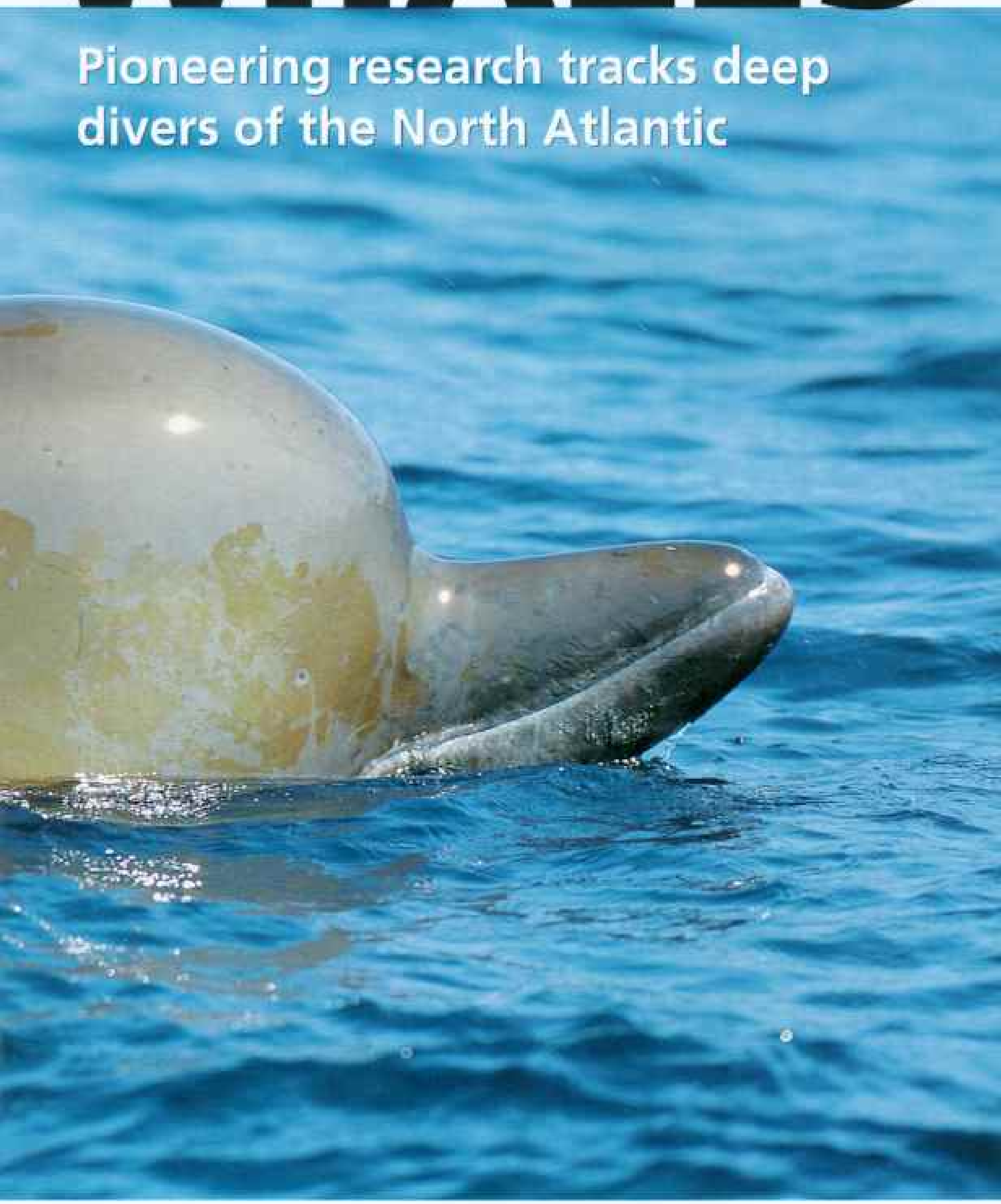
BY DOUGLAS H. CHADWICK PHOTOGRAPHS BY FLIP NICKLIN

BOTTLENOSE

The snouty profile of a northern bottlenose whale surfacing off Nova Scotia gives away its pedigree. Beaked whales are the least known large mammals on

WHALES

Pioneering research tracks deep divers of the North Atlantic



Earth. Biologist Hal Whitehead and the crew of the research vessel *Balaena* are the first to study the behavior of these enigmatic creatures in depth.

Out in the gray-green ocean 185 miles east of Halifax, Nova Scotia, fogs cloak the surface a third of the time, storms raise waves 50 feet high or more, and a thin crescent of dunes slowly wanders the edge of the continental shelf like a lost beach, forever building at one end and being eaten away by winds and currents on the other. This is Sable Island, whose shoals have claimed some 500 ships and 10,000 men over the years. Mariners came to call it the Graveyard of the Atlantic.

Fifty miles farther, the seafloor suddenly drops away into the biggest ravine off Canada's east coast. Seafarers named this place the Gully, but it is more like a drowned Grand Canyon, a dozen miles across and, in places, a mile straight down to the bottom.

Our sailboat ghosts over the Gully in a blur of mist. The only sounds are of rollers schussing past the hull and the creak of the rigging as it sways. Breaths like great, bursting sighs sound through the fog. Four creatures 20 to 30 feet long have risen from the chasm. The smallest one swims for the boat. A larger companion cuts it off, and they rejoin the others to float like swollen logs a short distance away.

A loud sigh and misty spout announce an algae-coated 20-foot cow and her calf (facing page). Whalers may have preferred mature bulls, like this 30-footer taken by Norwegians in 1971 (left)—two years before the last commercial hunt.

They have small fins but big, domed heads that bulge above narrow, protruding jaws. I can tell, because their heads are two-thirds out of the water now, all pointing our way. These animals aren't just watching us. A hydrophone quickly flung over the starboard rail reveals that they are scanning us with trains of rapid clicks just above the range of human hearing. We are being studied by northern bottlenose whales. Which is only fair, since that's what we came to do to them.

The northern bottlenose and at least 19 closely related midsize whales form the family Ziphiidae. Referred to as beaked whales, they add up to one of every four species of cetaceans—the marine mammals known as whales, dolphins, and porpoises.

The public may be infatuated with whales, but most folks wouldn't recognize a Cuvier's, Sowerby's, ginkgo-toothed, or any other kind of beaked whale if one surged through the living room. Even among scientists, ziphiids probably qualify as the least familiar of all big mammals. Several have only been glimpsed. Others are known solely from the odd carcass washed ashore.

Varying from 11 to 42 feet in length, beaked whales are typically toothless except for one or two pairs on the lower jaws of males. Most live fairly far offshore over deep waters. Pitting warm blood against darkness, cold, and unimaginable pressures, they plumb those depths in search of squid and an assortment of fish. Beyond such basic facts, records of ziphiid lives are almost as blank as the white sails hoisted by the *Balaena*, the 40-foot boat whose crew I have joined.

"These are some of the most extreme animals on the entire planet, probably among the most intelligent, and we hardly know a thing about them," says the captain, Hal Whitehead, a whale expert from Dalhousie University in Halifax. "It's as though you found various species of apes that appear to be as complex

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Douglas H. Chadwick and Flip Nicklin, both frequent contributors, are collaborating on a series of articles about whales.

Inquiring eye

Who's studying whom? A calf returns the stare of *Balaena*'s crew. Other whales rest on the surface as still as logs, breathing calmly before the next dive. Bottlenose whales can't resist investigating *Balaena*. They

often circle her, scanning with eyes and sonar clicks. Such curiosity can kill. When hunters entered bottlenose territory, they would cut their engines, wait for whales to approach, then fire their harpoon cannons.

as gorillas and chimps but live deep in the forest and remain a mystery. Beaked whales are a whole new frontier."

Hal began sailing at the age of eight in England, his native country. He went on to earn a degree in mathematics before the sea drew him back to take up the study of whales. Surveying male sperm whales that feed along the Scotian shelf over summer, he regularly found high numbers toward the Gully's edge and grew intrigued by reports of bottlenoses near the center.

"The first time I went out looking specifically for bottlenoses, I came up empty," Hal recalls. "On the next trip I was fogbound, finding nothing, when the whales came to visit the boat. They stayed close a long time, rather like today, and I felt a special connection. That was ten years ago." Foul weather might hide the whales all but a couple of days during a three-week outing—as happened this trip—but the information has been building ever since.

Widely scattered clusters of the northern bottlenose whale, *Hyperoodon ampullatus*, are found from Nova Scotia eastward to the waters north of Norway. Animals have been sighted at the edge of the Arctic pack ice and even along leads several miles inside.

Already some ten feet long at birth, northern bottlenoses continue to grow in size until age 20, reaching up to 30 feet. Adults weigh between five and seven tons, roughly the same as African elephants. The oldest age recorded is 37. Sexual maturity begins as early as age seven. Pregnancy lasts 12 months. Mothers nurse their young for a year and may reproduce every other year.

One more basic fact explains how we came by most of the others: Northern bottlenoses were the only beaked whales subject to intense commercial whaling. Scientists had lots of corpses to probe.

Intensive hunting by Norwegian whalers began in the 1880s as larger, more highly prized cetaceans were becoming harder to find. The inquisitive bottlenoses' tendency to approach boats, coupled with their reluctance to abandon an injured companion, made them a harpooner's dream.

By the late 1920s, some 60,000 northern bottlenoses had been rendered into vats of grease. As the population declined and cheap petroleum reduced the demand for animal oils, the slaughter slowed, but northern whaling nations would go on to kill thousands more for their meat, much of it sold to British pet-food companies. "I had no idea the dogs and cats of my childhood were eating these strange, endearing animals," Hal says.

The commercial harvest ended in 1973, when whalers sold exactly three animals. Although the original size of the population will never be known, authorities think 130,000 is the maximum. Whaling reduced it by at least 70 percent, and the species remains depleted today.

ON AUGUST 10, after the *Balaena* puts into port for minor repairs and new supplies and then noses back toward the Gully, I sign on with a fresh crew for three weeks. The new skipper is Sascha Hooker, a doctoral candidate studying bottlenoses under Hal's guidance. Robin Baird shares the research responsibilities, and Brad Carter, a ponytailed young salt with many a sea mile in his wake, is first mate.

Three volunteers round out the list: Cheri Recchia, former marine-sanctuary specialist for World Wildlife Fund–Canada; Annie Gorgone, whale-watching guide; and myself, chief landlubber, a cringer when waves rise and winds make the rigging sing.

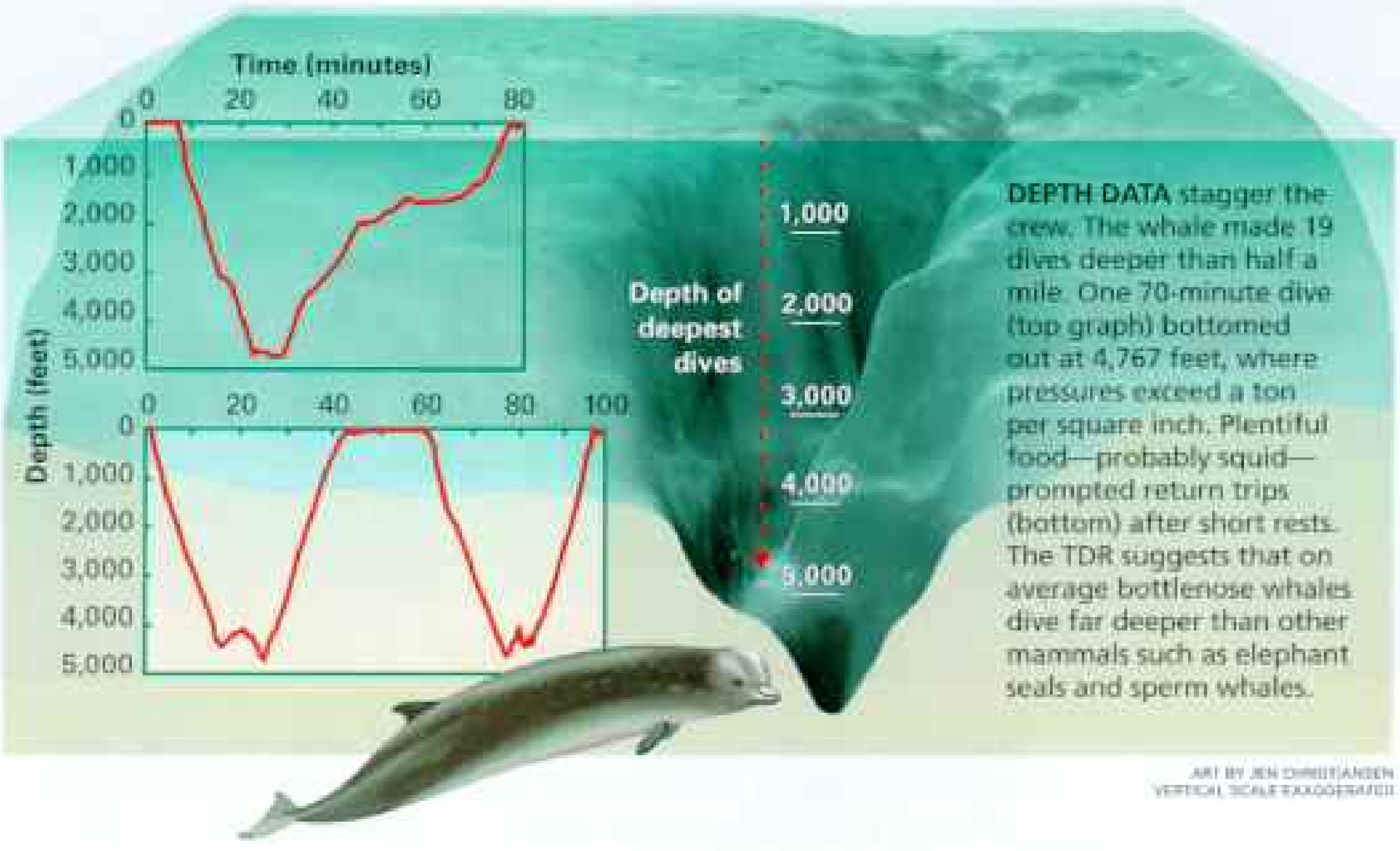
Shearwaters from South American breeding grounds glide so low in the rollers' troughs that their wing tips seem to merge with their reflections. The closer we get to the Gully, the livelier the encircling sea grows. I lean over the rails applauding the fellow mammals that have begun to escort us. Common, Atlantic white-sided, and striped dolphins slalom across our bow wave, swim upside down, go airborne, then roll onto one side to look up at me.

For elbowroom, I climb the mast to the crow's nest. Hanging on for dear life in my own private Tilt-A-Whirl, I survey 360 degrees of a world perfectly divided between water and sky. Before long I've learned to tell the tall, columnar spouts of blue whales from the low geysers of humpbacks. My first sperm whale floats among whitecaps, loosing a vapor stream from the blowhole skewed to one side of its colossal head.

At the fork of a major current, the Gully, with its swirls of nutrients, is habitat for a dozen kinds of cetaceans. The bottlenose turns out to be the most common one

Hitching a deep ride

Bottlenose whales spend only 15 percent of the day at the surface. To learn what they do in deep water, the team uses a crossbow and a suction-cup dart (above) to attach a time-depth recorder (TDR), a palm-size device bundled with a float and a radio transmitter (above right). Finding targets is the easy part. Whales congregate over the deepest parts of the Gully (art below), a submarine canyon 235 miles off Halifax. Getting TDRs to stick is harder. After days of frustration a TDR was finally secured to a whale for 28 hours.



ART BY JEN CHRISTIANSEN
VERTICAL SCALE EXAGGERATED

Synchronized swimmers

Symmetry in motion, two whales surface and exhale in unison, emerging to the rarest of North Atlantic days—a clear sky and a glassy sea. Although small groups often maneuver in tight formation for a short

time, the team's research suggests that the social bonds of most bottlenose whales are as transient as a teenager's. A month from now these whales will be swimming in sync with new best friends.

above dolphin size. As a rule we'll first see their bushy spouts far from the boat. We hurry over the swells and arrive to find that the whales have submerged on a long dive, presumably in search of deepwater squid, their favorite fare.

Then the waiting begins. It is how I imagine things were in the whaling days: seemingly interminable stretches of silence and tense expectancy followed by a sudden frenzy.

"Blows! Sixty degrees port side, 200 yards off!"

The helm wheel spins. Lines zither in and out as sails are realigned. Bodies race to quarters bearing binoculars, cameras, data sheets for noting behavior, and our miniature harpoon gun—a crossbow. It fires an arrow with a hollow tip designed to collect a tissue sample no larger than a pencil eraser.

Normally in groups of five or less, the whales have begun to join as many as a dozen others. The most noticeable additions are adult males with their imposing foreheads. They look like aquatic geniuses but are probably here out of lust, for late summer is the breeding and calving period. DNA from skin in the tissue plugs will help gauge the extent to which bottlenoses in the Gully, the species' southernmost population, are genetically isolated and therefore more vulnerable than those in contact with neighboring gene pools. Examining the chemistry of the blubber in a sample can provide clues about an animal's health and the type of food it favors.

To minimize disturbance, the samples are taken from only a small fraction of the whales and rarely from a group with a calf. But we photograph every bottlenose's head and dorsal fin when conditions allow. Markings on these areas are seldom the same for any two animals.

The Dalhousie team has identified scores of individuals. Graduate student Shannon Gowans later explains, "The more we are able to recognize, the sooner we can sort out social relationships." And the more closely researchers can estimate the size of the Gully population. The latest figure is 200 to 300. Most can usually be found within a five-by-twelve-mile area. This is a small piece of ocean to inhabit, but it is linked to very particular topography: the center of the chasm mouth, its deepest part.

If the bottlenoses don't swim too fast, we can keep

Whale of an attention getter, the bottlenose sometimes slaps the water with its flukes, perhaps in response to interlopers. A signal for humans as well? "Possibly," says Whitehead, "but I don't know if we're getting the message."

up and observe them in close formation, their movements accompanied by grunts, whistles, and Bronx cheers made by the blowholes. Every so often, one repeatedly lifts its flukes to give the water a resounding slap. Termed lobtailing, the display may function as yet another way to be heard. The same holds for breaching, though there is always the possibility that whales leap skyward and make a huge splash just because they can.

The paramount question is what goes on the other 85 percent of the time, when these animals are not on the surface? Men walked off whaling boats with stories of harpooned bottlenoses that dived and reeled out 500 fathoms of line—3,000 feet—in less than two minutes. One took out 6,000 feet, supposedly straight down. Injured animals were said to stay under a full hour or even two.

Such facts seemed exaggerated. Yet shortly before I joined the *Balaena*, Sascha and Robin tagged a bottlenose with a time-depth recorder (TDR), using the crossbow and a rubber suction cup to attach the device to the whale's skin. The TDR stayed on four and a half hours and surfaced with the first solid data ever obtained about a ziphiid in its submarine realm. Descending at a pace to match any whaler's tale, the bottlenose made several dives. One reached a depth of 2,800 feet, where pressures exceed 1,250 pounds per square inch.

We have three TDRs ready on this trip. The circuits in the first frazzle. Number two develops battery problems. The third must be the least aerodynamic package invented since the bread loaf. Robin and Brad fire it at whale after whale, only to watch the thing pinwheel off into the drink.

Almost two weeks pass without success. We all but give up. Sascha steers Brad close to a group of 11 bottlenoses. He tries one more shot, and we all run forward to see a young whale plunging away with the device stuck just below its dorsal fin. Now the challenge is to keep track of the TDR by its radio signal, which can only be traced at intervals when the whale surfaces. It ought to come off in eight or ten hours, issuing a steady series of blips for retrieval. But as night falls, we're hearing nothing at all.

During my watch in the wee hours, I get a faint signal. It fades after a few minutes. That means the TDR is still on the whale. Great. As long as it detaches soon. Another gale is forecast. Even if we stay and ride out the gusts with the sails reefed, big swells will carry off the TDR when it comes loose.

Morning dawns clear, and by midafternoon we have found more groups of bottlenoses than on any other day, but no clear radio signal.

The least frivolous person on the ship, Captain Sascha, suddenly bolts toward the bow with the radio receiver and earphones and a giddy grin, crying, "Beep! Beep! Beep! Beep!" Cheers erupt from all hands. The TDR has floated free after 28 hours. At dusk I scoop it up with a net, and we turn for Halifax to beat the storm. We will have journeyed 1,400 nautical miles this time out. The hand-size packet dripping onto my sleeve will more than triple what the researchers know about bottlenoses in the depths.

Not far from Sable Island we pass a massive well-drilling platform. Gas flares roar from flues on its superstructure, casting a dragon's breath glow on the sea a hundred feet below. A number of new platforms may soon reach along the Scotian shelf in the direction of the Gully to tap six natural gas fields. With more wells possible within prime bottlenose range, Canadians are debating a proposal to have the Gully declared a marine sanctuary.

After downloading the TDR's computer chip, Sascha tells me that the longest dive lasted an hour and 10 minutes and went almost a mile down. The whale made three other dives that plunged just as far. These revelations bolster Hal Whitehead's hunch that the world's deepest diver is the bottlenose whale—or one of the many other beaked whales yet to be studied. □

He lived some 2.8 million years ago in southern Africa, where his skull was dug from this quarry near Johannesburg. Named *Australopithecus africanus*, he is hundreds of millennia closer to man than the East African hominid best known from the skeleton called Lucy. But new research indicates that *africanus* may have had a more apelike body than Lucy. And this reopens the question of who belongs where on the human family tree.

THE DAWN OF HUMANS

Redrawing Our Family Tree?

By LEE BERGER
Photographs by KENNETH GARRETT
Art by JOHN GURCHE

"So you're saying they've got long arms and short legs, more like an ape?" asked Henry McHenry as he looked at the sketches and casts of 2.8-million-year-old hominid bones lying scattered on the floor of a hotel lobby in Oakland, California. "I think so," I said tentatively. Not even a year into my Ph.D., I was trying to convince one of the world's leading paleoanthropologists that his previous interpretations of our distant kin *Australopithecus africanus* (southern ape of Africa) were wrong.

I had come to California from South Africa, where for five years I had been living and studying new hominid fossils from a limestone quarry called Sterkfontein. Most of these fossils had been recovered by my mentor, Phillip Tobias, and his team, but they weren't widely known because of South Africa's isolation during its apartheid years. While I was writing my dissertation on australopithecine shoulder bones, I wanted to describe limb size in relation to the rest of the body. As I did my calculations, I noticed something very odd: The pattern didn't fit with current notions of what *africanus* ought to look like.

I NOTICED SOMETHING VERY ODD: THE PATTERN DIDN'T FIT WITH CURRENT NOTIONS.

Beginning about four million years ago, australopithecines roamed much of Africa. Those small-brained hominids—the transitional species between apes and humans—walked upright on two legs, the first hallmark of the human family. Scientists have identified at least seven species, but most assume that *Australopithecus afarensis*, which inhabited East Africa, begat a succession that led to our genus, *Homo*, about 2.5 million years ago.

Henry and I were conducting our mini-debate during a break in a professional meeting held in 1995. If I was right, then we paleoanthropologists would have to change our thinking about *africanus*. These southern hominids, which some scientists thought were a side branch on the human family tree, might be much closer to the main trunk—or perhaps even the species that became *Homo habilis*, the first member of our genus.

But in 1995 this theory was close to heresy.

As was well known, the early East African hominids had a primitive head and a surprisingly humanlike body, but I found that their southern counterparts looked much more like apes from the neck down. I was puzzled, because from the neck up they were more human than their older East African cousins.

But I needed better data, and Henry had it. Over the past two decades, at the University of California at Davis, he had tabulated the body weight and bone lengths of hundreds of humans and apes, assembling a database that enabled him to estimate the weight of an individual based on a single bone or joint. He could also calculate the length of almost any bone from just a tiny fragment of a joint. Without these data I couldn't prove my case, so I was eager for Henry to see in these bones what I had seen.

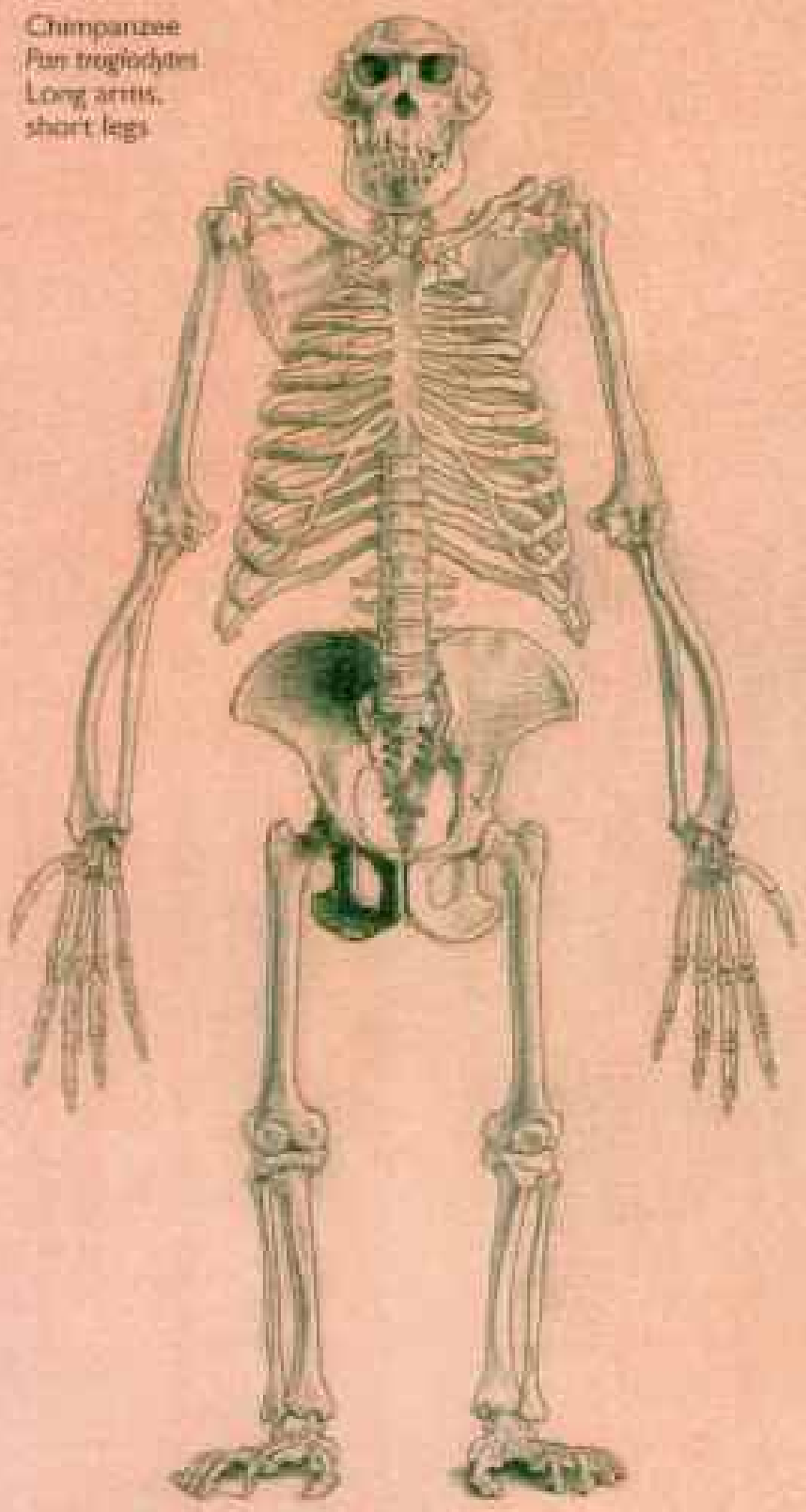
Henry picked up the casts of an *africanus* pelvis and sacrum—the bone where the spine connects with the pelvis—and compared them with two arm bones from the same animal. "They do look out of proportion," he said. "The lower body parts are too small for the upper body parts."

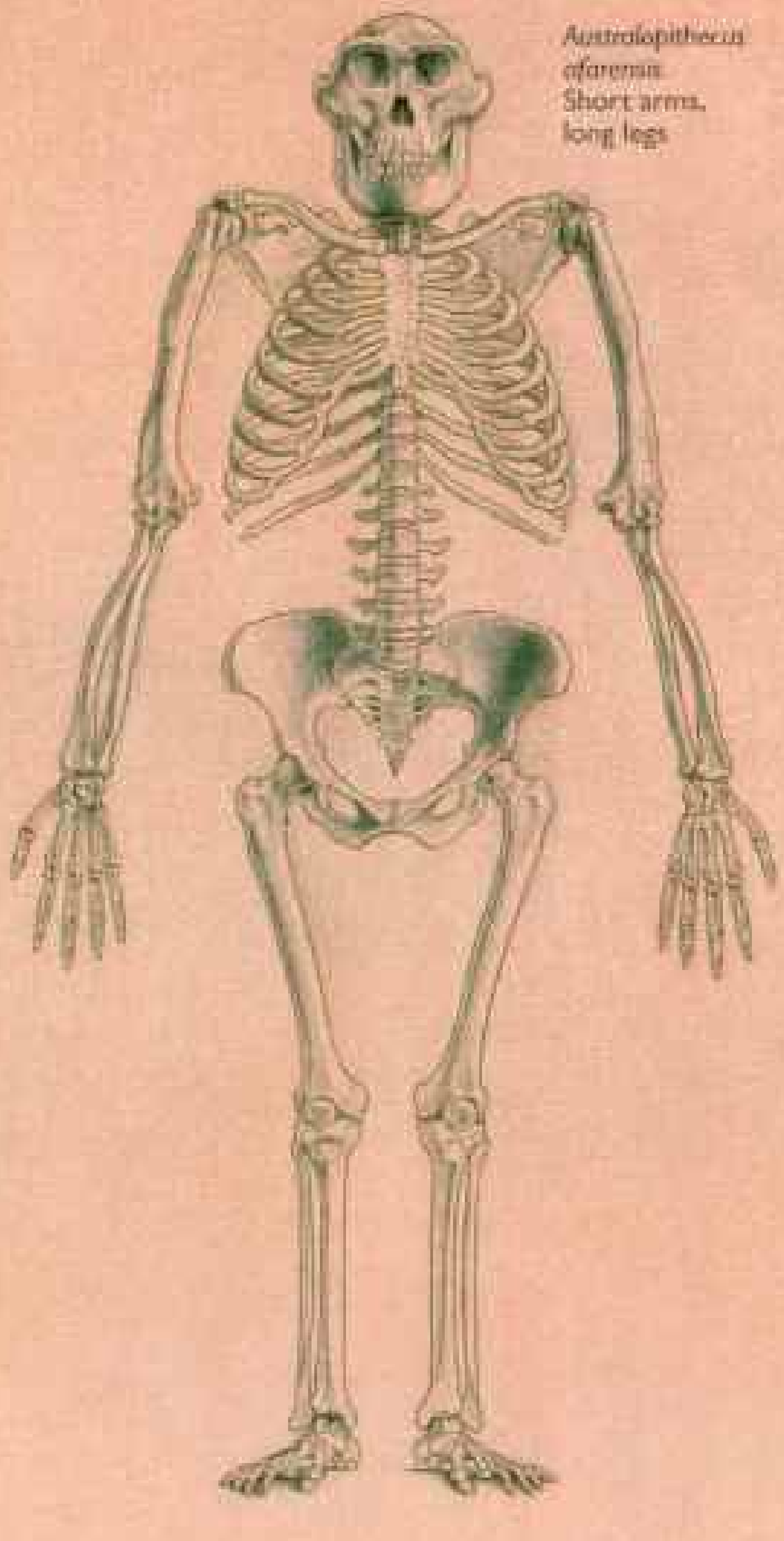
Intrigued, Henry embarked on a three-year

LEE BERGER is a professor of paleoanthropology at the University of the Witwatersrand in South Africa. Photographer KENNETH GARRETT is a veteran of 21 GEOGRAPHIC assignments, including six earlier stories in the "Dawn of Humans" series. Artist JOHN GURCHE draws on his training in anthropology as well as his artistic gift to flesh out bare bones.

When author Lee Berger examined this partial *africanus* skeleton, he noticed that its limb proportions were less humanlike than those of Lucy. Alone, this might make *africanus* a less likely human ancestor—but the first *Homo* species may also have had relatively long arms and short legs.

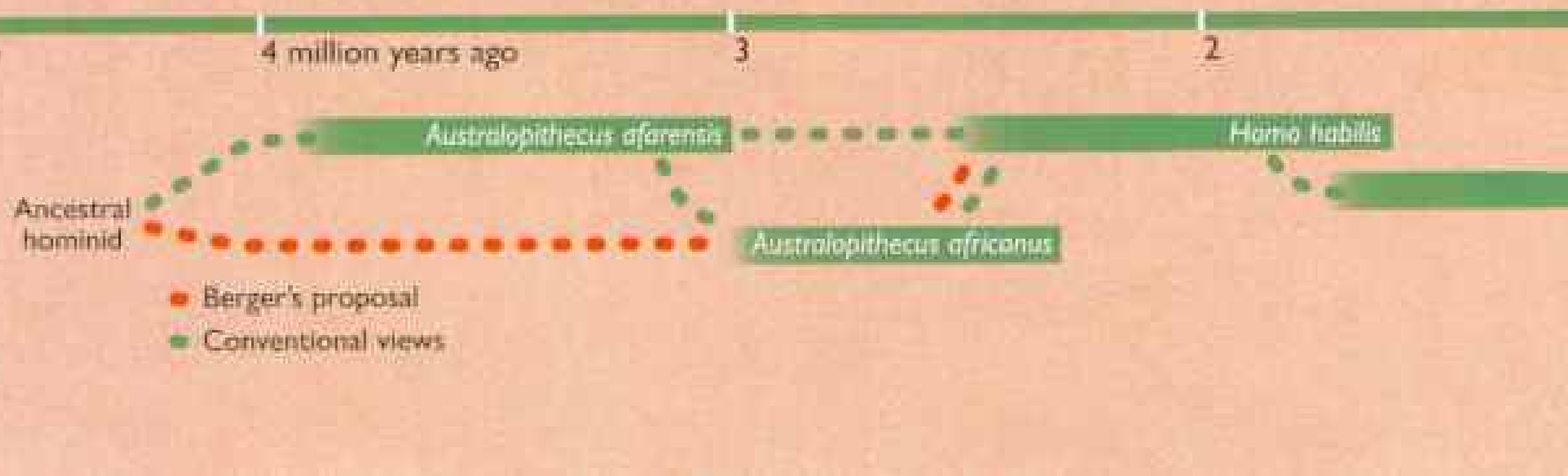
Old bones tell a new story

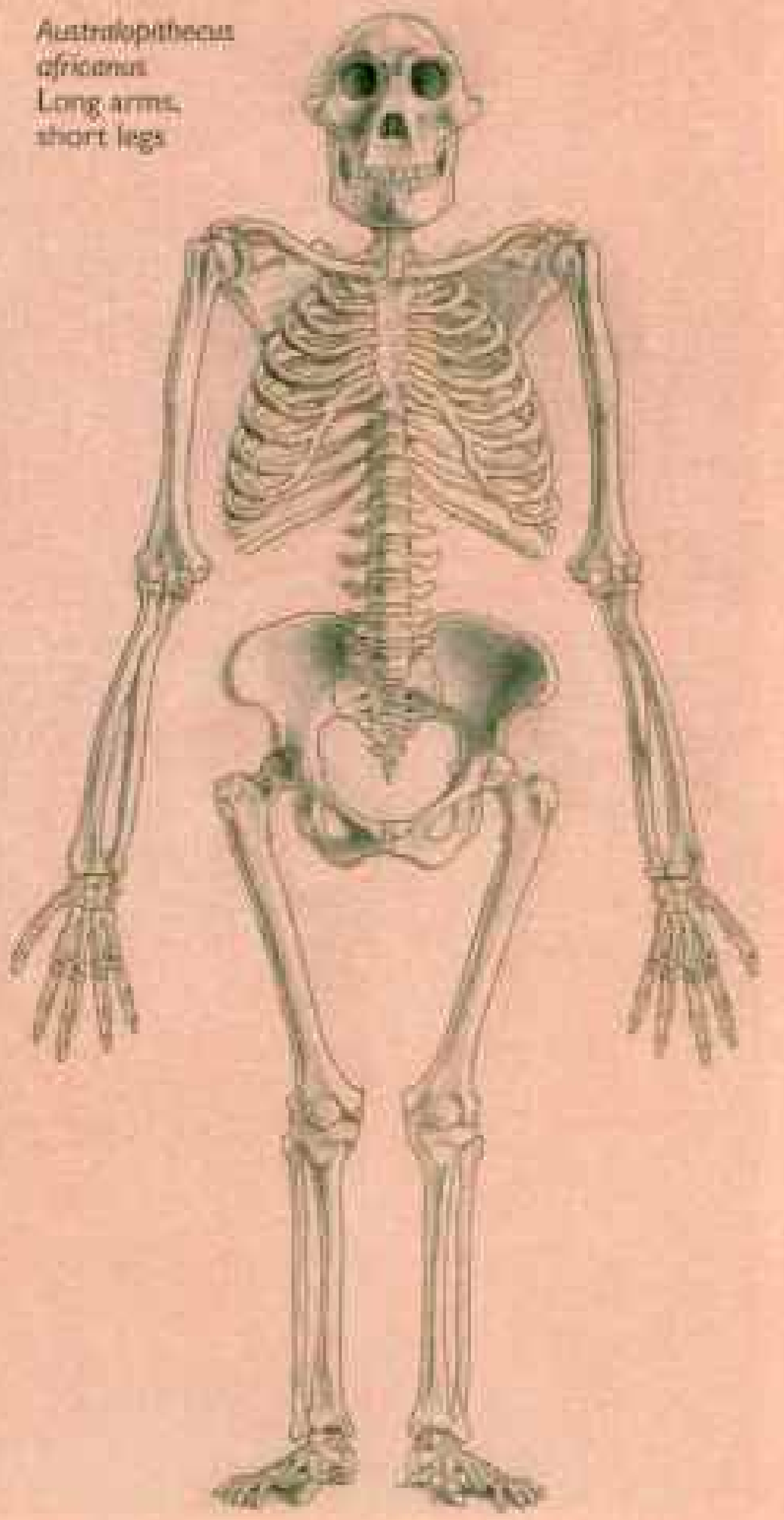


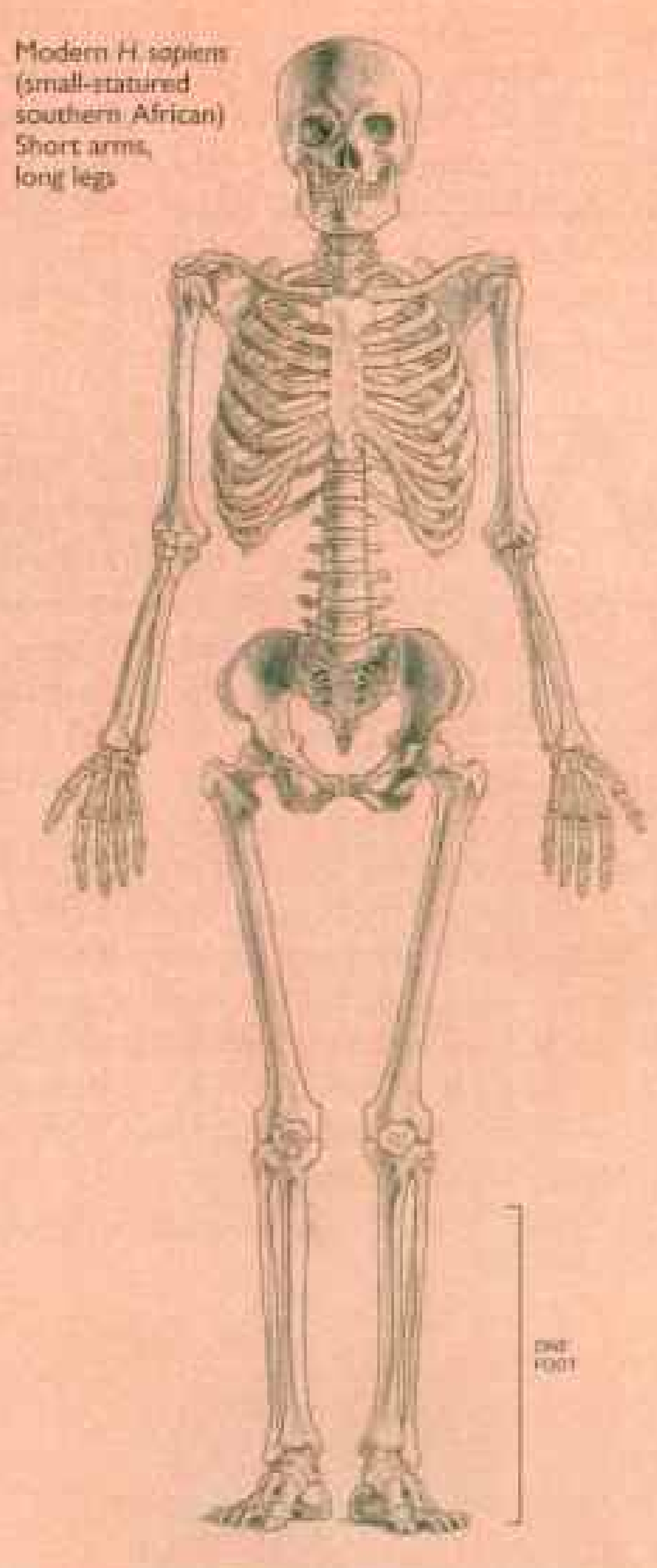


Because the fossil record for early hominids is so fragmentary, inferences and predictions fill in the gaps. In the absence of fossil specimens complete enough to gauge *africanus*'s body dimensions, it had been assumed that the species had at least as humanlike a build as the earlier *afarensis*, Lucy's species. Well-preserved skulls show that *africanus* had a slightly larger brain than *afarensis*, as well as skull features that resembled those of the first *Homo* species.

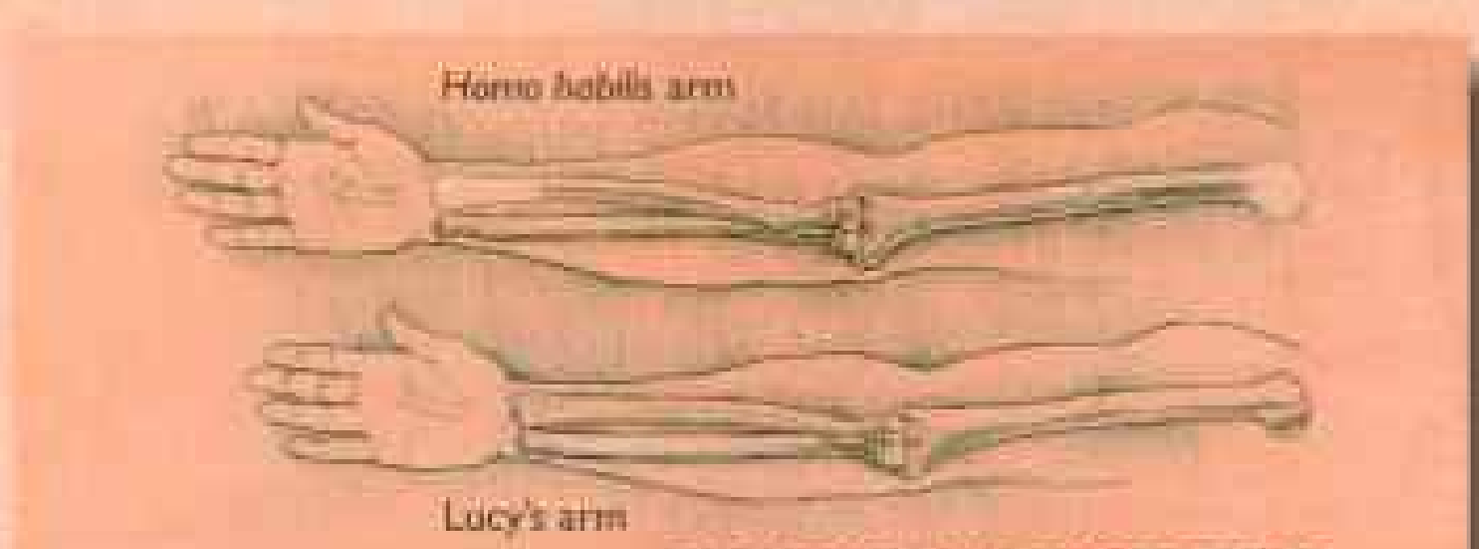
But a closer look at the available fossils reveals that *africanus* may have had longer arms and shorter legs—limbs that were more chimplike—than *afarensis*. If so, the implications are striking. One possibility is that hominids underwent an evolutionary reversal between *afarensis* and *africanus*, perhaps to adapt to a more arboreal







environment. Berger thinks it more likely, however, that the two species evolved separately. "The most probable idea is that *aforensis* and *africanus* are sister species that share a missing-link ancestor." If so, only one could have been ancestral to humans.



THE LONG AND SHORT OF IT
If the first *Homo* species, *Homo habilis*, descended via Lucy, one would expect its arms to be shortened and thus more humanlike. But a reconstruction using limb fragments (fossils are shaded here) suggests the opposite. The thighbones are the same length, but *habilis*'s arm is longer, making it more akin to *africanus*'s than to Lucy's. But too few *habilis* fossils have been found to draw firm conclusions.

project with me to study the Sterkfontein fossils. Our findings challenge the assumption that almost all the important events in human evolution occurred in East Africa—the so-called East Side Story.* The fossils from East Africa have told us one side of this complex saga; the remarkable new finds from South Africa are revealing another.

WHEN I MENTION that I am a paleoanthropologist, most people picture a lonely figure dressed like Indiana Jones scouring the crumbled ravines and weathered ridgetops of Africa's Great Rift Valley. Although I spend three or four months a year searching for telltale bones, I do most of my work in a fluorescent-lit laboratory at the University of the Witwatersrand in Johannesburg.

For me, finding the fossils is the easy part, even if the odds are only one in ten million. The hard work begins when those elusive bone fragments—some no bigger than a fingernail—arrive in the lab. As much as I love being in the bush, the rewards of this meticulous study are every bit as exciting and important as discovering a new hominid fossil.

*See "The First Steps," by Rick Gore, NATIONAL GEOGRAPHIC, February 1997.

Though East African *afarensis* fossils have garnered more attention in recent decades, paleontologists have been digging *africanus* fossils from South Africa's Sterkfontein quarry since 1936. The most prolific of four *africanus* sites, Sterkfontein is nestled in a hill overlooking the Bloubank valley (above), which was probably a subtropical woodland before the area began drying 2.5 million years ago.

The first australopithecine fossil made international headlines in 1925, after anatomist Raymond Dart identified an *africanus* skull unearthed in South Africa. Excavations there tapered off in the 1950s as the spotlight swung to East Africa with the pioneering work of Louis and Mary Leakey and the later discoveries of Richard and Meave Leakey, Tim White, Donald Johanson, and others. Now my studies and those of other colleagues are drawing the spotlight back to the unsung hominids of southern Africa.

In the past, based on work in East Africa, many scientists placed *Australopithecus afarensis* at the base of the family tree and drew a line leading ultimately to our own genus, *Homo*. Lucy, the best known *afarensis*, roamed the savannas and woodlands of the Great Rift Valley between 3.9 and 3 million years ago. When I first came to South Africa, I accepted the hypothesis that Lucy and her kind were the ancestors of all later hominids—until I studied the Sterkfontein fossils.

To prove my theory, Henry McHenry and I compared more than a hundred fossil bones from Sterkfontein and Hadar, the Ethiopian site where Lucy was found. We also included two partial skeletons: Lucy herself and STW 431, a male *africanus* from Sterkfontein.

On Henry's first visit to my lab we emptied the safe of all the limb bones—about 20 percent of Africa's hominid specimens. We laid them

A step toward humankind

Though it's clear that *aforensis* and *africanus* walked on two legs, their exact gaits are unknown. They may have walked more or less like modern humans, as shown here, or one or both of them may have had a more waddling stride. Though *africanus*'s longer arms and shorter legs made it a more likely tree climber, *aforensis* had hand and shoulder features that suggest it too spent time in trees.

Australopithecus afarensis

Australopithecus africanus

on a large, green-felt-covered table and measured each one. Henry had run the numbers, but he wouldn't believe the data until he studied the actual bones. After three exhausting days I felt relieved when Henry finally said, "OK." I knew if I could convince him, I could convince anyone.

Our analysis yielded some startling results. As might be expected, the *africanus* specimens, Lucy's supposed descendants, had heads that looked even more human, but their long arms and short legs were more primitive. They were top-heavy, as if the upper limbs belonged to a male and the lower to a female. For Lucy to evolve into these forms, evolution would have to go backward—which rarely happens.

I FELT RELIEVED. . . . I KNEW IF I COULD CONVINCE HIM, I COULD CONVINCE ANYONE.

Does the realization that *africanus* had an apelike body mean we're kicking it out of the family tree? Quite the contrary. Discoveries of *Homo habilis* skeletons in Kenya by Richard Leakey's team and in Tanzania by Tim White and Donald Johanson indicate that the first members of our genus also had long arms and short legs. Perhaps they inherited their odd bodies from *africanus*.

So rather than being the legendary mother of us all, Lucy may be just another branch on our family tree. And that branch might be a dead end: Lucy may have given rise to *Australopithecus boisei*, a robust australopithecine with big teeth and strong jaws that died out about a million years ago.

In fact, *africanus* shares more features with *Homo habilis*—a larger brain, shorter face, and smaller canine teeth, for example—than *afarensis* does. "I think *africanus* is close to the ancestor of *Homo*," says Henry McHenry. That reinforces my own conviction that *Homo* emerged from *africanus* in southern Africa and migrated north.

Our data also challenge the idea that the ability to walk on two legs like a human evolved only once. That bipedalism happened once means it might have happened many times. It may have arisen as a means of traveling between feeding patches.

I think bipedalism arose at least twice. *Afarensis* emerged in East Africa as a human-like biped but eventually died out. A second species—*africanus*—emerged at almost the same time in southern Africa, which may have stayed forested longer, requiring it to retain the ability to climb trees well. A complex mix of habitats with diverse predators and food sources may have stimulated *africanus* to become smarter—and its brain gradually to grow nearly as large as that of *Homo habilis*.

As more fossils turn up and scientific methods improve, new information will shed light on these questions. Did *africanus* evolve from *afarensis* and revert to a primitive apelike body? Or were *afarensis* and *africanus* sister species? If there was a common ancestor, what did it look like? Did it have an *africanus* body and an *afarensis* head? Whatever the results, one fact is clear: The paths of human evolution are far more complex than ever imagined. □

Lee Berger has published his findings in the *Journal of Human Evolution*. For a link, go to *www.nationalgeographic.com/media/ngm/9808/berger/*.

The fossil record has grown exponentially since Charles Darwin called it "paltry," but scientists are still trying to assemble broad theories from small piles of bones. Berger (above) thinks South Africa's unexplored terrain can help fill some gaps. "We're digging a lot of new sites that have fantastic fossils."

INDONESIA'S

PLAGUE OF FIRE

ABDUR RANI hunkered on the ground behind his home, little more than a box he'd nailed together from raw timber, and gazed across the still smoldering terrain at the acreage he'd just burned bare. For miles around this scorched field in southern Kalimantan, the Indonesian portion of the island of Borneo, the rolling land was baked black and crisp, dusted with feathery white ash. Tendrils of smoke curled from the peat ground cover and floated into the chrome yellow sky. Here and there charred and shattered tree trunks punctured the horizon, remnants of what had once been a dense tropical rain forest. The stillness of the sweltering afternoon was broken only by the rumbling and gear-growling of trucks hauling hardwood logs to the nearby Java Sea coast over roads that slashed the wilderness like red scars. In this landscape I could see only death and destruction. Abdur Rani saw opportunity, a new cycle, life itself.

To Abdur, a Dayak tribesman and a slash-and-burn farmer, fire is a regular marker on life's clock. He

By LEWIS M. SIMONS

Photographs by MICHAEL YAMASHITA

Ingredients for an environmental nightmare: late monsoon rains; the use of fire to clear land, practiced here by a farmer in Kalimantan; and industrial-scale deforestation. The resulting smoke from fires in Indonesia poisoned Asian skies.

THE DARK OF DAY

Traffic gropes through a veil of toxic haze in Palembang on the island of Sumatra. On this morning in late October 1997, the air pollution index registered 800, indicating dangerous air quality. Fearing panic and political embarrassment, Indonesian authorities were slow to declare an emergency.

counted his age, 41, by the annual rice-preparation fires he, and his parents before him, had set since his birth. Unlike subsistence farmers elsewhere who ready the soil by plowing and keep it productive by fertilizing, Abdur and millions like him burn off a few acres, plant, and then, in a few years, move to a nearby patch, repeating the process over and over again.

Slash-and-burn agriculture has been practiced for centuries throughout the tropics. By itself, it has done relatively little to destabilize the balance of nature in the rain forests, little more than, say, forest fires triggered by lightning in the northwestern United States. Small farmers generally control the scope of their fires carefully. But the Indonesian fire equation has changed dramatically in the past decade with the worldwide boom in tropical products such as palm oil.

The result, as seen in the 1997 round of fires, is one of the world's great environmental disasters. The land burned in Indonesia during that dry season has so far been estimated at 8,000 square miles, roughly the size of New Jersey. (This assessment will almost certainly grow; after the last great Indonesian drought, in 1982-83, it took experts three years to determine that 12,000 square miles had been torched.)

An estimated 20 million people were treated in the 1997 fires for illnesses such as asthma, bronchitis, emphysema, and eye, skin, and cardiovascular diseases; a passenger plane crashed in poor visibility over Sumatra, killing 234; ships collided in the Strait of Malacca, killing dozens. Pollution cost regional economies billions in aborted tourist plans, canceled airline flights, lost workdays, medical bills, and ruined crops. Wildlife has suffered too. Every day orangutans fleeing the smoke ambled, disoriented, into a conservation reserve near Pangkalanbuun; they were weakened by infections and respiratory ailments.

Abdur Rani was far too occupied with the business of survival to worry about the effects of fire on wild animals. Bald, bare-chested, and barefoot, he wore only a pair of shorts, so thoroughly patched that I couldn't identify what the original color had been. He was in his element. I looked and felt like an alien. From the eyes down, my face was hidden behind

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LEW SIMONS, a Pulitzer Prize-winning reporter who began his career covering the Vietnam War, says that the fire damage in parts of Indonesia looked as bad as anything he'd seen caused by U.S. carpet bombing in Vietnam. The photography of freelance MIKE YAMASHITA, a frequent contributor to the magazine, has been displayed at the National Gallery of Art.

EXPORTING SMOG

The lofty lights of Kuala Lumpur, the capital of Malaysia, dim under a cloud of smoke blown in from the forests of Borneo and Sumatra, the site of most of Indonesia's unchecked fires. Desperate officials ordered that all high-rise buildings have water sprayed from their heights to dissipate the choking haze. At its worst, before rains came in November and doused the fires, the pall spread over eight countries and 75 million people, covering an area larger than Europe.

NO WAY OUT

A ferry lies useless off the smogbound coast of Sumatra after smashing into a rock. Elsewhere a jetliner crashed, ships collided at sea, cars ran off roads. A shipment of surgical masks reached Jambi, Sumatra (right), but such masks provide little protection against particle-laden haze.

PHOTO: SAMSUDIN, INDOPIX

a blue-rubber respirator sprouting twin disks covered in pink fuzz. Inside the mask, my face ran with perspiration, while the rest of me was slathered in a reddish paste of road dust, soot, and sweat. I was a walking amalgam of a chimney sweep and R2-D2.

What passed for air seemed more like oatmeal, thick with carbon monoxide, sulfur dioxide, and other poisonous substances. I had no idea what the air pollution index, or API (coincidence: *api* is Indonesian for "fire"), was around Abdur's field outside the town of Pangkalanbuun. But I had already been in places where the official count was reported above 800, which doctors said was the equivalent of smoking four packs of cigarettes a day. By international standards an API of 100-200 is "unhealthy," 201-300 is "very unhealthy," 301-400 is "hazardous," 401-500 is "very hazardous," and anything higher is "dangerous." What we were inhaling, I guessed by the limited visibility and the tart taste on my tongue, must have been around seven or eight packs.

Abdur drew deeply on a yellowish *kretek*, the Indonesian cigarette blended of tobacco and cloves. The kretek gives off a spicy scent and a sweet taste that I've always associated with the romantic East I discovered as a fledgling foreign correspondent.

But it's rough on the lungs. Unlike me, Abdur didn't seem to be giving any thought to his lungs.

"Fire is good," he explained patiently during the course of a long and convoluted conversation through an interpreter. "Burning the land means we'll have enough food to fill our bellies for the year. Fire is life."

Fire is also free. Clearing land by bulldozer costs about $80 an acre—impossible for subsistence farmers. They operate in the wake of logging teams, mainly poachers, who scythe the forest, felling huge trees and skidding out the trunks on bamboo tracks. Using the scrap timber left behind, the farmers build shacks for their families. Then, swinging heavy-bladed *parangs*, they slash the remaining brush and saplings, mound them high, and set the heaps afire.

This time, taking advantage of a prolonged drought, Abdur had burned off much more than usual—the equivalent of five football fields. Even as some patches still smoked, he was planting bright green cassava seedlings alongside his house. In a few days, he, his wife, and their three children would jab

shallow holes into the warm peat with sharpened sticks and drop in rice seed.

The 1997 drought, Indonesia's most severe in 50 years, was largely the result of El Niño. This periodic warming of Pacific waters reverses global weather patterns, substituting dry seasons for rainy, storms for calm, hot for cold. It had held back the monsoon, which normally begins in September, until November. Abdur had never heard of El Niño, but he knew that the late monsoon gave him better conditions to burn. "More fire means more clear land," he said with a wave of his softly crackling kretek. "And more clear land means more planting and more food."

And more palm oil. Slash and burn has been industrialized. Giant agribusiness firms clear-cut the hardwoods for sale abroad, peel lesser trees into sheets for plywood, burn the scrub, and put in huge plantations of fast-growing, cash-earning oil palms for the world's soaps, salad dressings, and cookies.

Laying the bulk of the blame on those like Abdur Rani who burn to survive—which official propaganda and much of the resultant news coverage did—muddies the reality. Only burning by agribusinesses could spread such a pall of air pollution throughout Southeast Asia and shrink Indonesia's rain forest so quickly. And if the fires burst out of control, either by accident or by design, and they frequently do, then plantations may be expanded that much faster.

FOR A MONTH Mike Yamashita and I tracked the burning, experiencing its baleful effects. Then, shortly after I returned home, I began feeling as though my head were stuffed with cotton

batting. I became dizzy and even fell down the stairs. I couldn't concentrate. One doctor guessed that pollution had affected the inner ear, disturbing my balance. I recalled that a farmer I'd spoken with had complained of similar problems. After two months my symptoms cleared up.

Accompanied by a pair of local guides and a succession of truck drivers and boat and ferry pilots, we traveled some 1,200 miles in Kalimantan through smoke and fire. We also visited the Malaysian capital, Kuala Lumpur, one of Southeast Asia's most glittering cities. Even in normal times this low-lying city contends with industrial and automotive pollution. But Kuala Lumpur was in the flight path of the smoke coming across the South China Sea from Indonesia, and its residents were choking beneath a smelly, yellow-gray shroud.

As we drove through the jungle of Indonesian Borneo, rarely were we out of blackened terrain. Often we were ringed by open flames and smoldering peat, which pumped out particularly noxious smoke. Mike, ever mindful of light levels, pointed out that even though we were astride the Equator, the sun never pierced the smog sufficiently to cast a shadow. When the sun was at all visible, it seemed as small and pale as a brassy sequin pasted to a sheet of gray cardboard. Early mornings, midday, and late afternoons were indistinguishable—just gray. Visibility was so limited that we were continually startled by motorcycle and bicycle riders, cars, trucks, and pedestrians suddenly popping out of the gloom. Only a few wore flimsy cloth or paper masks, largely ineffective against the poisonous air.

RECKLESS PLAY

With local health clinics overflowing with patients complaining of breathing difficulties, two weekend soccer teams play as if nothing is amiss in haze-shrouded Palembang. Some 48 million Indonesians were stricken by the smoke.

One evening in the market town of Ketapang, a clerk at the Taruna hardware store was hanging a dozen paper masks on a wooden rack. This was the only shipment received in four months, and he doubted he'd sell many.

"We haven't been told about the haze being harmful," he said. "I don't think it's dangerous."

The next morning I couldn't see more than 20 yards up Jalan Merdeka, the main street. Children in blue-and-white uniforms held rags to their noses as they jounced along behind their parents, who were scootering them to school. The hardware man reported that he'd sold two masks.

We drove for hundreds of miles at a stretch, past rows of spiky green oil palms, some as tall as two-story buildings. At first the plantations seemed attractive, the trees heavy with clusters of the purple egg-size fruit that is the source of the rich oil. But as we traveled on, it became evident that entire forests had been destroyed to make way for these industrial gardens and that thousands more acres were going up in flames daily.

Indonesia ranks behind only Brazil in its endowment of tropical rain forest—10 percent of all that remains in the world. But the pace of burning is far ahead of planting, leaving a carbonized desert. Without ground cover to slow erosion, past rains had scrubbed the unpaved roads into ruts and canyons. Every few spine-crunching miles we had to pile out of our Indonesian-made utility vehicle, a Kijang, and shove timber scraps under the wheels for traction.

From time to time we passed collections of shacks coated in red dust—settlements of migrants from the teeming island of Java to the south. They're encouraged to move in exchange for five acres of land—part of which the government burns out of the forest for them.

Arriving at one of these settlements one afternoon, we met a dozen men unloading potted oil palm seedlings from a truck. A sign identified the plantation owner as the Good Hope company. The foreman, a genial migrant named Halim (like many Javanese he has only one name), said Good Hope was an Indonesian-Malaysian joint venture. This estate now measured about 50 miles by 50 miles, and crews like his were burning an additional 15 square miles a night to link up the property with another Good Hope holding 25 miles away.

Much like the slash-and-burn farmers, those who work on the oil palm estates ignore the health hazards and environmental damage their work causes. For them it's a powerful economic incentive, a step up from what they knew before. "It's hard work, very hot and dirty," Halim said, "but we have our own house, and a garden for vegetables and even some chickens."

THE INDONESIAN government issued more forest-clearing concessions in 1997 than ever before, mainly to companies owned by wealthy entrepreneurs with connections to then President Suharto. "The people who own these conglomerates have direct access to the president and

SLASH AND BURN

A ravaged piece of rain forest in Kalimantan, leveled by loggers months earlier, becomes the new home of Dayak farmer Abdur Rani. Planting cassava on ground he cleared and fertilized by fire, Rani will also grow rice before moving on in a few years, following an age-old pattern of life in the tropics.

his family," said Emmy Hafild, director of the Indonesian Forum for the Environment. "There are a few honest ministers and senior bureaucrats, but the big businessmen are far more powerful than they are. Corruption is the standard in our country. There is no rule of law."

From the perspective of environmentalists like Hafild, the chief culprit is Mohamad Hasan, one of the largest forest concession holders. He acknowledges having two million acres, but his critics claim that's a fraction of the land he controls. Known to everyone as Bob, Hasan, an ethnic Chinese who converted to Islam in his youth, became Suharto's weekly golfing partner. Operating as spinmeister for Suharto in the fire crisis, he deflected my request to arrange an interview with the president. But he received me at his home in south Jakarta, a palatial cream-colored structure with a living room the size of a basketball court, ringed by concrete walls guarded by uniformed armed men.

A diminutive, mustached figure in an egg-yolk-yellow batik shirt, characteristically sockless in black slip-ons, Hasan nimbly launched into an impressive-sounding recitation of the laws limiting exploitation of the rain forest: "We have in our country 143 million hectares [353 million acres] of forest, of which 64 million are production forest—meaning we're limited to taking only five to ten trees of 50-centimeter diameter per hectare. Then, 30 million hectares are protected, meaning we can't touch it, and then there's 19 million hectares of national park, which we also cannot touch. This leaves 30 million hectares of conversion land, which may be converted to agricultural purposes. Thirty million hectares out of 143 million is a small fraction." (It represents 21 percent of the area of the country under forest.)

Furthermore, Hasan said, industries based on forest products provide four million jobs. His land ("actually the people's land, which we're permitted to manage for them") is patrolled on the ground and by satellite. "I'd sack anyone who'd burn it." Indeed, he said, "I've suggested that the government take to court people who burn forest land. Because of my friendship with the president, Indonesia has become one of the world's leaders in reforestation."

The government claims that 1.5 million acres of forest were planted in 1996, but critics doubt this and allege that much more could have been done. An Indonesian economist said that in 1996 the 660-million-dollar national reforestation fund "loaned" 178 million dollars to a controversial national jet aircraft development program headed by B.J. Habibie, another Suharto friend. And 108 million dollars of reforestation money went to the giant Kiani Kertas paper and pulp project in Kalimantan—owned by Bob Hasan.

Anyway, said Hasan, Indonesians weren't the ones setting the big plantation fires. It was being done by "outsiders," a euphemism for

Malaysians. Investors from neighboring Malaysia are joint-venture partners in newer oil palm plantations. Many are interested only in burning fast and far. But although Indonesia and Malaysia have never been wholly at ease with each other, for the sake of regional harmony their leaders dance an elaborate minuet in which neither points fingers.

OUR JOURNEY into the Borneo fires had a touch of "Heart of Darkness." As we proceeded south from Kuching, in the Malaysian state of Sarawak,

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July 29, 1997

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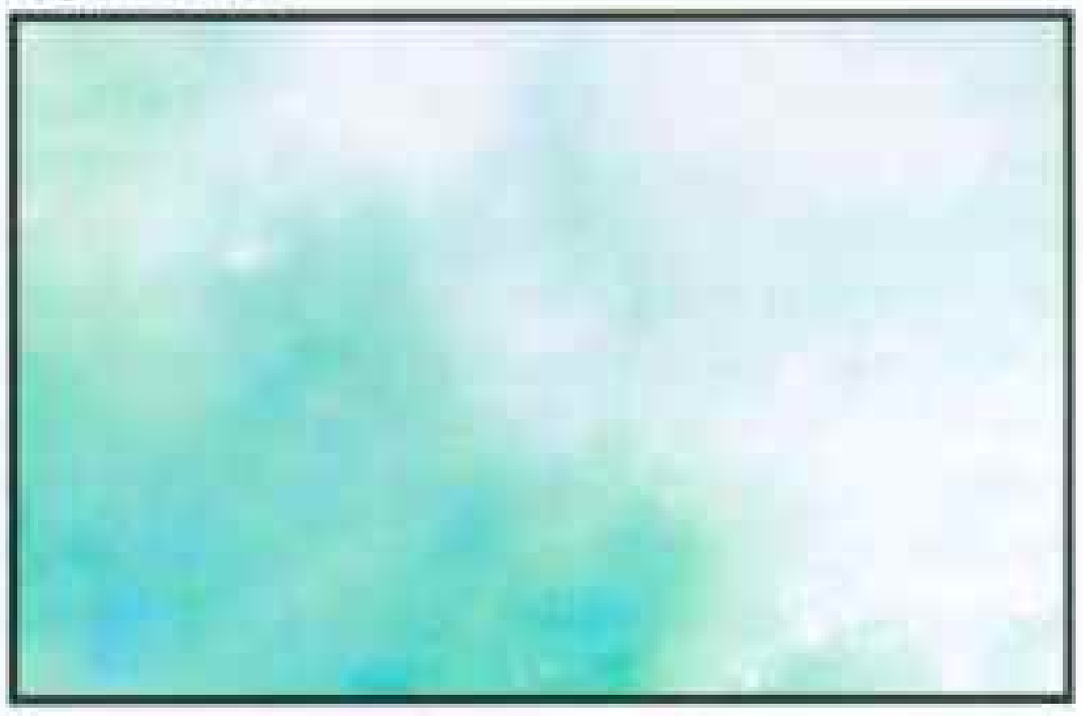


SMOKE SCREEN OF BLAME

As an estimated 8,000 square miles of land burned—an area as large as New Jersey—Indonesian officials looked for scapegoats. They pointed to an El Niño-induced drought that left ground so dry normal fires raced out of control, as in a banana plot (top) in Sumatra. They accused slash-and-burn farmers of clearing excessive amounts of land. But satellite imagery revealed the worst culprits. Large, influential companies were torching vast parcels of forest to create plantations for pulpwood, oil palms, and rice. Along the Barito River in Kalimantan (images above) so much land was burning that haze eventually blinded the satellite.

PLANTATION MENTALITY

When clear-cutting stops, debris burning begins, as loggers in Kalimantan finish off remnants of rain forest to make way for an acacia tree plantation and its quick payoff in pulpwood. The government outlawed large-scale burning in 1995, but developers openly defy the ban.

down West Kalimantan, then east across the bottom of the island to the gem center of Banjarmasin, not just the air but the very quality of life deteriorated. At Pontianak, a gritty frontier-style city, residents waded side by side in the Kapuas River, the longest in Borneo, using its green-brown water as a toilet and for bathing, laundering, cooking, cleaning teeth, and drinking. It was a sign of how far most of the 200 million Indonesians lag behind people in the more prosperous countries of the Association of South East Asian Nations, notably Malaysia, Singapore, and Brunei.

As the residents went about their ablutions, a tugboat shoved a raft of cut logs, measuring perhaps 100 by 150 feet, downriver. Headed in the opposite direction, three tugs pushed and pulled a barge of gasoline against the current: out with the rain forest, in with progress.

We left Pontianak for the next substantial town to the south, Ketapang, aboard the M.V. *Mitra Express II*, a slightly seedy coastal cruiser imaginatively designed to resemble an airliner. As we shoved off, people on the dock were doing group calisthenics, vigorously sucking smog deep into their lungs. Three hours later, about halfway to Ketapang, in the Karimata Strait, visibility dropped to zero. Then the boat stopped. It seems the navigator couldn't spot landmarks. We'd gone off course and run aground on a sandbar. Later, a few rickety fishing boats appeared, and the passengers, men first, clambered aboard the smaller boats for the remaining hour or so of the trip.

In Ketapang, Sarifah Hajijah, who assured me that she was a pious woman and had made the hajj, served us a dinner of spicy venison curry and rice in her three-table food shop. She apologized for the absence of vegetables, because there had been no sun for months.

SHORT-TERM FOREST

Rows of oil palms start off fast in a 30,000-acre tree farm wrested from Sumatran jungle. But drought and haze-reduced levels of sunlight caused crops and trees to wilt, resulting this year in widespread food shortages and a suspension of palm oil exports.

"This is a curse from God," Sarifah asserted. "He's angry with us." Her daily income had dropped from ten to five dollars. "My grandson, he's two, is sick all the time. He coughs and he's dizzy. I did hear that we should wear masks, but there are none. Our government doesn't care about us."

The government sees things differently. While Indonesia remains a poor country, the Suharto regime undeniably, and appreciably, reduced poverty. Government economists say that developing the world's largest palm oil industry will pay off at all levels of society. Until then, the cultural and economic roots of forest burning run so deep that the government is both unwilling and unable to attempt severing them.

When the smoke began drifting across the South China Sea last summer, inflaming the eyes, lungs, and tempers of Indonesia's neighbors, especially Malaysia and Singapore, officials in Jakarta gave a collective shrug. Their cavalier response was partly explained by the prevailing breezes—the capital itself remained clear, and its residents, including the nation's leaders, were untroubled by what local newspapers blandly referred to as "haze." Indeed, even as Indonesians in the smaller cities and towns gagged on the foul air, very few complained openly.

Yuchen, a 27-year-old woman wearing a modest black head scarf, was an exception. "It's the rich people," she said, as we chatted aboard a small ferry. "They want to make a lot of money very quickly. So they burn the forest instead of cutting it."

THERE'S LITTLE DOUBT that Suharto wasn't being kept up-to-the-minute on the fires of 1997. So common was it for his lieutenants to avoid delivering unsettling news that Indonesians created an abbreviation, ABS, for *asal bapak senang,*

COUNTERATTACK

Spearheading the international response, a C-130 Hercules from the Wyoming Air National Guard unleashes a 3,000-gallon water barrage on a dense peat fire in southern Sumatra. Several soakings slowed the blaze and prevented it from spreading into a wildlife reserve, home to endangered rhinoceroses.

PLAYING WITH FIRE

Despite roadside prohibitions (below) and grim pollution alerts, schoolchildren in Kalimantan learn that fire is the handiest tool for cleaning up waste. This ingrained habit plus continuing deforestation lends credence to fear that in Indonesia haze will become a chronic fact of life.

meaning "as long as father is happy." Eventually, though, he was compelled to act, and he apologized to neighboring countries. But his expression of regret was little more than Javanese formality. He blamed the haze on an act of God and took no meaningful action. Ironically, Suharto's rare apology sparked a reverse effect: Fearing that the government might stop issuing new land-clearing licenses, plantation operators set even more fires.

The fires coincided with a crisis Suharto had good reason to consider more pressing. The economy was collapsing around him, and world leaders were demanding that he straighten out the currency mess, which eventually led to riots that forced his resignation in May 1998.

In Indonesian culture, particularly the variant refined by Suharto over more than 30 years in power, all actions are ordered by the president or not at all. "The top-down system makes it wise for an official to keep his own counsel," explained a former government attorney. "Initiative can prove harmful to career and personal finance."

So, for example, when we stopped at the government office in Sampit and asked the tan-uniformed officer-in-charge where there were fires in the area, he shook his head. "Oh, there aren't any. Burning has been banned hereabouts for months." After coffee and handshakes, we drove less than five miles, right into a roadside fire. "We've been burning this land for the past four days," said Rosnan bin Lan, a 40-year-old widow with four children. "No one from the government told us not to."

It's a basic of everyday life in Indonesia that government workers often turn their backs in return for a bribe. But by the time I flew to Jakarta in mid-October 1997, four months after the fires began, a few officials were angry enough to speak up. Sarwono Kusumaatmadja, the environment minister whose Don Quixote-style struggle for political and bureaucratic reform has earned him quiet admiration for persistence and tongue-clucking pity for his inability to implement change, was one of these.

Sarwono assured me that the bad guys were the big guys—Suharto's friends. He helped draw up a list of 29 companies that had set illegal fires. The forestry ministry revoked their logging licenses. Yet the operators weren't worried; they knew the action didn't have teeth. "I've never seen any government effort succeed in stopping fires from being set," said André Balot, deputy chairman of the Indonesian Palm Oil Producers Association.

By February 1998, almost as soon as the rains halted, thousands of fires were sighted again, some in new locations and some where they'd been smoldering all along. Scientists worry that repeated cycles of fire of this magnitude will wreak terrible damage on human and animal life in the region, upsetting ecosystems, killing coral reefs in floods of eroded soil, and destroying one of the world's last remaining tropical rain forests. Whether the change in government will affect the rate of burning remains an open question. □


SEKOLAH DASAR NEGERI
SIDOREJO - 1
PUSAT KEGIATAN GURU
(PKG)

Abyssal darkness shrouds the Atlantic seafloor two and a half miles down. In 1991 high-intensity lighting systems allowed filmmakers to record *Titanic* in unprecedented detail. Here, made possible with computer video-editing tools, are never before seen 3-D images from that expedition.

Tragedy in Three Dimensions

TITANIC

3-D IMAGE PROCESSING BY CLAYTON R. BURNESTON, RICHARD OLSENIUS, AND BRIAN STRAUSS, ALL NGS STAFF; ART BY DON FOLEY

Inching beneath tons of crumbling steel for a look at *Titanic's* starboard propeller was "probably the most foolish thing I've done in a lifetime of doing foolish things," recalls photographer Emory Kristof. In the debris field a deck bench's bronze arabesques preserve a fragment of the liner's fabled elegance.

By JOSEPH B. MACINNIS
Photographs by EMORY KRISTOF

Are the details of any other maritime disaster as familiar as these? Shortly before midnight on April 14, 1912, the luxury liner *Titanic* struck an iceberg and less than three hours later sank into the North Atlantic, carrying more than 1,500 of her passengers and crew to their death.

Titanic titles crowd bookstore shelves. *Titanic* coal sells for up to $30 a lump. The most recent *Titanic* film quickly became the first movie to pull in a billion dollars.

Why this fascination? For some, *Titanic* epitomizes the power of crisis to reveal character—arrogant, cowardly, devoted, brave. For others, she is a cautionary tale about blind belief in one's own invincibility. For underwater explorers and filmmakers, she is the Mount Everest of shipwrecks.

Our joint Canadian-Russian-American expedition set out in 1991 to capture the clearest, highest resolution pictures of *Titanic* possible. Earlier expeditions used submersibles diving singly, with remotely operated cameras and lights that could illuminate only small areas of the wreck before their beams were swallowed by the deep ocean's utter blackness.

We used a pair of submersibles, each capable of diving 20,000 feet with a crew of three. Booms on each sub carried four high-intensity lights, their mercury-metallic-iodide bulbs adapted from movie sets. Together the subs focused on *Titanic* beams of light more than ten times brighter than any previously used.

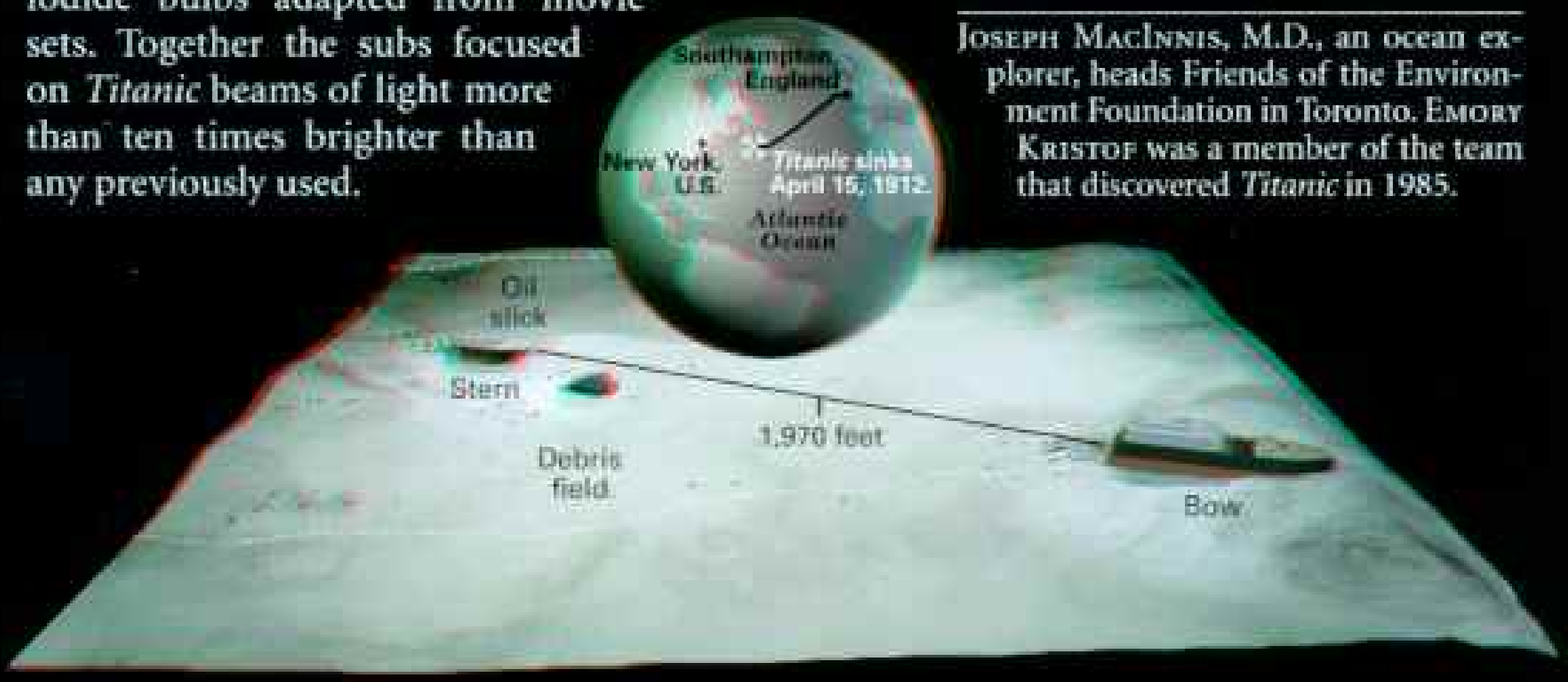
The subs bristled with cameras, including a pair of electronically synchronized video cameras that veteran National Geographic photographer Emory Kristof used to film the ship from every possible angle.

"Shooting the 3-D images under millions of tons of icy water was exhilarating," Emory says, "and dangerous." Dangling cables and ripped metal—hidden in darkness and swept by unpredictable currents—turn deep-ocean wrecks into steel traps for submersibles. "Shooting below the bridge deck we got entangled between railings and the hull," he reports. "It took 20 minutes to work ourselves free."

Our 17 dives to the bow, debris field, and stern resulted in an IMAX film, a TV special, and the pictures seen here. These poignant images—especially those of *Titanic*'s bow looming from the ocean floor (preceding pages)—helped inspire director James Cameron to use the same research ship and subs in making his award-winning film.

Titanic seems to sink as deeply into our minds as she did into the icy ocean, her unfinished voyage a recurring dream that demands we fully explore its significance. Like all compelling stories the dream begins with a series of dramatic scenes. For me the 3-D images on these pages re-create the wonder of peering through a sub's view port and seeing *Titanic* for the very first time.

JOSEPH MACINNIS, M.D., an ocean explorer, heads Friends of the Environment Foundation in Toronto. EMORY KRISTOF was a member of the team that discovered *Titanic* in 1985.



Icon of industrial prowess, *Titanic* sank without completing a single voyage. Now she's a rust-encrusted laboratory of decay and corrosion. One of Captain Edward Smith's cabin windows dangles open as the bulkhead framing it

collapses onto the forward section's boat deck. During 50 hours on the bottom, Kristof's paired cameras recorded the wreck in 3-D. "My cameras had a better view of *Titanic* than I had looking through the sub's tiny view ports," he says.

Despite striking bottom with enough force to drive her bow 50 feet into the seafloor, *Titanic*'s forward section seems eerily well preserved. A virtual sunrise of filmmakers' lights throws an anchor chain (above) into sharp relief. At chain's end the port anchor (below) still rides snug against the bow. A bridge telegraph (right) lies with its bronze mounting in the debris field, its connection to *Titanic*'s engine room shattered in the North Atlantic darkness 86 years ago.

For more on *Titanic*, join our online forum at www.nationalgeographic.com/media/ngm.

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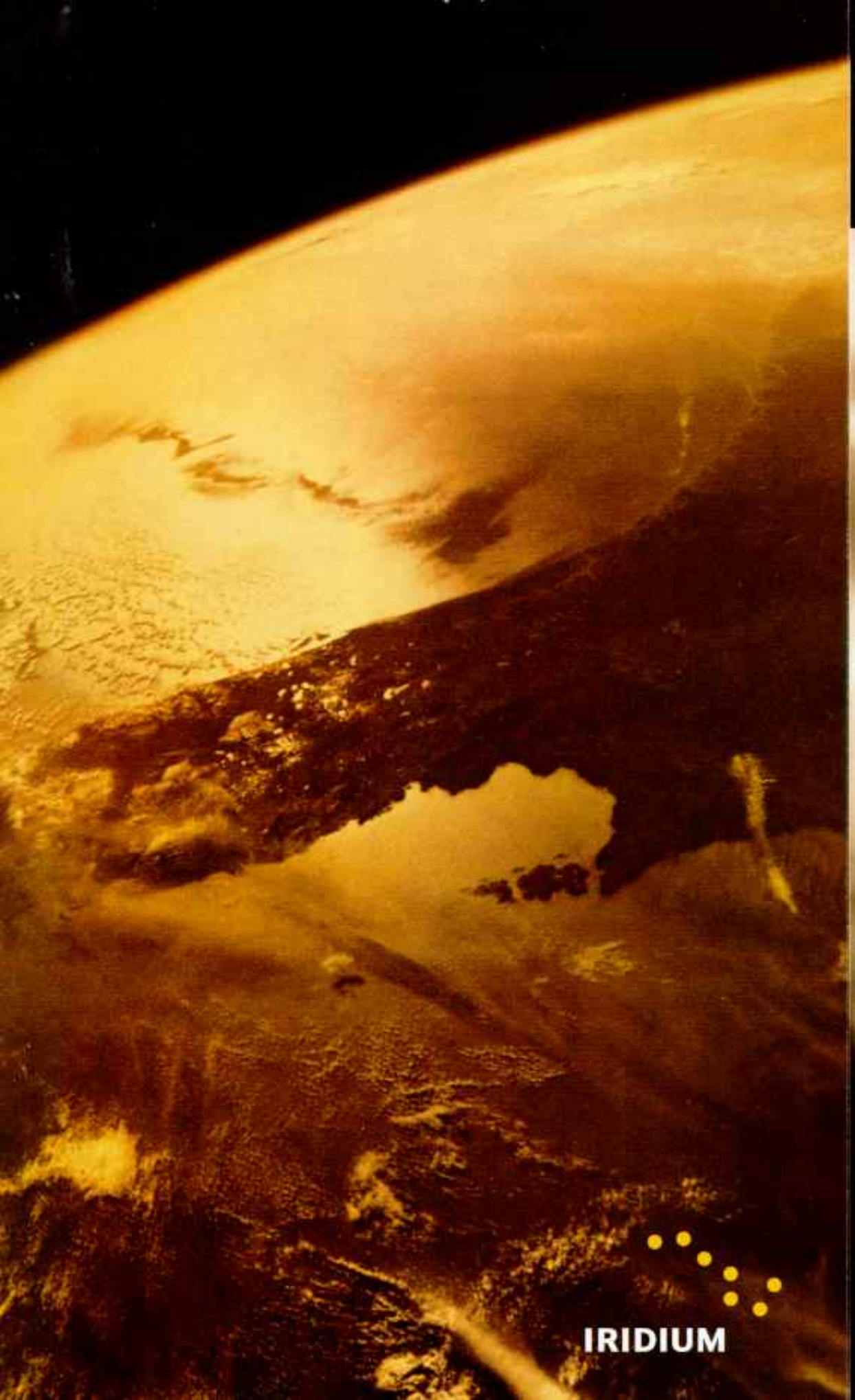

ANNUAL

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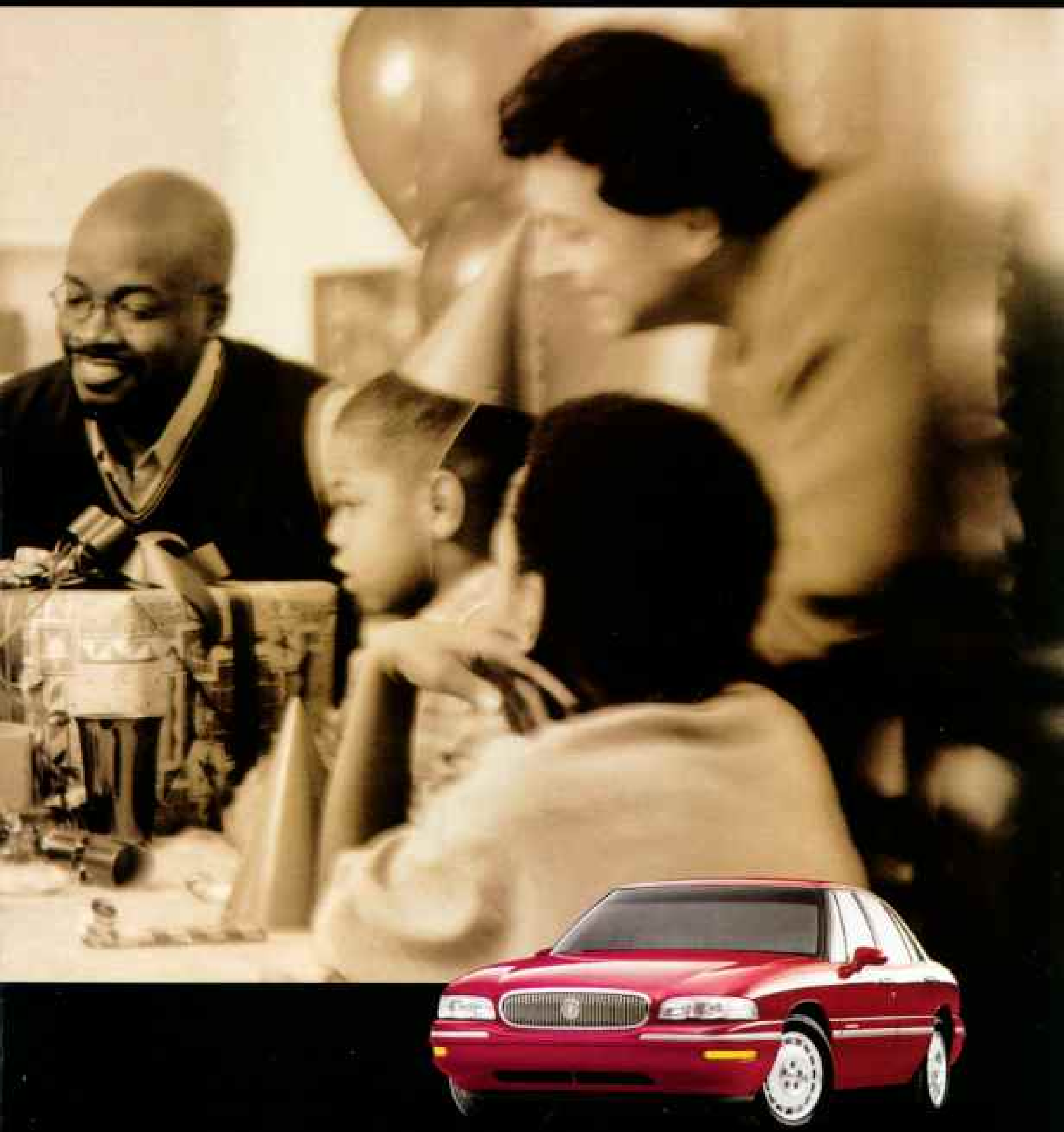

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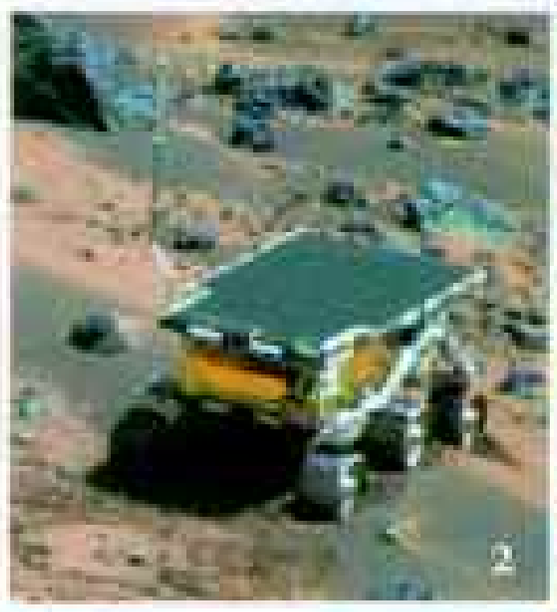
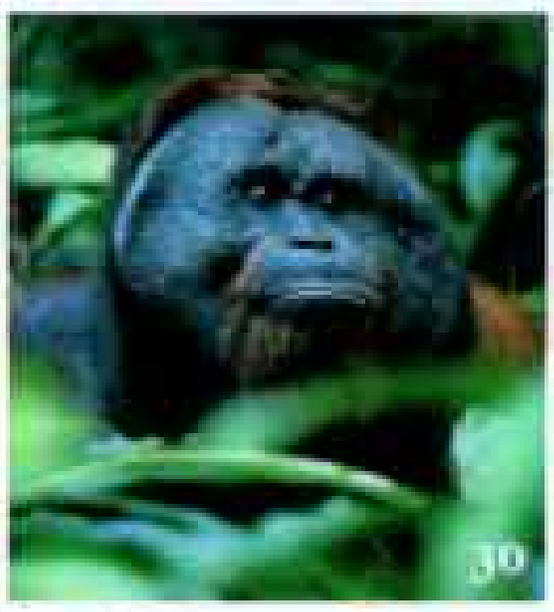
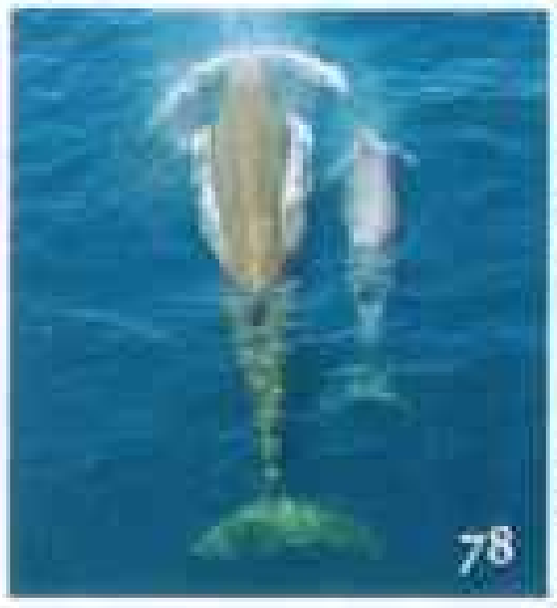
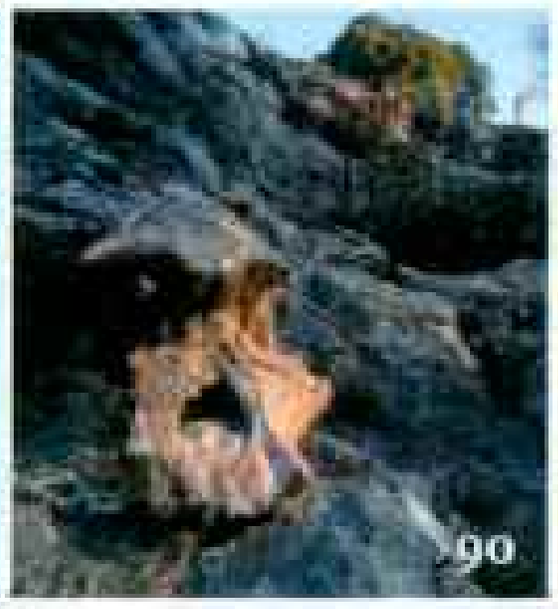
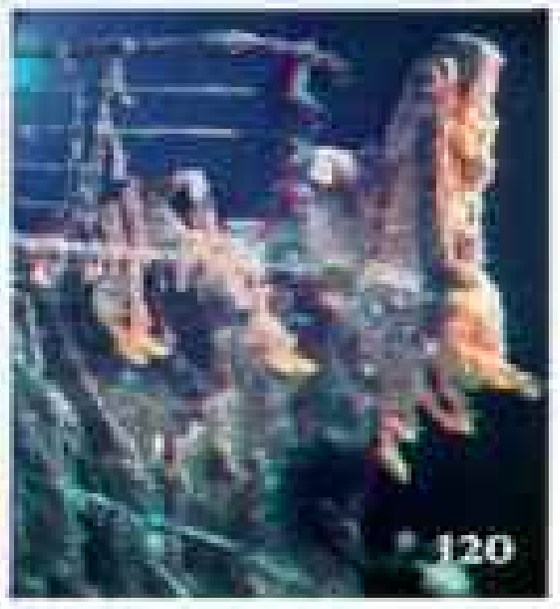
AUGUST 1998











2 **Return to Mars** *Twenty-one years after NASA landed its first emissary on the red planet, Pathfinder touched down on July 4, 1997, and recorded images and data that astounded the world.*
BY WILLIAM K. NEWCOTT
IMAGES BY NASA/JET PROPULSION LABORATORY

■ *Tear-out: 3-D glasses for viewing photographs of Mars and Titanic*

30 **Orangutans in the Wild** *Backbreaking fieldwork and meticulous attention to scientific detail bring a deeper understanding of the elusive red apes of the Borneo rain forest.*
BY CHERYL KNOTT PHOTOGRAPHS BY TIM LAMAN

58 **New York's Chinatown** *As immigration to New York surges, this vibrant Manhattan neighborhood provides Chinese newcomers a familiar setting in which to build their American dream.*
BY JOEL L. SWERDLOW PHOTOGRAPHS BY CHIEN-CHI CHANG

78 **Bottlenose Whales** *At home in pitch-dark depths lethal to most marine mammals, these cetaceans may be the deepest divers of all.*
BY DOUGLAS H. CHADWICK PHOTOGRAPHS BY FLIP NICKLIN

90 **The Dawn of Humans** *South Africa yields fossil evidence that challenges old assumptions about humankind's beginnings.*
BY LEE BERGER PHOTOGRAPHS BY KENNETH GARRETT
ART BY JOHN GURCHE

100 **Indonesia's Plague of Fire** *Unchecked fires smolder throughout the rain forests of Sumatra and Borneo, spawning respiratory illness, traffic accidents, and food shortages across Southeast Asia.*
BY LEWIS M. SIMONS PHOTOGRAPHS BY MICHAEL YAMASHITA

120 ***Titanic*: Tragedy in Three Dimensions** *Computer-aided editing transforms scenes from a diver's video into extraordinary still lifes of the somber wreck lying 12,500 feet below the surface.*
BY JOSEPH B. MacINNIS PHOTOGRAPHS BY EMORY KRISTOF

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On Television
Earth Almanac
Interactive
On Assignment

The Cover

Setting out to explore the Martian landscape, the rover Sojourner rolls toward a rock that scientists have named Barnacle Bill. View with the 3-D glasses enclosed. Image data by NASA/JPL; processing and color by Randolph Kirk, USGS

Cover printed on recycled-content paper.

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NATIONAL GEOGRAPHIC

Behind the Scenes

STEFANO RASTELLI

DAVID RUDDICK

The Shape of Things to Come

Tuareg guards get the Geographic treatment in Niger's Sahara, where NG Television's John Bredar carried our Yellow Border for a promotional spot with paleontologist Paul Sereno. Luminaries and sea lions have posed with our logo. "The sea lions," notes John, "left tooth marks."

Our Fresh Success, Italian Style

"The Society's mission is to diffuse geographic knowledge," says Bernard Ohanian, Senior Assistant Editor for International Editions. "Nobody ever said we could do that only in English." With Japanese and Spanish editions of the GEOGRAPHIC already a success, the Society introduced an Italian edition in February. Newsstands like this one in Rome's Piazza San Silvestro sold 85 percent of a 400,000-copy printing in 15 days, and Italians were ordering a thousand memberships a day. A Hebrew GEOGRAPHIC based in Israel debuted in June, and other editions are in the works. "We now sell close to a million GEOGRAPHICS in languages other than English each month," Bernard says. "And most letter writers from these countries are saying, 'Finally!'"

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MAYNARD OWEN WILLIAMS

Stuck in Trucks With National Geographic

MICHAEL YAMASHITA

Sometimes you just can't trust your transportation. The 1932 Trans-Asiatic Expedition found that this specially built vehicle (above) wasn't special enough to cross a Himalayan pass without help. To cover that trek, writer Maynard Owen Williams rode a pony that was "sinking to his belly at almost every step" in the snow. Our car for the Pueblo Bonito Expedition of 1921 was pulled from quicksand (below) by ten men, a team of horses, and a truck. Covering an earthquake in Guatemala in 1976, writer Bart McDowell (below right) got stuck mid-river. "You have to be flexible during natural disasters," he says. And strong. Shooter Mike Yamashita needed a hand in Indonesia last fall when ruts proved more than his truck could handle (above). "Somehow we got out of there," says Mike. We always do.

O.C. HAVENS

WILBUR E. GARRETT

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WALLIS W. NUTTING (LEFT); DAVID HANNAN

Still Shooting for Perfection

It's not the camera that's important—it's the eye behind it. Still, Society eyes have looked through a lot of different lenses over the years. Editor Gilbert Hovey Grosvenor (above left), an early proponent of photography in what began as a text-only journal of geography, practiced what he preached with his Graflex Series B (below left). By the end of the 19th century, fragile glass plates used in such equipment gave way to more durable technology, like this roll film camera of Arctic explorer Robert Peary (below right). And packability became crucial; staffer Barry Bishop, a member of the first American team to conquer Everest, used this extra-light Olympus Pen S Split Frame (center) on the 1963 climb. Chris Johns (above right) uses cameras like this Nikon F5 with an 800-mm lens (right) to record cheetahs in Botswana. "It may be a long lens," he says, "but it gets you as close as possible to your subject."

ALL CAMERAS FROM NGS COLLECTION; PHOTOGRAPHED BY MARK THIESSEN, NGS

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PHIL SCHOFIELD

Brownies Go for Gold

"I was afraid we'd never collect even 5,000 magazines," sighs Girl Scout troop leader Mary Kent. "I thought nobody would want to give up their GEOGRAPHICS!" For their service project her Seattle-area Brownies gathered 20,000 NATIONAL GEOGRAPHICS in a month-long magazine drive. The issues, donated in drop boxes at local businesses and churches and collected by the girls themselves, were shipped to schools in China via Bridge to Asia, a San Francisco organization Mary read about in this column in January.

In Love in Egypt

Making our first IMAX film, *Mysteries of Egypt*, producer Lisa Truitt got reacquainted with a college friend, *New York Times* Cairo bureau chief Douglas Jehl, and married him. She's still on staff but lives in Cairo. *Mysteries*, starring Omar Sharif, debuts nationwide this fall.

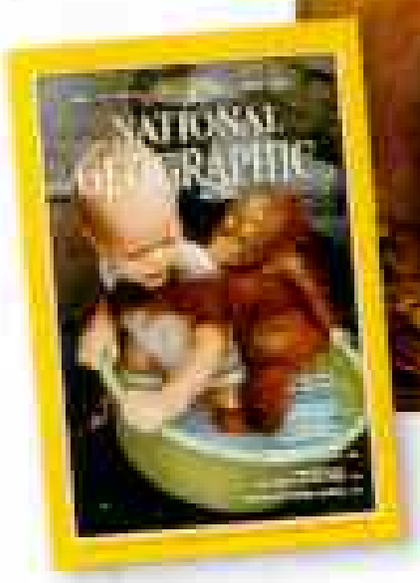
LISA TRUITT, NATIONAL GEOGRAPHIC TELEVISION

Orangutans Revisited

While photographing Indonesian fires for this issue, Mike Yamashita checked in with orangutan researcher Biruté Galdikas in Borneo. Drought and smoke-darkened skies have so limited the natural food supply that Biruté's staff supplements the apes' diet with daily drop-offs of fruit. When Mike visited, one of the first orangutans out of the forest was Princess. As an orphaned infant she had been raised with Biruté's son, Binti Paul, and was featured on our June 1980 cover. Released in 1984, she is a mom herself.

TEXT BY MAGGIE ZACKOWITZ

MICHAEL YAMASHITA



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There was a small decrease in the clearance of cetirizine caused by a 400 mg dose of theophylline; it is possible that larger theophylline doses could have a greater effect. **Carcinogenesis, Mutagenesis and Impairment of Fertility:** No evidence of carcinogenicity was observed in a 2 year carcinogenicity study in rats at dietary doses up to 30 mg/kg/day (approximately 10 times the maximum recommended human daily oral dose on a mg/m² basis). An increased incidence of benign liver tumors was found in a 2 year carcinogenicity study in male mice at a dietary dose of 16 mg/kg/day (approximately 4 times the maximum recommended human daily oral dose on a mg/m² basis). The clinical significance of these findings during long-term use of ZYRTEC is not known. Cetirizine was not mutagenic in the Ames test, and not clastogenic in the human lymphocyte assay, the mouse lymphoma assay, and an in vivo micronucleus test in rats. No impairment of fertility was found in a fertility and general reproductive performance study in mice at an oral dose of 64 mg/kg/day (approximately 26 times the maximum recommended adult human daily oral dose on a mg/m² basis). **Pregnancy Category B:** Cetirizine was not teratogenic in mice, rats and rabbits at oral doses up to 36, 22.5, and 135 mg/kg/day (or approximately 40, 180, and 245 times the maximum recommended adult human daily oral dose on a mg/m² basis, respectively). There are no adequate and well-controlled studies in pregnant women. Because animal studies are not always predictive of human response, ZYRTEC should be used in pregnancy only if clearly needed. **Nursing Mothers:** Retarded pup weight gain was found in mice during lactation when dams were given cetirizine at 36 mg/kg/day (approximately 40 times the maximum recommended adult human daily oral dose on a mg/m² basis). Studies in beagle dogs indicate that approximately 3% of the dose is excreted in milk. Cetirizine has been reported to be excreted in human breast milk. Because many drugs are excreted in human milk, use of ZYRTEC in nursing mothers is not recommended. **Geriatric Use:** In placebo-controlled trials, 196 patients aged 65 to 94 years received doses of 5 to 20 mg of ZYRTEC per day. Adverse events were similar in this group to patients under age 65. Subset analysis of efficacy in this group was not done. **Pediatric Use:** The safety of ZYRTEC, at daily doses of 5 or 10 mg, has been demonstrated in 376 pediatric patients 6-11 years of age in placebo-controlled trials lasting up to four weeks and in 254 patients in a non-placebo-controlled 12 week trial. *The effectiveness of ZYRTEC for the treatment of seasonal and perennial allergic rhinitis and chronic idiopathic urticaria in this pediatric age group is based on an extrapolation of the demonstrated efficacy of ZYRTEC in adults in these conditions and the likelihood that the disease course, pathophysiology and the drug's effect are substantially similar between these two populations.* The recommended dosage for the pediatric population are based on a cross-study comparison of the pharmacokinetics and pharmacodynamics of cetirizine in adults and pediatric subjects and on the safety profile of cetirizine in both adults and pediatric patients at doses equal to or higher than the recommended dosage. The cetirizine AUC and C_{max} in pediatric subjects 6-11 years of age who received a single dose of 10 mg of cetirizine syrup was estimated to be intermediate between that observed in adults who received a single dose of 10 mg of cetirizine tablets and those who received a single dose of 20 mg of cetirizine tablets. **ADVERSE REACTIONS**: Controlled and uncontrolled clinical trials conducted in the United States and Canada included more than 6300 patients aged 12 years and older, with more than 3900 receiving ZYRTEC at doses of 5 to 20 mg per day. The duration of treatment ranged from 1 week to 6 months, with a mean exposure of 30 days. Most adverse reactions reported during therapy with ZYRTEC were mild or moderate. In placebo-controlled trials, the incidence of discontinuations due to adverse reactions in patients receiving ZYRTEC 5 mg or 10 mg was not significantly different from placebo (2.0% vs. 2.4%, respectively). The most common adverse reactions in patients aged 12 years and older that occurred more frequently on ZYRTEC than placebo was somnolence. The incidence of somnolence associated with ZYRTEC was dose related: 6% in placebo, 11% at 5 mg and 14% at 10 mg. Discontinuations due to somnolence for ZYRTEC were uncommon (1.0% on ZYRTEC vs. 0.6% on placebo). Fatigue and dry mouth also appeared to be treatment-related adverse reactions. There were no differences by age, race, gender or by body weight with regard to the incidence of adverse reactions. Table 1 lists adverse experiences in patients aged 12 years and older which were reported for ZYRTEC 5 and 10 mg in controlled clinical trials in the United States and that were more common with ZYRTEC than placebo. **Table 1. Adverse Experiences Reported in Patients aged 12 years and older in Placebo-Controlled United States ZYRTEC Trials (Maximum Dose of 10 mg) at Rates of 2% or Greater (Percent Incidence), ZYRTEC (N=2034) vs Placebo (N=1612) respectively:** Somnolence (6.7% vs 6.3%); Fatigue (5.9% vs 3.5%); Dry Mouth (5.8% vs 2.3%); Pharyngitis (2.3% vs 1.8%); Dizziness (2.0% vs 1.2%). In addition, headache and nausea occurred in more than 2% of the patients, but were more common in placebo patients. Pediatric studies were also conducted with ZYRTEC. More than 1300 pediatric patients (6 to 11 years) with more than 900 treated with ZYRTEC at doses of 1.25 to 10 mg per day were included in controlled and uncontrolled clinical trials conducted in the United States. The duration of treatment ranged from 2 to 12 weeks. The majority of reported adverse reactions reported in pediatric patients (6 to 11 years) with ZYRTEC were mild or moderate. In placebo-controlled trials, the incidence of discontinuations due to adverse reactions in pediatric patients receiving up to ZYRTEC 10 mg was uncommon (0.4% on ZYRTEC vs 1.0% on placebo). Table 2 lists adverse experiences which were reported for ZYRTEC 5 and 10 mg in pediatric patients (6 to 11 years) in placebo-controlled clinical trials in the United States and were more common with ZYRTEC than placebo. (If there, abdominal pain was considered treatment-related and somnolence appeared to be dose related: 1.3% in placebo, 1.0% at 5 mg and 4.2% at 10 mg). **Table 2. Adverse Experiences Reported in Pediatric Patients (6 to 11 years) in Placebo-Controlled United States ZYRTEC Trials (5 or 10 mg dose) Which Occurred at a Frequency of ≥ 2% in Either the 5 mg or the 10 mg ZYRTEC Group, and More Frequently Than in the Placebo Group: ZYRTEC 5 mg (N=161), 10 mg (N=215) vs Placebo (N=329):** Headache (11.8%, 5 mg; 14.0%, 10 mg; 12.3%, placebo); Pharyngitis (6.2%, 5 mg; 7.8%, 10 mg; 2.9%, placebo); Abdominal pain (3.4%, 5 mg; 5.6%, 10 mg; 3.9%, placebo); Coughing (4.4%, 5 mg; 2.8%, 10 mg; 3.0%, placebo); Somnolence (1.9%, 5 mg; 4.2%, 10 mg; 1.3%, placebo); Diarrhea (3.1%, 5 mg; 1.9%, 10 mg; 1.0%, placebo); Epistaxis (0.7%, 5 mg; 1.0%, 10 mg; 2.3%, placebo); Bronchospasm (2.1%, 5 mg; 1.9%, 10 mg; 1.3%, placebo); Nausea (1.9%, 5 mg; 2.8%, 10 mg; 1.9%, placebo); Vomiting (2.5%, 5 mg; 2.3%; 10 mg; 1.0%, placebo). The following events were observed infrequently (less than 2%), in either adult and children (2 years and older or in 650 pediatric (6 to 11 years) patients who received ZYRTEC in U.S. trials, including an open adult study of six months duration; a causal relationship with ZYRTEC administration has not been established. **Autonomic Nervous System:** anaemia, urinary retention, flushing, increased salivation, dry mouth. **Cardiovascular:** palpitation, tachycardia, hypertension, cardiac failure. **Central and Peripheral Nervous Systems:** paresthesia, convulsion, hypokinesia, hypertonia, migraine, tremor, vertigo, leg cramps, ataxia, dysphonia, abnormal coordination, hyperesthesia, hypoesthesia, myelitis, paralysis, ptosis, twitching, visual field defect, syncope, dizziness. **Gastrointestinal:** increased appetite, dyspepsia, abnormal pain, diarrhea, flatulence, constipation, vomiting, ulcerative stomatitis, aggravated tooth caries, stomatitis, tongue discoloration, tongue edema, gastritis, rectal hemorrhage, hemorrhoids, melena, abnormal hepatic function, eructation. **Genitourinary:** polyuria, urinary tract infection, cystitis, dysuria, hematuria, micturition frequency, urinary incontinence. **Hearing and Vestibular:** earache, tinnitus, deafness, otorrhea. **Metabolic/Nutritional:** thirst, dehydration, diabetes mellitus. **Musculoskeletal:** myalgia, arthralgia, arthrosis, arthritis, muscle weakness. **Psychiatric:** insomnia, sleep disorder, nervousness, depression, emotional lability, impaired concentration, anxiety, depersonalization, paranoia, abnormal thinking, agitation, amnesia, decreased libido, euphoria. **Respiratory System:** epistaxis, rhinitis, coughing, bronchospasm, dyspnea, upper respiratory tract infection, hyperventilation, sinusitis, increased sputum, bronchitis, pneumonia, respiratory disorder. **Reproductive:** dysmenorrhea, female breast pain, intermenstrual bleeding, leukorrhea, menorrhagia, vaginitis. **Reticuloendothelial:** lymphadenopathy. **Skin:** pruritus, rash, dry skin, urticaria, acne, dermatitis, erythematous rash, increased sweating, alopecia, angioedema, furunculosis, bullous eruption, eczema, hyperkeratosis, hyperchlorosis, photosensitivity reaction, photosensitivity toxic reaction, maculopapular rash, seborrhea, purpura, skin discolor, skin nodule. **Special Senses:** taste perversion, taste loss, glaucoma. **Vision:** blindness, loss of accommodation, eye pain, conjunctivitis, xerophthalmia, glaucoma, ocular hemorrhage. **Body as a Whole:** increased weight, back pain, malaise, fever, asthenia, generalized edema, periorbital edema, peripheral edema, hypothermia, leg edema, face edema, hot flashes, enlarged abdomen, nasal polyps, pain, pallor, chest pain, accidental injury. Occasional instances of transient, reversible hepatic transaminase elevations have occurred during cetirizine therapy. A single case of possible drug-induced hepatitis with significant transaminase elevation (SGT to 1000 IU/L) and elevated bilirubin has been reported. In foreign marketing experience the following additional rare but potential severe adverse events have been reported: hemolytic anemia, thrombocytopenia, cerebral dyskinesia, severe hypotension, anaphylaxis, hepatitis, glomerulonephritis, stillbirth, and cholestasis. **DRUG ABUSE AND DEPENDENCE**: There is no information to indicate that abuse or dependency occurs with ZYRTEC. **OVERDOSAGE**: Overdosage has been reported with ZYRTEC. In one adult patient who took 150 mg of ZYRTEC, the patient was somnolent but did not display any other clinical signs or abnormal blood chemistry or hematology results. In an 18-month-old pediatric patient who took an overdose of ZYRTEC (approximately 100 mg), restlessness and irritability were observed initially. This was followed by drowsiness. Should overdose occur, treatment should be symptomatic or supportive, taking into account any concomitantly ingested medications. There is no known specific antidote to ZYRTEC. ZYRTEC is not effectively removed by dialysis, and diuresis will be ineffective unless a diuretic/cation agent has been concomitantly ingested. The acute minimal lethal oral dose in mice and rats was 333 and 562 mg/kg, respectively (approximately 55 and 265 times the maximum recommended human daily oral dose on a mg/m² basis). In rodents, the target of acute toxicity was the central nervous system, and the target of multiple-dose toxicity was the liver. **DOSAGE AND ADMINISTRATION: Adults and Children 12 years and older:** The recommended initial dose of ZYRTEC is 5 or 10 mg per day in adults and children 12 years and older, depending on symptom severity. Most patients in clinical trials started at 10 mg. ZYRTEC is given as a single daily dose, with or without food. The time of administration may be varied to suit individual patient needs. In patients with decreased renal function (creatinine clearance 11-31 mL/min), patients on hemodialysis (creatinine clearance less than 7 mL/min), and in hepatically impaired patients, a dose of 5 mg once daily is recommended. **Children 6 to 11 years:** The recommended initial dose of ZYRTEC in children aged 6 to 11 years is 5 or 10 mg (1 or 2 teaspoonfuls) once daily depending on symptom severity. The time of administration may be varied to suit individual patient needs. Cetirizine is licensed from UCB Pharma, Inc.

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Make the Campfire Right Before You Light

Smokey is counting on you to build a safe campfire.

1. Dig a small pit away from overhanging branches.
2. Circle the pit with rocks.
3. Clear a five-foot area around the pit down to the soil.
4. Keep a bucket of water and shovel nearby.
5. Stack extra wood upwind and away from the fire.
6. After lighting, do not discard match until it is cold.
7. Never leave a campfire unattended, even for a minute.

REMEMBER, ONLY YOU CAN PREVENT FOREST FIRES.

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Ad Council

Forum

Many readers enjoyed the three-part "Australia by Bike," which concluded in the April 1998 issue, but some were disappointed at the author's decision to leave Australia. The heated controversy described in "The Vanishing Prairie Dog" was reflected in equally impassioned letters, especially from Colorado.

Orinoco River

It is almost impossible to conceive of our most important river being at our back door; it remains unknown in all its vastness to most Venezuelans. Most of us do not know all the problems caused by the irrational exploitation of its mineral resources and its people. Donovan Webster's article makes us aware of what we could lose: El Dorado.

EDUARDO DOMINGUEZ
Caracas, Venezuela

The author describes a local banana as tasting "as if a regular banana has been pressed down to a purer form." Probably for the first time he was enjoying a real banana. We in the north believe the bananas we consume are the regular thing. Instead they are picked green, then treated with gas to produce a yellow fruit. One reason I enjoy your articles so much is that they continually remind me of the realities out there in other parts of the world.

JOHN TERPSTRA
Garson, Ontario

Drug trafficking is not new to the Orinoco, but law enforcement seemed better when I was there in the mid-1980s. One afternoon when I was relaxing on a desolate riverbank near Ciudad Bolivar, a police badge was suddenly flashed before my eyes. With a gun pointed to my head, I was told to hand over my travel bag. After a careful inspection of its contents, I was told to leave the area for my own safety.

BOGDAN KADEJ
Toronto, Ontario

Australia by Bike III

Roff Martin Smith's three-part article on his circumnavigation of Australia brought into sharp focus the nature of our unique geographic features and merciless climate. The warm mateship and sharp, cold edge of hate; the fertile, rolling fields of grapes; the giant forests and flat, featureless plains; the intense heat and bracing cold—a symphony of nature's challenges and human responses.

ED MAK
Adelaide, Australia

Smith's ride was accomplished in some luxury compared with a similar tour undertaken in 1899-1900

by the Australian Donald Mackay. He departed Brisbane on a single-speed bicycle with a backpack on July 28, 1899, and completed the counter-clockwise circuit in 240 days, 7 hours, 30 minutes. I recently traveled from Broome to Darwin in a 4x4 and found Mackay's adventure quite daunting. On his ride there were no sealed roads and few tracks, just hardwood sticks, stones, and endless wilderness. He carried only three days' supplies and relied on handouts from pioneer settlers, who pointed the way to the next farm. For one long stretch after Darwin, Mackay ran out of tires and rode on wheels banded with tape strips. Mackay's life story makes interesting reading and is well documented by Australian Frank Clune in *Last of the Australian Explorers*, published by Angus & Robertson, Ltd, London, 1942.

COLIN H. DICKINSON
Kaikoura, New Zealand

Smith may have an excuse for thinking the ocean off Warrnambool, Victoria, is the Indian, since he was ill. Locally the ocean is called the Great Southern, and indeed it can produce some wild weather.

CHRISTINE WEBB
Melbourne, Australia

The language was descriptive and colorful, and the anecdotes were great. Good photography too. Having been brought up on a cattle property in Queensland but moving to town for my education and ultimately to the city, I could relate to many experiences described. I suspect that although Roff Smith has left Australia to return to his homeland, he will never get Australia out of his heart.

ANN HAMILTON FAIRFAX
Sydney, Australia

Smith has decided to purchase a home near Adelaide, which will serve, along with his New Hampshire residence, as a base for his freelance career.

A lifetime of articles like this called me to the road during the autumn of 1996 after my residency and before I entered internal medicine practice. It was America by car. Places I assumed would be touristy contained the most spectacular things I've ever encountered—from Niagara Falls, the Grand Canyon, Devils Tower, and Mount Rushmore to the Badlands. A message to readers: Early September through late October is a wonderful time to tour the U.S. You basically have the parks to yourself. Spectacular things are accessible. At some space in your life, please listen to that call.

DAVID EPSTEIN
Hopkinton, Massachusetts

Rongelap Atoll

After beginning with a discussion of the deleterious health effects of radioactive fallout on the inhabitants of the atoll, the article focused on its aquatic organisms. This evaluation was based solely on the abundance and proliferation of these organisms, rather than on the identification of genetic

abnormalities as was the case with the humans. Thus, conclusions about human health effects relied on objective quantitative information, but conclusions about the health of aquatic life were based on subjective qualitative information. Better conclusions possibly could result from examining tissue samples of these organisms.

DAVID RIVARD-LENTZ
Jamesville, New York

Ozarks Harmony

Having spent the first 17 years of my life in the Ozarks, I was intrigued by Lisa Moore LaRoe's article. However, I do not completely agree with the caption on pages 80-81, mentioning "Arkansas's poorest counties." Poor is a relative word. Being only a short and beautiful drive from any modern convenience but still smack-dab in the middle of some of the best preserved nature on Earth is far from being poor. Even if one can't afford those conveniences, just living in the Ozarks makes one richer. Just don't tell too many. I want to go back someday.

MIKE PALMER
Mendoza, Argentina

The Buffalo National River was indeed the first river park under the 1970 Wild and Scenic Rivers Act, but by then Ozark National Scenic Riverways, protecting the Current and Jacks Fork Rivers, had been a National Park Service unit for half a decade.

BILL O'DONNELL
Eminence, Missouri

Contrary to the caption on page 77, hounds bay and donkeys bray.

H. H. HILDERBRAND
Bègo, France

People complain about the government taking over land, but if it had not, there would be no end to the development. On the other hand, just because the government owns land doesn't mean we can assume that it is not threatened. According to *Missouri Conservationist* magazine, the Doe Run Company has lost its first attempt to explore for lead in one of the most beautiful regions of our country [Mark Twain National Forest], but I guarantee they'll ask again and again. Those of us who oppose it must not fall asleep.

NANCY WOODFILL
Kansas City, Missouri

Vanishing Prairie Dog

The vivid and violent description of the shooting of a prairie dog by a varmint hunter in the opening paragraph sets an emotional tone that would predispose many readers against the control of these animals by this or other methods. It does not help to depict the hunters as gleeful killers. Your articles often cover controversial issues, and your tradition for balance is well established, but in this case you let the author tip the scales at the outset.

BROOKS ARTHUR PANGBURN
Davis, California

While prairie dog populations are a shadow of what existed before the settlement of the West, they have exploded in many parts of Colorado. Ask anyone who has been around the Denver suburbs for 20 years or more. All those black-tailed dogs in fields and vacant lots weren't there in the 1960s and '70s. The white-tailed dogs near my home in rural northwestern Colorado are so numerous that many years of "popping dogs" by locals has had no visible effect on the population. Road-killed dogs are so common that I once saw a stretch of highway that seemed to be paved in fur.

KEITH EILERS
Rangely, Colorado

It seems a pipe dream to attribute so many good works to one small rodent. They are cute, but the prairie dog towns on my ranch pastures resemble the face of the moon—denuded dirt covered with craters. My shoulder still hurts at night from when my horse stepped in an old hole years ago and rolled, breaking my collarbone and shoulder blade, luckily with no damage to the horse. Well, plague wiped out one prairie dog town a few years ago. I shoot a few sometimes, but I still have lots of them slowly expanding the face of the moon.

JAMES R. FLOYD
Liberal, Kansas

One possible solution to the prairie dog problem might be for cities or wildlife groups to compensate ranchers for placing the dogs on their land. This cost would be minuscule compared with court battles or land purchases to provide space for the animals. With cattle prices what they are now, if the rancher were compensated fairly, it might be more profitable to raise prairie dogs.

MICHAEL SHAY
Greeley, Colorado

You state that Santa Fe maintains a colony in one municipal park. But the March 27 *Santa Fe New Mexican* reports that the city has been quietly gassing prairie dog colonies in parks around the city [to prevent injuries from holes in playing fields]. It makes me sad to think that we can't live with the animals that were here long before we were.

MARGARET M. GALLAHER
Santa Fe, New Mexico

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

NATIONAL GEOGRAPHIC
Geographica

Window on a Small Southern Town

Four years before his death in 1934 at the age of 86, Frank S. McKnight called himself "the oldest photographer in the U.S. who is still on the job." He began his career making tintypes in 1872, working in a number of southern locales and eventually settling in the cotton-market town of Aberdeen, Mississippi, in 1894. Usually he made portraits, like that of "Miss Annie Laura Vassar and Old Nurse" (right). But he also recorded social and cultural life in the town of 6,900, such as the arrival of the bicycle (above) or a circus performer and snake (bottom left). Almost a third of McKnight's subjects were blacks, such as Dr. Houston Broomfield (bottom right); these commissioned portraits indicate that Aberdeen had a large African-American middle class.

Now Aberdeen's Evans Memorial Library, which acquired the meticulously documented collection of 13,838 glass negatives, has mounted an exhibit of McKnight's work. Its title is adapted from his advertising slogan: "Fine Work Guaranteed."

1894

Great Spotted Kiwi (*Apteryx haastii*) **Size:** Length, 45 cm **Weight:** Approx. 2.4 kg (male); 3.3 kg (female)
Habitat: Native forests, scrub, and tussock grasslands, from sea level to subalpine, on South Island, New Zealand
Surviving number: Estimated at 11,000
Photographed by Tui De Roy

WILDLIFE AS CANON SEES IT

The great spotted kiwi rustles about in leaf litter at night, sniffing under logs for earthworms and other soil-dwelling prey. Nostrils are located at the tip of the long bill which this furry-looking bird uses to tap and probe the forest floor. Kiwis are flightless birds, but big feet and powerful legs enable them to move in long, fast strides through thick underbrush. Monogamous pairs share in incubating a single egg. The lone chick hatches fully feathered, resembling a miniature adult. These unique birds live mainly in protected areas, but they remain vulnerable to introduced predators like stoats and ferrets. As a global corporation committed to social and environmental concerns, we join in worldwide efforts to promote greater awareness of endangered species for the benefit of future generations.

Hair-raising Tale of a Naked Ape

Jambo, a teenage chimpanzee in England's Twycross Zoo, was suffering. His skin itched, his hair fell out, he lost weight, and he seemed listless. Director Molly Badham called in Jean Brown (above), a farmwife who deals in natural medicines, for help.

Mrs. Brown put Jambo on an acid-free diet—heavy on cereal, yogurt, brown bread, and apricot jam—and concocted a cream from goat's milk and oils of wild rosemary, parsley, and marjoram. Now his health has returned. So has his hair. And Mrs. Brown is trying her diet and salve on humans; her husband is growing hair on a bald spot he's had for the past 45 years.

"I'm not interested in why it works," she says. "It works; that's all I care about." She plans to market the product.

Zoo vets believe Jambo's ailments stemmed from an immune-system problem. They are clueless about why the ointment works. "But he's in full form now," Badham says.

A Proud Moment Before Dying

Seafaring boys of summer, members of the U.S.S. *Maine*'s all-Navy baseball championship team—and Sharkey, their mascot—pose for a Key West, Florida, photographer before sailing to Havana, Cuba, in 1898. When an explosion ripped through their ship (GEOGRAPHIC, February 1998), the only team member to survive was right fielder John H. Bloomer (top row, far left).

"This photograph tells me the Navy took baseball seriously," says James Gates, Jr., National Baseball Hall of Fame librarian. "Nine had uniforms, unusual for the time, and they had bats, balls, and gloves." U.S. ships, Gates adds, helped spread baseball to Latin America, home of many of today's brightest stars.

Calculating Like a Roman

Roman numerals seem cumbersome. After our July and August 1997 articles on the Romans appeared, a reader asked how the architects and builders of the Roman Empire made the calculations needed to erect such complex structures as the Pantheon.

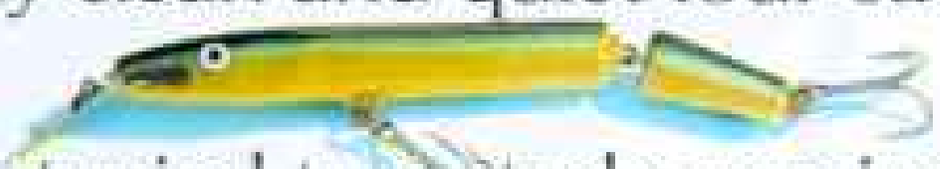
They didn't. "We greatly overestimate the amount of numerical calculation in the ancient world," says A. Trevor Hodge of Canada's Carleton University.

Instead the Romans probably employed simple geometry to establish the desired dimensions for their designs, creating standard lengths of chain or rope. Then they used a compass and straightedge to align architectural elements in correct and pleasing proportions. "The design of a temple depends on symmetry," wrote the Roman architect Vitruvius in a first-century B.C. treatise, illustrated here in a 16th-century edition.

Don't fish have enough on their minds without having to worry about the water?

It's not easy being a fish in the nineties. But thanks to Honda's commitment to clean water, at least they have one less thing to think about these days.

Since 1973, we've manufactured and sold only remarkably clean and quiet four-stroke outboard motors.



Unlike typical two-stroke marine engines, which leave unburned fuel and oil in the water, Honda outboards feature recirculating oil systems.

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Something we're sure all our underwater friends appreciate when trying to decide which minnows are really minnows.

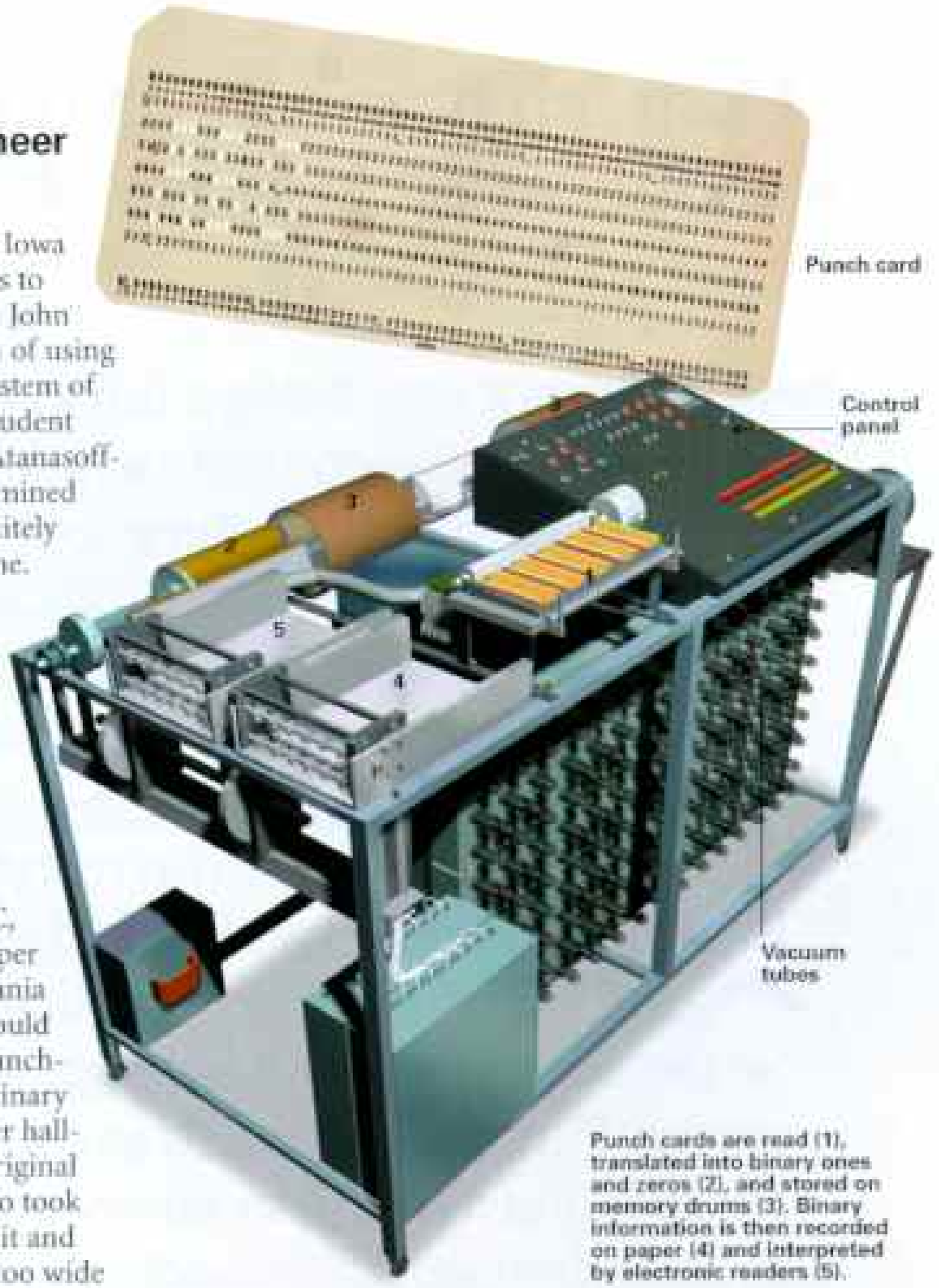
HONDA
Thinking.

As Simple as ABC: A Pioneer Computer Is Duplicated

In the 1930s a frustrated physicist at Iowa State College began to dream of ways to solve complicated equations quickly. John V. Atanasoff finally hit on the notion of using primitive electronics and a binary system of arithmetic. By 1940 with graduate student Clifford Berry he built the ABC, or Atanasoff-Berry Computer. A court later determined that it was the forerunner of all infinitely more complicated computers to come.

Last year Atanasoff's successors at what is now Iowa State University built a replica of the ABC, using vacuum tubes and other antique parts (right). The original cost the equivalent of $300,000 in today's dollars to build, says team member John Gustafson. The replica, with its hard-to-find parts, cost $360,000.

Later computers—notably ENIAC, created by John Mauchly and J. Presper Eckert at the University of Pennsylvania in 1946—showed how the devices could be used by a larger world. But the punch-card-fed ABC was the first to use a binary system, parallel processing, and other hallmarks of modern computers. The original ABC no longer exists. A scientist who took over Atanasoff's lab tried to remove it and then had it dismantled when it was too wide to fit through the doors.



ART BY DON FOLEY

How Pepper Sends Pain to the Brain

Bite into a hot pepper, like this Scotch bonnet, and you will feel intense pain. A molecule called capsaicin produces that excruciating sensation. But how does capsaicin's action get transmitted from the tongue to the brain and make us howl in agony?

David Julius of the University of California, San Francisco, has found what he calls the holy grail in the field of pain research: The elusive trigger is a unique protein in nerve cells. When capsaicin "pushes the button," the protein activates an ion channel and sends the painful message to the brain. Julius and his team used DNA-cloning technology to isolate the pesky protein. It's more than a chili pepper receptor, he believes; the same protein probably is involved in causing us to react to hot water or an iron burn. Knowing where it "lives" may enable researchers to create drugs to fight heat-related pain.

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Dr. John Bandes
Veterinarian and Top Breeder

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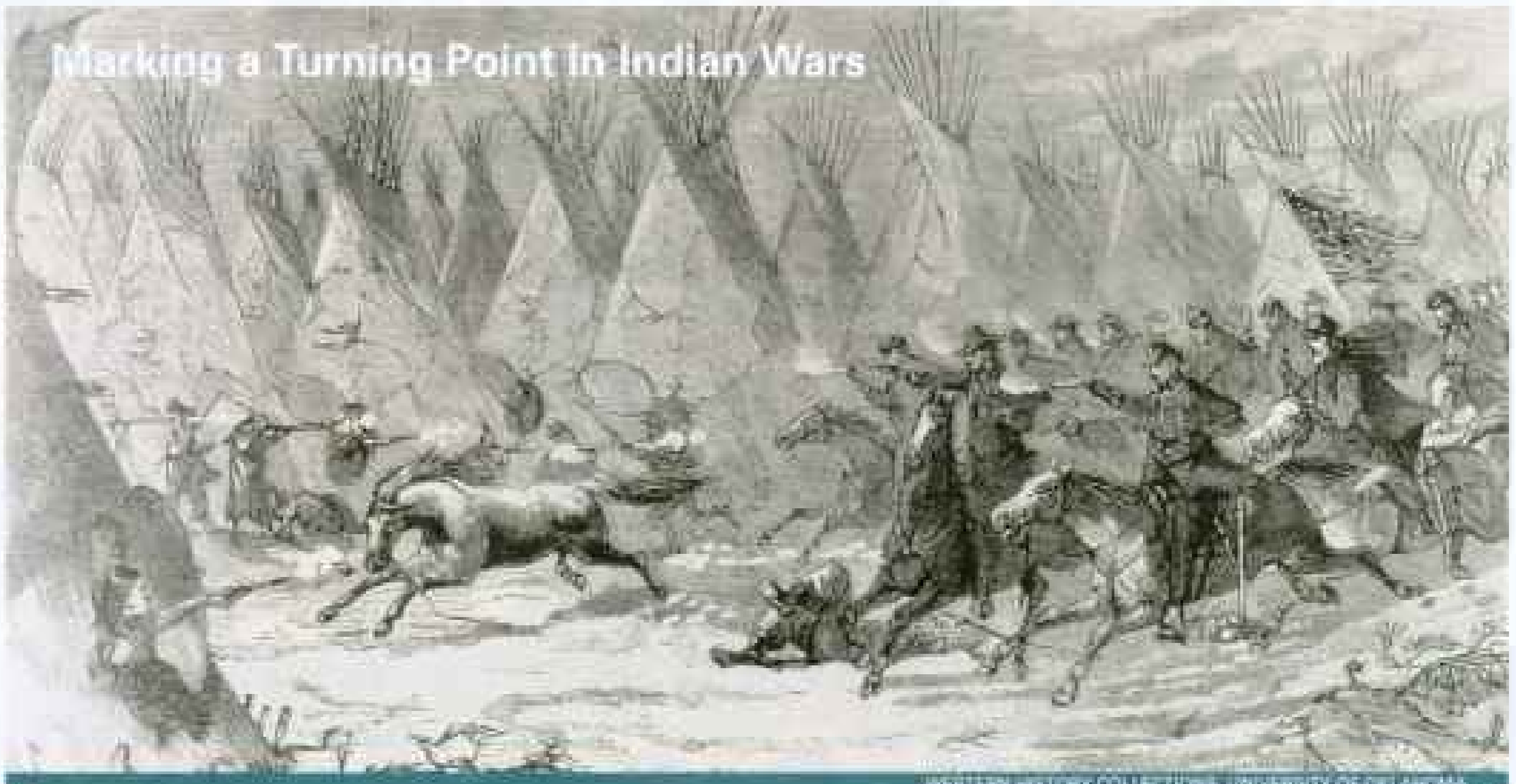

Marking a Turning Point in Indian Wars

WESTERN HISTORY COLLECTIONS, UNIVERSITY OF OKLAHOMA

In the gloom before dawn on November 27, 1868, Lt. Col. George Armstrong Custer's Seventh Cavalry attacked sleeping villages of the Southern Cheyenne on the Washita River in western Oklahoma. The surprise assault came in response to raids by renegades who ignored peace pledges by their chief, Black Kettle. About 100 Cheyenne men, women, and children—including Black Kettle—died, 53 were captured, and a traditional nomadic way of life began to fade. Within six years, their will broken, the Cheyenne submitted. The creation of Washita Battlefield National Historic Site last year pleases today's Cheyenne, but not its name: To them the attack was not a battle but a massacre.

Climate Change Affects Penguins

For more than 600 years only Adélie penguins (right) lived along the chilly shores of the Western Antarctic Peninsula in the Palmer region. Ornithologist and paleontologist Steven Emslie of the University of North Carolina, Wilmington, found Adélie bones (below) in nests near Palmer Station dating from as early as the 14th century.

But two other penguin species have moved in,

STEVEN EMSLIE

MARK THIESSEN, NGS

apparently as the result of a 50-year warming trend that has seen winter temperatures rise seven to nine degrees F and lessened the amount of ice around the peninsula. "Adélies require the edges of pack ice for foraging," Emslie says. As the ice shrinks, he believes, their numbers decline. Chinstrap penguins, which forage in the open ocean and aren't affected by ice breakup, began to arrive in the 1950s. Gentoos, normally a subantarctic species, first appeared here in 1975. The two newcomers now form a major portion of the region's penguin population.

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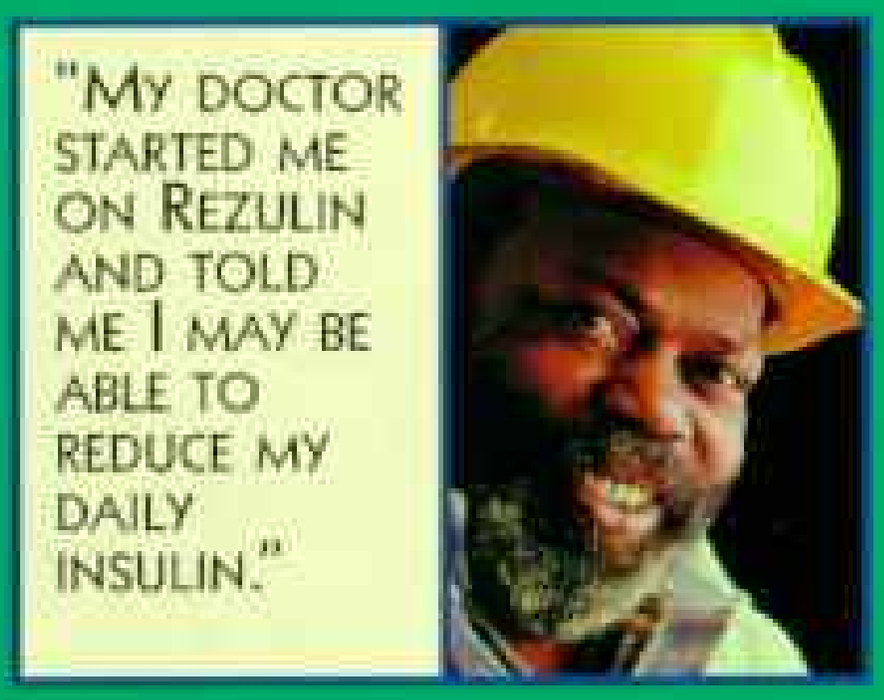
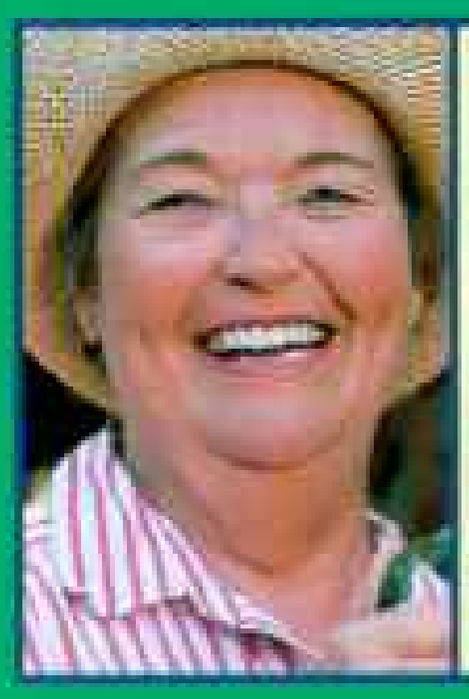


MAY CHANGE HOW YOUR DOCTOR TREATS TYPE 2 DIABETES.



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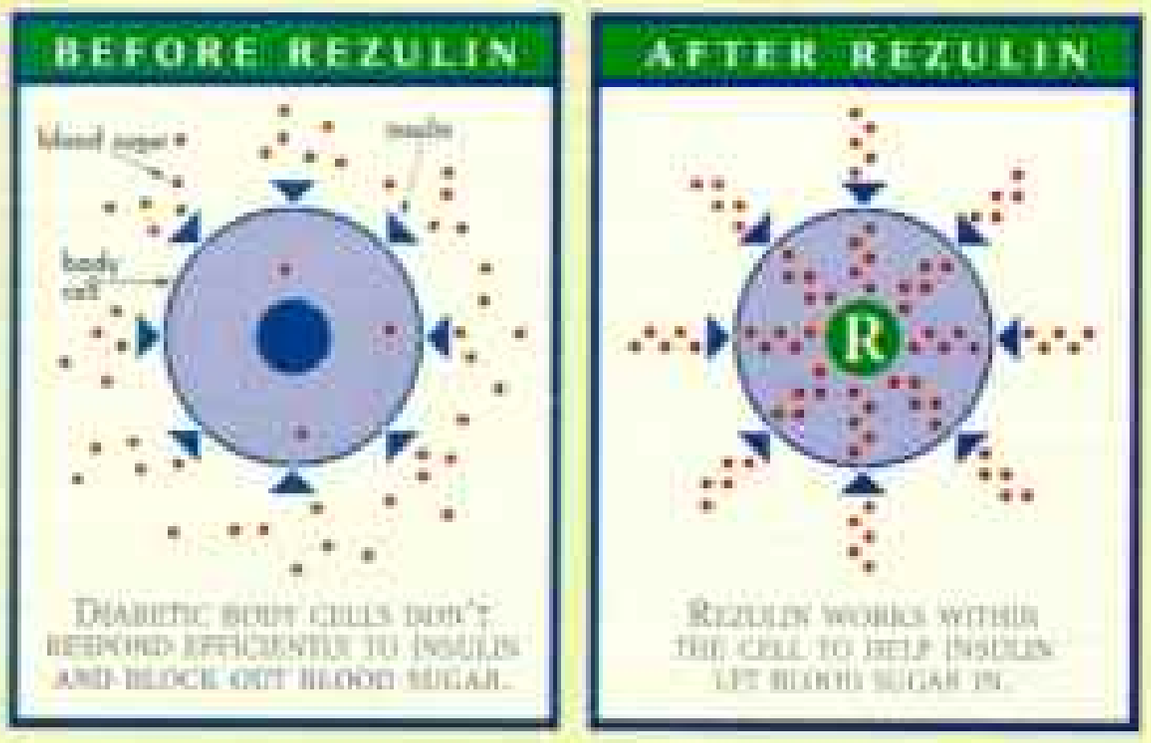
Rezulin (troglitazone) is a once-a-day pill for diabetes that helps your body use its own insulin for improved blood sugar control. Rezulin may be used for patients not well controlled with diet and exercise alone, oral pills known as sulfonylureas, or insulin.



Can Reduce And Perhaps Eliminate The Need For Insulin Injections.

Because Rezulin makes improved use of insulin, it can make a difference if insulin injections are part of your type 2 diabetes treatment. With Rezulin, you may be able to decrease the amount of insulin or the number of injections you're taking. You may even be able to eliminate injections altogether.

Increases The Effectiveness Of Many Oral Medications. Your doctor may find that Rezulin provides better blood sugar control when added to diabetes pills known as sulfonylureas such as Amaryl,* Glucotrol XL,* Glynase* PresTab,* glipizide, or glyburide.

Ask Your Doctor If Rezulin Is Right For You. Rezulin can provide a useful treatment option for millions of people with type 2 diabetes. Please be aware that Rezulin should not be used by patients with type 1 diabetes.

Rezulin, like all the diabetes medications currently available to treat type 2 diabetes, has been associated with side effects. Although they are not usually serious, you should discuss these possibilities with your doctor. In rare cases, Rezulin has been associated with serious liver problems, which are generally reversible, but in very rare instances, these have resulted in liver failure and fatality. Your doctor can advise you about the new recommendations for regular liver monitoring with Rezulin, which will require routine blood tests. The most common side effects reported in medical studies were similar to placebo (a tablet with no medicine); they include infection (22% placebo vs. 18% Rezulin), headache (11% placebo vs. 11% Rezulin), and pain (14% placebo vs. 10% Rezulin). Talk to your doctor immediately if you have nausea, vomiting, stomach pain, fatigue, lack of appetite, dark urine, or yellowing of the skin (jaundice), as these may be signs or symptoms of a liver problem. Adhere to any dietary, exercise or weight-loss recommendations made by your doctor, and test your blood sugar regularly. As with any drug, tell your doctor or healthcare professional about any other medications you may be taking. If your therapy includes Rezulin and pills known as sulfonylureas, there is a chance you may incur a manageable weight gain. If you are a premenopausal woman who is not ovulating, you should know Rezulin therapy may result in resumption of ovulation, thus putting you at risk for pregnancy.

Over 900,000 People Have Begun Using Rezulin To Help Manage Diabetes. And the number keeps growing. Your doctor or healthcare professional is the best source for finding out if Rezulin is right for you. To know more, see the important information on the adjacent page, and call:

Toll Free 1-888-900-TYPE2.

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ASK YOUR DOCTOR ABOUT THE REZULIN DIFFERENCE.

Please see important additional information on adjacent page.

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TABLETS

WARNINGS

Hepatic

Rare cases of severe idiosyncratic hepatocellular injury have been reported during marketed use (see ADVERSE REACTIONS). The hepatic injury is usually reversible, but very rare cases of hepatic failure, leading to death or liver transplant, have been reported. Injury has occurred after both short- and long-term troglitazone treatment.

During all clinical studies in North America, a total of 46 of 2510 (1.8%) Rezulin-treated patients and 3 of 425 (0.8%) placebo-treated patients had ALT levels greater than 3 times the upper limit of normal. Twenty of the Rezulin-treated and one of the placebo-treated patients were withdrawn from treatment. Two of the 20 Rezulin-treated patients developed reversible jaundice; one of these patients had a liver biopsy which was consistent with an idiosyncratic drug reaction. An additional Rezulin-treated patient had a liver biopsy which was also consistent with an idiosyncratic drug reaction. (See ADVERSE REACTIONS, Laboratory Abnormalities.)

It is recommended that serum transaminase levels be checked at the start of therapy, monthly for the first six months of therapy, every two months for the remainder of the first year of troglitazone therapy, and periodically thereafter. Liver function tests also should be obtained for patients at the first symptoms suggestive of hepatic dysfunction, eg, nausea, vomiting, abdominal pain, fatigue, anorexia, dark urine. Rezulin therapy should not be initiated if the patient exhibits clinical or laboratory evidence of active liver disease (eg, ALT>3 times the upper limit of normal) and should be discontinued if the patient has jaundice or laboratory measurements suggest liver injury (eg, ALT>3 times the upper limit of normal).

BRIEF SUMMARY

Consult Package Insert for full Prescribing Information.

INDICATIONS AND USAGE

Rezulin may be used concomitantly with a sulfonylurea or insulin to improve glycemic control. Rezulin, as monotherapy, is indicated as an adjunct to diet and exercise to lower blood glucose in patients with type II diabetes (see DOSAGE AND ADMINISTRATION in Package Insert for full Prescribing Information). Rezulin should not be used as monotherapy in patients previously well-controlled on sulfonylurea therapy. For patients inadequately controlled with a sulfonylurea alone, Rezulin should be added to, not substituted for, the sulfonylurea.

Management of type II diabetes should include diet control, caloric restriction, weight loss, and exercise are essential for the proper treatment of the diabetic patient. This is important not only in the primary treatment of type II diabetes, but in maintaining the efficacy of drug therapy. Prior to initiation of Rezulin therapy, secondary causes of poor glycemic control, eg, infection or poor injection technique, should be investigated and treated.

CONTRAINDICATIONS

Rezulin is contraindicated in patients with known hypersensitivity or allergy to Rezulin or any of its components.

WARNINGS

SEE BOXED WARNING.

PRECAUTIONS

General

Because of its mechanism of action, Rezulin is active only in the presence of insulin. Therefore, Rezulin should not be used in type I diabetes or for the treatment of diabetic keto-acidosis.

Hypoglycemia: Patients receiving Rezulin in combination with insulin or oral hypoglycemic agents may be at risk for hypoglycemia and a reduction in the dose of the concomitant agent may be necessary. Hypoglycemia has not been observed during the administration of Rezulin as monotherapy and would not be expected based on the mechanism of action.

Ovulation: In premenopausal anovulatory patients with insulin resistance, Rezulin treatment may result in resumption of ovulation. **These patients may be at risk for pregnancy.**

Hematologic: Across all clinical studies, hemoglobin declined by 3 to 4% in troglitazone-treated patients compared with 1 to 2% in those treated with placebo. White blood cell counts also declined slightly in troglitazone-treated patients compared to those treated with placebo. These changes occurred within the first four to eight weeks of therapy. Levels stabilized and remained unchanged for up to two years of continuing therapy. These changes may be due to the dilutional effects of increased plasma volume and have not been associated with any significant hematologic clinical effects (see ADVERSE REACTIONS, Laboratory Abnormalities).

Use in Patients With Heart Failure

Heart enlargement without microscopic changes has been observed in rodents at exposures of parent compound and active metabolite exceeding 7 times the AUC of the 600 mg human dose (see PRECAUTIONS, Carcinogenesis, Mutagenesis, Impairment of Fertility, and Animal Toxicology). Serial echocardiographic evaluations in monkeys treated chronically at exposures at 4-8 times the human exposure to parent compound and active metabolite at the 600 mg dose did not reveal changes in heart size or function. In a 2-year echocardiographic clinical study using 300 to 600 mg/day of Rezulin in patients with type II diabetes, no increase in left ventricular mass or decrease in cardiac output was observed. The methodology employed was able to detect a change of about 10% or more in left ventricular mass. In animal studies, troglitazone treatment was associated with increases of 8% to 15% in plasma volume. In a study of 24 normal volunteers, an increase in plasma volume of 6% to 8% compared to placebo was observed following 8 weeks of troglitazone treatment.

No increased incidence of adverse events potentially related to volume expansion (eg, congestive heart failure) have been observed during controlled clinical trials. However, patients with New York Heart Association (NYHA) Class III and IV cardiac status were not studied during clinical trials. Therefore, Rezulin is not indicated unless the expected benefit is believed to outweigh the potential risk to patients with NYHA Class III or IV cardiac status.

Information for Patients

Rezulin should be taken with meals. If the dose is missed at the usual meal, it may be taken at the next meal. If the dose is missed an one day, the dose should not be doubled the following day.

It is important to adhere to dietary instructions and to regularly have blood glucose and glycosylated hemoglobin tested. During periods of stress such as fever, trauma, infection, or surgery, insulin requirements may change and patients should seek the advice of their physician.

Patients who develop nausea, vomiting, abdominal pain, fatigue, anorexia, dark urine or other symptoms suggestive of hepatic dysfunction or jaundice should immediately report these signs or symptoms to their physician.

When using combination therapy with insulin or oral hypoglycemic agents, the risks of hypoglycemia, its symptoms and treatment, and conditions that predispose to its development should be explained to patients and their family members.

Use of Rezulin can cause resumption of ovulation in women taking oral contraceptives and in patients with polycystic ovary disease. Therefore, a higher dose of an oral contraceptive or an alternative method of contraception should be considered.

Rezulin may affect other medications used in diabetic patients. Patients started on Rezulin should ask their physician to review their other medications to make sure that they are not affected by Rezulin.

Drug Interactions

Oral Contraceptives: Administration of Rezulin with an oral contraceptive containing ethinyl estradiol and norethindrone reduced the plasma concentrations of both by approximately 30%, which could result in loss of contraception. Therefore, a higher dose of oral contraceptive or an alternative method of contraception should be considered.

Terfenadine: Coadministration of Rezulin with terfenadine decreases the plasma concentration of both terfenadine and its active metabolite by 50-70% and may result in decreased efficacy of terfenadine.

Cholestyramine: Concomitant administration of cholestyramine with Rezulin reduces the absorption of troglitazone by 30%; thus, coadministration of cholestyramine and Rezulin is not recommended.

Glyburide: Coadministration of Rezulin and glyburide does not appear to alter troglitazone or glyburide pharmacokinetics.

Digoxin: Coadministration of Rezulin with digoxin does not alter the steady-state pharmacokinetics of digoxin.

Warfarin: Rezulin has no clinically significant effect on prothrombin time when administered to patients receiving chronic warfarin therapy.

Acetaminophen: Coadministration of acetaminophen and Rezulin does not alter the pharmacokinetics of either drug.

Metformin: No information is available on the use of Rezulin with metformin.

Ethanol: A single administration of a moderate amount of alcohol did not increase the risk of acute hypoglycemia in Rezulin-treated patients with type II diabetes mellitus.

The above interactions with terfenadine and oral contraceptives suggest that troglitazone may induce drug metabolism by CYP3A4. Studies have not been performed with other drugs metabolized by this enzyme such as: simvastatin, calcium channel blockers, cisapride, corticosteroids, cyclosporine, HMG-CoA reductase inhibitors, tacrolimus, triazolam, and trimetrexate. The possibility of altered safety and efficacy should be considered when Rezulin is used concomitantly with these drugs.

Patients stable on one or more of these agents when Rezulin is started should be closely monitored and their therapy adjusted as necessary.

Carcinogenesis, Mutagenesis, Impairment of Fertility

Troglitazone was administered daily for 104 weeks to male rats at 150, 400, or 600 mg/kg and to female rats at 25, 50, or 200 mg/kg. No tumors of any type were increased at the low and mid doses. Plasma drug exposure based on AUC of parent compound and total metabolites at the low and mid doses was up to 24-fold higher than human exposure at 600 mg daily. The highest dose in each sex exceeded the maximum tolerated dose. In a 104-week study in mice given 50, 400, or 800 mg/kg, incidence of hemangiosarcoma was increased in females at 400 mg/kg and in both sexes at 800 mg/kg; incidence of hepatocellular carcinoma was increased in females at 800 mg/kg. The lowest dose associated with increased tumor incidence (400 mg/kg) was associated with AUC values of parent compound and total metabolites that were at least 2-fold higher than the human exposure at 600 mg daily. No tumors of any type were increased in mice at 50 mg/kg at exposures up to 40% of that in humans at 600 mg daily, based on AUC of parent compound and total metabolites.

Troglitazone was neither mutagenic in bacteria nor clastogenic in bone marrow of mice. Equivocal increases in chromosome aberrations were observed in an in vitro Chinese hamster lung cell assay. In mouse lymphoma cell gene mutations assays, results were equivocal when conducted with a microtiter technique and negative with an agar plate technique. A liver unscheduled DNA synthesis assay in rats was negative.

No adverse effects on fertility or reproduction were observed in male or female rats given 40, 200, or 1000 mg/kg daily prior to and throughout mating and gestation. AUC of parent compound at these doses was estimated to be 3- to 9-fold higher than the human exposure.

Animal Toxicology

Increased heart weights without microscopic changes were observed in mice and rats treated for up to 1 year at exposure (AUC) of parent and active metabolite exceeding 7 times the human AUC at 600 mg/day. These heart weight increases were reversible in 2- and 13-week studies, were prevented by coadministration of an ACE inhibitor, and 14 days of troglitazone administration to rats did not affect left ventricular performance. In the lifetime carcinogenicity studies, microscopic changes were noted in the hearts of rats but not in mice. In control and treated rats, microscopic changes included myocardial inflammation and fibrosis and karyomegaly of atrial myocytes. The incidence of these changes in drug-treated rats was increased compared to controls at twice the AUC of the 600 mg human dose.

Pregnancy

Pregnancy Category B. Troglitazone was not teratogenic in rats given up to 2000 mg/kg or rabbits given up to 1000 mg/kg during organogenesis. Compared to human exposure at 600 mg daily, estimated exposures in rats (parent compound) and rabbits (parent compound and active metabolite) based on AUC at these doses were up to 9-fold and 3-fold higher, respectively. Body weights of fetuses and offspring of rats given 2000 mg/kg during gestation were decreased. Delayed postnatal development, attributed to decreased body weight, was observed in offspring of rats given 40, 200, or 1000 mg/kg during late gestation and lactation periods; no effects were observed in offspring of rats given 10 or 25 mg/kg.

There are no adequate and well-controlled studies in pregnant women. Rezulin should not be used during pregnancy unless the potential benefit justifies the potential risk to the fetus.

Because current information strongly suggests that abnormal blood glucose levels during pregnancy are associated with a higher incidence of congenital anomalies as well as increased neonatal morbidity and mortality, most experts recommend that insulin be used during pregnancy to maintain blood glucose levels as close to normal as possible.

Nursing Mothers

It is not known whether troglitazone is secreted in human milk. Troglitazone is secreted in the milk of lactating rats. Because many drugs are excreted in human milk, Rezulin should not be administered to a breast-feeding woman.

Pediatric Use

Safety and effectiveness in pediatric patients have not been established.

Geriatric Use

Twenty-two percent of patients in clinical trials of Rezulin were 65 and over. No differences in effectiveness and safety were observed between these patients and younger patients.

ADVERSE REACTIONS

Two patients in the clinical studies developed reversible jaundice; one of these patients had a liver biopsy which was consistent with an idiosyncratic drug reaction. An additional patient had a liver biopsy which was also consistent with an idiosyncratic drug reaction. Symptoms that are associated with hepatic dysfunction or hepatitis have been reported, including: nausea, vomiting, abdominal pain, fatigue, anorexia, dark urine, abnormal liver function tests (including increased ALT, AST, LDH, alkaline phosphatase, bilirubin). Also see WARNINGS.

The overall incidence and types of adverse reactions reported in placebo-controlled clinical trials for Rezulin-treated patients and placebo-treated patients are shown in Table 1. In patients treated with Rezulin in placebo-controlled studies (N=1706) or uncontrolled studies (N=510), the safety profile of Rezulin appeared similar to that displayed in Table 1. The incidence of withdrawals during clinical trials was similar for patients treated with placebo or Rezulin (4%).

TABLE 1. North American Placebo-Controlled Clinical Studies: Adverse Events Reported at a Frequency ≥ 5% of Rezulin-Treated Patients

% of Patients

	Placebo N = 402	Rezulin N = 1458		Placebo N = 402	Rezulin N = 1458
Infection	22	18	Nausea	4	8
Headache	11	11	Rhinitis	7	6
Pain	14	10	Diarrhea	6	5
Accidental Injury	6	9	Urinary Tract Infection	6	5
Asthenia	5	8	Peripheral Edema	5	5
Dizziness	5	8	Pharyngitis	4	5
Back Pain	4	8			

Types of adverse events seen when Rezulin was used concomitantly with insulin (N=340) were similar to those during Rezulin monotherapy (N=1231), although hypoglycemia occurred on insulin combination therapy (see PRECAUTIONS).

Laboratory Abnormalities

Hematologic: Small decreases in hemoglobin, hematocrit, and neutrophil counts (within the normal range) were more common in Rezulin-treated than placebo-treated patients and may be related to increased plasma volume observed with Rezulin treatment. Hemoglobin decreases to below the normal range occurred in 5% of Rezulin-treated and 4% of placebo-treated patients.

Lipids: Small changes in serum lipids have been observed (see CLINICAL PHARMACOLOGY, Pharmacodynamics and Clinical Effects in Package Insert for full Prescribing Information).

Serum Transaminase Levels: During all clinical studies in North America, a total of 46 of 2510 (1.8%) Rezulin-treated patients and 3 of 425 (0.8%) placebo-treated patients had ALT levels greater than 3 times the upper limit of normal. During controlled clinical trials, 2.2% of Rezulin-treated patients had reversible elevations in AST or ALT greater than 3 times the upper limit of normal, compared with 0.8% of patients receiving placebo. Hyperbilirubinemia (>1.2x upper limit of normal) was found in 8.7% of Rezulin-treated patients compared with 1.3% of patients receiving placebo. In the population of patients treated with Rezulin, mean and median values for bilirubin, AST, ALT, alkaline phosphatase, and GGT were decreased at the final visit compared with baseline, while values for LDH were increased slightly (see WARNINGS).

Postintroduction Reports

Adverse events associated with Rezulin that have been reported since market introduction, that are not listed above, and for which causal relationship to drug has not been established include the following: congestive heart failure, weight gain, edema, fever, abnormal lab tests including increased CPK and creatinine, hyperglycemia, syncope, anemia, malaise.

Rx only

February 1998

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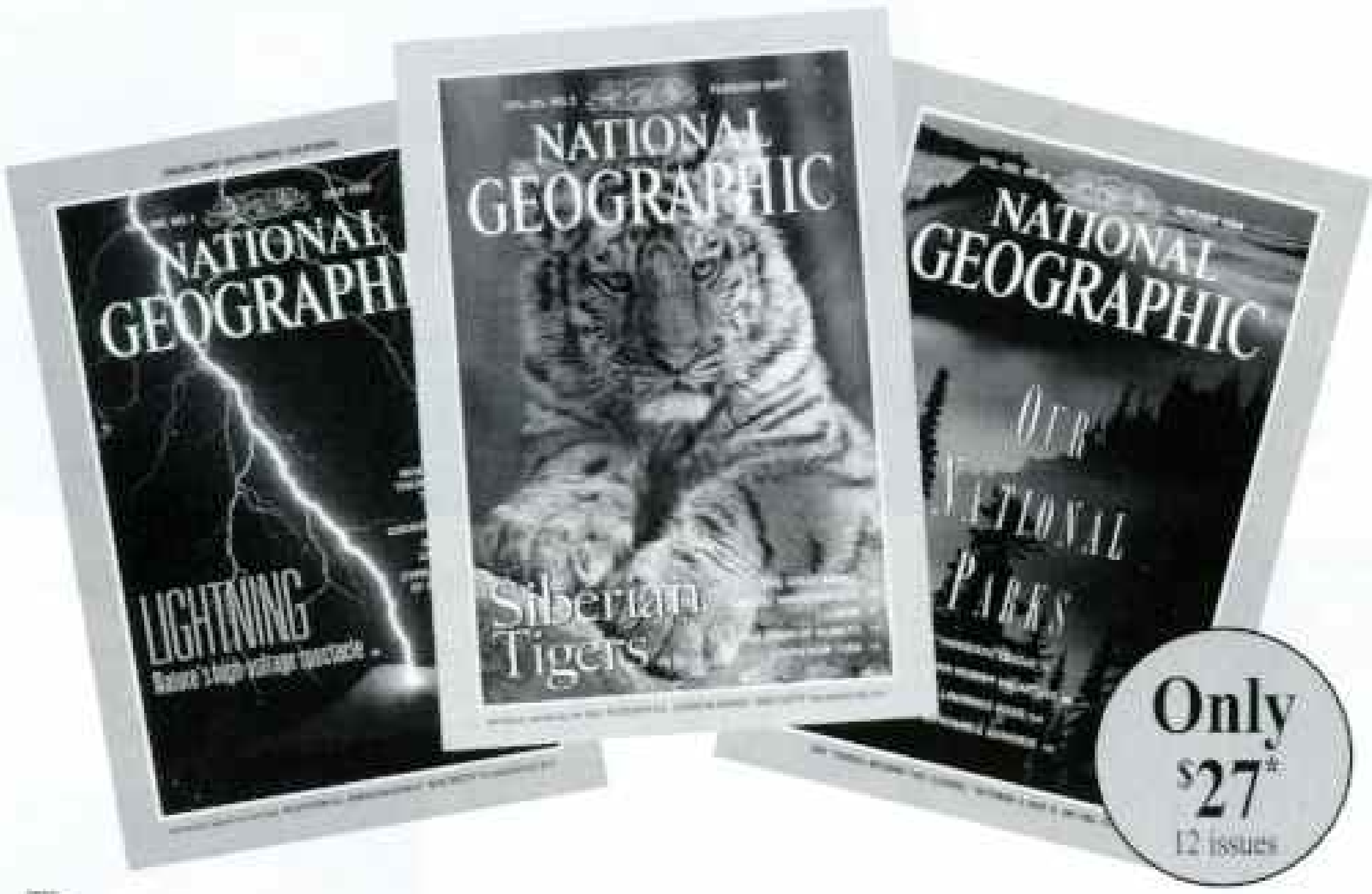

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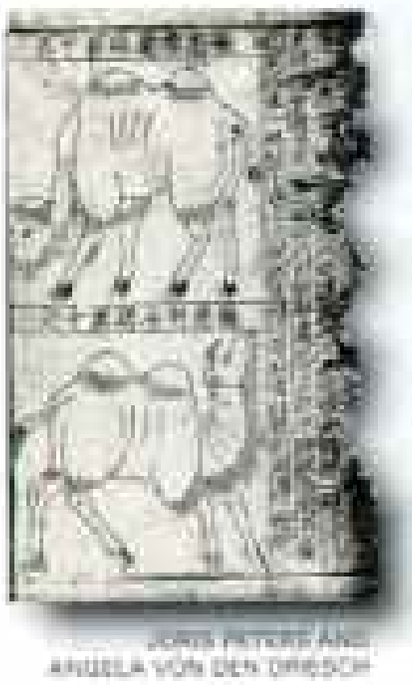
NGAB104

Cure an Ailing Camel the Old Chinese Way

If your camel suffers from a "kidney cold"—an ailment you'll detect when it scratches its flanks while walking—here's the cure: a potion made of coarse cinnamon bark, magnolia bark, and onions cooked in wine.

That prescription comes from an 11th-century Chinese manual (detail below), the world's oldest existing treatise on camel medicine. Recently translated into German by Herbert Franke, a Chinese history specialist, it sheds light on Chinese attitudes toward the Bactrian camel, for centuries vital as a beast of burden and tended for its milk, meat, and dung.



JOHN PETERS AND ANGELA VON DEN DRIESCH

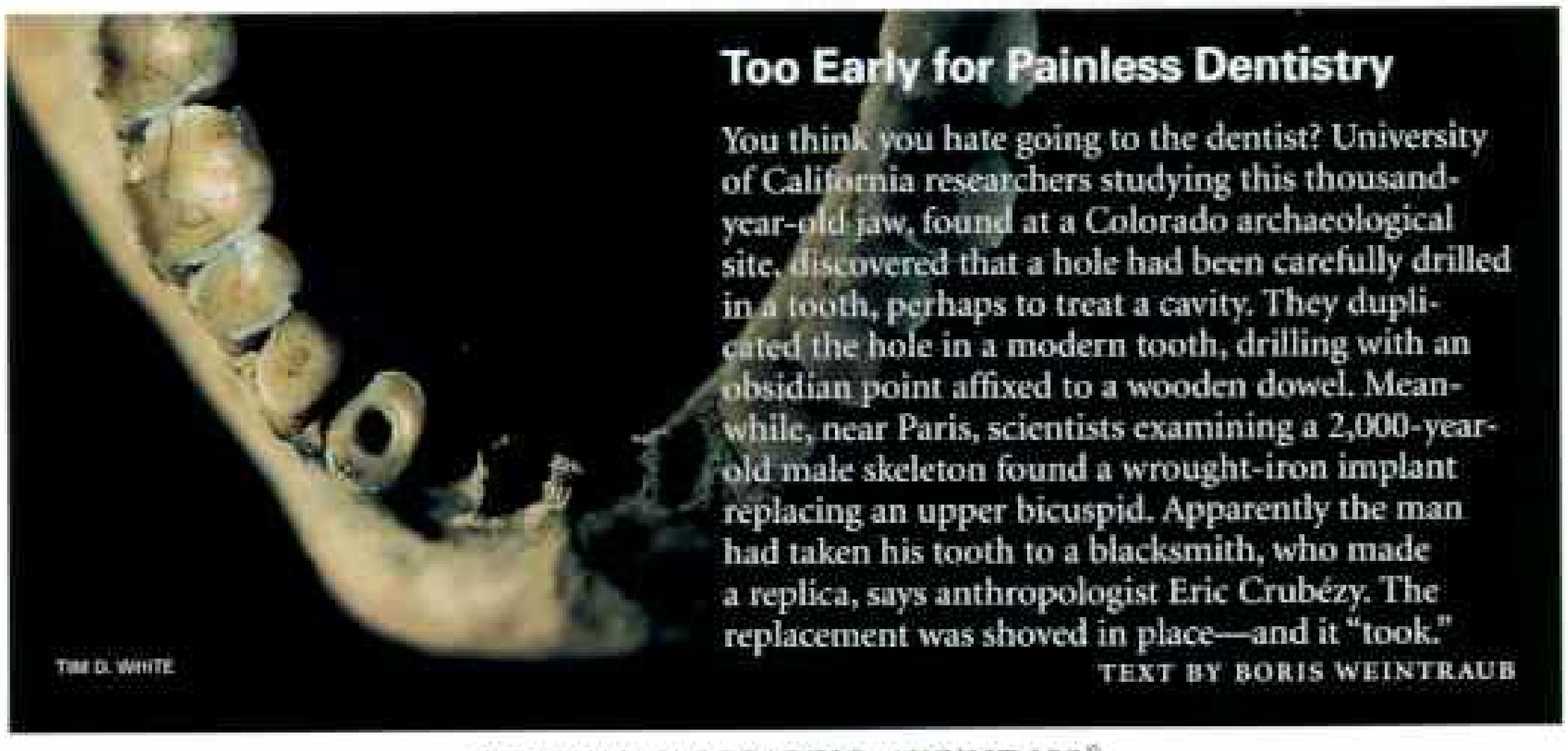
The manual's medical guidance is analogous to traditional Chinese medicine for humans, says Angela von den Driesch, a historian of veterinary medicine at the University of Munich. In fact, acupuncture is urged in treating such camel illnesses as joint infection, disease of the spleen, and a neck deformity called wryneck.

JIM RICHARDSON (ABOVE AND BELOW)

It's Odd (West Virginia) and a Novelty (Ohio)

There's nothing peculiar about Peculiar, Missouri, Frank Gallant learned in researching a book about unusual American place-names. In 1868 the town's first postmaster proposed names that Washington, D.C., kept rejecting. Exasperated, he wrote the Postmaster General asking him to take over the job: "We don't care what name you give us so long as it is sort of peculiar." And so it was.

Gallant, the editor of *Rural Electrification Magazine*, found that many places got their names by accident or error. Correct, Indiana, for example, is incorrect; its residents' choice, Comet, was misread. Residents of Lolita, Texas, sought a new moniker in vain after a novel by that name gave it unwanted—and lurid—overtones. And Dorothy, the heroine of *The Wizard of Oz*, would be happy to know there really *is* a place like Home in Kansas.



TIM D. WHITE

Too Early for Painless Dentistry

You think you hate going to the dentist? University of California researchers studying this thousand-year-old jaw, found at a Colorado archaeological site, discovered that a hole had been carefully drilled in a tooth, perhaps to treat a cavity. They duplicated the hole in a modern tooth, drilling with an obsidian point affixed to a wooden dowel. Meanwhile, near Paris, scientists examining a 2,000-year-old male skeleton found a wrought-iron implant replacing an upper bicuspid. Apparently the man had taken his tooth to a blacksmith, who made a replica, says anthropologist Eric Crubézy. The replacement was shoved in place—and it "took."

TEXT BY BORIS WEINTRAUB

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- What does APXS stand for?
- Mars gets its red color from?
- How long does a day on Mars last?
- Temperatures on Mars range from:
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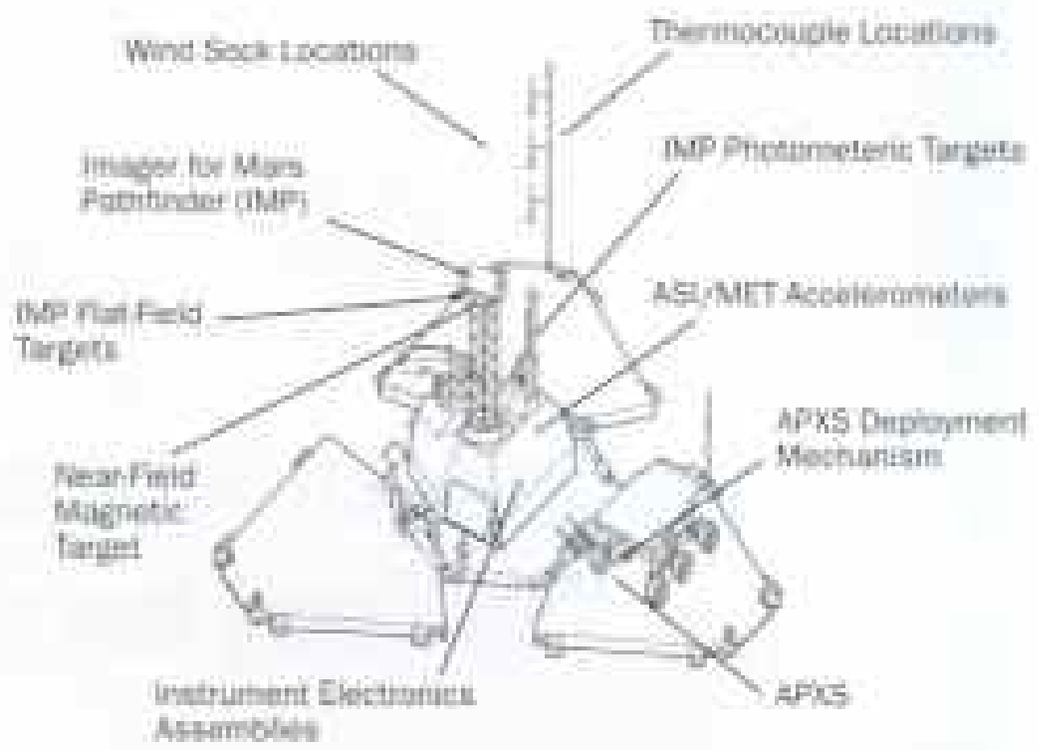
THE NASA PATHFINDER



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Mars and Titanic in 3-D

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Return to Mars

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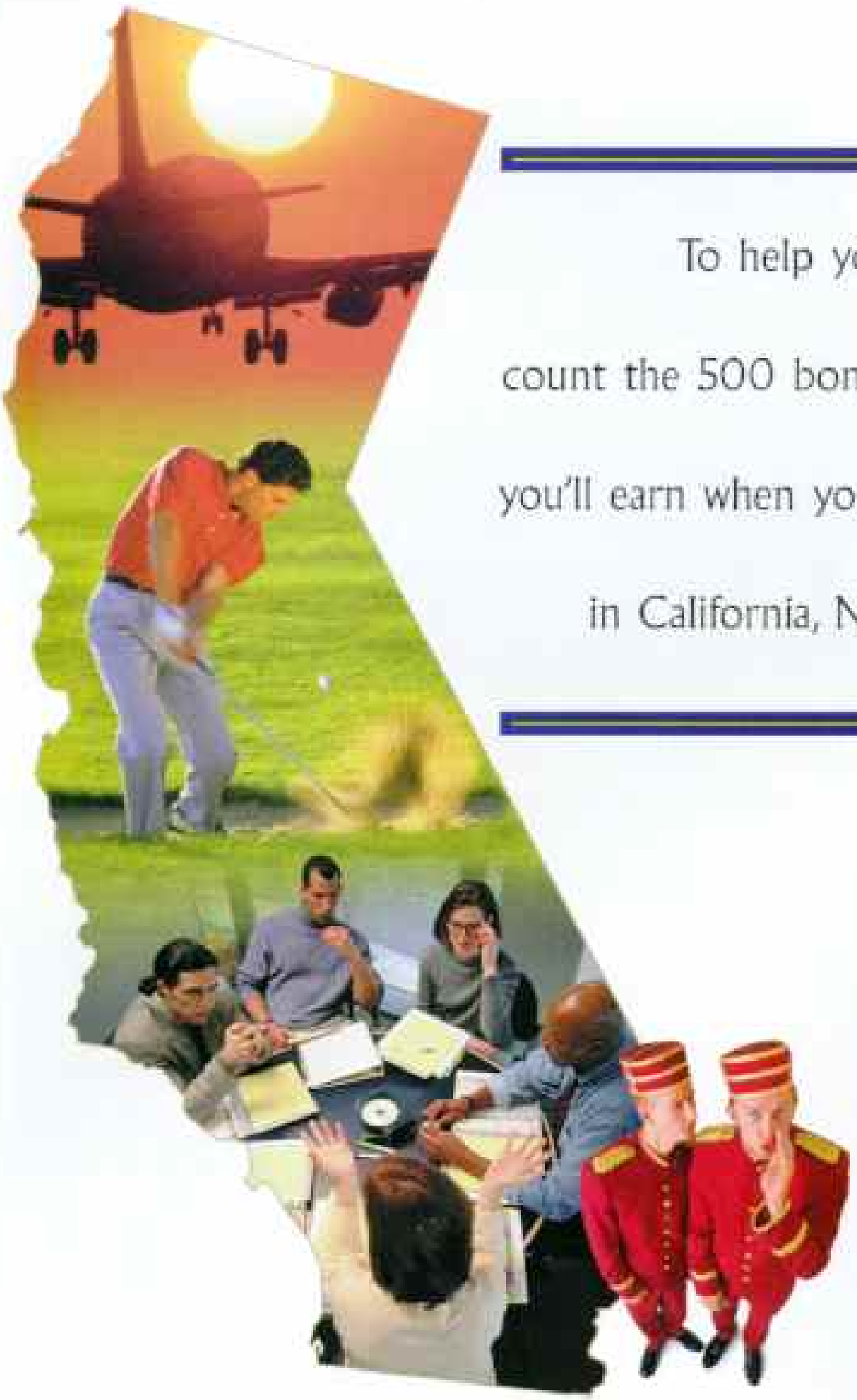

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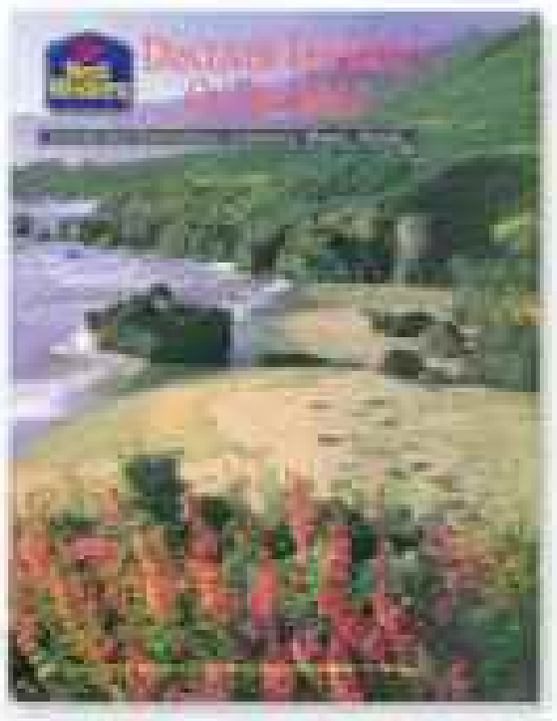

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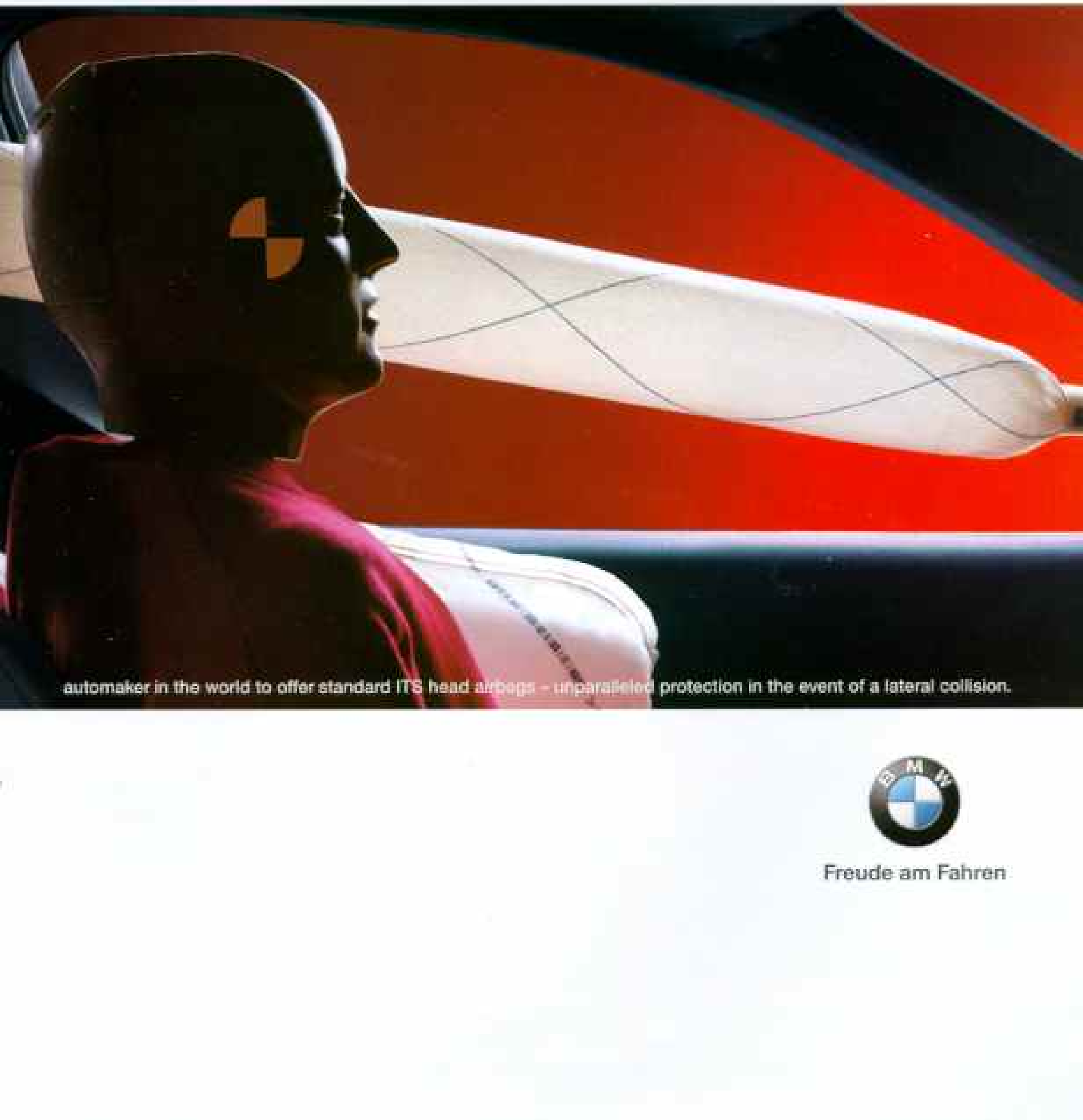

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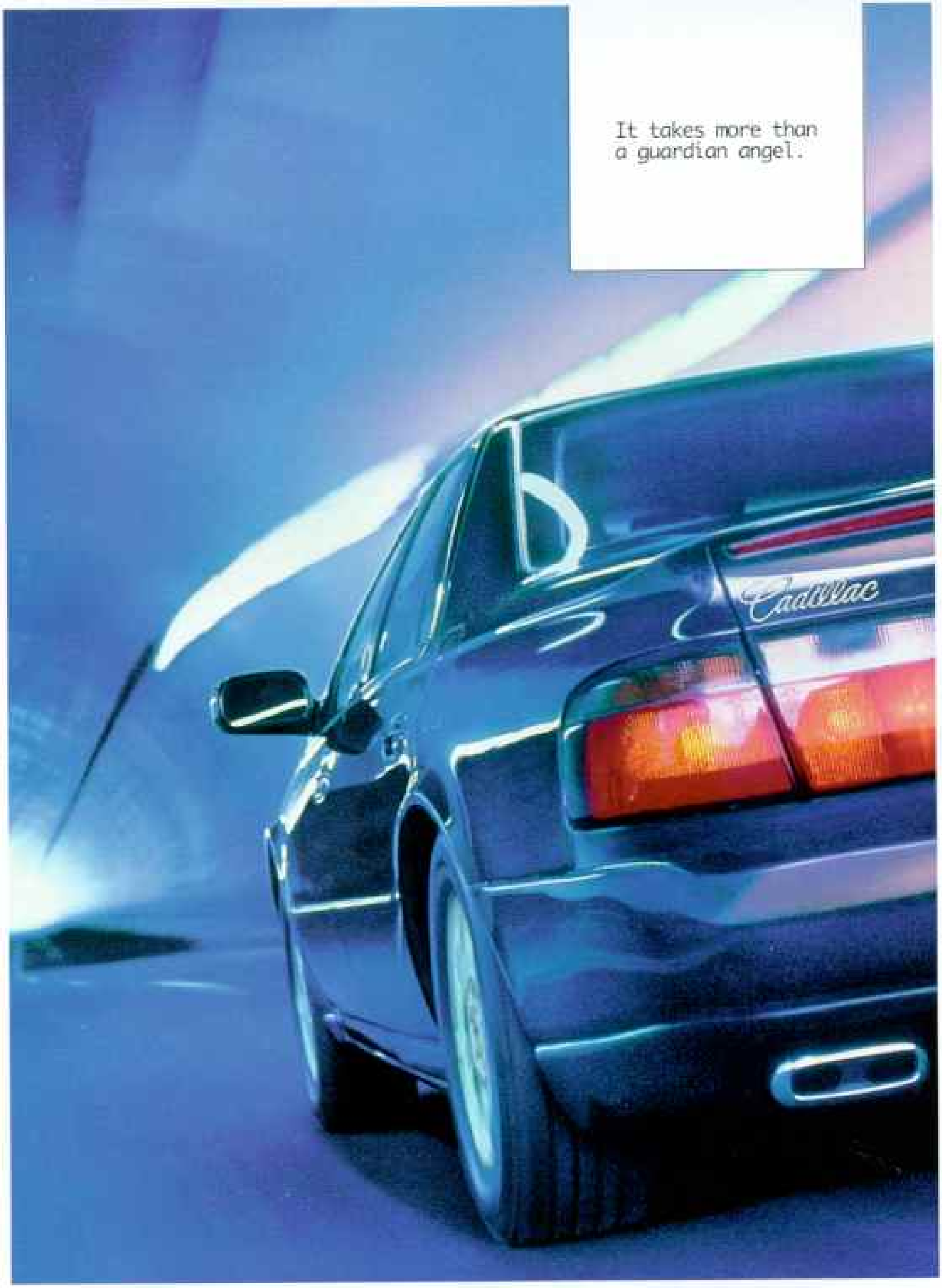

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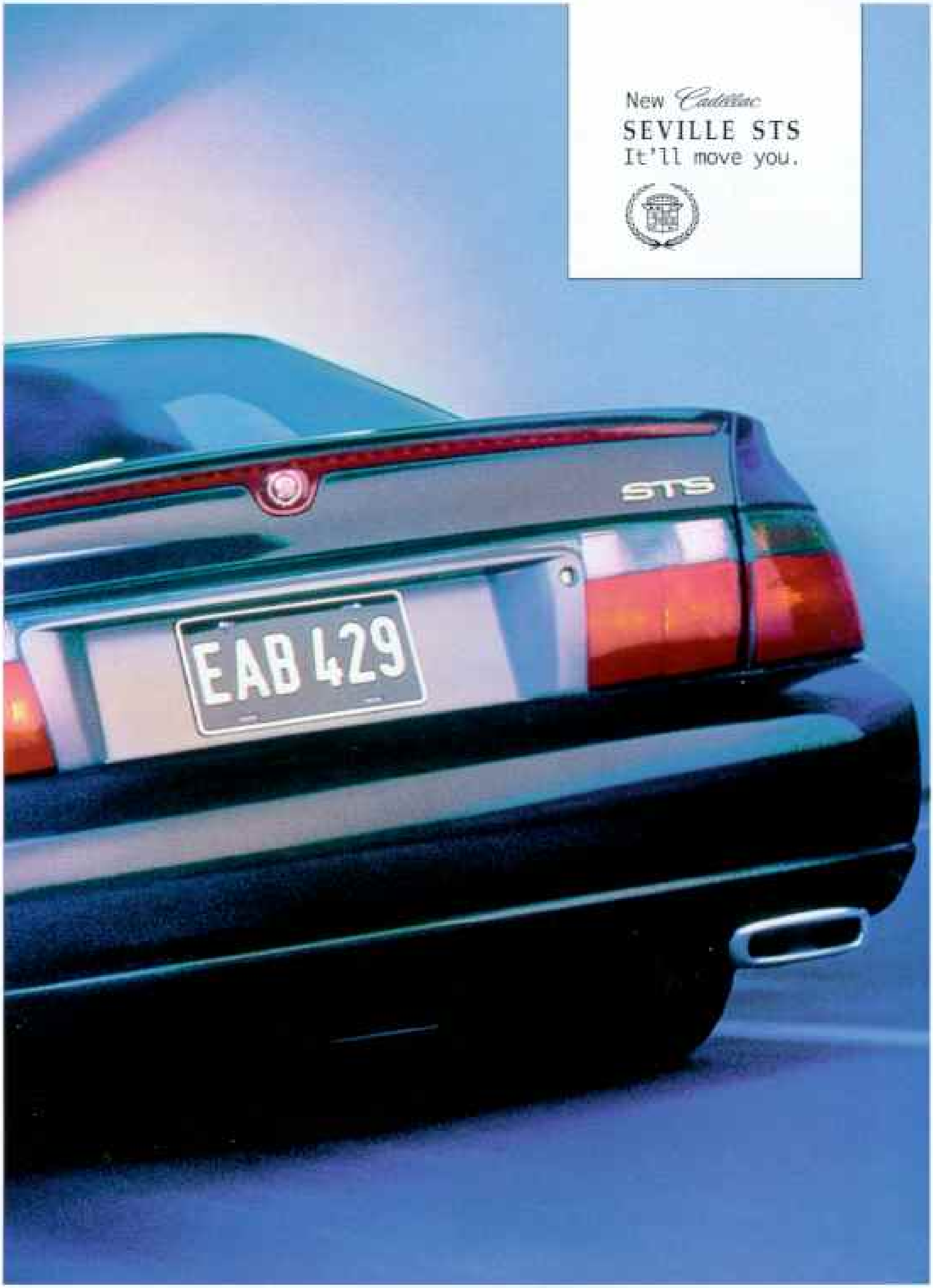

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If Degas
had used a Hasselblad instead
of a paint brush

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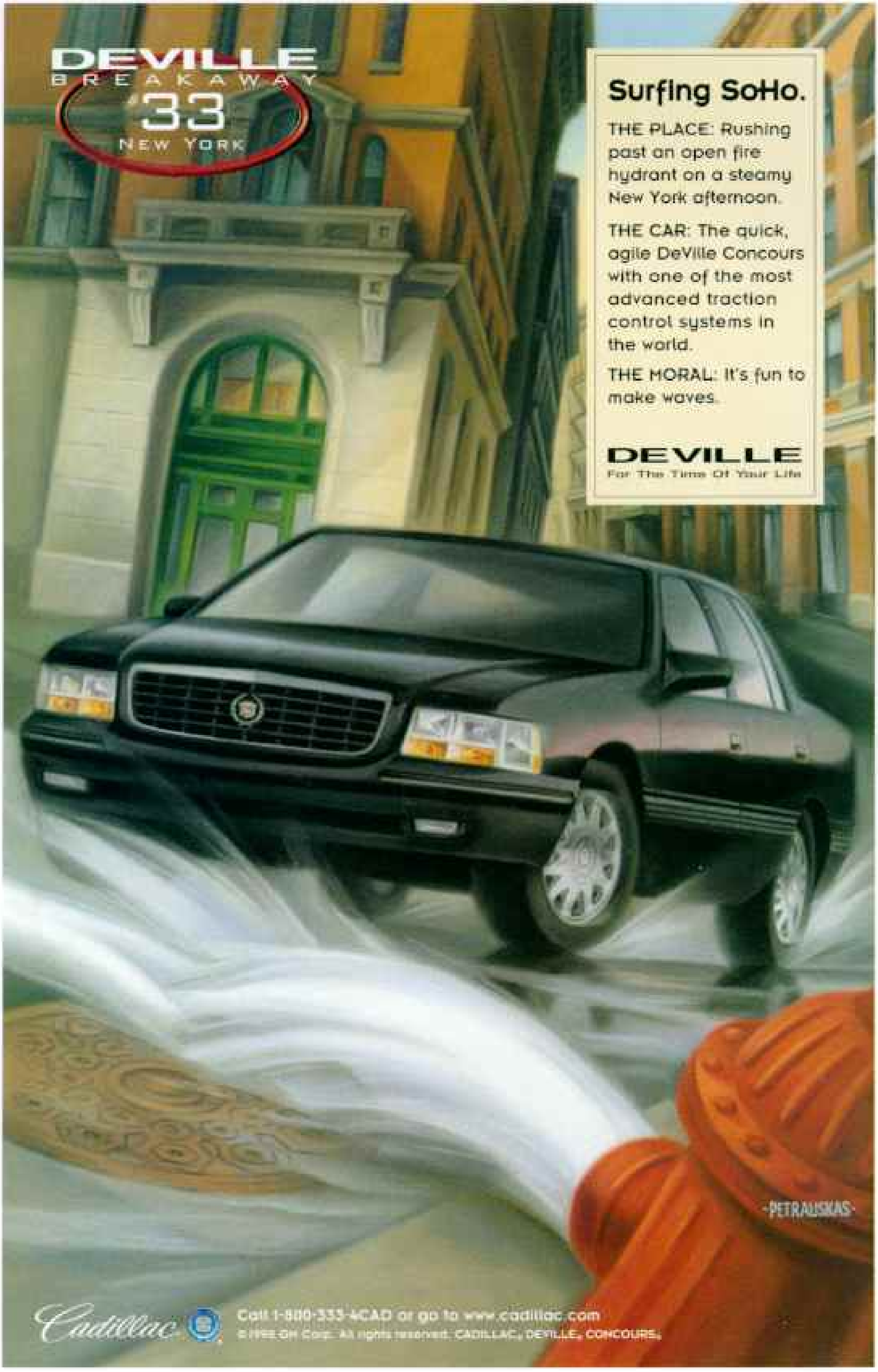
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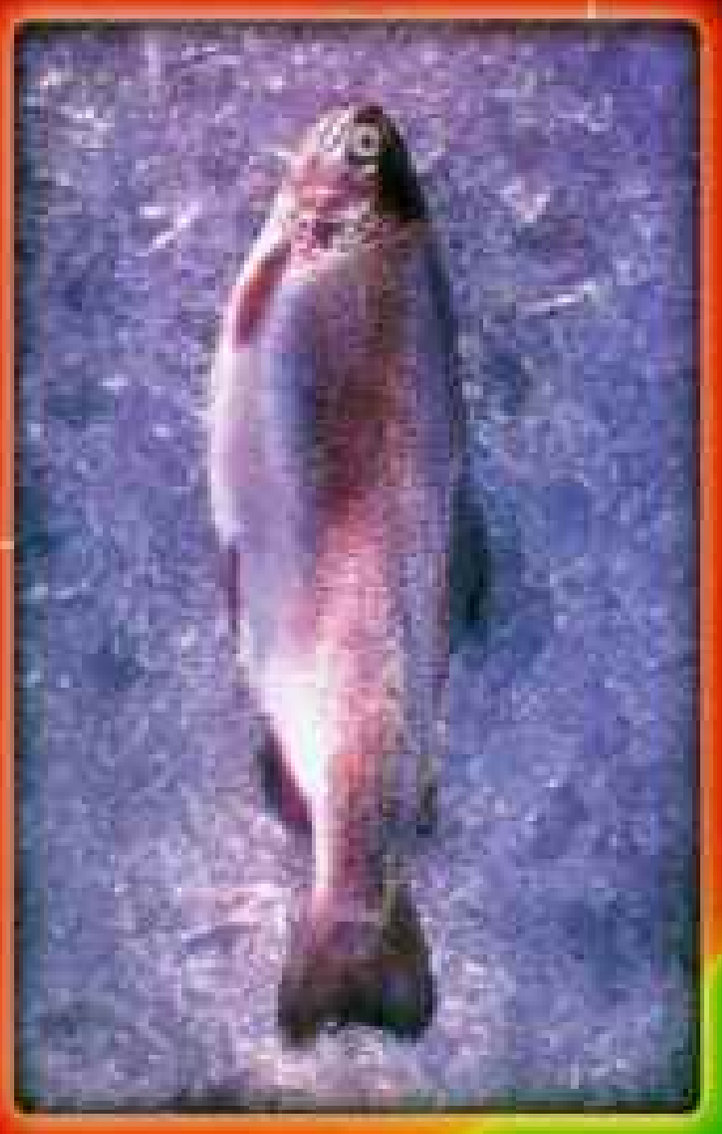

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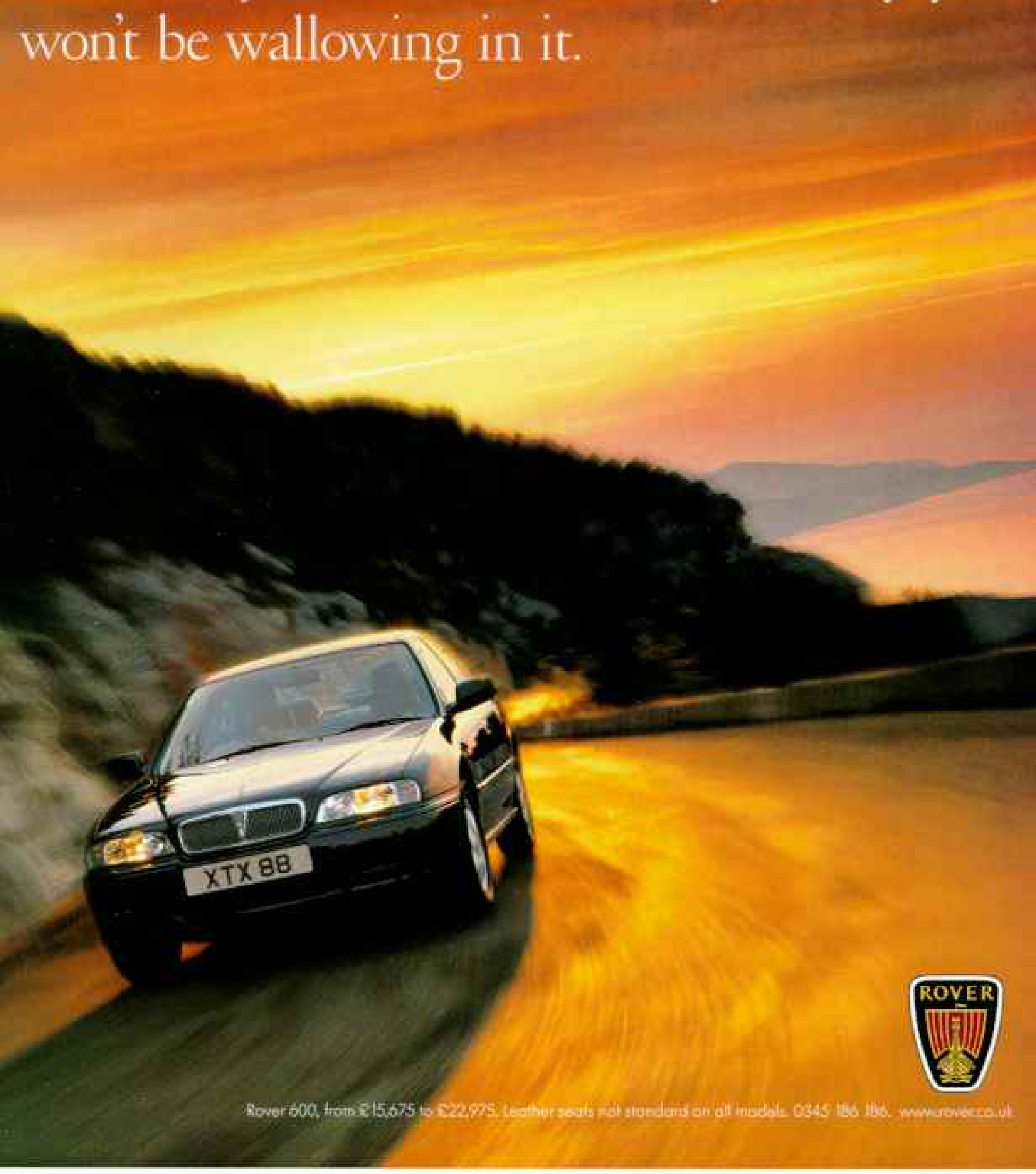

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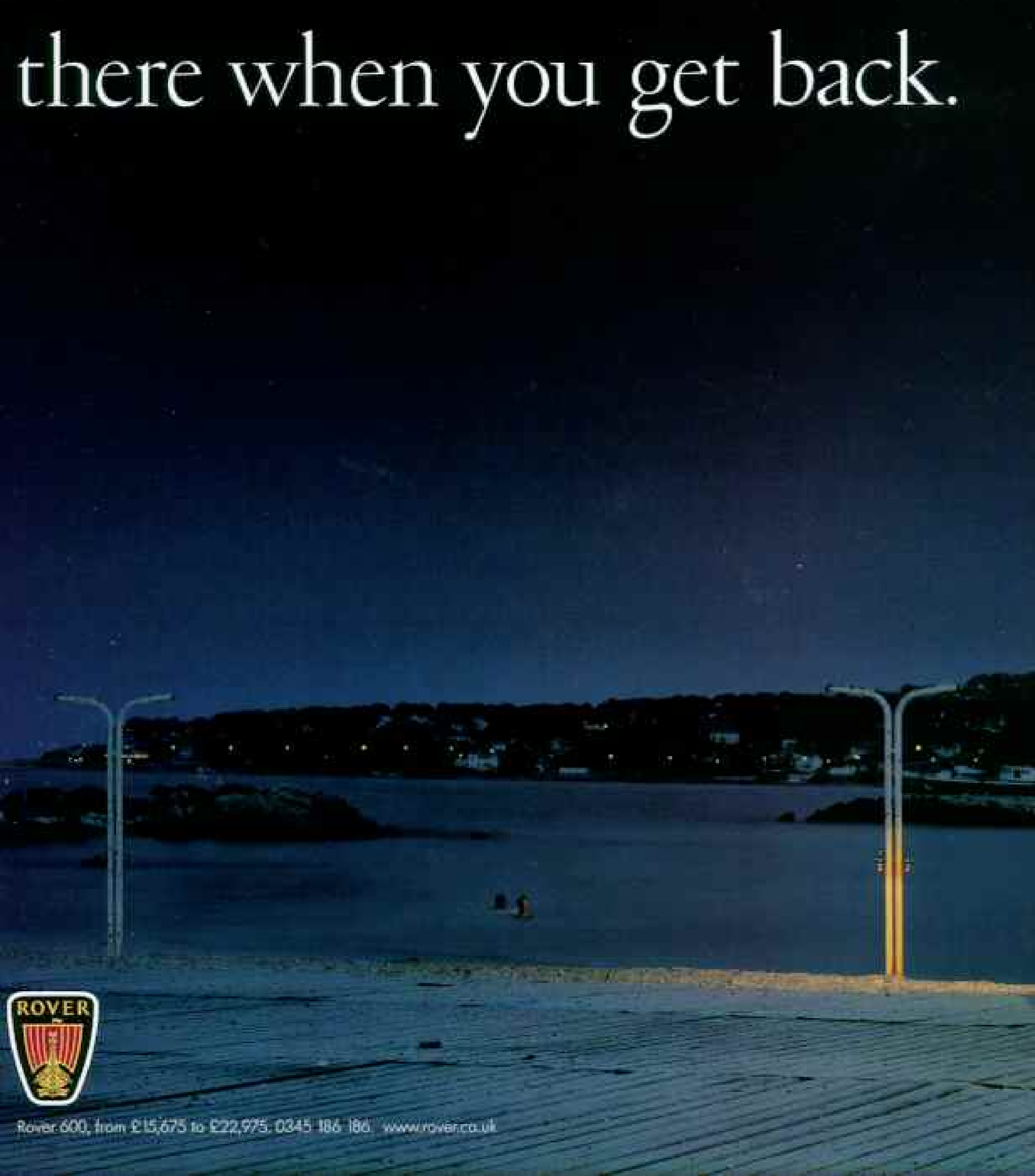

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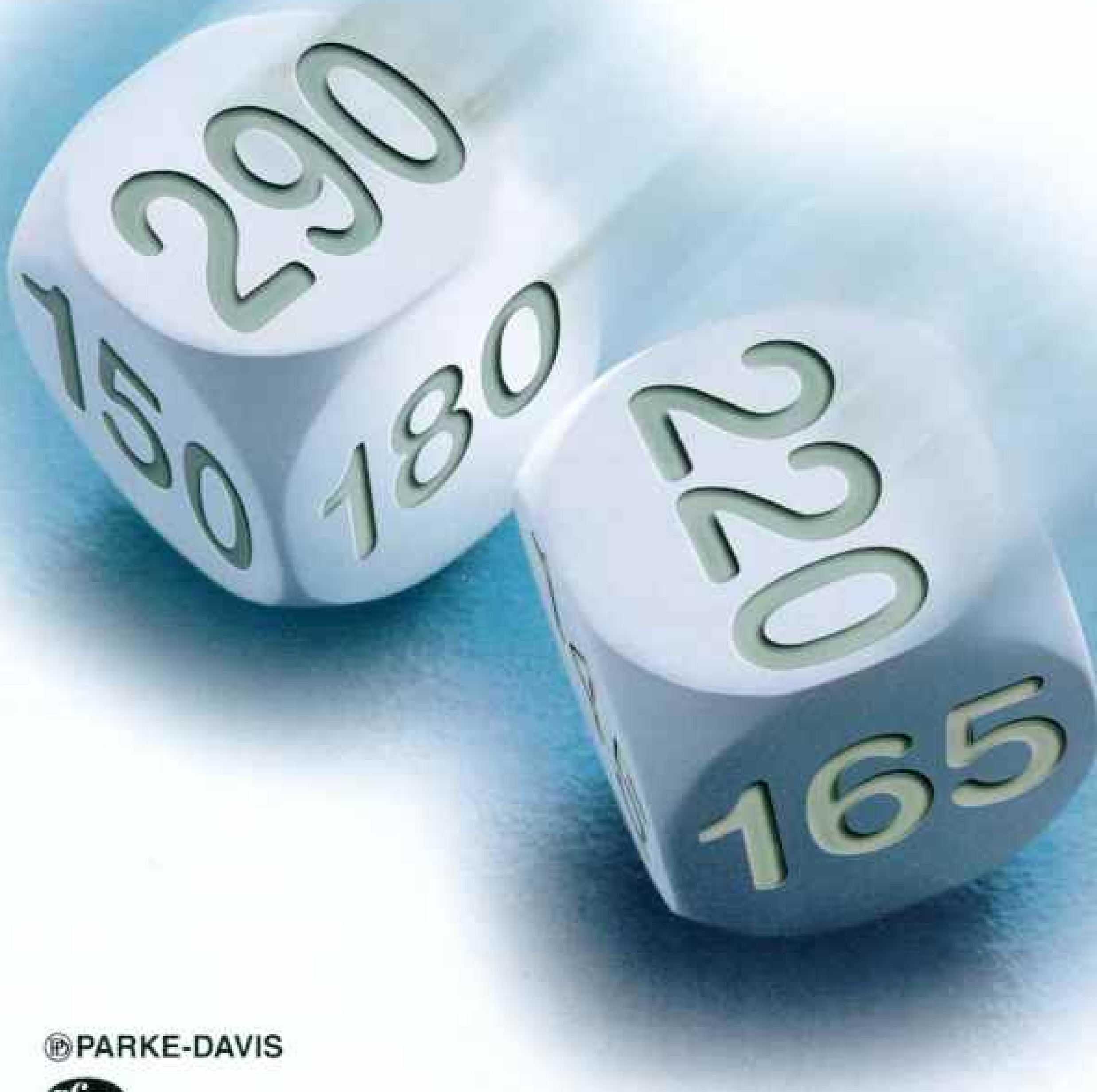

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TAKE YOUR BAD CHOLESTEROL NUMBERS TO NEW LOWS.

LIPITOR (atorvastatin calcium), in combination with diet and exercise, was proven in clinical studies to reduce LDL "bad" cholesterol by 39%–60%. See chart at right.

"DIET AND EXERCISE JUST WEREN'T DOING IT — BUT ONE MONTH AFTER MY DOCTOR STARTED ME WITH LIPITOR, I GOT MY TOTAL CHOLESTEROL DOWN FROM 255 TO 185."

LIPITOR also significantly lowers total cholesterol and triglycerides while raising HDL "good" cholesterol. And LIPITOR is taken only once a day, at any time of day, with or without food.

ONLY YOUR DOCTOR

or healthcare provider knows if LIPITOR is right for you. Some people should not take LIPITOR, including those with liver disease or possible liver problems, women who are nursing, pregnant, or who may become pregnant, or people who are allergic to any of the ingredients in LIPITOR. It's important to tell your doctor about any medications you are currently taking to avoid possible serious drug interactions. Your doctor may perform simple blood tests to monitor liver function before and during treatment.

LIPITOR IS GENERALLY WELL TOLERATED.

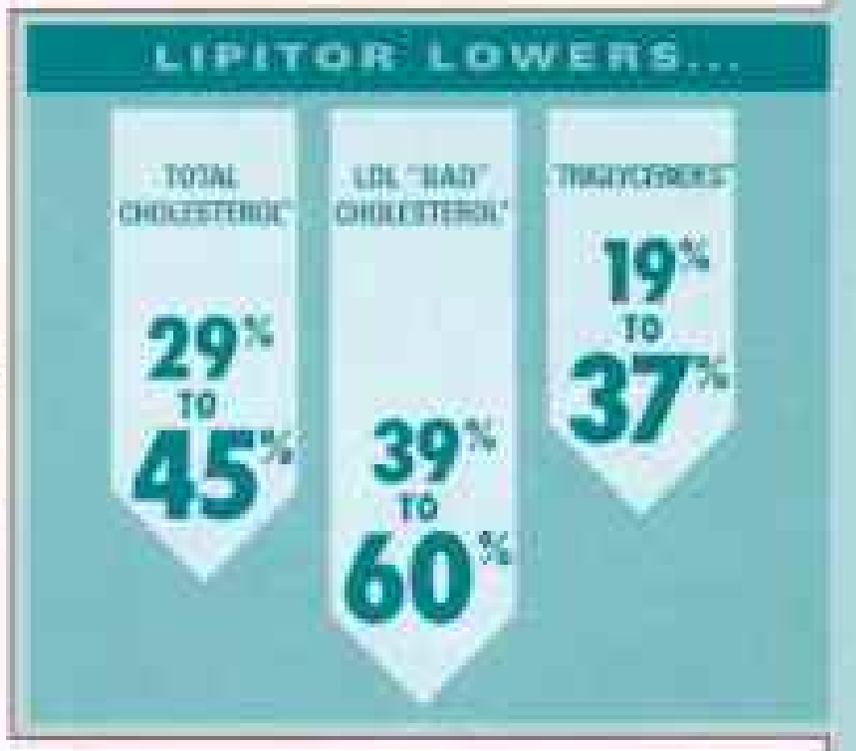
Side effects are usually mild and temporary. In clinical studies, less than 2% of patients had to stop taking LIPITOR because of adverse effects. If you take LIPITOR, tell your doctor about any unusual muscle pain or weakness, as this could be a sign of serious side effects.

"I'VE TRIED FOR YEARS TO GET MY CHOLESTEROL BELOW 250. SINCE MY DOCTOR PUT ME ON LIPITOR, I'M BELOW 200 — AT LAST!"

TODAY LIPITOR IS PRESCRIBED MORE THAN ANY OTHER CHOLESTEROL MEDICATION.

Over 3 million people have started using LIPITOR to lower their cholesterol. For more information about LIPITOR, please ask your doctor or pharmacist. Information about LIPITOR and a free brochure are also available by calling toll free, **1-888-LIPITOR**.

Please see important additional information on adjacent page.



*Results of two placebo-controlled dose-response studies of 10 to 80 mg of LIPITOR in high cholesterol patients.

LIPITOR®

atorvastatin calcium

tablets

The Lower Numbers You're Looking For

LIPITOR® (Atorvastatin Calcium) Tablets

Brief Summary of Prescribing Information

CONTRAINDICATIONS: Active liver disease or unexplained persistent elevations of serum transaminases. Hypersensitivity to any component of this medication. **Pregnancy and Lactation:** Atherosclerosis is a chronic process and discontinuation of lipid lowering drugs during pregnancy should have little impact on the outcome of long-term therapy of primary hypercholesterolemia. Cholesterol and other products of cholesterol biosynthesis are essential components for fetal development (including synthesis of steroids and cell membranes). Since HMG-CoA reductase inhibitors decrease cholesterol synthesis and possibly the synthesis of other biologically active substances derived from cholesterol, they may cause fetal harm when administered to pregnant women. Therefore, HMG-CoA reductase inhibitors are contraindicated during pregnancy and in nursing mothers. ATORVASTATIN SHOULD BE ADMINISTERED TO WOMEN OF CHILDBEARING AGE ONLY WHEN SUCH PATIENTS ARE HIGHLY UNLIKELY TO CONCEIVE AND HAVE BEEN INFORMED OF THE POTENTIAL HAZARDS. If the patient becomes pregnant while taking this drug, therapy should be discontinued and the patient apprised of the potential hazard to the fetus.

WARNINGS: Liver Dysfunction — HMG-CoA reductase inhibitors, like some other lipid-lowering therapies, have been associated with biochemical abnormalities of liver function. **Persistent elevations (>3 times the upper limit of normal [ULN] occurring on 2 or more occasions) in serum transaminases occurred in 0.7% of patients who received atorvastatin in clinical trials. The incidence of these abnormalities was 0.2%, 0.2%, 0.6%, and 2.3% for 10, 20, 40, and 80 mg, respectively.** One patient in clinical trials developed jaundice. Increases in liver function tests (LFT) or other patients were not associated with jaundice or other clinical signs or symptoms. Upon dose reduction, drug interruption, or discontinuation, transaminase levels returned to or near pretreatment levels without sequelae. Eighteen of 30 patients with persistent LFT elevations continued treatment with a reduced dose of atorvastatin. **It is recommended that liver function tests be performed prior to and at 12 weeks following both the initiation of therapy and any elevation of dose, and periodically (eg, semiannually) thereafter.** Liver enzyme changes generally occur in the first 3 months of treatment with atorvastatin. Patients who develop increased transaminase levels should be monitored until the abnormalities resolve. Should an increase in ALT or AST of >3 times ULN persist, reduction of dose or withdrawal of atorvastatin is recommended. Atorvastatin should be used with caution in patients who consume substantial quantities of alcohol and/or have a history of liver disease. Active liver disease or unexplained persistent transaminase elevations are contraindications to the use of atorvastatin (see CONTRAINDICATIONS). **Skeletal Muscle — Rhabdomyolysis with acute renal failure secondary to myoglobinuria has been reported with other drugs in this class.** Uncomplicated myalgia has been reported in atorvastatin-treated patients (see ADVERSE REACTIONS). Myopathy, defined as muscle aches or muscle weakness in conjunction with increases in creatine phosphokinase (CPK) values >10 times ULN, should be considered in any patient with diffuse myalgias, muscle tenderness or weakness, and/or marked elevation of CPK. Patients should be advised to report promptly unexplained muscle pain, tenderness or weakness, particularly if accompanied by malaise or fever. Atorvastatin therapy should be discontinued if markedly elevated CPK levels occur or myopathy is diagnosed or suspected. The risk of myopathy during treatment with other drugs in this class is increased with concurrent administration of cyclosporine, fibric acid derivatives, erythromycin, niacin, or azole antifungals. Physicians considering combined therapy with atorvastatin and fibric acid derivatives, erythromycin, immunosuppressive drugs, azole antifungals, or lipid-lowering doses of niacin should carefully weigh the potential benefits and risks and should carefully monitor patients for any signs or symptoms of muscle pain, tenderness, or weakness, particularly during the initial months of therapy and during any periods of upward dosage titration of either drug. Periodic creatine phosphokinase (CPK) determinations may be considered in such situations, but there is no assurance that such monitoring will prevent the occurrence of severe myopathy. **Atorvastatin therapy should be temporarily withheld or discontinued in any patient with an acute, serious condition suggestive of a myopathy or having a risk factor predisposing to the development of renal failure secondary to rhabdomyolysis (eg, severe acute infection, hypotension, major surgery, trauma, severe metabolic, endocrine and electrolyte disorders, and uncontrolled seizures).**

PRECAUTIONS: General — Before instituting therapy with atorvastatin, an attempt should be made to control hypercholesterolemia with appropriate diet, exercise, and weight reduction in obese patients and to treat other underlying medical problems (see INDICATIONS AND USAGE in full prescribing information).

Information for Patients — Patients should be advised to report promptly unexplained muscle pain, tenderness, or weakness, particularly if accompanied by malaise or fever. **Drug Interactions** — The risk of myopathy during treatment with other drugs of this class is increased with concurrent administration of cyclosporine, fibric acid derivatives, niacin (nicotinic acid), erythromycin, azole antifungals (see WARNINGS, Skeletal Muscle). **Antacid** (Two antacids and Maalox® TC suspension were coadministered.) Mixing concentration of atorvastatin decreased approximately 35%. However, LDL-C reduction was not altered. **Antipyrine** Because atorvastatin does not affect the pharmacokinetics of antipyrine, interactions with other drugs metabolized via the same cytochrome isozymes are not expected. **Colestipol** Plasma concentrations of atorvastatin decreased approximately 25% when colestipol and atorvastatin were coadministered. However, LDL-C reduction was greater when atorvastatin and colestipol were coadministered than when either drug was given alone. **Cimetidine** Atorvastatin plasma concentrations and LDL-C reduction were not altered by coadministration of cimetidine. **Digoxin** When multiple doses of atorvastatin and digoxin were coadministered, steady-state plasma digoxin concentrations increased by approximately 20%. Patients taking digoxin should be monitored appropriately. **Erythromycin** In healthy individuals, plasma concentrations of atorvastatin increased approximately 40% with coadministration of atorvastatin and erythromycin, a known inhibitor of cytochrome P450 3A4 (see WARNINGS, Skeletal Muscle). **Oral Contraceptives** Coadministration of atorvastatin and an oral contraceptive increased AUC values for norethindrone and ethinyl estradiol by approximately 30% and 20%. These increases should be considered when selecting an oral contraceptive for a woman taking atorvastatin. **Warfarin** Atorvastatin had no clinically significant effect on prothrombin time when administered to patients receiving chronic warfarin treatment. **Other Concomitant Therapy** In clinical studies, atorvastatin was used concomitantly with antihypertensive agents and estrogen replacement therapy without evidence of clinically significant adverse interactions. Interaction studies with specific agents have not been conducted. **Endocrine Function** — HMG-CoA reductase inhibitors interfere with cholesterol synthesis and therefore theoretically might blunt adrenal and/or gonadal steroid production. Clinical studies have shown that atorvastatin does not reduce basal plasma cortisol concentration or impair adrenal reserve. The effects of HMG-CoA reductase inhibitors on male fertility have not been studied in adequate numbers of patients. The effects, if any, on the pituitary-gonadal axis in premenopausal women are unknown. Caution should be exercised if an HMG-CoA reductase inhibitor is administered concomitantly with drugs that may decrease the levels or activity of endogenous steroid hormones, such as ketoconazole, spironolactone, and cimetidine. **CNS Toxicity** — Brain hemorrhage was seen in a female dog treated for 2 months at 120 mg/kg/day. Brain hemorrhage and optic nerve vacuolation were seen in another female dog that was sacrificed in moribund condition after 17 weeks of escalating doses up to 380 mg/kg/day. The 120 mg/kg dose resulted in a systemic exposure approximately 16 times the human plasma area under the curve (AUC 0-24 hours) based on the maximum human dose of 80 mg/day. A single brain vacuolation was seen in each of 2 male dogs dose treated at 10 mg/kg/day and one at 120 mg/kg/day) in a 2 year study. No CNS lesions have been observed in mice after chronic treatment for up to 2 years at doses up to 400 mg/kg/day or in rats at doses up to 100 mg/kg/day. These doses were 8 to 11 times (mouse) and 8 to 16 times (rat) the human AUC (0-24) based on the maximum recommended human dose of 80 mg/day. CNS vascular lesions, characterized by perivascular hemorrhages, edema, and mononuclear cell infiltration of perivascular spaces, have been observed in dogs treated with other members of this class. A chemically similar drug in this class produced optic nerve degeneration (Wallerian degeneration of optic nerve and thalamus in the epididymis of 2 of 10 rats treated with 100 mg/kg/day of atorvastatin for 2 months (15 times the human AUC at the 80 mg dose); testis weights were significantly lower at 36 and 108 mg/kg and epididymal weight was lower at 108 mg/kg. Male rats given 100 mg/kg/day for 11 weeks prior to mating had decreased sperm motility, spermatid head concentration, and increased abnormal sperm. Atorvastatin caused no adverse effects on semen parameters or reproductive organ histopathology in dogs given doses of 10, 40, or 120 mg/kg for two years. **Pregnancy: Pregnancy Category X** — **See CONTRAINDICATIONS.** Safety in pregnant women has not been established. Atorvastatin crosses the rat placenta and reaches a level in fetal liver equivalent to that in maternal plasma. Atorvastatin was not teratogenic in rats at doses up to 300 mg/kg/day or in rabbits at doses up to 100 mg/kg/day. These doses resulted in multiples of about 30 times (rat) or 20 times (rabbit) the human exposure based on surface area (mg/m²). In a study in rats given 20, 100, or 225 mg/kg/day, from gestation day 7 through to lactation day 21 (weaning), there was decreased pup survival at birth, neonatal weaning, and maturity in pups of mothers dosed with 225 mg/kg/day. Body weight was decreased on days 4 and 21 in pups of mothers dosed at 100 mg/kg/day; pup body weight was decreased at birth and at days 4, 21, and 91 at 225 mg/kg/day. Pup development was delayed (reduced performance at 100 mg/kg/day and ossified sternbrae at 225 mg/kg/day, pinnae detachment and eye opening at 225 mg/kg/day). These doses correspond to 6 times (100 mg/kg) and 22 times (225 mg/kg) the human AUC at 80 mg/day. Rare reports of congenital anomalies have been received following intrauterine exposure to HMG-CoA reductase inhibitors. There has been one report of severe congenital bony deformity, tracheo-esophageal fistula, and anal atresia (VATER association) in a baby born to a woman who took lovastatin with dietary complications during the first trimester of pregnancy. LIPITOR should be administered to women of child bearing potential only when such patients are highly unlikely to conceive and have been informed of the potential hazards. If the woman becomes pregnant while taking LIPITOR, it should be discontinued and the patient advised again as to the potential hazards to the fetus. **Nursing Mothers:** Nursing rat pups had plasma and liver drug levels at 36% and 40%, respectively, of that of their mother's milk. Because of the potential for adverse reactions in nursing infants, women taking LIPITOR should not breast feed (see CONTRAINDICATIONS). **Pediatric Use:** Treatment experience in a pediatric population is limited to doses of LIPITOR up to 80 mg/day for 1 year in 8 patients with homozygous FH. No clinical or biochemical abnormalities were reported in these patients. Some of these patients were below 6 years of age. **Geriatric Use:** Treatment experience in adults age ≥65 years with doses of LIPITOR up to 80 mg/day has been evaluated in 221 patients. The safety and efficacy of LIPITOR in this population were similar to those of patients <65 years of age.

ADVERSE REACTIONS: LIPITOR is generally well tolerated. Adverse reactions have usually been mild and transient. In controlled clinical studies of 2502 patients, <2% of patients were discontinued due to adverse experiences attributable to atorvastatin. The most frequent adverse events thought to be related to atorvastatin were constipation, flatulence, dyspepsia, and abdominal pain. **Clinical Adverse Experiences:** Adverse experiences reported in ≥2% of patients in placebo-controlled clinical studies of atorvastatin, regardless of causality assessment:

Adverse Events in Placebo-Controlled Studies (% of Patients)

BODY SYSTEM/ Adverse Event	Placebo N = 270	Atorvastatin 10 mg N = 863	Atorvastatin 20 mg N = 36	Atorvastatin 40 mg N = 79	Atorvastatin 80 mg N = 68
BODY AS A WHOLE					
Infection	10.8	10.3	2.8	10.1	1.4
Headache	7.0	5.8	16.7	2.5	8.8
Accidental Injury	3.7	4.2	0.0	1.3	2.2
Flu Syndrome	1.9	2.2	0.0	2.5	2.2
Abdominal Pain	0.7	2.8	0.0	2.8	2.7
Back Pain	2.6	2.8	0.0	2.8	2.1
Allergic Reaction	2.6	0.8	2.8	1.3	0.0
Asthenia	1.9	2.2	0.0	2.8	0.0
DIGESTIVE SYSTEM					
Constipation	1.9	2.1	0.0	2.8	1.1
Diarrhea	1.5	2.1	0.0	2.8	5.2
Dyspepsia	4.1	2.2	2.8	1.3	2.1
Flatulence	2.2	2.1	2.8	1.3	1.1
RESPIRATORY SYSTEM					
Sinusitis	2.6	2.8	0.0	2.5	0.0
Pharyngitis	1.5	2.3	0.0	1.3	2.1
SKIN AND APPENDAGES					
Rash	0.7	2.0	1.9	3.8	1.1
MUSCULOSKELETAL SYSTEM					
Arthralgia	1.5	2.9	0.0	5.1	0.0
Myalgia	1.1	3.3	5.6	1.3	0.0

The following adverse events were reported, regardless of causality assessment in patients treated with atorvastatin in clinical trials. The events in italics occurred in <2% of patients and the events in plain type occurred in >2% of patients:

Body as a Whole: Chest pain, face edema, fever, neck rigidity, malaise, photosensitivity reaction, generalized edema. ***Digestive System:*** Nausea, gastroenteritis, liver function tests abnormal, colitis, vomiting, gastritis, dry mouth, rectal hemorrhage, esophagitis, eructation, glossitis, mouth ulceration, anorexia, increased appetite, enteritis, biliary pain, cheilitis, duodenal ulcer, dysphagia, enteritis, melena, gum hemorrhage, stomach ulcer, leukoplakia, ulcerative stomatitis, hepatitis, pancreatitis, cholestatic jaundice. ***Respiratory System:*** Bronchitis, rhinitis, pneumonia, dyspnea, asthma, epistaxis. ***Nervous System:*** Insomnia, dizziness, paresthesia, somnolence, amnesia, abnormal dreams, libido decreased, emotional lability, incoordination, peripheral neuropathy, hallucination, facial paralysis, hypokinesia, depression, hypesthesia, hypertonia. ***Musculoskeletal System:*** Arthritis, leg cramps, bursitis, tenosynovitis, myasthenia, tendinous contracture, myositis. ***Skin and Appendages:*** Pruritus, contact dermatitis, alopecia, dry skin, sweating, acne, urticaria, eczema, seborrhea, skin ulcer. ***Urogenital System:*** Urinary tract infection, urinary frequency, cystitis, hematuria, impotence, dysuria, kidney calculus, moniliasis, epididymitis, fibrocystic breast, vaginal hemorrhage, albuminuria, breast enlargement, metrorrhagia, nephritis, urinary incontinence, urinary retention, urinary urgency, abnormal ejaculation, uterine hemorrhage. ***Special Senses:*** Amblyopia, tinnitus, dry eyes, conjunctivitis, eye hemorrhage, deafness, glaucoma, parosmia, taste loss, taste perversion. ***Cardiovascular System:*** Palpitation, vasodilation, syncope, migraine, postural hypotension, phlebitis, arrhythmia, angina pectoris, hypertension. ***Metabolic and Nutritional Disorders:*** Peripheral edema, hyperglycemia, creatine phosphokinase increased, gout, weight gain, hypoglycemia. ***Hemic and Lymphatic System:*** Ecchymosis, anemia, lymphadenopathy, thrombocytopenia, petechia. ***Postintroduction Reports:*** Adverse events associated with LIPITOR that have been received since market introduction that are not listed above, and that may have no causal relationship to drug include the following: angioneurotic edema and thrombocytopenia.

OVERDOSAGE: There is no specific treatment for atorvastatin overdosage. In the event of an overdose, the patient should be treated symptomatically and supportive measures instituted as required. Due to extensive drug binding to plasma proteins, hemodialysis is not expected to significantly enhance atorvastatin clearance. **Caution** — Federal law prohibits dispensing without prescription.

Consult package insert before prescribing LIPITOR® (Atorvastatin Calcium) Tablets.

Revised February 1998

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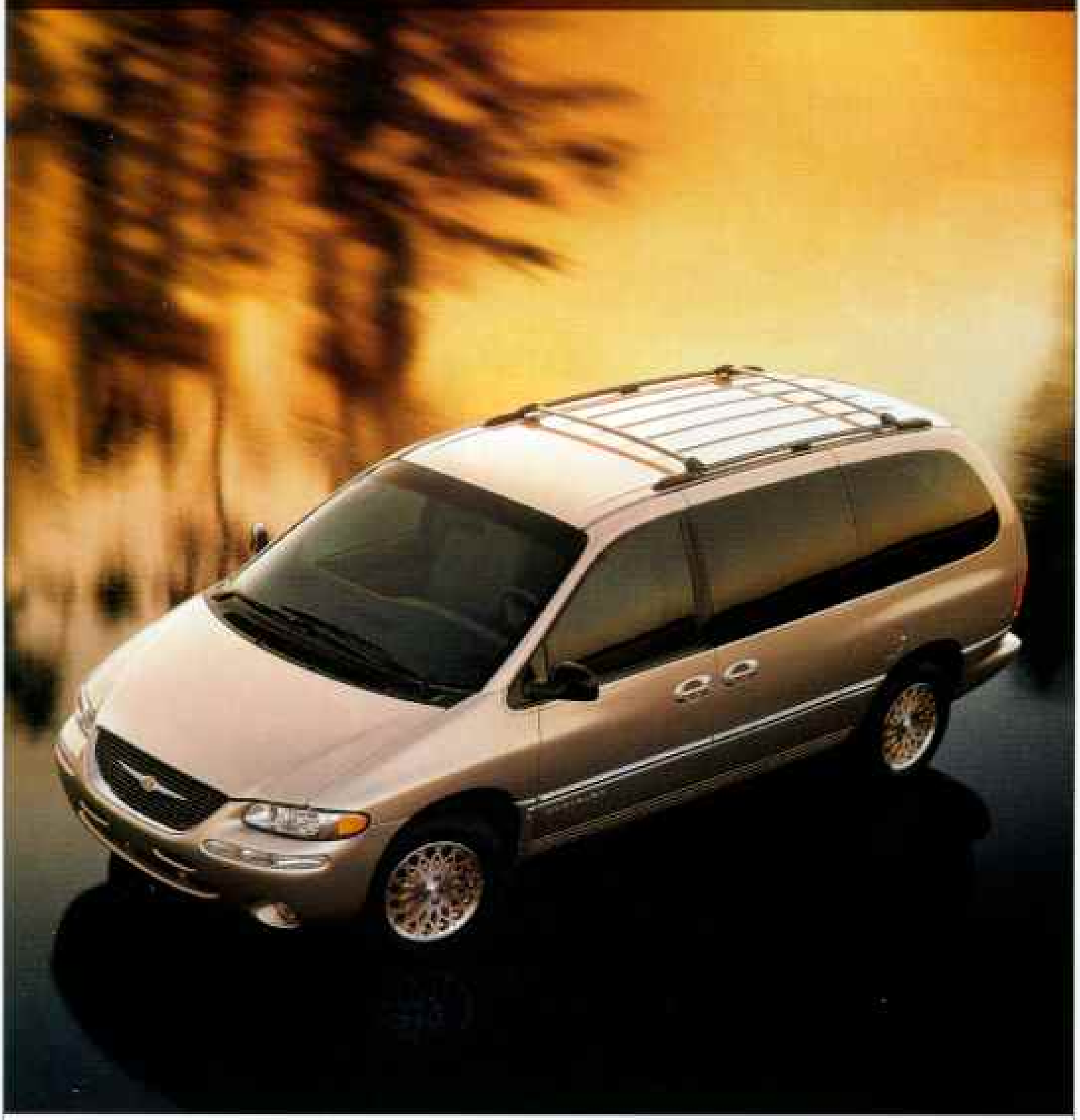
■ FROM THE GEOGRAPHIC ARCHIVES

A Tall One on the Rocks

Only titanic embarrassment ensued when the S.S. *Princess May* hit a reef near Alaska's Sentinel Island early one foggy morning in August 1910. Passengers, crew, and cargo were safely removed from the Canadian Pacific Railway vessel before retreating tides left her high and dry. Despite the best efforts of rock blasters the ship sat lodged upon the crags for nearly a month before tugboats could pull her free. Damage, including a gash 50 feet long and 18 inches wide, was repaired, and the *Princess May* served nine more years along the British Columbia coast. Then she was sold and took a Caribbean tour shipping fruit before being scuttled in 1930 off Kingston, Jamaica. This photo, acquired by an early contributor, Thomas Riggs, Jr., probably during his travels surveying the Alaska-Canada border, was never published in the GEOGRAPHIC.

The New Chrysler Town & Country

We made it exceptionally quiet. However, it still produces an occasional buzz.



Chrysler Town & Country. "America's Most Appealing Minivan" Two Years In A Row.
—J.D. Power and Associates

For the second year in a row, the Chrysler Town & Country has been honored with J.D. Power and Associates' prestigious APEAL award. In their recent study, Town & Country tied as "America's Most Appealing Minivan" after its owners rated it on over 100 attributes.* So while we always insist that it be quiet, we certainly don't mind hearing this sort of noise.

CHRYSLER

ENGINEERED TO BE GREAT CARS

*J.D. Power and Associates 1997 APEAL Study—Automotive Performance, Execution and Layout Study℠. Segment: Compact van. Study based on a total of 29,187 consumer responses.

POINT OF VIEW

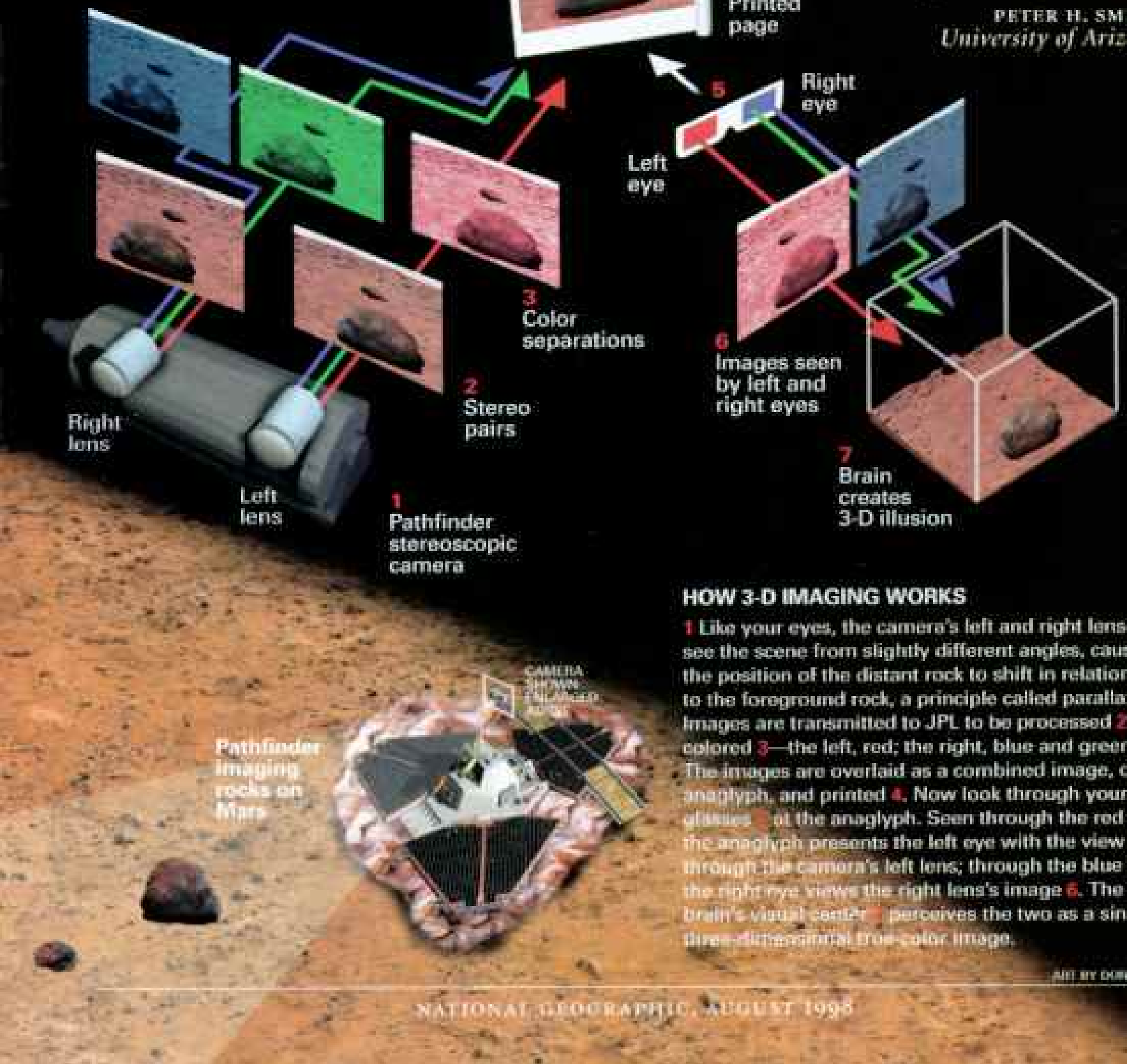
Putting People on Mars

Visiting Florida's Epcot Center in 1981, I put on polarized glasses to view a 3-D movie made by Kodak. During a bucolic scene, dandelion fuzz floated right off the screen to within my reach. That's when I realized the power of three-dimensional technology to put the viewer in the picture.

Conveying that sense of place seemed crucial for the Pathfinder mission to Mars. In 1993 my colleagues and I decided to compete for the camera contract. NASA wanted a small, lightweight unit capable, at minimum, of black-and-white imaging. My concept, which came to me in a dream, combined stereoscopic vision with color filters in a compact robotic head. It would have two lenses, six inches apart, working just like human eyes. With 3-D we could measure the distance and size of each rock. Knowing the size distribution of rocks in a field is critical to determining their origin. Those from an impact crater have different shapes and sizes from those carried downstream by floodwaters. From 3-D images we could also make topographic maps and simulate driving the rover on a computer before giving instructions to the real rover on Mars.

The finely calibrated digital camera, Imager for Mars Pathfinder, recorded 16,661 frames, which we are still analyzing. A similar camera will go to Mars's south polar region on a mission launching in January 1999.

PETER H. SMITH
University of Arizona



HOW 3-D IMAGING WORKS

1 Like your eyes, the camera's left and right lenses see the scene from slightly different angles, causing the position of the distant rock to shift in relation to the foreground rock, a principle called parallax. Images are transmitted to JPL to be processed 2 and colored 3—the left, red; the right, blue and green. The images are overlaid as a combined image, or anaglyph, and printed 4. Now look through your 3-D glasses 5 at the anaglyph. Seen through the red filter, the anaglyph presents the left eye with the view through the camera's left lens; through the blue filter the right eye views the right lens's image 6. The brain's visual center 7 perceives the two as a single three-dimensional true-color image.

ART BY DORI FOLEY

SEXUAL HEALTH

Most men will have an isolated erection problem at some time in their lives, but for others it happens more frequently. If the inability to respond naturally to your partner has become a recurring problem, you may be suffering from a treatable medical condition called erectile dysfunction (E.D.), also known as impotence. The following questions and answers are designed to give you a brief introduction to the causes of E.D. and the various treatment options available. If you believe you are suffering from E.D., or want to know more about the condition, talk to your doctor or other healthcare professional.

ERECTION PROBLEMS: WHAT EVERY MAN SHOULD KNOW

WHAT IS E.D.?

Erectile dysfunction is the consistent inability to achieve and/or maintain an erection sufficient for satisfactory sexual activity. That means not just an occasional problem, but one that has been occurring repeatedly for a period of time. It's a widespread condition, shared by approximately 30 million men in the United States.

WHAT CAUSES E.D.?

It was once believed that E.D. is all in your head, or just an inevitable result of getting older. Actually, the majority of E.D. cases are associated with physical conditions or events, including some that are age-related.

The most common risk factors for E.D. include:

- *Diabetes, high blood pressure, hardening of the arteries, or high cholesterol*
- *Injury or illness, such as spinal cord injury, multiple sclerosis, depression, stroke, or surgery for the prostate or colon*
- *Medications that may bring about E.D. as an unwanted side effect*
- *Cigarette smoking or alcohol/drug abuse*
- *Psychological conditions, such as anxiety and stress*

If you want to know more about E.D., talk to your doctor.

CAN ERECTILE DYSFUNCTION BE TREATED?

Yes. The good news is that, regardless of the cause, the vast majority of E.D. cases are treatable. Patients have a variety of treatment options from which to choose, including oral medication, hand-held vacuum pumps, self-administered injections, pellet suppositories, and surgical implants.

CAN ANYONE USE THESE TREATMENTS?

It's important to remember that these treatments are not for everyone, but only for men diagnosed with E.D. You and your doctor can determine the appropriate treatment for you.

HOW DO I KNOW IF I HAVE E.D.?

If you have erection problems, you probably already know it. But before your condition can be treated, you need to get a diagnosis from your doctor. There is no need to be embarrassed or ashamed when discussing E.D. with your doctor. He or she has probably diagnosed and treated E.D. many times but may not have discussed it with you out of respect for your privacy. Your doctor can provide you with understanding, support, and best of all, information.

To diagnose E.D., doctors typically ask a few specific questions and give a routine physical exam. This should help your doctor arrive at a diagnosis.

Based on this information, you and your doctor will decide on the treatment that is best for you.

REMEMBER:

E.D. is a common medical condition.

It's not an inevitable result of growing older.

E.D. is treatable with a variety of methods.

Only your doctor can prescribe the appropriate treatment.

NATIONAL GEOGRAPHIC

On Television

© GERALDINE WILKINS KADINGA, LOS ANGELES TIMES

■ EXPLORER, AUGUST 23

When Earth Lets Go

By March 19, 1998, more than 24 inches of rain had fallen on Laguna Niguel, south of Los Angeles. That was nearly twice the seasonal average. Anxious residents watched as El Niño-driven rains saturated the soil of an artificial hill where expensive homes had been built above a condominium complex.

Recorded in EXPLORER's new film "Landslide!," the collapse that had been predicted for years by geologists finally happened, sending two homes crashing onto a terraced slope (above) and destroying five of the condos at the bottom of the hill.

The houses and demolished condos, earlier judged the most imperiled by the hill, had been evacuated in December. But residents in other units remained worried. The day before the landslide fire trucks and police cars were stationed nearby and engineers kept watch. About 3 a.m. residents were awakened and told to evacuate immediately. No one was injured.

On the other side of the globe, the Alpine sky shines a brilliant blue and sunlight sparkles on snow. The danger beneath this beauty breaks loose with a low rumble in "Thunder on the Mountain," as great slabs of snow come to life and gather speed, hurtling down to bury anything—and anybody—in the way.

Computer animation illustrates the hidden dynamics of avalanches, set in motion by a variety of often unpredictable conditions. The film follows scientists at the Swiss Federal Institute for Snow and Avalanche Research as they examine the physics of snow structure.

Together the EXPLORER films show the human costs when Earth's soil or its winter blanket moves with sudden and unstoppable force.

■ PROGRAM GUIDE

National Geographic Specials
NBC. See local listings.
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TBS. Sundays, 7 p.m. ET.
National Geographic Videos and Kids Videos Call 1-800-627-5162.
Programming information accurate at press time; consult local listings.

Look for the National Geographic Channel when traveling in Europe, Australia, Southeast Asia, and Taiwan.

NATIONAL GEOGRAPHIC

EarthAlmanac

DAVE STEINCE, U.S. FOREST SERVICE

A Wild Wind Roared Out West

When the sun rose last October 25 over Routt National Forest northwest of Denver, it revealed an amazing sight. In the dead of night a violent freak storm with 120-mile-an-hour winds had leveled five million Engelmann spruce and subalpine fir trees. Such blowdowns typically cover 50 to 100 acres. This one flattened about 20,000 acres—more than 30 square miles. "The scope is just phenomenal," says Frank Cross of the U.S. Forest Service.

What to do with some 200 million board feet of downed timber? That's the service's dilemma. About 60 percent lies within the Mount Zirkel Wilderness Area, where logging is prohibited. About 3,000 acres outside the wilderness may be logged. One big concern: The dead trees may attract millions of destructive spruce bark beetles.

In a Blink, Firefly Gets a Potent Meal

Female fireflies attract mates with blinking signals unique to their own kind. But femmes fatales of the genus *Photuris* lure males of another genus, *Photinus*, by imitating female *Photinus* flashes. The female imposter not only dines on the duped male, far right, she absorbs toxins from his blood, a defense against birds and spiders that she otherwise lacks.

THOMAS EISNER


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To: Everyone
From: Larry Stopczynski

I come from a family of police officers. Imagine how I felt when my very first car was stolen from in front of our house.

It took a few years, but I finally got even with the bad guys. My team invented a thief's worst nightmare: SecuriLock™. Each key has a unique code that matches the one in your vehicle. Without it, you're going nowhere fast.

And there are 72 quadrillion possible codes. We could put a different one in every vehicle we sell worldwide for the next four billion years.

Larry Stopczynski

Larry Stopczynski
Engineer, SecuriLock Team

You're 10,000 times more likely

to win the lottery than to steal my car.

Ford Motor Company
BETTER IDEAS. DRIVEN BY YOU.™

SECURITY

PERRY THORSVIK, BALTIMORE SUN (TOP); MARIA CECIL, DEFENDERS OF WILDLIFE

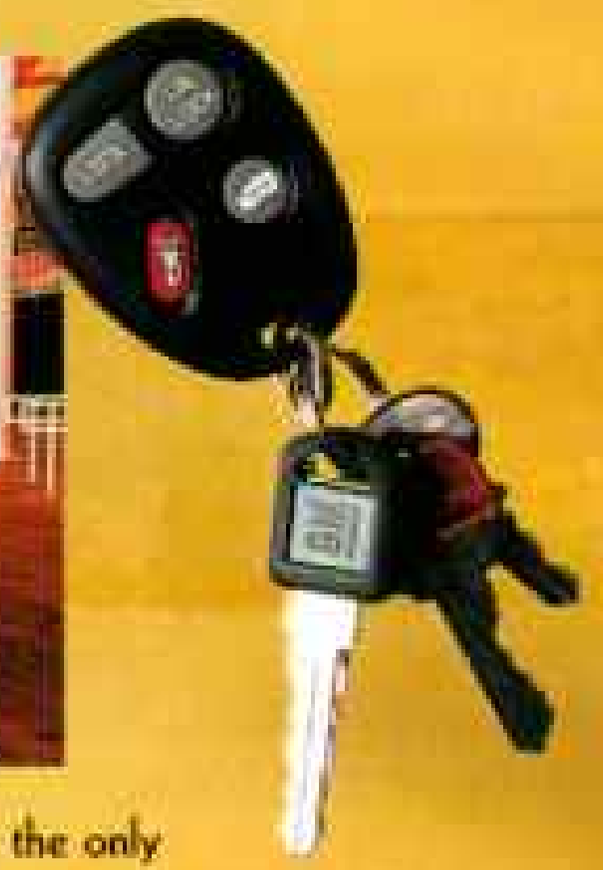
Swans Follow Man's Wings to Find the Way Home

A trio of female trumpeter swans—Isabelle, Yoyo, and Sydney—touched down with an ultralight at Magruder Ferry, Maryland, last December 18. After overnighting, the swans completed their 103-mile flight to a Chesapeake Bay farm, their new winter home. They began near Airlie, a Virginia research center where the swans were imprinted on ultralights and humans. Researchers played a recording of a plane's engine to them before they hatched. Here biologist Kevin Richards reinforces the bond.

The flight was a real-life reel from *Fly Away Home*, the movie that featured earlier work with Canada geese used as test birds with ultralights before the swans were tried. The long-term project, recently a collaboration between Airlie zoologist Bill Sladen and Defenders of Wildlife, seeks to reestablish migratory trumpeters in the eastern U.S., where they numbered 100,000 until settlers wiped them out by the mid-19th century. In Alaska and the West some 20,000 trumpeters remain. Researchers are trying to teach some birds the old migration route between Ontario and Maryland. "This fall we hope to truck some Airlie-raised swans to a site in New York State, train them to fly alongside an ultralight, and then lead them down to the Chesapeake Bay," says Sladen. "If they return to New York next spring and then migrate to the Chesapeake on their own next fall, that will be the ultimate success."

TEXT BY JOHN L. ELIOT

Oh great, another remote
for men and women to fight over.



Get ready for another power struggle. The Chevy™ Venture® is the only **minivan to offer a Remote Power Sliding Passenger-side Door** for keyless entry into its comfortable rear seats. Of course, that leaves your hands free to grasp, grab and grapple with all the things your family needs to hit the road. You'll probably still fight over the remote though, so try not to hog it.

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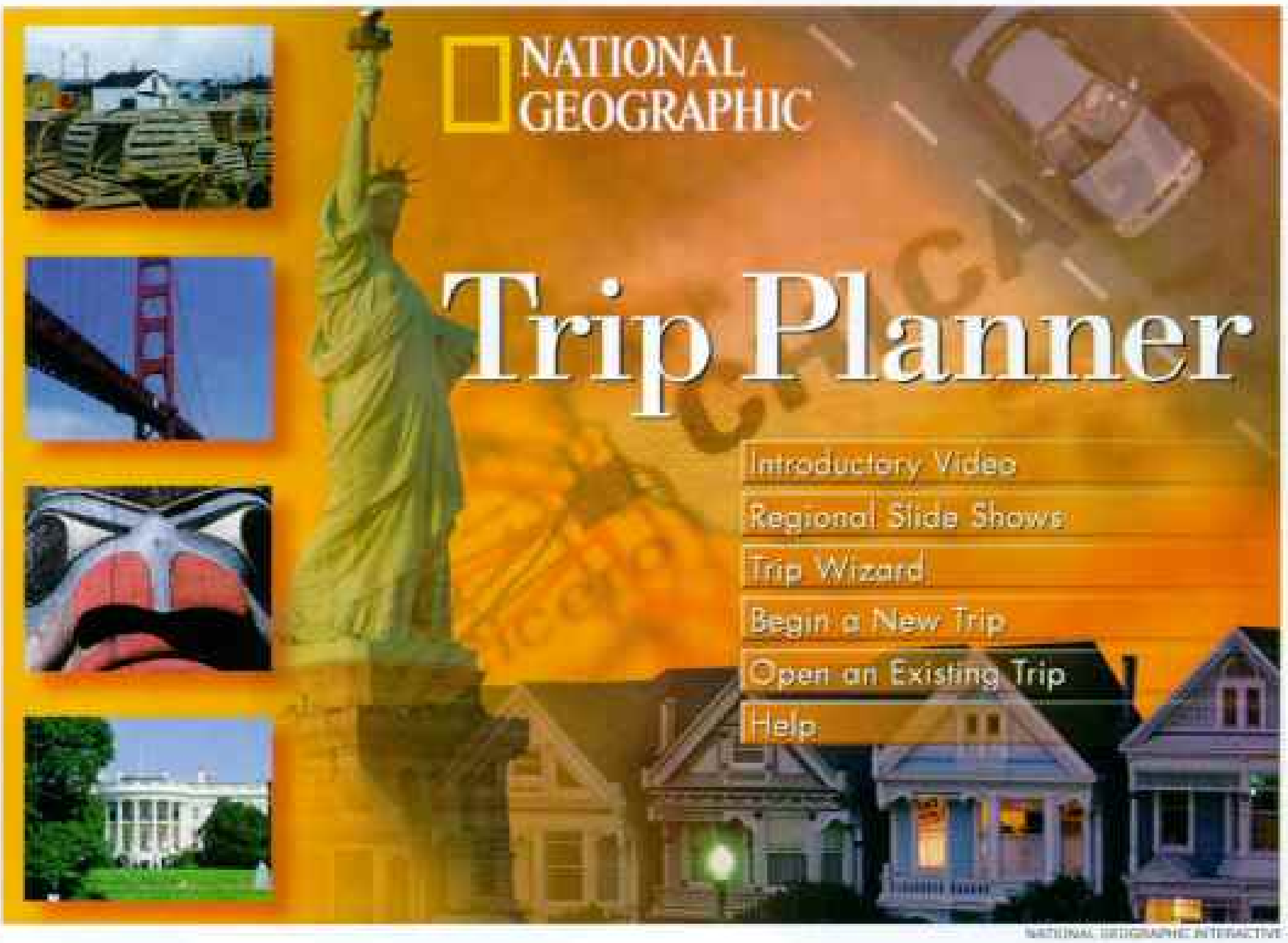

NATIONAL GEOGRAPHIC INTERACTIVE

■ CD-ROM

Taking a Trip? Let the Fun Start Before the Car Does

Grandma's having a barbecue at her new condo 500 miles away, and you need directions more specific than "over the river and through the woods." So you start up our new CD-ROM, *Trip Planner,* enter your origin and destination in the U.S. or Canada, and set your preferences (scenic roads versus interstates, for instance). The result: a customized map and point-to-point directions, ready to print out. You will also find state/province guides that offer more than 70,000 places of interest, including finds by National Geographic field researchers. And you can follow walking tours through major cities, get photo tips from professionals, tailor your journey for kids or seniors, and add or subtract side trips as your heart desires. Just be sure you get to Grandma's before the burgers burn.

■ ONLINE

See Mars on the Web in 3-D

Enjoy the Mars story? Then take the glasses in this issue to your computer and log on for a 3-D look at the red planet. You can also see a simulated Pathfinder landing and add your views to our forum at *www.nationalgeographic.com/features/98/mars.*

■ FOR INFORMATION

E-mail for Interactive: ngi@ngs.org. **E-mail for Member Services:** ngsline@customersvc.com
CD-ROMs: Call 1-800-881-9919, U.S. and Canada; elsewhere call 1-916-939-1004.

A pill that helps men with erectile dysfunction respond again.

Please see brief summary of product information for VIAGRA (25-mg, 50-mg, 100-mg) tablets on the following page.

Now there's a simple new pill for the treatment of erectile dysfunction (a common medical problem also called impotence).

VIAGRA™ (sildenafil citrate) is a prescription pill that may help you achieve erections the natural way—in response to sexual stimulation.

Naturally, the response has been positive.

With VIAGRA, you may be able to respond naturally once again—with the ease of a pill. Ask your doctor if VIAGRA is the right step for you.

VIAGRA should not be taken by men who use drugs known as nitrates (most often used to control angina) in any form, at any time. Nitrates can reduce blood pressure to unsafe levels if used with VIAGRA. Be sure to talk to your doctor about any medications you take.

In clinical trials, VIAGRA was well tolerated. Some men experienced side effects, including headache, facial flushing, and upset stomach. A small percentage of men experienced mild and temporary visual effects. (See product information for more details.) ***For more information, call 1-888-4VIAGRA or visit www.viagra.com.***

VIAGRA™
(sildenafil citrate) tablets
Let the dance begin.

Let the dance begin.

Brief summary of prescribing information

VIAGRA
(sildenafil citrate) tablets

INDICATION AND USAGE

VIAGRA is indicated for the treatment of erectile dysfunction. The studies that established benefit demonstrated improvements in success rates for sexual intercourse compared with placebo.

CONTRAINDICATIONS

Use of VIAGRA is contraindicated in patients with a known hypersensitivity to any component of the tablet. Consistent with its known effects on the nitric oxide/cGMP pathway (see CLINICAL PHARMACOLOGY), **VIAGRA was shown to potentiate the hypotensive effects of nitrates, and its administration to patients who are concurrently using organic nitrates in any form is therefore contraindicated.**

PRECAUTIONS

General

A thorough medical history and physical examination should be undertaken to diagnose erectile dysfunction, determine potential underlying causes, and identify appropriate treatment.

There is a degree of cardiac risk associated with sexual activity; therefore, physicians may wish to consider the cardiovascular status of their patients prior to initiating any treatment for erectile dysfunction.

Agents for the treatment of erectile dysfunction should be used with caution in patients with anatomical deformation of the penis (such as angulation, cavernosal fibrosis or Peyronie's disease), or in patients who have conditions which may predispose them to priapism (such as sickle cell anemia, multiple myeloma, or leukemia).

The safety and efficacy of combinations of VIAGRA with other treatments for erectile dysfunction have not been studied. Therefore, the use of such combinations is not recommended.

VIAGRA has no effect on bleeding time when taken alone or with aspirin. *In vitro* studies with human platelets indicate that sildenafil potentiates the antiaggregatory effect of sodium nitroprusside (a nitric oxide donor). There is no safety information on the administration of VIAGRA to patients with bleeding disorders or active peptic ulceration. Therefore, VIAGRA should be administered with caution to these patients.

A minority of patients with the inherited condition retinitis pigmentosa have genetic disorders of retinal phosphodiesterases. There is no safety information on the administration of VIAGRA to patients with retinitis pigmentosa. Therefore, VIAGRA should be administered with caution to these patients.

Information for Patients

Physicians should discuss with patients the contraindication of VIAGRA with concurrent organic nitrates.

The use of VIAGRA offers no protection against sexually transmitted diseases. Counseling of patients about the protective measures necessary to guard against sexually transmitted diseases, including the Human Immunodeficiency Virus (HIV), may be considered.

Drug Interactions

Effects of Other Drugs on VIAGRA

In vitro studies: Sildenafil metabolism is principally mediated by the cytochrome P450 (CYP) isoforms 3A4 (major route) and 2C9 (minor route). Therefore, inhibitors of these isoenzymes may reduce sildenafil clearance.

In vivo studies: Cimetidine (800 mg), a non-specific CYP inhibitor, caused a 56% increase in plasma sildenafil concentrations when co-administered with VIAGRA (50 mg) to healthy volunteers.

When a single 100 mg dose of VIAGRA was administered with erythromycin, a specific CYP3A4 inhibitor, at steady state (500 mg bid for 5 days), there was a 182% increase in sildenafil systemic exposure (AUC). Stronger CYP3A4 inhibitors such as ketoconazole, itraconazole or ritonavir would be expected to have still greater effects, and population data from patients in clinical trials did indicate a reduction in sildenafil clearance when it was co-administered with CYP3A4 inhibitors (such as ketoconazole, erythromycin, or cimetidine). It can be expected that concomitant administration of CYP3A4 inducers, such as rifampin, will decrease plasma levels of sildenafil.

Single doses of antacid (magnesium hydroxide/aluminum hydroxide) did not affect the bioavailability of VIAGRA.

Pharmacokinetic data from patients in clinical trials showed no effect on sildenafil pharmacokinetics of CYP2C9 inhibitors (such as tolbutamide, warfarin), CYP2D6 inhibitors (such as selective serotonin reuptake inhibitors, tricyclic antidepressants), thiazide and related diuretics, ACE inhibitors, and calcium channel blockers. The AUC of the active metabolite, N-desmethyl sildenafil, was increased 62% by loop and potassium-sparing diuretics and 102% by non-specific beta-blockers. These effects on the metabolite are not expected to be of clinical consequence.

Effects of VIAGRA on Other Drugs

In vitro studies: Sildenafil is a weak inhibitor of the cytochrome P450 isoforms 1A2, 2C9, 2C19, 2D6, 2E1 and 3A4 (IC50 >150 μM). Given sildenafil peak plasma concentrations of approximately 1 μM after recommended doses, it is unlikely that VIAGRA will alter the clearance of substrates of these isoenzymes.

In vivo studies: No significant interactions were shown with tolbutamide (250 mg) or warfarin (40 mg), both of which are metabolized by CYP2C9.

VIAGRA (50 mg) did not potentiate the increase in bleeding time caused by aspirin (150 mg).

VIAGRA (50 mg) did not potentiate the hypotensive effect of alcohol in healthy volunteers with mean maximum blood alcohol levels of 0.08%.

No interaction was seen when VIAGRA (100 mg) was co-administered with amlodipine in hypertensive patients. The mean additional reduction on supine blood pressure (systolic, 8 mmHg; diastolic, 7 mmHg) was of a similar magnitude to that seen when VIAGRA was administered alone to healthy volunteers (see CLINICAL PHARMACOLOGY).

Analysis of the safety database showed no difference in the side effect profile in patients taking VIAGRA with and without anti-hypertensive medication.

Carcinogenesis, Mutagenesis, Impairment of Fertility

Sildenafil was not carcinogenic when administered to rats for 24 months at a dose resulting in total systemic drug exposure (AUCs) for unbound sildenafil and its major metabolite of 29- and 42-times, for male and female rats, respectively, the exposures observed in human males given the Maximum Recommended Human Dose (MRHD) of 100 mg. Sildenafil was not carcinogenic when administered to mice for 18-21 months at dosages up to the Maximum Tolerated Dose (MTD) of 16 mg/kg/day, approximately 0.5 times the MRHD on a mg/m² basis.

Sildenafil was negative in *in vitro* bacterial and Chinese hamster ovary cell assays to detect mutagenicity, and *in vitro* human lymphocytes and *in vivo* mouse micronucleus assays to detect clastogenicity.

There was no impairment of fertility in rats given sildenafil up to 60 mg/kg/day for 36 days to females and 102 days to males, a dose producing an AUC value of more than 25 times the human male AUC.

There was no effect on sperm motility or morphology after single 100 mg oral doses of VIAGRA in healthy volunteers.

Pregnancy, Nursing Mothers and Pediatric Use

VIAGRA is not indicated for use in newborns, children, or women.

Pregnancy Category B. No evidence of teratogenicity, embryotoxicity or fetotoxicity was observed in rats and rabbits which received up to 200 mg/kg/day during organogenesis. These doses represent, respectively, about 20 and 40 times the MRHD on a mg/m² basis in a 50 kg subject. In the rat pre- and postnatal development study, the no observed adverse effect dose was 30 mg/kg/day given for 36 days. In non-pregnant rats the AUC at this dose was about 20 times human AUC. There are no adequate and well-controlled studies of sildenafil in pregnant women.

ADVERSE REACTIONS

VIAGRA was administered to over 3700 patients (aged 19-87 years) during clinical trials worldwide. Over 550 patients were treated for longer than one year.

In placebo-controlled clinical studies, the discontinuation rate due to adverse events for VIAGRA (2.9%) was not significantly different from placebo (2.3%). The adverse events were generally transient and mild to moderate in nature.

In trials of all designs, adverse events reported by patients receiving VIAGRA were generally similar. In fixed-dose studies, the incidence of some adverse events increased with dose. The nature of the adverse events in flexible-dose studies, which more closely reflect the recommended dosage regimen, was similar to that for fixed-dose studies.

When VIAGRA was taken as recommended (on an as-needed basis) in flexible-dose, placebo-controlled clinical trials the following adverse events were reported:

TABLE 1. ADVERSE EVENTS REPORTED BY ≥2% OF PATIENTS TREATED WITH VIAGRA AND MORE FREQUENT ON DRUG THAN PLACEBO IN PRN FLEXIBLE-DOSE PHASE II/III STUDIES

Adverse Event:	Percentage of Patients Reporting Event	
	VIAGRA N=734	PLACEBO N=725
Headache	16%	4%
Flushing	10%	1%
Dyspepsia	7%	2%
Nasal Congestion	4%	3%
Urinary Tract Infection	3%	2%
Abnormal Vision	3%	0%
Diarrhea	3%	1%
Dizziness	2%	1%
Rash	2%	1%

Abnormal Vision: Mild and transient, predominantly color tinge to vision, but also increased sensitivity to light or blurred vision. In these studies, only one patient discontinued due to abnormal vision.

Other adverse reactions occurred at a rate of >2% but equally common on placebo: respiratory tract infection, back pain, flu syndrome, and arthralgia.

In fixed-dose studies, dyspepsia (1.7%) and abnormal vision (1.1%) were more common at 100 mg than at lower doses. At doses above the recommended dose range, adverse events were similar to those detailed above but generally were reported more frequently.

No cases of priapism were reported.

The following events occurred in < 2% of patients in controlled clinical trials; a causal relationship to VIAGRA is uncertain. Reported events include those with a plausible relation to drug use; omitted are minor events and reports too imprecise to be meaningful.

Body as a whole: face edema, photosensitivity reaction, shock, asthenia, pain, chills, accidental fall, abdominal pain, allergic reaction, chest pain, accidental injury.

Cardiovascular: angina pectoris, AV block, migraine, syncope, tachycardia, palpitation, hypotension, postural hypotension, myocardial ischemia, cerebral thrombosis, cardiac arrest, heart failure, abnormal electrocardiogram, cardiomyopathy.

Digestive: vomiting, glossitis, colitis, dysphagia, gastritis, gastroenteritis, esophagitis, stomatitis, dry mouth, liver function tests abnormal, rectal hemorrhage, gingivitis.

Hemic and Lymphatic: anemia and leukopenia.

Metabolic and Nutritional: thirst, edema, gout, unstable diabetes, hyperglycemia, peripheral edema, hypercalcemia, hypoglycemic reaction, hyperkalemia.

Musculoskeletal: arthritis, arthrosis, myalgia, tendon rupture, tenosynovitis, bone pain, myasthenia, synovitis.

Nervous: ataxia, hypertonia, neuralgia, neuropathy, paresthesia, tremor, vertigo, depression, insomnia, somnolence, abnormal dreams, reflexes decreased, hypesthesia.

Respiratory: asthma, dyspnea, laryngitis, pharyngitis, sinusitis, bronchitis, sputum increased, cough increased.

Skin and appendages: urticaria, herpes simplex, pruritus, sweating, skin ulcer, contact dermatitis, exfoliative dermatitis.

Special senses: mydriasis, conjunctivitis, photophobia, tinnitus, eye pain, deafness, ear pain, eye hemorrhage, cataract, dry eyes.

Urogenital: cystitis, nocturia, urinary frequency, breast enlargement, urinary incontinence, abnormal ejaculation, genital edema and anorgasmia.

OVERDOSAGE

In studies with healthy volunteers of single doses up to 800 mg, adverse events were similar to those seen at lower doses but incidence rates were increased.

In cases of overdose, standard supportive measures should be adopted as required. Renal dialysis is not expected to accelerate clearance as sildenafil is highly bound to plasma proteins and it is not eliminated in the urine.

HC150R98

VIAGRA
(sildenafil citrate) tablets

XC614A97

Pfizer U.S. Pharmaceuticals

NATIONAL GEOGRAPHIC

On Assignment

MICHAEL YAMASHITA

■ INDONESIA FIRES

Breathless Reporting

"Sometimes the smoke was too thick to see more than a few yards ahead," says writer Lew Simons, who covered Indonesia's fires with photographer Mike Yamashita. Mike—a volunteer fireman back home in New Jersey—brought the respirators he and Lew wore constantly. "It never occurred to me that we'd need masks," admits Lew. "But we couldn't have worked without them." A New Jersey native, Lew has spent three decades writing about Asia. While Tokyo bureau chief for Knight-Ridder Newspapers, he won a Pulitzer for his reporting on the Philippines.

■ NEW YORK'S CHINATOWN

East Side Story

He's written about subjects from Burma to the brain. But for Assistant Editor Joel Swerdlow, here with Fifth Precinct Deputy Inspector Thomas Chan, reporting on Chinatown was still a tough assignment. "A lot of people didn't want to talk," he says. "They worry about immigration officials and safety inspectors. Outsiders like me are trouble." Still, working with Chinese photographer Chien-Chi Chang eased Joel's way, as did the universal language of food. "Chinatown's restaurants are great," Joel says. "But sometimes, for a change, I'd take my Chinese friends a few blocks away for dinner in Little Italy."

CHIEN-CHI CHANG

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