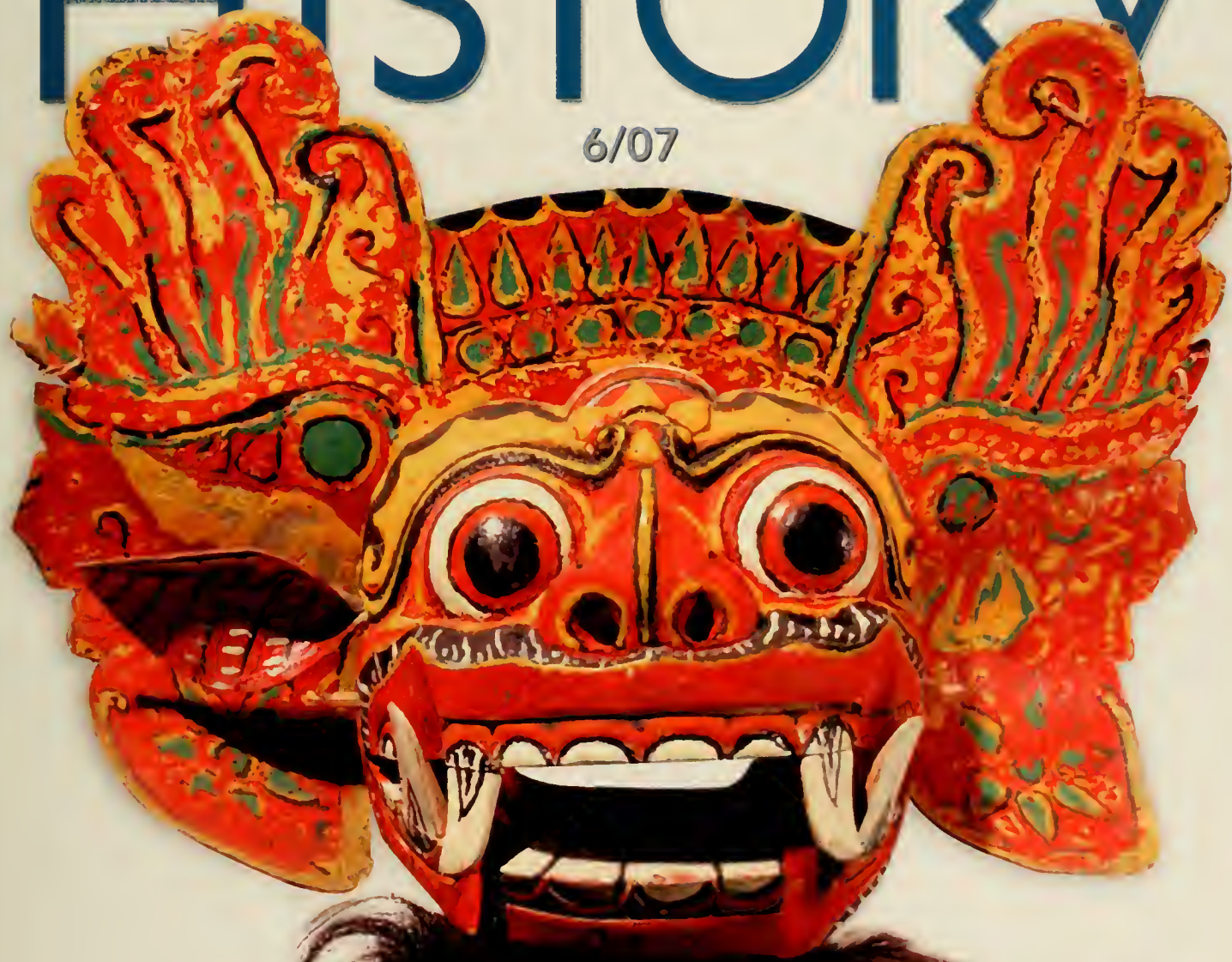


NATURAL HISTORY

6/07



MYTHIC CREATURES
AND THEIR ICONS



In 1983, at the invitation of China's Ministry of Health and university medical centers, Project HOPE became the first private international health organization to make a long-term commitment to improving that vast nation's healthcare system.

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JUNE 2007

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NUMBER 5

FEATURES

18 BONES FROM THE TAR PITS

La Brea continues to bubble over with new clues about life that flourished 40,000 years ago, where Los Angeles is today.

JOHN M. HARRIS



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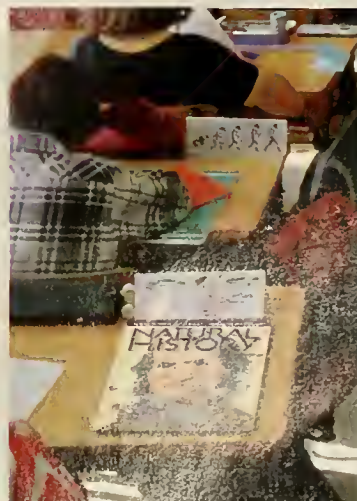
The forests of southern Bahia, Brazil, threatened by development, shelter numerous rare plants, which botanists are racing to document before they disappear.

WM. WAYT THOMAS

28 DARWIN IN COURT

Eighteen months after the "monkey trial" in Dover, Pennsylvania, a bumper crop of books puts the battle in perspective and asks, What's next?

RICHARD MILNER



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Toe Hold

Photograph by Kevin Schafer

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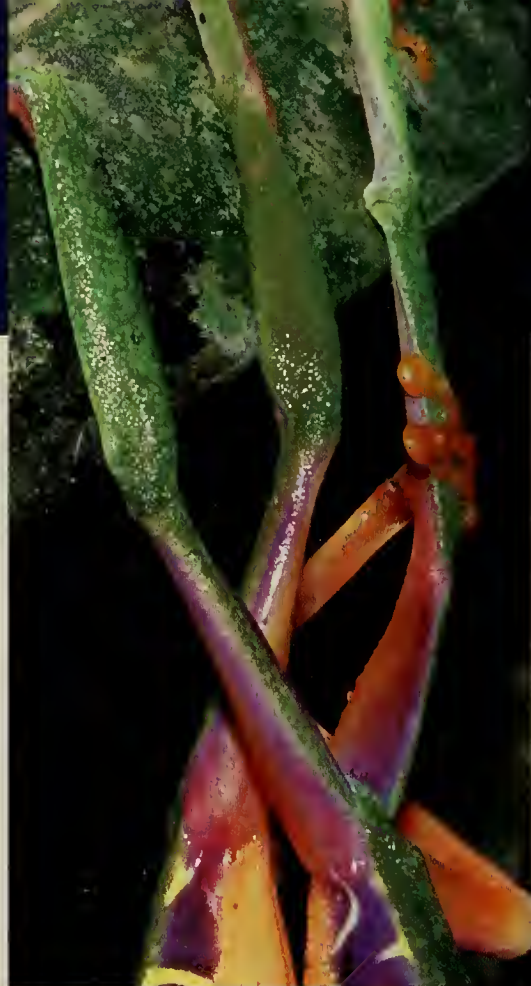
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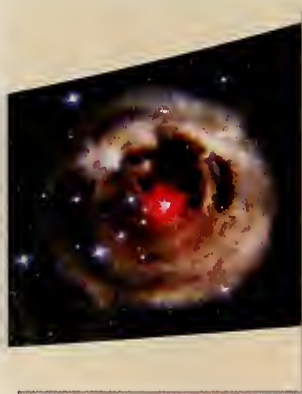
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◀ See preceding two pages

When the first heavy rains of spring drench Costa Rica, a certain league of suitors begins fighting. Think WWF, as in Wild Wrestling Frogs. Here, two male red-eyed tree frogs (*Agalychnis callidryas*) put a hold on each other unmatched even by the most pumped-up pro wrestlers: dangling upside down, belly to belly, they wrap their arms around each other's heads and gouge their sticky, orange hands into crimson eyes.



Photographer Kevin Schafer had heard about a seasonal breeding pool for *A. callidryas* on Costa Rica's Caribbean coast, but no one had prepared him for what he stumbled upon one night in early June. Dozens of frogs were out in colorful view, calling raucously for mates. Schafer described the scene as "a wild amphibian orgy."

Frogs not locked in upside-down combat were doing their best to engage in another kind of embrace. Males were grasping females around the abdomen and not letting go. Sometimes a male holds on for days, as he fends off other suitors and even as his mate dives underwater to fill her bladder and wet her eggs.

Finally, after fertilization, the female lays her eggs on leaves that hang over the water, to keep the eggs temporarily safe from hungry fish. But what about other predators? Recent observations show that the growing tadpoles can distinguish among vibrations—sensing a difference between, say, a strong gust of wind and a snake—and so control when to take the big plunge.

—Erin Espelie

Tales from the Tar Pits

The George C. Page Museum in Los Angeles is one of the few museums whose main subject matter is a natural phenomenon that lies virtually underfoot. The Page, a branch of the Natural History Museum of Los Angeles County, was opened in 1977 on the site of one of the most exciting fossil finds of the nineteenth century: the La Brea tar pits. The pits, which are actually pools of asphalt seeping up from an oil field 1,000 or more feet below the surface, have been trapping unwary animals in thick, sticky black goo for more than 40,000 years. John M. Harris, a curator at the Page, describes the pits and their fossil treasures in his article "Bones from the Tar Pits" (page 18).

I spoke with Harris about how museum volunteers take part in the ongoing excavation of Pit 91. "There are two kinds of people who work in the pit," Harris says, "those who remain pristine, and the rest of us who get absolutely covered with tar. You're working fourteen to fifteen feet below the surface, it's hot, and you have to work from crosswalks, with your arms extended" to reach the bones. "In the summer, it's quite physically demanding," he adds, putting it mildly.

The excavators include two full-time staff paleontologists, assisted by volunteers, but no more than eight people can work in the pit at one time. The volunteers are a mix of young and old: students, young professionals, and retired people. One staff member has been excavating at Pit 91 since the current project began: Christopher A. Shaw, the collections manager for the Page, became involved as a student, in 1969, and is now in charge of excavation. "His ambition is to be present when the excavation is finished," Harris told me—perhaps fifteen years from now.

I asked Harris whether anyone had gotten caught in the pit during its modern excavation. No, he replied, but someone once tried to commit suicide by throwing himself into a seep. The attempt was unsuccessful because "the person just stuck to the top like a fly on flypaper, and the fire department got angry because they got their ladders and ropes very dirty."

• • •

Our cover this month pictures a Balinese mask of a Barong Ket, a beneficent spirit creature that, according to legend, protects a village and restores order out of chaos. Spirit creatures are a major focus of a new exhibition, "Mythic Creatures: Dragons, Unicorns & Mermaids," which opens May 26 at the American Museum of Natural History in New York City. Laurel Kendall, one of the curators of that exhibition, describes her own memorable encounter with masks, spirits, and a festival built around them in Vietnam, in her "Endpaper" titled "Eye of the Dragon" (page 48).

• • •

Readers who haven't visited our Web site recently will find a hive of new activity there. We're revamping the design, adding new features, and posting more information than ever about the articles in the magazine. You can download the full audio, for instance, of my interview with John Harris. There's also an archive of selected articles ("Picks from the Past") from 107 years of past issues of *Natural History*. Check it out (www.naturalhistorymag.com).

—PETER BROWN



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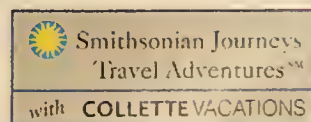
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Conservationist **KEVIN SCHAFER** ("The Natural Moment," page 4) is based in Seattle, Washington, but has traveled extensively—to Costa Rica for this month's photograph of fighting tree frogs, as well as to such faraway places as Madagascar and the Bering Sea—in his quest to document threatened ecosystems. He has written more than ten books illustrated by his photography, including *Penguin Planet* (NorthWord Press, 2000), which received the 2000 National Outdoor Book Award, and *Living Light* (Bitterroot Press, 2006). The North American Nature Photography Association selected Schafer as the Outstanding Nature Photographer of the Year for 2007. Visit his Web site (www.kevinschafer.com) to view more of his photographs.

JOHN M. HARRIS ("Bones from the Tar Pits," page 18) was trained as a geologist and served as the director of paleontology at the National Museum of Kenya before joining the Natural History Museum of Los Angeles County in 1980. He now works there as chief curator of vertebrate studies and oversees the vast collection of late Pleistocene fossils from the La Brea tar pits, housed at the George C. Page Museum. Although he has published widely on La Brea, he is perhaps better known scientifically for his work on East African ungulate fossils associated with the remains of early hominids. He edited a book with the paleoanthropologist Mary Leakey on the fossil footprints of Laetoli, Tanzania, and another with the paleoanthropologist Meave Leakey on the fossil site of Lothagam, Kenya.



Ever since childhood, which he spent in Southeast Asia, **WM. WAYT THOMAS** ("Survival of the Rarest," page 24) has been intrigued by the natural history of tropical forests. As a youngster he focused on things that move, but he soon began to appreciate that plants provide the framework for all other life in a forest. Thomas is the Elizabeth G. Britton Curator of Botany at the New York Botanical Garden, where he studies the conservation and plant diversity of the Atlantic coastal forests of Brazil, focusing on the state of Bahia. He is fascinated with how species are distributed, endemism, and the dynamics of rarity. Thomas also studies the evolution and systematics of the sedge family in the New World tropics.

A Darwin scholar and historian of science, **RICHARD MILNER** ("Darwin in Court," page 28) is an associate in anthropology at the American Museum of Natural History in New York City, and a contributing editor to this magazine. His work for *Natural History* has included editing a special section on Darwin and evolution (November 2005) and, most recently, co-authoring an article on hominid portraits. He is currently working on a book titled *Darwin's Universe: Evolution from A to Z*, which will be published in 2008 by the University of California Press.



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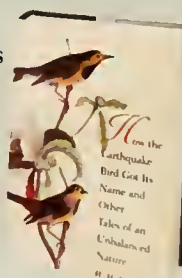


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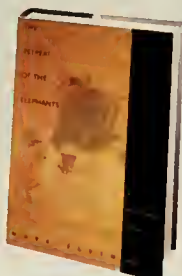
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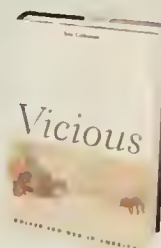
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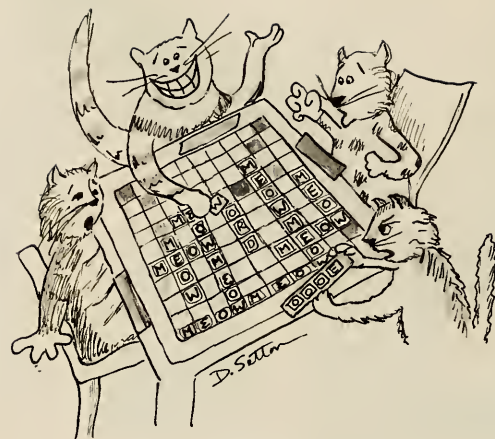
The Play's the Thing

Lynda L. Sharpe's article ["Meerkats At Play," 4/07] was a treat. But I wonder, could play simply be the product of mammalian brainpower? Does one need to play to maintain a more highly developed brain? As a kid, I'd say "I'm bored," and the response would be, "Go outside and play!" In no time, I'd be enjoying myself and discovering things.

C.-A. Thompson
Gloucester, Massachusetts

LYNDA L. SHARPE REPLIES:

C.-A. Thompson's idea is one of the few theories put forward to explain play that is supported by some scientific evidence. There



"Challenge!"

seems to be a correlation between relative brain size and the tendency to play, in birds as well as mammals. And labora-

tory studies have found that young rats develop better learning abilities, heavier cerebral cortexes, and greater neural con-

nectivity when exposed to a complex environment. Sensory stimulation and arousal alone did not affect the rats' brains, but when those factors were accompanied by interactive behavior (as in play), brain growth increased.

Long Life

In "Pregnancy Reconcived" [5/07], Gil Mor notes that fetal cells reside in the mother decades after her pregnancy, and that those cells can repair maternal tissue. Could that phenomenon help explain why, on average, women live longer than men?

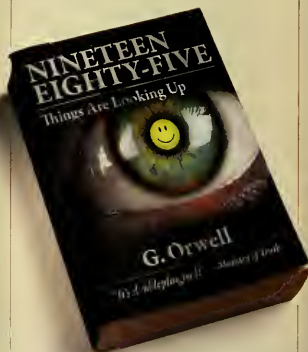
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(Continued on page 42)

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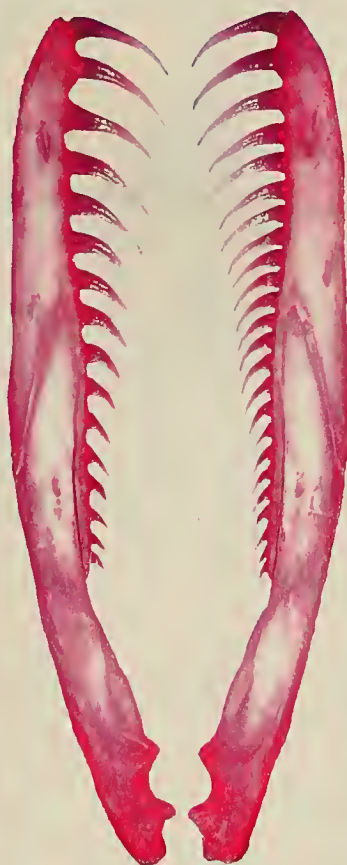
Dental Carries

During their prolonged migration out of Africa, our ancestors were not alone. The cavity-causing bacterium *Streptococcus mutans* went along for the ride, clinging to their teeth. *S. mutans* is transmitted mainly from mother to infant, and so its evolutionary history probably parallels that of its human hosts. A new study takes advantage of the intimate parasite-host relationship to trace the dispersal of *Homo sapiens* across the globe.

Peter W. Chouffey, a professor of dentistry at New York University, and his colleagues isolated hundreds of *S. mutans* strains collected from the mouths of people on five continents. The investigators compared several segments of DNA from the genomes of thirty-three of the most informative strains. The team then estimated the relatedness of all several hundred strains and built a phylogenetic tree to show their evolutionary relationships.

The tree has its root in central Africa, the homeland of the common ancestor of all *S. mutans* strains—and of their human hosts. A distinct branch extends to Asia, and from there to Europe, representing at least one migratory wave of people, who founded a group of modern-day Caucasians. A second African founder population might have reached Europe via a more direct route—possibly through the Middle East. Analysis of additional DNA segments could reveal the host's and the parasite's journey together to other parts of the world. The results support the "out of Africa" theory, which posits a single African origin of modern humans between 100,000 and 200,000 years ago. (*Journal of Bacteriology*)

—Graciela Floris



"Right-mouthed" snake jaw

No Left Turn

With their slender, drab-colored bodies, snakes of the genus *Pareas* seem quite ordinary—until you look them in the mouth. When they open wide, many *Pareas* species display a remarkable asymmetry: in *P. iwasakii*, for example, about twenty-five teeth line the right side of the jaw, whereas only about seventeen line the left. The asymmetry was recently discovered by Masaki Hoso; his graduate advisor, Michio Hori, an ecologist at Kyoto University in Japan; and a colleague.

The investigators suggested that the reason for the snakes' "right-mouthedness" might be traceable to their diet of snails. The snakes pull snails from their shells by alternately retracting the left and right sides of their jaws. Snail shells usually coil to the right, or dextrally, so having more teeth on the right side could be helpful for the snakes.

To test that idea, the investigators obtained snails whose shells coiled to the left, or sinistrally, then measured the predation success of four *P. iwasakii* snakes on sinistral and dextral snails. The snakes took about twice as long to handle the sinistral snails, retracted their jaws about one-third more frequently, and still succeeded a quarter less often, compared with their attacks on dextral prey.

Sinistral snails tend to be scarce worldwide, but in Southeast Asia and Japan—where the right-mouthed snakes live—they're present in more species. Having evolved a particular jaw dentition to handle the more abundant dextral shells, the snakes may now be exerting selective pressure on snails for more sinistral shells. (*Biology Letters*) —Stéphan Reeb

What Do You Know?

"Is that your final answer?" With such signature lines, TV quiz-show hosts inject drama into their proceedings even as they question the confidence of their contestants. Two investigators at the University of Georgia in Athens recently posed a similar question—to rats. The upshot of their query: rats might not be smarter than fifth graders (to invoke one popular show), but they do know the limits of their knowledge.

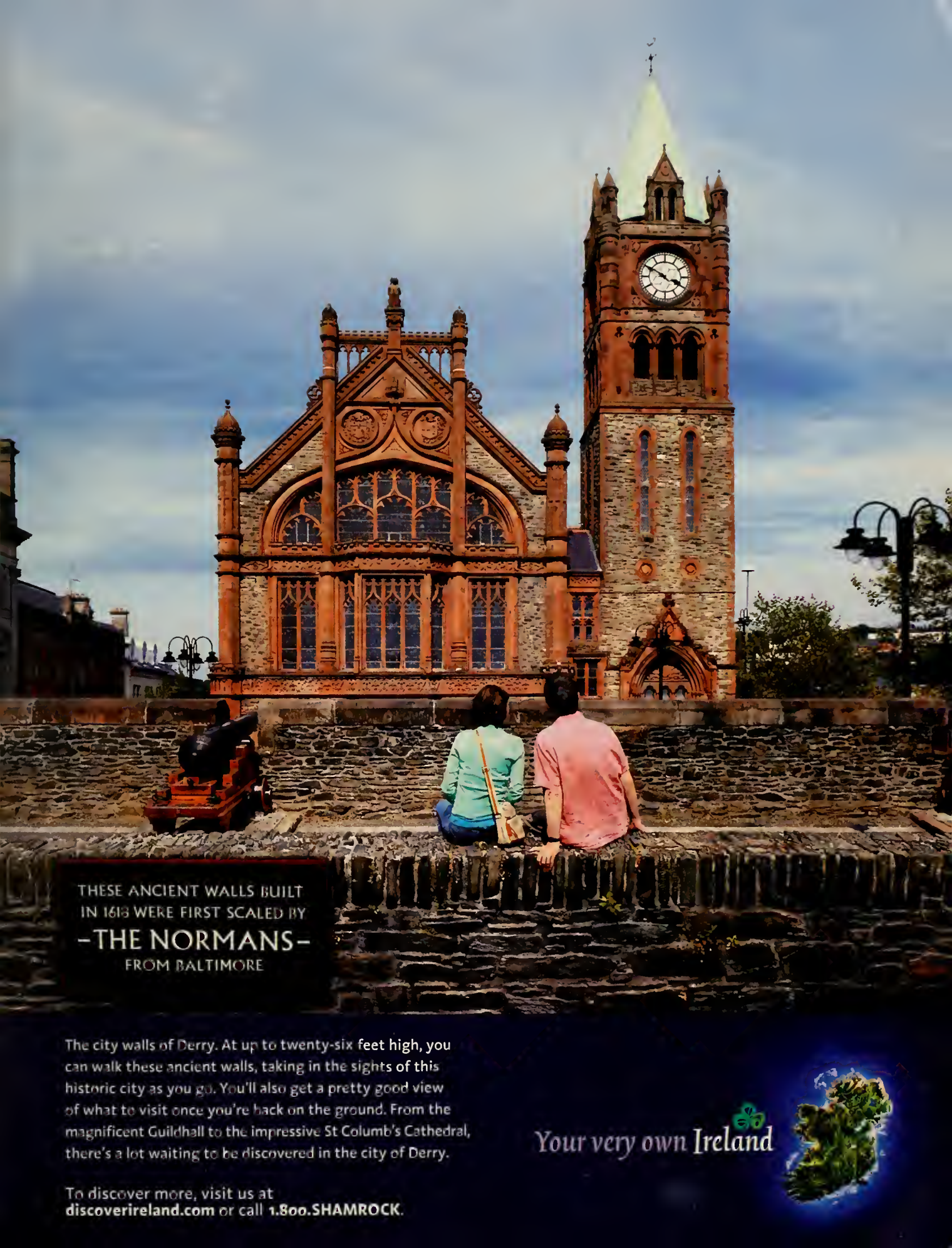
Allison L. Foote, a graduate student, and Jonathon D. Crystal, a psychologist, gave six food pellets (a big reward) to rats whenever they showed they could distinguish short sounds from long sounds by pressing the correct one of two levers. (Choosing the wrong lever yielded no reward.) The rats also learned that they could refuse to take a test and instead poke their noses into an opening in the wall of the test chamber to secure a medium reward: three pellets.

Next, the investigators presented the rats with a series of sounds of varying length. The rats seldom declined to press a lever when the sounds were very short or very long. But when the sounds were intermediate in length—and thus harder to categorize—the rats often turned down

the chance at the big reward for the sure bet of a medium reward. In sum, they acted as if they were aware of the limits of their ability. Indeed, when forced to take the test for intermediate-length sounds, they often chose the wrong lever.

Metacognition—the awareness of one's own knowledge—is difficult to study in animals because they cannot respond to questions about what they know. But now, by displaying behavioral signs of metacognition, rats join a select group previously limited to primates and dolphins. (*Current Biology*) —S.R.





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Follow Your Beak

Homing pigeons and other birds can sense the Earth's magnetic field, an ability that helps them find their way home, even when home is hundreds of miles away. But how this magnetic sense works remains one of the most puzzling questions in sensory biology.

To learn the birds' secret, Gerta Fleissner, a neurobiologist at the University of Frankfurt in Germany, teamed up with physicists and other biologists. Their investigation focused on the skin of the upper beak—where the mysterious magnetic sense is thought to reside. With powerful microscopes they identified three clusters of nerve endings on each side of the homing pigeon's beak, each cluster oriented along one of the bird's three perpendicular axes (beak-tail, wing-wing, and back-belly). Inside the nerve cells they discovered something even more intriguing: two kinds of magnetic iron oxide—square platelets of maghemite and bullet-shaped particles of magnetite. The investigators propose that an extremely delicate arrangement of those intracellular minerals constitutes the long-sought receptor for birds' magnetic sense.

Here's how they think it works: Each pair of clusters (one on each side of the beak) is tuned to detect one of the three perpendicular spatial components of the Earth's magnetic field (north-south, east-west, and up-down). Depending on how closely a pair of clusters aligns with its magnetic-field component, the maghemite platelets in the clusters line up and magnetically attract the magnetite bullets. The rearrangement of maghemite and magnetite in all three pairs of clusters triggers nerve impulses to the bird's brain, enabling the bird to sense the angle and intensity of the local magnetic field—and fly home. Fleissner located similar iron-bearing nerves in several other bird species, and she suspects all birds possess them. (Naturwissenschaften)

—G.F.

Virtual Hitchhikers

You can get just about anything online, from a stuffed moose to an acre of the moon. So it goes without saying that seemingly harmless plants can also be added to your e-shopping cart. Online retailers sell them, of course, and enthusiastic gardeners in chat rooms trade the seeds of their favorite blooms.

But all that e-trade could present a growing threat—literally—to biodiversity, according to Yorick Reyjol, an ecologist at the University of Quebec at Trois-Rivières in Canada. Reyjol warns that enabling plants to travel across the planet so freely risks introducing invasive, exotic species to vulnerable ecosystems. Many invasive plants started their destructive journeys as commercial

offerings that were subsequently exchanged among gardeners. (Water hyacinth, a South American plant with attractive purple flowers, is a classic example: it now clogs waterways and chokes out native vegetation across a swath of the United States and in many other nations.) Internet exchanges simply streamline the invasion.

Webmasters can help by warning about the dangers of trading exotic species, and by pointing out the various regulations governing the movement of biological material. Without greater precautions, the liberties of the virtual world could easily take their toll on the much more precious real one. (*Biodiversity and Conservation*)

—Nick Atkinson

Whence the Beef?

Beginning around 800 B.C., the Etruscan civilization developed in what is now Tuscany, in Italy. Its people influenced the founding of Rome at the edge of their territory. Eventually Rome grew, swallowed up its Etruscan neighbor, and went on to greater things.

Scholars have long debated the origins of the Etruscans. Some contend their roots were local; others, such as Herodotus, the fifth-century-B.C. chronicler from Greece, have argued that the Etruscans emigrated from the eastern Mediterranean.

The latter view has now gotten a big boost of modern support. A team of geneticists led by Marco Pellecchia and Paolo Ajmone-Marsan of the Catholic University of the Sacred Heart in Piacenza, Italy, has discovered that the mitochondrial DNA of modern-day Tuscan cattle is much closer to that of Turkish and Middle Eastern bovines than to that of other Italian or European breeds.

Proponents of the local-origin hypothesis might argue that the Etruscans, a seafaring people, simply obtained

foreign cows through maritime trade. But another Italian study, led by Alessandro Achilli and Antonio Torroni, geneticists at the University of Pavia, reveals that modern-day Tuscan people also show genetic similarities to Turkish and Middle Eastern populations. So it looks as if the ancestors of the Etruscans came from the east by sea, bringing their livestock along. "Told you so," Herodotus would say. (*Proceedings of the Royal Society B; American Journal of Human Genetics*)

—S.R.

Maremmana, a Tuscan breed of cattle





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She was an Italian supermodel.





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Great Lake Bake

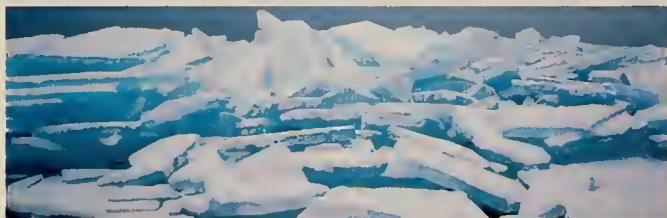
With so much evidence that global warming is real, it's no surprise to learn that summer temperatures on Lake Superior have been rising for twenty-seven years. More puzzling, however, is that the water temperature is increasing faster than the air temperature around the lake.

Two limnologists, Jay A. Austin and Steven M. Colman, both of the University of Minnesota Duluth, analyzed data gathered since 1980 from surface buoys and weather stations in and around the Great Lakes. They report that the average summertime air temperature around Lake Superior rose 2.7 degrees between 1980 and 2005. Yet the average water temperature increased almost double that amount, about five degrees. Preliminary analyses show similar trends for lakes Michigan and

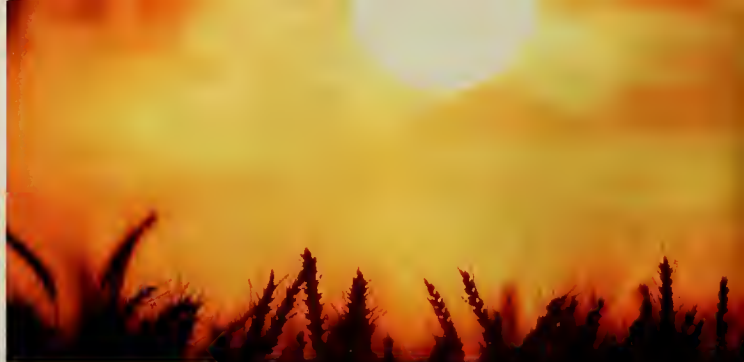
Huron; Lake Erie is warming, too, though more slowly.

Why the steep rise in summer water temperatures? Austin and Colman discovered that Lake Superior's winter ice cover has been shrinking by an average of 0.4 percent a year. Water is warmed by contact with the overlying air and by the Sun's radiation. Light-colored ice reflects more sunlight than dark-colored water. Less ice in the winter leads to an earlier thaw in the spring, and therefore a longer sunning season.

At the current rate of change, Lake Superior will be ice-free most years in about three decades. Big lakes can have big regional weather effects and sustain important fisheries, so the rapid warming of three Great Lakes should make North Americans sit up and take note. (*Geophysical Research Letters*) —S.R.



Icing on the Lake



Cereal Killer

The consequences of global warming loom far in the future, or so most people think. But farmers are already feeling the heat—in fact, they've been losing crops to rising temperatures for more than twenty-five years.

Many factors affect crop yields: pollinators, seed strains, and farm technology, to name a few. To tease out the effect of temperature, two ecologists in California, David B. Lobell of Lawrence Livermore National Laboratory in Livermore and Christopher B. Field of the Carnegie Institution in Stanford, designed a statistical model. The model integrates worldwide temperature, rainfall, and yield data from 1961 through 2002 for the world's six most widely planted crops—barley, corn, rice, sorghum, soybeans, and wheat.

In those four decades total crop yields nearly doubled. Yet Lobell and Field determined that, as global temperatures began to rise

in the early 1980s, the extra heat slowed the growth. By 2002, about 40 million tons of barley, corn, and wheat—worth nearly \$5 billion and constituting 2 to 3 percent of the crop—were being lost each year. Since then, temperatures and crop prices have only increased, so the value of the missing crops should continue mounting.

One of the primary causes of global warming, however, has just the opposite effect on cereals: rising levels of carbon dioxide (CO₂) increase crop yields. Lobell and Field estimate that the yield gains from higher CO₂ levels were roughly equal to the losses from heat. So far, so good—but as CO₂ levels climb, the yield gains are predicted to decelerate, while the losses should speed up and overtake them. Meanwhile, the population keeps adding mouths that farmers and agronomists must figure out how to feed.

(*Environmental Research Letters*)
—Rebecca Kessler

Let the Sunshine In (Or Maybe Not)

Haze—made up of dust, soot, and other airborne aerosol particles—seems to have been on a steady, worldwide decline during the past decade and a half, according to new research. That's cause for a round of pats on the back, since it could signal a drop in pollution. But some nail-biting might also be in order. Haze reflects incoming sunlight back to space, so less haze permits more sunlight to reach Earth's surface, enhancing global warming.

To quantify the trend, Michael I. Mishchenko, a physicist at the NASA

Goddard Institute for Space Studies in New York City, and his colleagues analyzed data from weather satellites on the amount of sunlight reflected by haze over the world's oceans. The data indicate that since 1991, the opacity of the haze has declined by as much as 20 percent. That's not nearly enough to explain global warming as a whole—but it could have contributed to the greater-than-expected rise in temperatures of the past decade.

The results also mesh nicely with observations that the amount of sunlight

reaching the Earth's surface has jumped noticeably, beginning in 1990. Whether "global brightening," as the phenomenon is called, is a direct consequence of pollution-control measures, or merely reflects changes in naturally occurring airborne particles, remains uncertain. But NASA's Glory mission, scheduled to launch a new satellite in December 2006, could help clarify the matter. The new satellite will carry a sensor that can distinguish between natural aerosols and pollution. (*Science*) —S.R.

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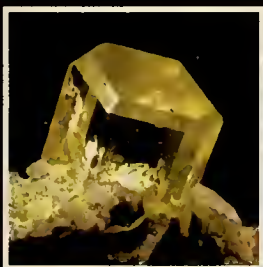


Aquamarine
Shigar Valley,
Pakistan; 7 inches



Gold, 4.2 inches
Wire Patch Mine
Breckenridge, Colorado
(mined in the 1880's)
Currently featured in
the GOLD! Exhibit at the
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Photographs by Jeffrey Scovil
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Bones from the Tar Pits

La Brea continues to bubble over with new clues about life that flourished 40,000 years ago, where Los Angeles is today.

By John M. Harris

We have dredged and scraped, on hands and knees, to a depth of fourteen feet, where the air is redolent with sulfurous hydrocarbons. Our excitement mounts as we expose the skull of a saber-toothed cat, entombed in the asphalt. This site, Pit 91, lies within one of the richest pockets of Ice Age fossils in the world, and

those of us working the pit collect thousands of bones and hundreds of gallons of surrounding material every summer. Finding a saber-tooth here is common, yet every skull continues to be special. Will this one have its canines? Its lower jaw?

The skull turns out to be nearly complete. One summer as long ago

as 40,000 years, the great cat might have ventured onto uncertain ground to feed on an easy target, a bison perhaps, mired in the sticky asphalt, or "tar." The temptation would be the cat's last. When the saber-tooth attacked, its fate—along with the bison's—was sealed. It and literally thousands of other animals have become trapped at a unique spot that paleontologists now comb for remnants of ancient life.

With the discovery of the saber-tooth our dedicated band of tar-stained volunteers takes a brief pause, but soon they are back at work, painstakingly continuing the excavation of Pit 91. The justly famous La Brea tar pits lie just seven miles west of downtown Los Angeles, in what is known as Hancock Park, where Pit 91 is the last active

excavation [see map on page 20]. The volunteers work under the guidance of Christopher A. Shaw, the collections manager for the George C. Page Museum, which was built by the Natural History Museum of Los Angeles County in 1977 to house fossils from the tar pits. Shaw keeps the excavators following a rigorous procedure not unlike the one initiated here by paleontologists in the early 1900s. (Boiling kerosene, though, no longer serves to clean the sticky bones—nor does it accidentally catch fire and singe the eyebrows of workers.) Shaw's volunteers clear square grids three feet on a side and dig down through the layers six inches at a time, all the while coping with the thick asphalt bubbling up around the bones.

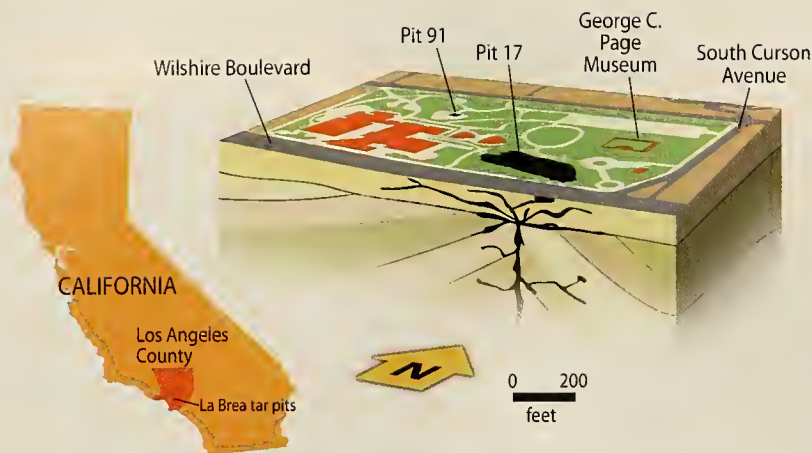
In spite of those challenges, the excavation pours out the remains of fossils from the late Pleistocene epoch, between 27,000 and 40,000 years ago, some of which may be completely new to science. Since the current excavation began in 1969, more than 320 species have been added to the 270 or so that were first collected here ninety years ago. Together they provide a detailed picture of ancient life in the Los Angeles Basin, from giant mammals down to water fleas.

Real tar, technically, is a product distilled from wood, coal, or peat, whereas the sticky black "tar" responsible for the rich accumulation of fossils is natural asphalt made up mostly of crude petroleum. It oozes up through natural plumbing in the Earth's crust from the Salt Lake Oil Field, about 1,000 feet below the surface of Hancock Park. More petroleum has collected even farther



Early excavations at the La Brea tar pits of central Los Angeles during the period 1913–1915 (above left) unearthed roughly a million bones from nearly a hundred sites. All the fossils were housed in the old "bone room" (right) at the Natural History Museum of Los Angeles County, before being transferred to the George C. Page Museum in 1977.





down—as deep as 10,000 feet underground—in 5-million-year-old rock, which helps feed the current asphalt seeps. The pressures at such depths have squeezed crude oil, natural asphalt, and methane gas to the surface for at least the past 50,000 years. Similar sites have been discovered in Asia, the Middle East, South America, and elsewhere. One exciting asphalt seep in Venezuela has recently been coughing up ancient armadillo fossils.

In California, people collected the asphalt from the tar pits long before its fossil content was discovered. Native Americans began using it in pre-historic times as a caulk for baskets and canoes. Early settlers in Los Angeles used it as a fuel and as waterproofing for their roofs. In 1828, when southern California was still part of Mexico, the Mexican government included the current La Brea pits as part of a land grant known as Rancho La Brea (Spanish for “the tar ranch”), which stipulated that the landowner must permit Angelinos to retrieve as much tar as they needed for personal use. By the late nineteenth century, asphalt from La Brea fetched twenty dollars a ton after it was refined for various purposes, including road building.

Bones recovered in those early collections were dismissed as the remains of domestic animals. It was not until 1875 that the geologist William Denton visited the tar pits and identified the canine tooth of a saber-toothed cat. Denton reported his find, but the rest of the scientific community took little

notice. No one bothered with any large-scale recovery of the fossils until after 1901, when William W. Orcutt, a geologist who was investigating oil resources in the vicinity, noted that the bones in the asphalt seeps belonged to many extinct species.

Suddenly the tar pits became all the rage, as amateurs and institutions competed for the fossil treasures. Excavation peaked at Rancho La Brea between 1905 and 1915, when literally millions of bones were taken out of the ground. In 1913, the landowner, George Alan Hancock, finally acted on his fears that the fossils would be taken from the community and scattered widely; he granted exclusive rights to excavate the fossil resources to Los Angeles County’s fledgling Natural History Museum—but only for two years.

The museum took full advantage of its brief time window. Between 1913 and 1915, museum crews intensively explored the twenty-three acres of the area that would become Hancock Park, making nearly a hundred excavations and collecting roughly a million bones. Hancock later donated that part of his property to the county, with instructions that the tar pits be preserved and appropriately displayed.

The spectacular array of fossils from the 1913–15 excavations were subsequently housed in the basement of the Natural History Museum. They included carnivorous saber-toothed cats, dire wolves, lions, and short-faced bears, as well as herbivorous camels, ground sloths, mammoths, and mastodons. In all, the species count from the excavations in the early 1900s included 133 birds, 63 insects, 43 mammals, and 29 plants, plus a handful of amphibian, mollusk, reptile, and water flea species.

Thick, sticky asphalt seeping to the surface from petroleum reservoirs thousands of feet underground has trapped animals for tens of thousands of years, as portrayed in the schematic diagram. In summer, when the asphalt liquefied, animals such as the ground sloth (left panel) became stuck and then, often, were killed by carnivores. In winter, the asphalt hardened and sediment mixed with it to cover the seep (center panel). For thousands of years the matrix of asphalt and sediment has accumulated, along with the remains of trapped animals, plants, and seeds, creating large, inverted cones underground, chock full of fossils (right panel).



What makes the tar such an effective and deadly animal trap? In the warm summer months the asphalt reaching the surface becomes viscous and sticky, and so it quickly acquires a deceptive surface covering of dust and leaves. Cows and horses have been observed in modern times wandering across oil seeps, where an inch or so of sticky asphalt is all it takes to totally immobilize them. Similarly, Pleistocene herbivores inadvertently stepping into the edges of the La Brea seeps would have found themselves held as fast as flies on flypaper—vulnerable to starvation, dehydration, and predatory attacks.

As cool winter temperatures returned, the asphalt would resolidify, sealing in the summer's bones. Winter winds and rain would further cover the surfaces of the seeps with sediment washed down from the nearby Santa Monica Mountains. Then, once temperatures warmed up in the spring, the seepage would start again, and the trap would reset. For a few thousand years, masses of tangled bones would accumulate in conical pits on the rising coastal plain, until the existing vents became blocked [see illustration below]. Most of those accumulated bones, paleontologists found, were carnivores; in fact, they outnumbered herbivores by almost nine to one. The bird species, too, were primarily birds of prey. Such an abundance of carnivores at La Brea led to the entrapment hypothesis: that mired animals served as bait for predators and scavengers.

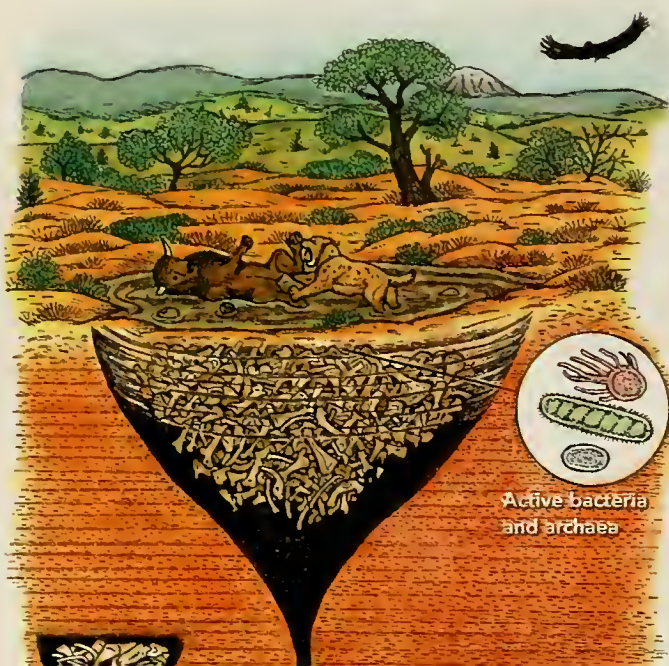
In the half century that followed the initial description of the Rancho La Brea fossils, it became apparent that crucial information was missing. The museum excavators had concentrated on the trophy specimens—the lions, mammoths, and saber-toothed cats—and had largely ignored smaller fos-

sils such as rodents, seeds, and snails. Paleontologists now recognize that the smaller fossils often provide the best evidence about the habitats and environments in which the fossils accumulated. Larger creatures may have wandered for miles during their lives, whereas the small mammals and insects probably never strayed more than a few hundred feet from where they were trapped.

So in 1969 the Natural History Museum of Los Angeles County began another excavation, focusing on Pit 91, which had been discovered in 1915. County museum staff had left the mass of bones in place, hoping for a future exhibit that would show park visitors how the fossils were found in the ground. Fortunately for science, the bone mass remained undisturbed in the ensuing years. And on Friday, June 13, 1969—"Asphalt Friday" of Page Museum lore—the excavation of Pit 91 began.

The new excavation has added 131 plant species, 88 insect species, 63 mollusk species, and 18 small-mammal species to the menagerie of Rancho La Brea. Moreover, the masses of bones from Pit 91, cleaned and catalogued, helped to prepare a test for the entrapment hypothesis. I took part in that project with Lillian Spencer, an anthropologist at Arizona State University in Tempe; Blaire van Valkenburgh, a paleobiologist at the University of California, Los Angeles (UCLA); and a team of UCLA students. Together we studied 18,000 bones and found, first of all, that the great majority of them showed little or no weathering. Once the bones were mired in asphalt, they were rapidly buried by sediment, debris, and more asphalt—rather than being exposed or carried for any distance.

What about other markings on the bones? If the asphalt seeps acted as carnivore traps, with mired



animals as bait, one might expect to find tooth marks, for instance. Yet of the 18,000 bones, only 2 percent had been scored, notched, or punctured by carnivores, and 76 percent of the adult bones were complete. Nevertheless, our study also noted that many bones from ground sloths, ruminants, and deer were so fragmentary they could not be properly identified. Those bone fragments had probably been scavenged and crushed by predators near the asphalt seeps. The unmarred bones were probably from parts of the carcasses too mired in asphalt for carnivores to disturb.

The skeletal proportions of the trapped animals provide further, telling evidence of scavenger activity. Carnivores at kill sites often remove a limb from a carcass and carry it to a safer place for feeding. A tally of each of the seven most common species at Pit 91 showed that for every skull in the sample there was only one forelimb and one hind limb. The missing limbs provide strong circumstantial evidence that mired animals were ravaged by carnivores. The skeletal remains also show

that not all species were equally attractive to scavengers. For horses, more than 75 percent of the limb bones were represented, whereas among bison, more than half the limb bones were missing. The bison bones also tended to be less complete than those of the horses. Spencer, van Valkenburgh, and I think those data show that carnivores preferred bison limbs, probably because of their greater fat content.

Our interpretation recently gained support from work I undertook with Joan B. Coltrain, an archaeologist at the University of Utah in Salt Lake City. Features of an animal's diet and local environment can be inferred from the proportions

of stable isotopes in its remains. For example, the ratio of nitrogen-15 to nitrogen-14 changes from species to species when moving up the food chain, providing a clue as to who is feeding on whom. By analyzing the nitrogen-isotope ratios in bones from Rancho La Brea, we found that the coyotes were omnivorous; that the dire wolves and lions were feeding on horses, ground sloths, and ruminants (but not on mastodons); and that the saber-toothed cats preferred bison and camels.

The asphalt continuously seeping into Pit 91 has been a constant problem for the excavators, but the muck, even without bones, has opened up an unexpected line of research. A recent study by David E. Crowley and Jong-Shik Kim, both microbiologists at the University of California, Riverside,

revealed that hundreds of species of bacteria and archaea also thrive in the asphalt seeps. One key part of the microorganisms' adaptation to life in the asphalt is that they "eat" petroleum: they grow by breaking down petroleum hydrocarbons, which they incorporate into their cells.

The discovery of such microfauna has enormous potential for biotechnology. To take just a few examples, understanding their biochemical pathways could lead to new medicines, polymers, and petroleum-based biodegradable plastics. If some of the microorganisms can be isolated from the asphalt and grown in the laboratory, they may be effective in treating oil wastes and contaminated soils.

At the present work rate, the excavation of Pit 91 could take another ten to fifteen years to complete. In that time, continuing research on the microorganisms could lead to an efficient way to clean the backlog of bones at La Brea—not to mention fossils from other asphalt seeps around the world. If that comes to pass, a lot of storage containers at La Brea undoubtedly hold the bones of new species—as well as trusty saber-tooth skulls—that will finally get the cleaning they deserve. □

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Cleaned skull of a saber-toothed cat



Pit 91 continues to be excavated every summer with the help of volunteers. Bones larger than a half inch long are removed for cleaning; the surrounding asphalt is saved in the hopes of future processing.



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Survival of the Rarest

The forests of southern Bahia, Brazil, threatened by development, shelter numerous rare plants, which botanists are racing to document before they disappear.

By Wm. Wayt Thomas

Come on, it's right up here, at the edge of the forest," Jomar shouted as he bounded through the sun-dappled plantation. *Theobroma cacao* trees, the source of cocoa and chocolate, grew all around us, partly shaded by a high overstory of native rainforest trees. When we reached the far edge of the cacao plantation, or *cabruca*, the parklike ground gave way to untended tropical forest, a dense riot of herbs, shrubs, and vines, all crowding upward and outward. Jomar walked along the forest's edge for a while, then bent down, pulled some shrubs aside, and motioned me over.

The two of us squatted to examine what Jomar had sought out: one of the world's rarest plants. *Anomochloa marantoidea* is a low-growing, clumped

grass with wide, pointed, oval leaf blades about six inches long. Now known to be the most primitive species in the grass family, *A. marantoidea* holds a special fascination for botanists who study the evolutionary history of grasses. The species, the only one in the genus *Anomochloa*, was first described scientifically in 1851. But the description was based on plants grown in Paris from seeds of uncertain provenance. They were thought to be from the southern part of the Brazilian state of Bahia, where Jomar and I now crouched.

In 1976 a botanist from the Smithsonian Institution in Washington, D.C., Cleofé E. Calderón, went to Bahia with the goal of rediscovering *Anomochloa*. She had tried, but failed, to do so on an earlier expedition, despite the assistance of a gifted local plant collector, Talmon S. dos Santos, of the Brazilian government's Cocoa Research Center (known as CEPEC, for its name in Brazilian Portuguese) in Ilhéus. Calderón and dos Santos—a



Dense forest in southern Bahia (left) typifies the region's botanical diversity, concealing rare and potentially intriguing plant species. As the map shows (above), only about 8 percent of the region's original forest remains.

former logger with a fifth-grade education—spent days fruitlessly searching the forests of southern Bahia. Finally, on a foray during which the pair had split up to cover more ground, dos Santos found the species that had gone missing 125 years earlier.

It was a population of about ninety *Anomochloa* plants, the same one Jomar and I now examined. We found the population diminished to just thirty plants, but otherwise healthy, ignored, and for the time being safe. Only one other population—located near the first—has been found in the years since the species' rediscovery.

Anomochloa is just one of many rare plants inhabiting southern Bahia, where I have been studying plant diversity for more than fifteen years. I work closely with Jomar—full name, Jomar G. Jardim—a doctoral candidate at the State University of Feira de Santana; André M. Amorim, a botanist at the State University of Santa Cruz in Ilhéus; dos Santos; and others at CEPEC. We share a particular interest in rare plants, not only because they are the species most at risk of extinction, but also because their ecology, chemistry, and potential uses are often all but unknown. Knowledge of rare plants in economically important families, such as *Anomochloa* in the grasses, could guide botanists in improving more common, marketable species. Some rare plants are limited to a certain soil type or a certain microclimate, and so they are useful “indicator species” for identifying and understanding those unique ecosystems. Finally, rare species with narrow ranges can help conservationists determine which areas merit the highest priority in the efforts to conserve biodiversity.

But finding and documenting rare plants is no small challenge, as you might imagine, in the diverse forests of a region such as southern Bahia. As one of the world's biodiversity “hot spots,” the region is so complex that bringing rare species to light is often a matter of chance encounters deep in the jungle. A survey is also complicated by the uncertain future of the forests themselves.

Southern Bahia is an area about the size of Connecticut and New Jersey put together. Within the region, rainfall, topography, and geology all vary, giving rise to a patchwork of distinct forest types and an extremely rich flora. A two-and-a-half-acre survey might reveal more than 250



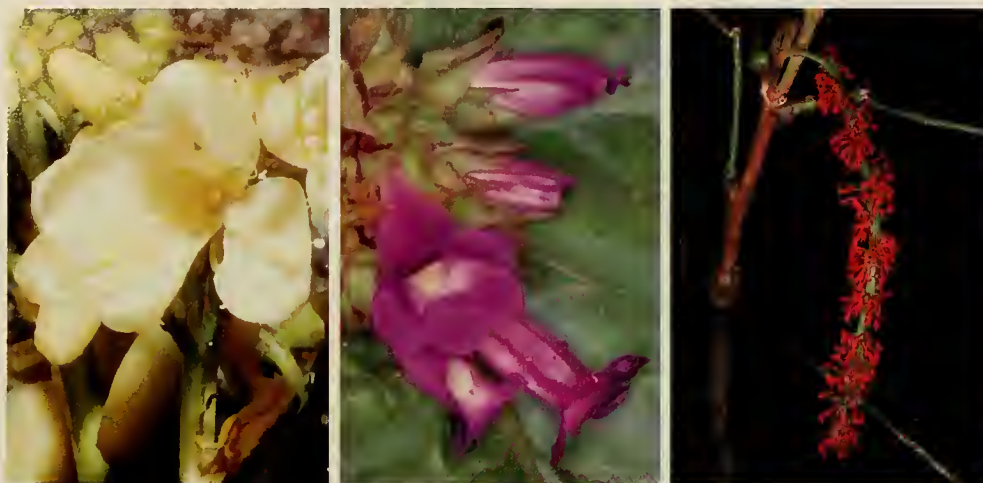
Plant specimens from a southern Bahia forest come back for identification and analysis in plastic bags carried by the author (right), André M. Amorim (center), and two of their colleagues.

species of trees whose trunks are more than four inches across. By comparison, all the native trees in temperate eastern North America belong to just 230 species. More than a quarter of the plant species in southern Bahia are endemic to the region—an unusually high number—as are numerous mammals, birds, and other animals.

The forest in southern Bahia is part of Brazil's Atlantic coastal forest, a strip that in pre-Columbian times reached 200 miles wide and stretched more than 1,500 miles along Brazil's eastern coast [see map on opposite page]. Five centuries of deforestation for agriculture and development have reduced the intact forest canopy to a mere 8 percent of its original acreage—a trend that continues to this day.

Precisely because of their scarcity, rare plants are the most vulnerable to deforestation. Many, such as *Anomochloa*, are known from startlingly few locales. In 1981, for instance, dos Santos and a colleague discovered an unusual tree with yellow flowers that they had never seen before in a cocoa plantation on CEPEC's grounds. In 1998 a botanist assigned it to a new genus of the orange family (the Rutaceae) comprising a single species, *Andreodoxa flava* [see leftmost photograph on next page].

In spite of its conspicuous yellow flowers and years of searching by botanists, the genus *Andreodoxa* is still known only from that single individual, pro-



Andreodoxa flava (left) is known only from a single tree. *Gloxinia macrophylla* (center) occurs in just one known population; its habitat is poorly explored, however, and additional surveys could reveal more plants. After first discovering *Picramnia coccinea* (right), the author noticed the species in familiar, well-studied forests, whose lush vegetation had previously hidden it.

tected between two boulders in a cabruca. Since *Anomochloa* and *Andreodoxa* are known only from cabucas, they might be restricted to the same moist, fertile soils that cacao trees prefer. If so, they were probably more common before cocoa became widely cultivated than they are today. Perhaps other rare species share a similar history.

Fortunately, in the cases of both *Anomochloa* and *Andreodoxa*, the right person passed by a rare species at the right time and noticed it. But how many other populations of those two species have simply never been noticed? And how many other species have been overlooked entirely or have even disappeared as a result of deforestation before biologists could describe them?

Even if other populations remain to be discovered, it is clear that *Anomochloa* and *Andreodoxa* are, at best, uncommon plants. Other species are hard to find for different reasons. Some are common in certain areas, but restricted to a small range. Others are rare in southern Bahia but more common elsewhere. Still others have been discovered in areas that remain poorly known; those species might turn out to be more common once such areas are better surveyed.

That last scenario is the case for a relative of the African violet, *Gloxinia macrophylla*—a low-growing, fuzzy-leaved plant with bright purple flowers almost two inches long [see middle photograph above]. My colleagues and I were amazed to encounter a population of *G. macrophylla* while exploring a dry forest, one of southern Bahia's least studied and most threatened habitats. The species had been collected in the same

area for the first and only other time in 1817. *G. macrophylla* was described scientifically in 1823 and, despite its showy flowers, was never again collected until we happened upon it. Is it as rare as *Anomochloa*? We can't yet tell.

Actually, the extraordinary diversity of the Bahian forests has the somewhat paradoxical consequence that even the most common species are scarce. That makes the inconspicuous or rare ones difficult to find indeed. The plants come in so many different shapes, sizes, and varieties—and so few of them display distinguishing flowers or fruits at any one time—that noticing something new is difficult.

Once, when collecting in a forest fragment inside the city limits of Ilhéus, I came upon a six-foot-tall tree with spikes of red flowers [see rightmost photograph above]. I knew right away that it was a species of *Picramnia*, but I had never seen anything like it before. My colleagues and I looked around and found a few more, all lacking flowers or fruits. Curiously, when we returned to two nearby forests where we had repeatedly collected, *Picramnia* was there, too, no longer invisible amidst the background vegetation. It wasn't common or easy to spot, but it certainly was present. It turned out to be a species new to science, which I later described as *Picramnia coccinea*.

Quantitative studies, in which botanists collect and identify every woody plant in a plot, are a good way to unmask such invisibility. One such study in southern Bahia led to the discovery of a dozen tree species, all new to science. The new species comprised more than 10 percent of the tree flora in their home forest—yet because their flowers and fruits are hidden in the canopy, they had never before been noticed.

The history of southern Bahia's forests largely dictates the rarity or abundance of the region's plant species. Unlike the Amazonian forests farther inland, the Atlantic coastal forest has been strongly affected by European colonization for more than half a millennium. On April 22, 1500, the Portuguese explorer Pedro Cabral and his crew were the first Europeans to set foot on the land now called Brazil. The Portuguese quickly settled, inexorably displacing the indigenous Tupi. The first colonists

in southern Bahia grew sugarcane and cotton and harvested pernambuco trees from the forest. Pernambuco (*Caesalpinia echinata*), or brazilwood, is endemic to the Atlantic coastal forest. Its beautiful deep-red wood yields a red dye that became an immediate commercial success for the Portuguese and led to the decimation of the species.

In the 1740s cacao, native to the Amazon Basin, was introduced for cultivation in the forests of southern Bahia. It wasn't until the second decade of the 1900s, however, that its cultivation—predominantly in cabruças—became widespread. By the late 1970s cabruças covered a million acres in southern Bahia, and dry cocoa beans fetched more than \$3,700 a ton.

In the cabruça system only the forest understory is cleared, and cacao trees are planted in the shade of the original canopy [see “The Chocolate Tree,” by Russell Greenberg and Robert A. Rice, July/August 2003]. Cabruças thus preserve some of the original diversity of trees and epiphytes in the forest, and they provide some habitat and nourishment for birds and primates.

But the diversity preserved in the cabruças suffered a severe setback following the crash of the region's cocoa-driven economy in the late 1980s and 1990s. Increased cocoa production throughout the world dropped prices to around \$1,200 a ton by 1999. And as the price was bottoming out, a disease fungus, *Crinipellis pernicioso*, swept through the Bahia plantations, reducing Brazil's annual cocoa output from 380,000 tons in the late 1980s to 90,000 tons in the late 1990s. Brazil, the world's second-largest exporter in the 1980s, had to import cocoa.

When prices and production fell, the income from a typical plantation dropped to a tenth of its former level. Families who tended the cacao abandoned the farms for the cities. Many landowners could no longer maintain their cabruças, so they felled the shade trees for timber and cleared the land for pasture or coffee plantations. Half the forest acres that had been semipreserved in cabruças were permanently cleared.

Today, most of southern Bahia's scant remaining forest is under development pressure of one kind or another. Moist, fertile soils make the hilly region near Ilhéus ideal for growing cacao; most of the natural forest there has already been converted to cabruças. Woodlands and sandy savannas along the coast, called *restingas*, are severely threatened by beachfront development. The hot, humid, low-lying forests of the southern coastal plain, called *tabuleiro*

forests, are ideal for pastures, for papayas and other crops, or for large-scale plantations of eucalyptus, grown for paper. The drier inland forests, the most threatened, have soils that are excellent for pastures. It comes as no surprise, then, that most of the large forest fragments that have remained intact possess poor soils that are relatively undesirable for agricultural development.

As Jomar and I studied the population of *Anomochloa*, counting the individual plants and their inflorescences, I was struck by their precarious future, and that of the forest ecosystem around them. Will the family that owns the forest maintain it as is, or will they clear its understory to plant more cacao? Does the *Anomochloa* population (and others that may still lie undiscovered) have the genetic diversity to perpetuate itself? And what about *Andreodoxa*? Is it one of the “living dead,” a single individual



Crop of green cassava plants grow among the debris where trees once stood. Most of the scant forest remaining in southern Bahia is under pressure for agricultural or housing development.

doomed to extinction? What of the other endemics to southern Bahia—plants and animals alike?

I remain hopeful that preservation of key areas in a variety of forest ecosystems can preserve enough species—and enough genetic variability within each species—to ensure their long-term survival. That hope drives my work: improving the understanding of Bahian forests so that the crucial decisions about conservation can be made as wisely as possible. □

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Darwin in Court

Eighteen months after the “monkey trial” in Dover, Pennsylvania, a bumper crop of books puts the battle in perspective and asks, What’s next?

By Richard Milner

*I am inclined to believe
The story of Adam and Eve.
There’s no chimpanzee
In my pedigree*

And you can’t make a monkey of me.

—From the song “You Can’t Make a Monkey
Out of Me,” popular during the Scopes-trial era;
©Billy Rose and Clarence Gaskill, 1925

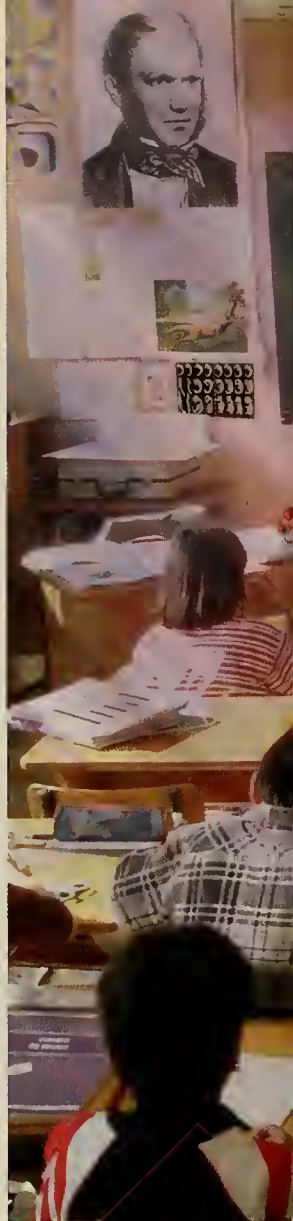
Every few years in America (and nowhere else) God tells someone to haul Charles Darwin and evolutionary biology into court. No other scientific theory—not atomic theory, not string theory, not the big bang—has ever been put on trial in a court of law. That may be because “Darwin matters,” to borrow a phrase from Michael Shermer, a historian of science and self-labeled “former fundamentalist.” Shermer’s essential little book, *Why Darwin Matters*, shows how the revolutionary Darwinian time bomb is still ticking. Subtitled *The Case Against Intelligent Design*, the book refutes creationism’s latest incarnation and chronicles the recent brouhaha over high school textbooks in Dover, a small town in rural Pennsylvania.

Three years ago, members of the Dover school board decided to require teachers or administrators to read a formal disclaimer in ninth-grade biology class, urging students to be skeptical of Darwin’s “theory” of evolution and to consider intelligent design (ID) as an alternative explanation for the origin of life. They also sought to introduce an auxiliary textbook that promotes ID, *Of Pandas and People: The Central Question of Biological Origins*, by Percival Davis and Dean H. Kenyon. Tammy Kitzmiller, a working mother with two daughters in the high school, along with ten other parents, sued the board for violating their constitutional rights under the First Amendment’s Establishment Clause. *Kitzmiller v. Dover Area School District* was

the first time anyone had challenged a public school district in the federal courts about the teaching of ID, which the parents argued was not a scientific theory at all.

Board members protested that their agenda was not about religion, but rather about teaching an important new scientific idea. A new idea? Hardly. In 1831, when Charles Darwin, then a young theology student, set sail aboard HMS *Beagle*, he believed in design by a Creator. He also accepted the church-approved doctrine that the Earth’s species had been created instantaneously and in their present form. Like the seventeenth-century theologian William Paley, Darwin thought that such marvels of natural engineering as the human eye and the eagle’s wing were “evidences” of the Creator’s handiwork. Paley’s famous watchmaker analogy—if you find an intricate timepiece, you must conclude it had a maker—was a well-worn form of argument for the existence of God, traceable back to Thomas Aquinas and beyond.

In John Brockman’s anthology *Intelligent Thought: Science Versus the Intelligent Design Movement*, the historian of science Frank Sulloway of the University of California, Berkeley, has concisely traced Darwin’s path in rejecting those ideas. During the voyage of the *Beagle*, Darwin began to see that animals and plants had been patched together and modified throughout a period of organic evolution. Evolutionary history, with all its quirky and sometimes inefficient pathways, is embedded in our bones.





Artist's digital collage portrays a classroom dominated by icons of evolution. The teacher gestures toward Pennsylvania, site of the landmark case *Kitzmiller v. Dover Area School District*.

Does nature ever produce a downright *unintelligent* design? That question is addressed (unforgettably, but alas, unsatisfactorily) in the lighthearted documentary *Flock of Dodos*, made by Randy Olson, a marine-biologist-turned-filmmaker. In Olson's film, James Hanken, the director of Harvard's Museum of Comparative Zoology, gives his Award for Most Unintelligent Design to—of all animals—the rabbit. "It's a truly disgusting design," he adds.

When rabbits chew and swallow their veggies, Hanken explains in the film, they shunt the food past both large and small intestines to a special fermentation pouch, known as the cecum, from which they expel marble-size pellets called cecotropes. Then, at night, your pet bunny eats its own droppings. This time, however, they are processed in the intestines, where the half-digested food is absorbed,

and the resulting waste discharged as true feces. Who knew? Olson's night-vision camera shows a rabbit filmed in the dark, and, sure enough, you can actually see what's up, doc. "For every example of intelligent design in nature," says Hanken, "I can cite you ten others of *unintelligent* design."

But that's just one way of looking at it. The rabbit works well enough to have survived, after all, so it must be a successful design—no matter what we might think about the "intelligence" of a design that requires an animal to eat its own excreta. Indeed, it is peculiar for a biologist to maintain that some living things are less intelligently designed than others. If all biological systems arose from natural, mechanistic processes, they're *all* unintelligently designed.

Although the phrase "intelligent design" does invite "unintelligent design" as its opposite, the op-

erative word is "design." Creationists believe that you can't get something as complicated and finely tuned as a rabbit through unplanned, intermediate steps. The greater the intricacies, they insist, the higher the intellect must have been to create it. That biologists think that they could improve on the design of the rabbit is ultimately no answer to the creationists' argument, particularly if the improvements merely reflect human prejudices about what is an optimal or beautiful design.



But if biologists can't shed their human constraints, neither can the advocates of ID. Throughout the film, they keep showing Olson pictures of Mount Rushmore, insisting that any fool can see that the granite presidential portraits must have been designed, rather than the result of natural forces shaping the mountain. "Yes," Olson keeps adding, "by a *human* designer."

Olson and his film crew crisscrossed the country, interviewing creationists and ID advocates, as well as evolutionists. Some of the opponents of evolution turn out to be disarmingly likable, whereas some of the scientists can be arrogant and off-putting. During a poker game among Ivy League biologists, when the conversation turns to ID, the pros sound as smug and condescending as any entrenched priesthood. In so doing, they have thrown away a winning hand.

Both sides, in the filmmaker's view, are silly, vulnerable dodos. Like those extinct birds, creationists cannot adapt; they're unaware that their under-

It is peculiar for a biologist to maintain that designed than others. If all biological systems they're all unintelligently designed.

standing of nature was decisively displaced more than a century ago. But the evolutionary biologists are equally behind the times. They seem blind to the information revolution, in which public relations gurus and spin doctors promote disguised religious agendas with spectacular success.

Matthew Chapman is no dodo. A Hollywood screenwriter, he covers the Dover trial with an ear for idiosyncratic language and a dramatist's eye for the nuances of character. His reportage in *40 Days and 40 Nights* is a tour de force, hilarious without sacrificing seriousness of purpose. Chapman, by the way, is a great-great-grandson of Charles Darwin: his is a personal quest for the meaning and impact of his family legacy.

Chapman squelches any inclination he might have had to imitate H.L. Mencken, the acerbic American journalist who, during the 1925 Scopes trial, sneered that the creationists were hicks and hillbillies, and who coined the enduring term "Bible Belt." Rather, Chapman argues, to dismiss militant religionists as harmless and trivial is to invite being blindsided. Most scientists, he writes, simply cannot imagine that religious fundamentalists "might eventually, through sheer force of will and faith engendered by bitterness or fear, emerge victorious."

Works Discussed

Intelligent Thought: Science versus the Intelligent Design Movement
edited by John Brockman
Vintage, \$14.00

40 Days and 40 Nights: Darwin, Intelligent Design, God, OxyContin, and Other Oddities on Trial in Pennsylvania
by Matthew Chapman
HarperCollins, \$25.95

Creationism's Trojan Horse: The Wedge of Intelligent Design
by Barbara Forrest and Paul R. Gross
Oxford University Press, \$19.95

Monkey Girl: Evolution, Education, Religion, and the Battle for America's Soul
by Edward Humes
HarperCollins, \$25.95

Flock of Dodos: The Evolution—Intelligent Design Circus
(comedic-documentary film: 85 minutes)
Written and directed by Randy Olson
Prairie Starfish Productions, home video to be distributed by New Video, August 28, 2007, \$26.95

Not in Our Classrooms: Why Intelligent Design Is Wrong for Our Schools
Edited by Eugenie C. Scott and Glenn Branch
Beacon Press, \$14.00

Why Darwin Matters: The Case Against Intelligent Design
By Michael Shermer
Times Books, \$22.00

The Battle Over the Meaning of Everything: Evolution, Intelligent Design, and a School Board in Dover, PA
by Gordy Slack
Jossey-Bass, \$24.95

some living things are less intelligently
arose from natural, mechanistic processes,



Of all the witnesses to testify at the trial, the chroniclers agree, the hero was Barbara C. Forrest, a philosopher and historian from Southeastern Louisiana University in Hammond. Forrest had co-au-

Edward Humes, a nonfiction writer and Pulitzer Prize-winning journalist, and Gordy Slack, a science journalist, also covered the Dover trial, apparently often bumping into Chapman and each other. They, too, have produced excellent, if inevitably overlapping, accounts. Humes gives the most detailed coverage of the testimony and cross-examination of witnesses. His account of the cross-examination of Michael J. Behe, an amiable biochemist from Lehigh University and the only major proponent of ID to take the stand, is particularly compelling. Behe is well known for his argument that a mousetrap exemplifies “irreducible complexity,” because it could not work if even one element were missing from its design. But the plaintiffs’ lawyers mousetrapped Behe into contradicting his own ideas.

Judge John E. Jones III, an appointee of President George W. Bush, presided over the case. Slack describes Jones as having “something of the conservative 1950s father figure about him.” A lifelong Republican, Jones has flatly stated that he is not a judicial activist. Yet the judgment he eventually reached outraged some of his fellow conservatives.

Among the various scientists, theologians, atheists, deists, and politicians who appeared before Judge Jones (it was a bench trial, without a jury), one was Eugenie C. Scott, executive director of the National Center for Science Education in Oakland, California. Slack, who dubs her the Empress of the Evolutionary Forces, describes the center as “the only national organization dedicated solely to keeping evolution in public school classrooms and creationism out.”

As it happens, Scott and her deputy director, Glenn Branch, have edited their own book, a concise volume of counterarguments to ID titled *Not in Our Classrooms*. The book features essays by biologists, educators, philosophers, and theologians, each approaching the subject from a distinct perspective. Branch offers his own handbook for activists, and others attack ID not only as pseudoscience, but also as an exemplar of pandering politics, poor pedagogy, and tacky theology. The collection gives teachers plenty of ammunition for fighting verbal battles or answering students’ questions.

thored a damaging exposé of the creationists’ organizations, tactics, and goals: *Creationism’s Trojan Horse*. She and her co-author, Paul R. Gross, a biologist at the University of Virginia in Charlottesville, tracked the creationist movement’s history—through the group’s own internal documents—and revealed that its objective was never scientific, but had always been religious. The movement’s agenda is to manipulate the issue of evolution as a wedge that will lead to a change in the very definition of science. Supernatural causes would be allowed to replace the hated “naturalistic materialism” of science. And the creationists’ own, literal interpretation of the Bible would become the highest authority on morals, culture, and knowledge of the natural world.

For the trial, Forrest had also analyzed the Dover school board’s new proposed textbook, *Of Pandas and People*. Conducting a word search in successive versions, from the original draft in 1983 until its initial publication in 1989, she found the only substantive changes were to replace every instance of the words “creation” or “creationism” by the phrase “intelligent design.” (As the book defines it, “Intelligent design means that various forms of life began abruptly through an intelligent agency, with their distinctive features already intact.”) Tellingly, the switch had occurred after the creationists lost their 1987 appeal to the Supreme Court in *Edwards v. Aguillard*. The ruling in that case had blocked their attempt to introduce their faith-based “science” into Louisiana public schools.

When school board members took the stand, the depths of their ignorance appalled even those who might have been sympathetic. One woman cheerily testified that she knew nothing about either evolution or ID, but had voted to require the disclaimer because another school board member (an ex-cop and corrections supervisor) was “in law enforcement.” Reading Chapman’s account, you can almost hear the author’s jaw drop when it dawns on him that “an auto repairman” (the school board chairman) had appointed the ex-cop, “a biblical literalist without a shred of knowledge,” to decide which books the kids should learn from—backed up unquestioningly by

"a woman who had no curiosity about anything, even her most deeply held beliefs."

In the final moments of the trial, one of the plaintiffs' attorneys, Patrick Gillen, asked the judge a question: "Your Honor . . . by my reckoning, this is the fortieth day since the trial began and tonight will be the fortieth night, and I would like to know if you did that on purpose." Jones, smiling at the allusion to the length of time Noah's ark was tossed about in the Great Flood, instantly replied: "Mr. Gillen, that is an interesting coincidence, but it was not by design." And Matthew Chapman got his book title.

In the end, Judge Jones ruled against the school board, concluding that ID was grounded in a particular sectarian religion, not in science, and thus violated the Establishment Clause of the First Amendment. It is worth noting the stern tone of his concluding opinion:

It is ironic that several of these individuals, who so staunchly and proudly touted their religious convictions in public, would time and again lie to cover their tracks and disguise their real purpose. . . .

. . . The breathtaking inanity of the Board's decision is evident when considered against the factual backdrop which has now been fully revealed through this trial. The students, parents, and teachers of the Dover Area School District deserved better than to be dragged into this legal maelstrom, with its resulting utter waste of monetary and personal resources.

One thing about creationists, though: they constantly evolve. Over the years they have repeatedly reinvented themselves: from fundamentalists to creationists, to creation scientists, and now to ID scientists. The draft of *Design of Life*, essentially *Of Pandas and People* under a new title, includes a new phrase—"sudden emergence"—for another old idea, that of the spontaneous appearance of species by Divine fiat. An attorney for the plaintiffs read the definition for the court: "Sudden emergence holds that various forms of life began with their distinctive features already intact, fish with fins and scales, birds with feathers and wings, animals with fur and mammary glands." He then commented to the judge, "Hopefully we won't be back in a couple of months for the sudden emergence trial." "Not on my docket," said Jones, "let me tell you."

The battle no doubt will go on, but there may be one saving grace in the fabric of American culture: vast apathy. Attempting to interview teenagers about the case, Chapman discovers that many have absolutely no interest in the controversy. Slack finds the kids he speaks with equally clueless. "So this is the front line of America's

culture war," he writes, "pimply kids who don't have the foggiest idea, or care much, if at all, what natural selection or 'irreducible complexity' are, let alone which one suggests a better explanation for the diversity of life on Earth."

During a recent boat cruise, on which I lectured about Darwin's voyage as we retraced some of his steps through the Galápagos Islands, I met a practicing Christian named Frank Wheeler. Wheeler has wide contacts with Christian philanthropic and other groups, and he genially wrote to me after our cruise: "During nearly twenty-seven years of participation in Christian organizations, I cannot recall any discussions of evolution or how it and other science might be in conflict with Bible teachings." Since returning from our trip, he continues,

I have sent a number of e-mails to a wide group of people from many walks of life, including several pastors, and they generally share my views that most American Christians are both "evolutionist and creationist" and see no conflict. If God set the world in motion in a way that opened the door for living things to evolve, most seem to think this was even more amazing and awe-inspiring than creating at the snap of a finger. . . . Most of us are more concerned about helping people improve their lives than in a literal interpretation of Genesis.

After all the hoopla, the drained emotions, and the wasted money, in the immortal words of Yogi Berra, "It's déjà vu all over again." It's the same story that played out in the Scopes trial of 1925, and more than a century and a half ago, when the English novelist Samuel Butler accused Charles Darwin of single-handedly depriving mankind of faith, hope, and purpose. But sixteen years after Darwin's death, perhaps with his longtime adversary in mind, Butler penned an extraordinary sonnet about immortality called "The Life After Death." Its concluding lines seem eerily prescient, reminding us that though the players change, the game remains eternally the same:

We shall not argue saying "'Twas thus" or "Thus,"
Our argument's whole drift we shall forget;
Who's right, who's wrong, 'twill all be one to us;
We shall not even know that we have met.
Yet meet we shall, and part, and meet again,
Where dead men meet, on lips of living men. □

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Catch of the day

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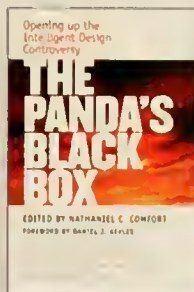
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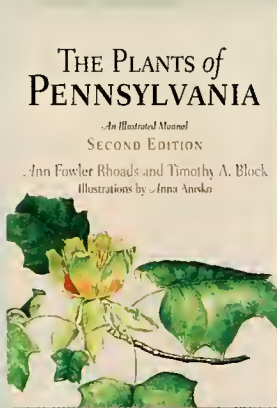


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THE SKY IN JUNE

By Joe Rao

Mercury is easy to find at dusk as June begins. Look for it about twenty-two degrees to the lower right of Venus (the width of your fist held at arm's length is roughly ten degrees across the sky). Mercury appears at magnitude +0.5 and sets just before the end of evening twilight. On the 2nd it reaches its greatest eastern elongation, or apparent angular separation from the Sun: twenty-three degrees. The planet is still as much as fifteen degrees above the horizon at sunset. A week later, on the 10th, it sets an hour and a half after the Sun, but by then it is also much dimmer, appearing at magnitude +1.5. From then on the planet fades rapidly. It passes inferior conjunction, roughly in line between Earth and the Sun, on the 28th.

Venus is by far the most brilliant evening "star" in the west after sunset. Sharp-eyed observers might even pick it out a little north of due west as the Sun sets. The interval between sunset and Venus-set shrinks from more than three hours at the start of the month to less than two and a half hours by month's end. In a telescope the planet is rapidly waning even as it grows in size, the telltale signs that Venus is swinging toward us along its orbit. Meanwhile, the planet is brightening by some 30 percent, reaching magnitude -4.5 by early July.

By pure geometry, Venus should appear half-illuminated on the 9th, when it reaches its greatest elongation from the Sun. But its actual observed half phase, or "dichotomy," will likely appear some days earlier, though nobody knows exactly why. Thereafter Venus becomes a crescent that noticeably thins and lengthens. On the evening of the 18th a slender crescent Moon appears to hover almost midway between Venus (to its lower right) and Saturn (to its upper left). And at the end of the month Venus itself has a close encounter with Saturn (described under "Saturn").

Mars rises before 3 A.M. local daylight time on the 1st and an hour earlier than that by the 30th. Throughout the

month it races eastward against the stars, crossing from the constellation Pisces, the fish, into the constellation Aries, the ram, on the 27th. Mars is the bright orange "star" below and to the right of the Great Square of the constellation Pegasus, the winged horse, as dawn breaks at the start of the month. For the rest of the month it lies well below the stars of the constellation Andromeda, the chained princess.

Jupiter, glaring regally at magnitude -2.6, passes opposition to the Sun on the night of the 5th. After Venus sets, it is by far the brightest starlike object in the sky. It dominates the southeast during the early evening. Then, accompanied by the stars of the constellation Scorpius, the scorpion, with its ruddy heart, Antares, this magnificent planet treks across the southern sky all night before setting around dawn. But even at a respectably bright magnitude of +1.1, Antares is only about a thirtieth as bright as Jupiter.

Saturn lies in the constellation Leo, the lion, and appears in the western sky at dusk at magnitude +0.5. On the 1st, the planet sets more than four hours after the Sun; by the 30th, Saturn sets soon after evening twilight ends. Late in the month Venus, a hundred times brighter than Saturn, approaches from the west, coming within about three-quarters of a degree directly below the ringed planet on the 30th.

The **Moon** is at last quarter on the 8th at 7:43 A.M. It wanes to its new phase on the 14th at 11:13 P.M. and waxes to first quarter on the 22nd at 9:15 A.M. The June full Moon, sometimes called the "Strawberry Moon," takes place on the 30th at 9:49 A.M.

The solstice takes place on the 21st at 2:06 P.M. Summer officially begins in the Northern Hemisphere, winter in the Southern Hemisphere.

Unless otherwise noted, all times are eastern daylight time.

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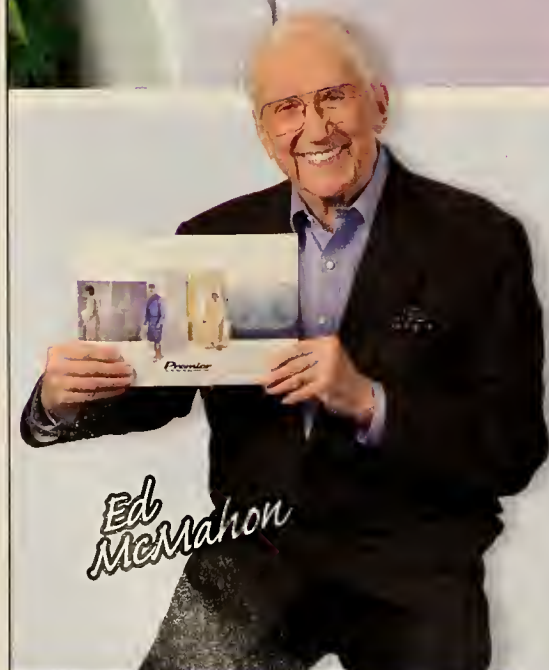
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Dr. Bart D. Ehrman is the James A. Gray Professor and Chair of the Department of Religious Studies at The University of North Carolina at Chapel Hill. He received his Masters of Divinity and Ph.D. from Princeton Theological Seminary. He has won several teaching awards, including the Students' Undergraduate Teaching Award and the Bowman and Gordon Gray Award for Excellence in Teaching. Professor Ehrman has written or edited more than 15 books, including the New York Times bestseller, *Misquoting Jesus*, and *Jesus: Apocalyptic Prophet of the New Millennium*.

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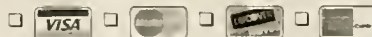
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A Cool Young Star

*A distant nova dazzles with its beauty.
But where's the missing white dwarf?*

By Charles Liu

In January 2002, a previously unremarkable star—one of the distant stars forming the hazy band known as the Milky Way—suddenly flared up. The star, in the direction of the constellation Monoceros, the unicorn, became hundreds of thousands of times more luminous than our Sun, and briefly claimed the title of the most luminous star in our galaxy. Yet even at its brightest, the star was barely visible to the unaided eye from Earth. Four months after its initial flare-up it had settled back to its original brightness, roughly a ten-thousandth of its peak luminosity.

We astronomers call such a powerful stellar eruption a nova (Latin for “new”)—not to be confused with a supernova, in which a star literally blows itself apart. But V838 Mon, as this star-gone-nova is known, quickly showed that it was a one-horned horse of a different color—not at all like your typical nova. Soon some media outlets were comparing it to Vincent van Gogh’s painting *The Starry Night*, with its lustrous round stars encircled by rings of concentric brushstrokes. Today, V838 Mon has become one of the most closely studied single stars

in our galaxy, in large part because of the extraordinary way it lit up the dust that surrounds it.

But the star is cool too—literally, as stars go. In fact, it’s almost too cool to be a star, and not nearly as hot as the stars that undergo typical, so-called classical nova eruptions. At an international astronomy conference devoted to this one object, held last spring in the Canary Islands, a fascinating hypothesis was put forward: could the eruption of V838 Mon have been caused not by the flare-up of a single star but by the collision of two stars?

What causes a nova to erupt? Classically, the process begins as two stars orbit each other in a binary-star system. One of the two stars might be a mature star like our Sun. The other star is typically a white dwarf—a compact remnant left over after a sunlike star has ceased its thermonuclear activity. The two stars become locked in a tight gravitational embrace—usually with an orbital period of a few hours to a few days. The white dwarf has about the same mass as the sunlike star, but it’s a hun-

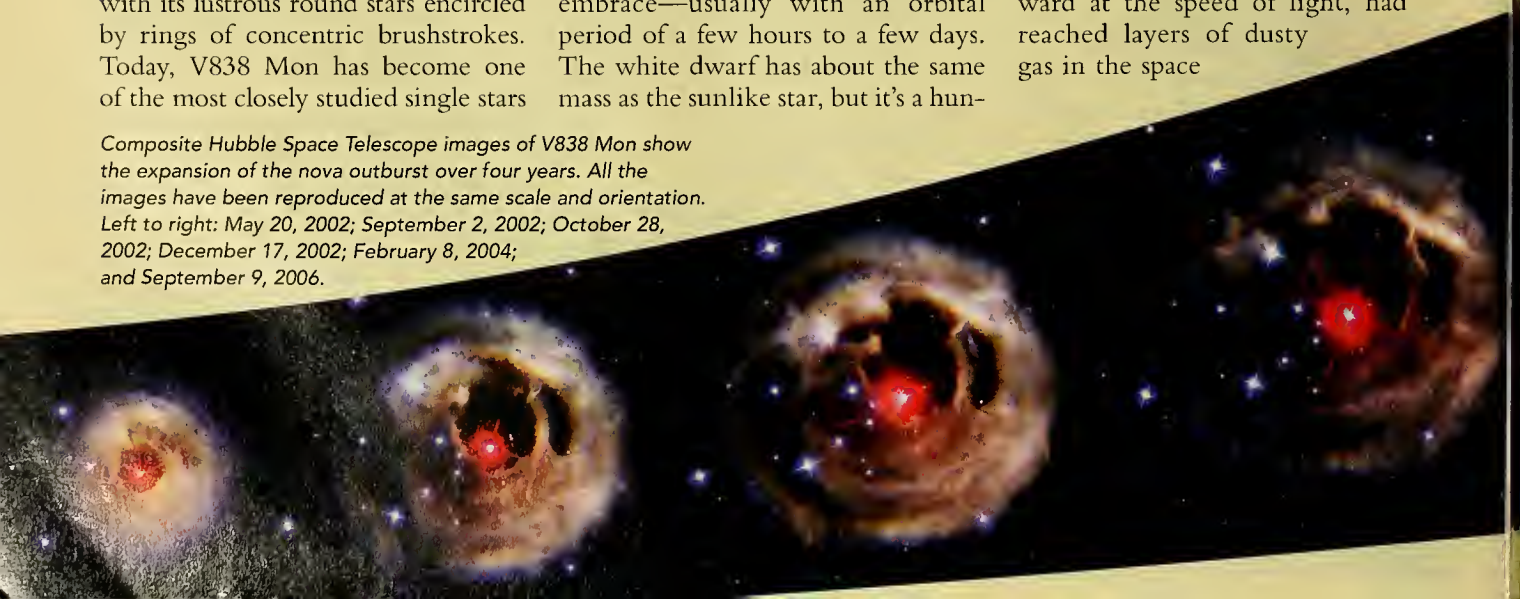
dred times smaller and a million times denser—a teaspoon of white-dwarf material weighs several tons. Its powerful gravitational field tugs on the outer gaseous layers of its companion, drawing off a stream of stellar gas.

As the captured gas builds up on the surface of the white dwarf, the surface temperature and pressure go up until they reach a critical point. The gas detonates in a thermonuclear flash, with the power of trillions upon trillions of terrestrial H-bombs. Matter from both stars, glowing brightly from the explosion, is blasted into space. As the glow gradually fades, the hot white dwarf sometimes becomes briefly visible at the core of the explosion. Then the cycle begins anew: gas continues to rain down onto the white dwarf from the sunlike star, setting the stage for another nova years, centuries, or even millennia later.

Because there aren’t enough professional astronomers in the world to discover and monitor all the novae that take place, dedicated amateurs play a critical role in finding and studying novae. So it was not surprising that an amateur astronomer, Nicholas J. Brown of Quinns Rock, Western Australia, was the first to see V838 Mon, on the evening of January 6, 2002.

Six weeks later, a team led by Arne Henden at the U.S. Naval Observatory in Flagstaff, Arizona, observed a stellar bonus: the flash of radiation from the “new” star, blasting outward at the speed of light, had reached layers of dusty gas in the space

Composite Hubble Space Telescope images of V838 Mon show the expansion of the nova outburst over four years. All the images have been reproduced at the same scale and orientation. Left to right: May 20, 2002; September 2, 2002; October 28, 2002; December 17, 2002; February 8, 2004; and September 9, 2006.



around the star. Some of the dust grains, aligned just right, acted like countless angled mirrors, collectively reflecting part of the outward-radiating light toward us. Here on Earth, astronomers could watch a progression of “light echoes” as the outburst radiated into space [see the series of composite images below].

Beyond the breathtaking beauty of its light echoes, V838 Mon is also undergoing rigorous scientific analysis. The first thing to measure was the distance to the star. Usually that is a pretty tough number to get—it’s not as if you can run a tape measure out there. But the expanding radius of the echoes marked the progression of light away from the explosion, and by timing the echoes, astronomers determined that the distance to the nova is almost exactly 20,000 light-years. That implied that V838 Mon at its peak brightness, back in early February 2002, was some 600,000 times more luminous than the Sun!

Here’s where the enigma began. The astronomers monitoring V838 Mon, expecting to see the standard pattern for classical novae, watched and waited for the hot white-dwarf system to reveal itself after the smoke

had cleared. But it never did. Instead, as time went on, V838 Mon just got cooler. The most recent observations suggest it has become cooler than the coolest ordinary stars, and now is only as warm as a typical “failed star,” or brown dwarf. If there’s no white dwarf in the system, what caused the explosion? A number of hypotheses have been put forward, most of which propose one of two competing explanations. Either the white dwarf remains obscured in some way—after all, the light echoes show that dust is all around the region—or a previously unknown kind of explosion has taken place on the white dwarf’s surface.

But now a study by Melike Afar of Ege University in Izmir, Turkey, and Howard E. Bond of the Space Telescope Science Institute in Baltimore, Maryland, has thrown cold water on both those explanations. Spectroscopic data from the region of space around V838 Mon revealed that the star system that likely birthed the nova is actually part of a small star cluster, whose stars all formed about 25 million years ago. That’s only a small fraction of the time needed for a star

to become a white dwarf. In other words, the time frame suggests that there is no white dwarf in the V838 Mon system at all. What then caused the eruption?

The evidence suggests a seemingly outlandish explanation: could two stars, neither one very bright, or one not-very-bright star and a giant planet, have collided? If the two bodies merged rapidly, any ongoing, ordinary thermonuclear fusion would be overwhelmed by an influx of fresh fuel. On a cosmic scale, it would be like flooding a campfire with a tanker truck’s worth of gasoline.

A lot more work will need to be done before the idea of a “stellar splash of fuel” can be confirmed or ruled out. Until then, astronomers will have to wonder whether this cosmic “starry night” was produced by the meticulous brushstrokes of a classical master—or by the maniacal paint swirls of a modernist.

CHARLES LIU is a professor of astrophysics at the City University of New York and an associate with the American Museum of Natural History.



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Free Lunch

By Robert Anderson

My Los Angeles neighborhood teems with scavengers: coyotes, crows, raccoons, and rodents. Recently I watched as several dozen vultures, those icons of the ilk, circled lazily overhead. Eyeing them suspiciously, I wondered if their Hollywood image was true—had something large died nearby? Later, an ornithologist friend reassured me that the birds were not hovering over a carcass. The "Questions and Answers" section of the Turkey Vulture Society's Web site (vulturesociety.homestead.com/Attract.html) confirmed my friend's assertion: the flock of vultures, known as a "venue," had no immediate plans to dine. Instead it had formed a "kettle," so named for the birds circling upward on a thermal of rising hot air, reminiscent of bubbles that rise in a kettle of boiling water.

Inspired to delve more deeply into the lives of scavengers, I learned that among the vertebrates there are few true scavengers—animals that feed solely on carrion. But other animals populate a vast gray area. Predators such as lions readily chew on someone else's abandoned kill; animals such as raccoons, regarded mainly as scavengers, also hunt prey. True scavengers are common, however, in the invertebrate world, particularly on the deep ocean floor.

All diners on the dead perform a valuable service by cleaning the planet of rotting and often diseased flesh, thereby recycling nutrients into the food web. The adaptations that enable them to fill their niche are as remarkable as anything in nature.

Please go to our Natural History Web site (www.naturalhistorymag.com), where I report on more tidbits, scavenged from various sites on the Internet, about these remarkable animals.

Robert Anderson is a freelance science writer living in Los Angeles.

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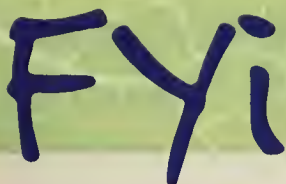
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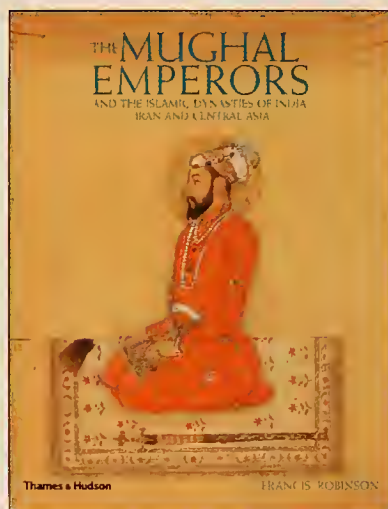
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(Continued from page 10)

GIL MOR REPLIES: That might be a significant factor, but to evaluate that possibility, one would have to determine whether women who live longer are more likely to have been pregnant at some time in their lives. And one would have to control not only for differences between women and men that might affect their differential longevity (such as occupational stress), but also for whatever differences lead some women to get pregnant during their lives, and others not.

The Eyes Have It

A caption that accompanies Jennifer A. Mather's article on octopuses ["Eight Arms, with Attitude," 2/07] states that the octopus eye "is a remarkable example of convergent evolution [with the vertebrate eye] despite more than 1.2 billion years of independent evolution." But to my knowledge, every animal species examined so far owes the development of its eye to the *Pax-6* gene, a gene of remarkable persistence.

Frank M. Sturtevant
Sarasota, Florida

THE EDITORS REPLY: Frank Sturtevant is correct; we fell into repeating an outdated example of convergent evolution. According to Sean B. Carroll, a molecular biologist at the University of Wisconsin–Madison, "One of the most surprising discoveries from the study of the evolution of animal development is that all sorts of eyes form under the control of a set of regulatory proteins, including *Pax-6*, which date to a common ancestor of vertebrates, arthropods, and cephalopods that lived at least 550 million years ago."

Natural History welcomes correspondence from readers. Letters should be sent via e-mail to nhmag@naturalhistorymag.com or by fax to 646-356-6511. All letters should include a daytime telephone number, and all letters may be edited for length and clarity.

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At the Museum

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Sniffing Out Polar Bears

Dogs may be (hu)man's best friend, but at least one canine is the best friend a polar bear could ever have. Quinoa, a two-year-old Dutch shepherd trained by graduate student Linda Gormezano to sniff out polar bear scat, is helping obtain genetic samples that may shed light on this threatened mammal's population size, structure, and behavior near Hudson Bay in northeastern Canada.

Gormezano began her Ph.D. work at the American Museum of Natural History through City University of New York (CUNY) in 2004, initially focusing on extracting DNA samples from coyote scat to study pack structure in Westchester County. The goal, she said, was also to develop new ways of identifying an animal repeatedly without putting it through the stress of being darted and tagged. She had heard of dogs being used before to find scat samples and passively "tag" animals and began to think she could do the same.

During a trip to Wapusk National Park in Manitoba with Robert F. Rockwell, her advisor and Research Associate in the Museum's Department of Ornithology, they both realized



Gormezano and Quinoa on the trail of polar bears near Churchill, Manitoba

that applying Gormezano's tagging techniques to polar bears represented the next logical step in her research. The idea of using a dog became even more compelling, as it would be able to cover a lot of tundra and gather the large number of samples needed to do her work.

In 2005, Gormezano bought six-month-old Quinoa, who had flunked out of police training because he was more of a lover than a fighter. For the next year, she used samples of coyote and polar bear scat to teach Quinoa to seek out the scent of each in the wild. His reward when he finds either is a tennis ball, but his work is anything but play—polar bears in Wapusk are believed to be heavily threatened by global warming-induced changes to their habitat.

"When Quinoa's out in the field, his nose is glued to the ground," said Rockwell. "He's serious about this. Linda and Quinoa are opening up a whole new frontier in tracking and monitoring animal populations."



An uncommon summer gathering of polar bears in Wapusk National Park. Gormezano's work may help reveal behavioral changes linked to global warming.

EVERYONE WANTS TO KNOW SOMETHING

WWW.AMNH.ORG

No matter how many hours children spend at the American Museum of Natural History, they often leave hungry for more. Frankly, that's our goal, to spark their curiosity and inspire a lifetime habit of learning. So, to extend the Museum experience, we offer Ology, an award-winning Web site filled with fun activities for kids interested in science.

Created by the National Center for Science Literacy, Education, and Technology, part of the Museum's Education Department, the site offers layer after layer of learning as only the Web can—with interactive games, quizzes, puzzles, polls, and stuff to do away from the computer.

Children can set up their own privacy-protected home pages with a unique, jazzy, nature-oriented Ology member name (think "prickly

platypus" or "happy newt") where they can collect information cards and create projects to submit to the Ology Hall of Fame. "Meet the Ologists" describes the people doing science at the Museum, and what first got them interested in their fields, and includes a team of kid Ologists. The site also contains a helpful teacher's guide for grades 3 through 8.

"Ology is about the real world," the site explains.

"And nothing is more fascinating than what's real." Log on, and we think you'll agree. Ology can be reached from the Museum's home page at www.amnh.org or directly at ology.amnh.org.



Food for Thought

As with all new endeavors, when the Museum started its "Adventures in the Global Kitchen" series highlighting cultures through cuisine, there were a few bugs to work out—literally! The exciting first program offered up such delights as scorpion sushi, waterbug canapés, and cricket pizza. Bringing new meaning to "fusion food," a Museum entomologist worked with a chef and a planner for the Explorers Club Annual Dinner to turn ethnic recipes in which insects were the star ingredient into dishes worthy of a four-star restaurant—and daring diners.



A Museum visitor prepares to enjoy a mealworm at the inaugural Global Kitchen program.

Bugs! a giant-screen film about the insect world, just as the second in the series, *Fiery Foods* (southwestern cuisine), in December 2004, was inspired by the exhibition *Totems to Turquoise: Native North American Jewelry Arts of the Northwest and Southwest*. Similarly, *Golden Sake*, in January this year, connected to the exhibition *Gold*, which

remains on view until August 19.

Sea Serpent Stew and Dragon Brew: Fanciful Foods of the Middle Ages, scheduled for Tuesday, June 26, celebrates the new exhibition *Mythic Creatures: Dragons, Unicorns, and Mermaids*, on view through January 6, 2008. Francine Segan, noted food historian, will discuss foods and dining customs of the Middle Ages, when chefs created improbable culinary creatures like the cockatrice, which was part capon, part pig.

Also upcoming is *Insatiable* with Gael Greene, Thursday, July 7, an evening of tales and tastings with the long-time author of "The Insatiable Critic" column for *New York* magazine and cofounder and board chair of Citymeals-on-Wheels.

This series has been extremely popular, especially since tastings are included with every lecture; many programs sell out well in advance. Stay tuned for further Adventures in the Global Kitchen!



Dandelions are tasty in salads or as tea or wine.

That was May 2004, and since then, there have been more than a dozen amazing evenings of talks, tastings, and Q&A sessions, all designed to amplify the Museum's mission to share ideas about human cultures and the natural world.

Over the past three years, Adventures in the Global Kitchen has explored the cuisines of Brazil and China; the historic roles of rum, beer, and wine in various cultures; the significance of corn in the American food chain; and special dishes associated with Mexico's Day of the Dead. Earlier this year, a panel considered the evolution of human taste and smell, while more recent programs focused on the dandelion, honey, mushrooms, and winemaking.

Often, chosen subjects tie in with concurrent Museum programs and exhibitions. The much-publicized first event coincided with the showing of



Viniculture was a popular Global Kitchens topic.

PEOPLE AT THE AMNH

Mick Ellison

Senior Principal Artist
Division of Paleontology



It takes imagination—and dogged attention to detail—to draw a fleshed-out prehistoric creature, something no one has ever seen. Before Mick Ellison even attempts to render a particular specimen, he sculpts a clay model, working with the fossil record and scientific data, so he can first "visualize it in 3-D." To complete one of his most famous illustrations—a feathered dinosaur from China's Liaoning Province—Mick scoured New York's Garment District for the just-right rooster hackles to match an impression literally cast in stone. "The fossils yield a lot of clues," he says.

Mick also photographs fossils as they're discovered in the field, documents expeditions, makes maps and charts, and does anatomical restorations and reconstructions. Besides China, his work has taken him to Japan, Thailand, Myanmar, Laos, and Mongolia's Gobi Desert. Two fossils unearthed there during the Museum's joint expeditions with the Mongolian Academy of Sciences bear Mick's name: the sauropod *Erketu ellisoni*, for which he shares the billing with a Mongolian deity, and a lizard, *Temujinia ellisoni*, whose genus name refers to Genghis Khan.

Mick will never forget the ad that drew him to the Museum in 1990. "Museum seeking artist to work in paleontology. Must be willing to travel on field expeditions internationally." It was a dream come true for a 20-something art school graduate who'd spent his childhood doodling dinosaurs. "I love that I can draw and travel and get paid for it," he says.

Museum Events

AMERICAN MUSEUM OF NATURAL HISTORY



www.amnh.org

EXHIBITIONS

Mythic Creatures: Dragons, Unicorns, and Mermaids
Through January 6, 2008
Tracing the natural history roots of some of the world's most enduring mythological creatures, *Mythic Creatures* highlights legendary beings of land, sea, and air. Cultural artifacts bring to light surprising similarities—and differences—in the ways peoples around the world have depicted these beings, and fossil specimens suggest a physical basis for the many forms they have taken.

Mythic Creatures: Dragons, Unicorns, and Mermaids is organized by the American Museum of Natural History, New York (www.amnh.org), in collaboration with The Field Museum, Chicago; Canadian Museum of Civilization, Gatineau; Australian National Maritime Museum, Sydney; and Fernbank Museum of Natural History, Atlanta. *Mythic Creatures* is proudly supported by MetLife Foundation.

Frogs: A Chorus of Colors
Through September 9, 2007
This delightful live-animal exhibition introduces visitors to the colorful and richly

diverse world of frogs, exploring their biology, ecology, and conservation.

Frogs: A Chorus of Colors is made possible, in part, by the Eileen P. Bernard Exhibition Fund. This exhibition is presented with appreciation to Clyde Peeling's Reptiland.

Gold
Through August 19, 2007
This glittering exhibition explores the captivating story of the world's most desired metal. Extraordinary geological specimens, cultural objects, and interactive exhibits explore and illuminate gold's timeless allure.

Gold is organized by the American Museum of Natural History, New York (www.amnh.org), in cooperation with The Houston Museum of Natural Science. This exhibition is proudly supported by The Tiffany & Co. Foundation, with additional support from American Express® Gold Card.

Undersea Oasis: Coral Reef Communities
Through January 13, 2008
Brilliant color photographs capture the dazzling invertebrate life that flourishes on coral reefs.

Beyond
Through April 6, 2008
Exquisite images from unmanned space probes take visitors on a journey through the alien and varied terrain of our planetary neighbors.

The presentation of both *Undersea Oasis* and *Beyond* at the American Museum of Natural History is made possible by the generosity of the Arthur Ross Foundation.



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GLOBAL WEEKENDS
Mythic Festival
Sunday, 6/24, 1:00–5:00 p.m.
A family festival tying together cultural, historical, and scientific perspectives on mythic creatures. For details, visit www.amnh.org/mythic.

Global Weekends are made possible, in part, by The Coca-Cola Company, the City of New York, the New York City Council, and the New York City Department of Cultural Affairs. Additional support has been provided by the May and Samuel Rudin Family Foundation, Inc., the Tolan Family, and the family of Frederick H. Leonhardt.

LECTURES
The Griffin and the Monster of Troy
Thursday, 6/14, 7:00 p.m.
Folklorist Adrienne Mayor investigates the link between mythical creatures and the fossil remains of extinct animals.

Seeing beneath Mount Everest
Thursday, 6/14, 7:00 p.m.
Geologist Anne Sheehan, University of Colorado at Boulder, discusses her

research on the faults beneath the Himalayas.

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ADVENTURES IN THE GLOBAL KITCHEN
LECTURES AND TASTINGS
Insatiable with Gael Greene
Thursday, 6/7, 7:00 p.m.
An evening of tales and tastings with Gael Greene, longtime author of "The Insatiable Critic" column for *New York* magazine and cofounder and board chair of Citymeals-on-Wheels.

Sea Serpent Stew and Dragon Brew
Tuesday, 6/26, 7:00 p.m.
Francine Segal, food historian, discusses foods and dining customs of the Middle Ages inspired by mythical creatures such as dragons, griffins, and sea serpents.

FIELD TRIPS
Up the Hudson River
Tuesday, 6/19, 6:00–9:00 p.m.



D. FINNIN/AMNH

This "life-size" model of a roc, an enormous, legendary bird of prey, swoops towards visitors in *Mythic Creatures*.



ROSE CENTER FOR EARTH AND SPACE

Sets at 6:00 and 7:30 p.m.

Friday, June 1

Visit www.amnh.org for lineup.

The 7:30 performance will be broadcast live on WBOG Jazz 88.3 FM.

Learn about the geologic and cultural history of the lower Hudson valley on this three-hour cruise.



The Little Red Lighthouse is a landmark on the Hudson River in New York City.

Evening Bat Walks in Central Park
Friday, 6/15, 8:30 p.m.

Friday, 6/22, 8:30 p.m.
Join the New York Bat Group for a bat walk through Central Park.

FAMILY AND CHILDREN'S PROGRAMS

Dr. Nebula's Laboratory: Mythic Stories and Tales
Sunday, 6/24, 2:00–3:00 p.m.
(For families with children ages 4 and up)
Join Dr. Nebula's apprentice, Scooter, as she explores mythic stories and tall tales in this interactive show.

This program is made possible, in part, by an anonymous donor.

AMNH ADVENTURES SUMMER CAMPS

Fossils and DNA
Monday–Friday, 6/18–22,
9:00 a.m.–4:00 p.m. (For children entering grades 2 or 3)

AMNH Sampler Camp
Tuesday–Thursday, 6/26–28,
9:00 a.m.–1:00 p.m. (For children entering grade 1)

INFORMATION

Call 212-769-5100 or visit www.amnh.org.

TICKETS AND REGISTRATION

Call 212-769-5200, Monday–Friday, 9:00 a.m.–5:00 p.m., or visit www.amnh.org. A service charge may apply. All programs are subject to change.

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Two campers show off their Ocean Adventures projects.

Ocean Adventures
Tuesday–Thursday, 6/26–28,
9:00 a.m.–3:00 p.m. (For children entering grades 2 or 3)

HAYDEN PLANETARIUM PROGRAMS

TUESDAYS IN THE DOME Virtual Universe
Exploring the Orion Nebula
Tuesday, 6/5, 6:30–7:30 p.m.

Celestial Highlights Summer Night Delights
Tuesday, 6/26, 6:30–7:30 p.m.

HAYDEN PLANETARIUM SHOWS

Cosmic Collisions
Journey into deep space to explore the hypersonic impacts that drive the formation of our universe. Narrated by Robert Redford.

Cosmic Collisions was developed in collaboration with the Denver Museum of Nature & Science; GOTO, Inc., Tokyo, Japan; and the Shanghai Science and Technology Museum.

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Cosmic Collisions was created by the American Museum of Natural History with the major support and partnership of the National Aeronautics and Space Administration's Science Mission Directorate, Heliophysics Division.

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Eye of the Dragon

By Laurel Kendall

In the days before the Vietnamese Mid-Autumn Festival (Tết Trung Thu), the market along Hanoi's Hang Ma Street is resplendent with brightly colored toys, masks, and paper and plastic lanterns. Struggling to keep my balance in the press of the crowd, I look down and see a small red unicorn staring up at me. The dark brown eyes of a child, about five or six years old, peer out through the open mouth of his mask, and we share a shy smile. For now, he is an Asian unicorn with a fur beard and a curved horn on the top of his head. Similar masks, made of recycled paper and paint, are piled on the stalls that line the street, competing with plastic action-hero masks from China.

Insistent gongs and the steady throb of a big drum announce the arrival of a more spectacular unicorn. He prances into view, shaking his spangled coat, nodding his horned head high and low, and lunging playfully at the crowd. The children squeal with delight while the two dancers, "head" and



"tail" under a common coat, continue down the street. One of the four auspicious beasts of ancient times, the unicorn dances at the festival to bring good fortune. Eastern mythology relates that the unicorn appears only when the world is ready for the birth of a sage. Legend has it that Confucius made the last sighting, just before his death in the fifth century B.C. In other words, no one alive now

has ever seen one—yet anyone who has been to a Mid-Autumn or New Year festival in Vietnam, China, Japan, or New York City has likely encountered a unicorn.

I recalled my visit to the Hanoi market when I worked as a member of the curatorial team for "Mythic Creatures: Dragons, Unicorns & Mermaids," a new exhibition for the American Museum of Natural History in New York City. How could we represent a "mythic creature"? How were we to talk about things that weren't "really" there? We would, of course, describe mistaken sightings, such as the rhinoceros that Marco Polo encountered on his way home from China and described as a unicorn. But as an anthropologist among biologists, I hoped we would not reduce all of our mythic creatures to other peoples' misunderstandings of the natural world. Our exhibition might also try to evoke the kind of playful wonder I had seen on that autumn day in Vietnam, when everyone knew that real dancers animated the unicorn costume. That was part of the enchantment.

For the exhibition we will have a unicorn mask like the one I saw in the market. We have also borrowed a mask and costume of the Balinese Barong Ket, a lionlike creature. The mask is the work of a master carver named Cokorda Raka Tisnu, of Singapadu Village in Bali. When he creates such a mask, Cokorda takes special care, knowing that it will be consecrated by a priest and inhabited by an otherwise invisible spirit. In Bali-



Vietnamese child wears a unicorn mask at the Mid-Autumn Festival market in Hanoi. Below left: A painted clay dragon represents one of the twelve animals of the East Asian zodiac; it was made by Hoang Ba Phat of Tu Khe Village, Vietnam.

nese temple festivals, the Barong Ket lopes through the village, brought to life through the combined skill of carver, priest, and dancers. As a protective deity, he restores order where Rangda the witch sowed chaos. Such is the artful work of culture.

The dragons that dance in parades for Chinese New Year are awakened in a ritual known as "eye opening": the leader of the troupe removes a red paper that covers the eyes, then dots the eyes and, subsequently, the entire costume with red cinnabar, bringing each part of the creature to life. Seven years ago the Wan Chi Ming Institute, practitioners of the Hung Gar style of Kung-fu in New York City's Chinatown, commissioned an enormous dragon from Hong Kong. When it arrived, they opened its eyes and immediately danced the awakened dragon around the block. That dragon is now retired from active duty, but it has an honored place in "Mythic Creatures." Meanwhile, a newly energized dragon will perform downtown.

Laurel Kendall is a curator in the division of anthropology at the American Museum of Natural History in New York City.

Getting your feet wet in Belize.



"We were hiking through the rainforest with our guide, Pablo, when the 100 foot tall trees over our heads opened in front of us. We were at a tiny lagoon at the Cave Branch River in Belize, starting a subterranean adventure called cave tubing.

Pablo told us some of the caves we were floating through were up to seven miles deep and a couple hundred thousand years old (Pablo knew his history and explained everything in perfect English). Each cave we passed through was different. My favorite was where the sparkling quartz crystals on the ceiling shimmered like a beautiful chandelier when it was hit by patches of sunlight.

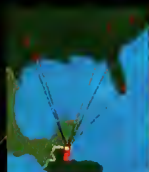
Another cave we went through was like going to a spa. Pablo told us the subterranean mud we found on the walls made a great natural face mask. We couldn't resist the free beauty treatment!

As we came out of the cave system we were greeted by green jungle and bright sunlight bouncing off white limestone cliffs. It was awesomely beautiful, and we were sad this chapter of our great Belize adventure was coming to a close."

— Tiffany Piecewicz —

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