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OMNI

JULY 1993

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EXCLUSIVE!
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OMNI

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DEPARTMENTS

Close Encounters of the Carnosaur Kind? Steven Spielberg meets Michael Crichton in this summer's release of the cinematic *Jurassic Park* (Illustration by Walter Stuart, ©Wildlife Education, Ltd., additional art and photo credits, page 46)

FEATURES

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FIRST WORD

THE WORLDS OF THOMAS JEFFERSON.
Statesman, philosopher, architect—and amateur scientist

By Daniel P. Jordan

Often when asked to describe Thomas Jefferson I find myself borrowing a line from John F. Kennedy. At a 1962 White House dinner, President Kennedy remarked that the Nobel Prize winners gathered there were "the most extraordinary collection of talent of human knowledge, that has ever been gathered together at the White House with the possible exception of when Thomas Jefferson dined alone."

After all, what do you say to sum up the life of the author of the Declaration of Independence, third President of the United States, and founder of the University of Virginia? Especially when that man took enormous pleasure in the knowledge and mastery of every aspect of life, from gardening, cooking, and architecture to music, art—and, yes, science.

Mr. Jefferson as amateur scientist—that, in fact, is one of the roles that will be highlighted this year on the 250th anniversary of his birth in a landmark exhibition, "The Worlds of Thomas Jefferson at Monticello," in Charlottesville, Virginia, April 13–December 31.

Jefferson was extremely well versed in scientific issues of the day, and scientists such as Priestley and von Humboldt considered him an integral part of the scientific community on the strength of his correspondence. His *Notes on the State of Virginia*, for example, written in response to inquiries by the French intellectual and diplomat Francois de Barbe-Marbois, incorporated geology, geography, archaeology, botany, and many other fields of natural philosophy.

An inveterate and thoughtful collector, Jefferson maintained a museum in the entrance hall of Monticello. His "museum of civilization," or "Indian Hall," was one of the most important private collections of Native American artifacts and fossils and natural-history specimens in this country at the time and was the culmination of his lifelong fascination with Native Americans and the natural history of his home continent. On loan this year to Monticello as part of the exhibition will be clothing, utensils, and weapons sent to Jefferson from the Lewis and Clark expedition, including a buffalo robe from the Mandan tribe, which depicts a battle, and a tobacco pouch of otter skin from the Sauk-Fox.

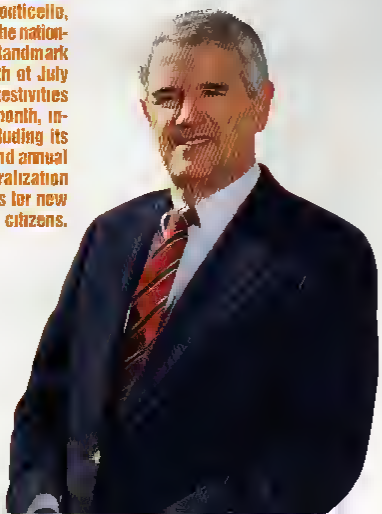
Our third president was also keenly interested in meteorology, checking the temperature at Monticello every day, twice daily, from 1776 to 1826, with some breaks, in order to make conclusions about and describe the climatology of the area. Jefferson also attempted to start a corps of national weather observers, much like the National Weather Service today, to gather information about the American climate.

Often considered the father of American paleontology, Jefferson made substantial contributions to this scientific field. Furthermore, as an archaeologist, he undertook a dig on a Native American burial mound in Albemarle County, in Virginia. The methods he used to excavate the mound utilized the principle of stratigraphy—that layers of the earth at the same depth hold remains from the same period of time—100 years before stratification became an accepted theory. Though Jefferson did not publicize his work, his excavation techniques became instrumental in Darwin's research and are similar to those used by contemporary archaeologists.

By modern standards Jefferson was not a theoretical scientist. In the long term, his contributions on behalf of science are far more important than his contributions to science. He was committed to the advancement of science in each of his public roles and constantly sought to promote the growth of scientific thinking both inside the scientific community and among laymen.

Jefferson also established public policy to encourage the development and use of scientific knowledge in the conduct of affairs of state and nation. His support of the expedition by Lewis and Clark is another example of his scientific patronage. One might even conclude that science dominated Jefferson's mode of thinking about public service. He epitomized the ideals of the Enlightenment, combining his curiosity about the natural world with a profound concern for the social benefits of knowledge.

Jefferson made his greatest contributions to science as an informed patron and champion of scientific inquiry and study in America. While some may not consider Thomas Jefferson to have been a true scientist, he was truly a man of science. DQ



Jordan, the executive director of Monticello, will lead the national landmark in Fourth of July festivities this month, including its thirty-second annual naturalization ceremonies for new U.S. citizens.

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COMMUNICATIONS

READERS' WRITES:

Your honor, may I approach the flight deck; dreams deferred; and notes on numbers

Ruminating Responses

Never has an article grabbed me like the one on John Allen Paulos by Janet Stites ["Running the Numbers," April 1993]. As a math phobic (made worse by pedagogical girls-don't-need-math-they're-only-going-to-get-married anyway stereotyping), I have always regretted the lack of this vital *language*. Sadly, it's like missing a sense, like that of sight or hearing, so that part of the world is closed to one. I have Paulos' first book, and I appreciate his message. I ask that he please reiterate it with attention to the front-line troops—math teachers everywhere.

Beverley-Ann Slade
Toronto, Ontario, Canada

I would like to express my joy in reading about John Allen Paulos. So far, I've loved everything I've read by him, and I like to think there's hope for innumerates everywhere. I am a father to a nine-year-old girl who occasionally asks for help with her homework. Last year, she needed an easier way to do subtraction, so I showed her that it was really addition in disguise. Her teacher told her she shouldn't do it that way. When she had trouble borrowing in larger problems, I told her how she could use negative numbers to help—more illustration, more understanding. Just the other day, she wondered what it would be like to suck soda through a mile-long straw. Well, I estimated how much soda would weigh and thus explained why she would need a metal straw. She suddenly realized why water tanks are on tops of hills. I believe the key to making math palatable is to invoke the proper mental pictures. By the way, I'm no whiz at math myself, but I did estimate the number of jellybeans in a jar at a church function so closely that many people thought I had cheated.

Michael Revelle
Marin County, CA

I work in fast food. As a child, I wanted to be an engineer; however, I was never a good math student. I wonder how many children have the early aspiration to grow up to be a scientist or engineer but fail in math and science and lose hope of the dream.

Michael Williams
Marmet, WV

Deep Space Decor

Your February/March [1993] issue concerning *Star Trek: Deep Space Nine* was fascinating, especially the deductions on Cardassian technology and society. Some further conclusions on the Cardassian home world could be: It is a dark planet, presumably orbiting a dim star as shown by their preference for dark colors and low lighting, and its gravity is less than Earth's, evidenced by their tall, thin bodies.

Olin E. Phillips
Chesapeake, VA

All Rise

As a third-year law student, I was interested in your space-law article featured in the April [1993] issue. I completed a space-law survey course at Akron University Law School, which was a particularly interesting experience. The course demonstrated to me that world peace depends on the exploration and development of outer-space resources, because the ever-increasing competition for the earth's existing finite wealth can only lead to conflict. Space exploration is certainly an area that will need outstanding legal talent and offers an opportunity for the legal profession to serve the public interest. My hat is off to *Omni* for recognizing the importance of this contribution.

Mark Hayes, DPM
Fairview Park, OH **OO**

Got something to say but no time to write? Call **1-900-407-4494, ext. 70103.** Your comments will be recorded and may appear in an upcoming issue of *Omni!* The cost for the call is 95 cents per minute. You must be 18 or older. Touch-tone phones only. Sponsored by Pure Entertainment, P.O. Box 166, Hollywood, California 90078.

FORUM

SCIENCE-FICTION FILM AND PRINT

New books and a new film remind us that SF is alive and well

By Keith Ferrell

This is shaping up as a big summer for science fiction, with perhaps the largest of the season's events being the release of Steven Spielberg's film of Michael Crichton's *Jurassic Park*. To that end we asked Don Lessem, author of *Dinosaurs Rediscovered*, just out in paperback from Simon & Schuster/Touchstone, to take a look at the science behind the film. Few people are better connected to the dinosaur world than Don, and he put his network to good use. Check out 'Designing Dinosaurs' for some insight into the year's biggest and most spectacular science-fiction film.

But it's been a good year for science fiction in its textual incarnation as well, with three novels over the last few months standing out in particular. All are by established masters of the form, and each shows off special aspects of their talent.

In *The Gripping Hand* (Pocket Books), Larry Niven and Jerry Pournelle revisit the scenes, cultures, and beings of their largest success, *The Mote in God's Eye*. Once more the human race faces the threat of the Moties, a species of alien unlike any other in science fiction. This is very much science fiction in the classic mode: interstellar empires, scientific puzzles and mysteries, the clash of cultures. Another lovely entertainment from the field's leading collaborative team.

Arthur C. Clarke graces the bookstores with the latest of what I think of as his "novels written after the latest retirement." This one is called *The Hammer of God* (Bantam) and is an expansion of a story that appeared last year. The story confronts the possibility that our world may face collision with another body. All the customary Clarke grace notes are here: clear and almost documentary prose, wit, effortless-seeming extrapolation, intelligent characters, and an underlying sense of the poignancy of our all-too-human situation. A nice volume from one of the true masters.

And finally there is *Forward the Foundation* (Doubleday), the final volume in Isaac Asimov's greatest series, and one of the most personal novels the great Doctor ever wrote. Completed against the gathering shadows of Isaac's final illness, *Forward the Foundation* distills Asimov's wisdom, his concerns for our species, his love of ideas, all of it in an elegiac volume that looks both forward and back. A year and some after his death, Isaac Asimov offers us a final, and memorable, gift.

So if the lines for *Jurassic Park* or the other films of summer grow too long, stop by your local bookstore and try some science fiction in its most ideal format: the printed word.

Once you've caught up with the current crop of SF novels you might wish to look back at some of the field's classics. You won't find a better guide than Jack Williamson, himself one of the genre's classic writers. In this month's Books column, Jack casts his experienced eye back at some of the field's most memorable novels—and at the publishing programs that are restoring them to print.

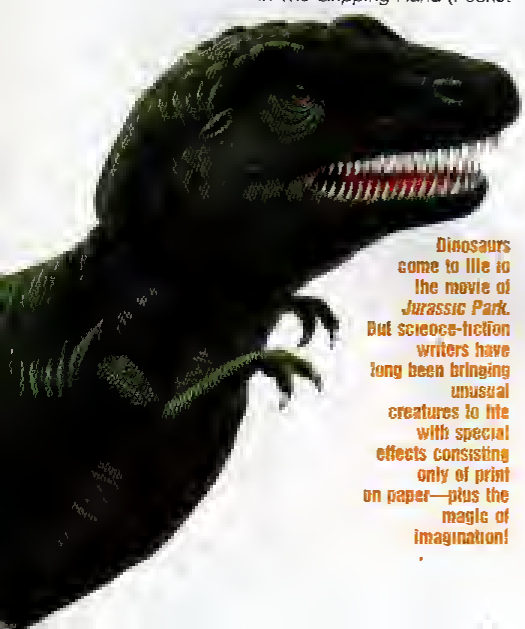
Science fiction at its best explores the universe and our place in it—which, of course, is what *Omni* does every month, in fact as well as in fiction. In addition to our look at *Jurassic Park*, we cast our net this month over a fascinating and disparate group of subjects.

Peter Gorman visits the borderland between magic and medicine and finds it among the Matses Indians deep in the Amazon jungle. This is as unusual a piece of science reporting as you are likely to see this year.

The health-care crisis preoccupies much of the government and much of the media. Being *Omni*, we wanted to take a different look at the subject and found that look via Melanie Menagh, who tackles five of the most crucial health-care issues for us and finds five solutions—and the dedicated people behind them.

Our interview this month takes us to Berkeley, where radicalism remains a rallying cry. Meet Mary-Claire King, a brilliant scientist, who understands that laboratories, to be effective, must be viewed as very much a part of a quite real and troubled world.

All this, plus Terry Bisson's wonderful fiction, "England Underway," as well as Continuum, Antimatter, and our columns—a lively, enlightening mix. There may be summer doldrums out there somewhere—but you won't find them in the pages of *Omni*. ∞



Dinosaurs come to life in the movie of *Jurassic Park*. But science-fiction writers have long been bringing unusual creatures to life with special effects consisting only of print on paper—plus the magic of imagination!

FUNDS

GROWTH INDUSTRIES OF THE 1990s
Cashing in on the next great boom

By Linda Marsa

The dream is always the same. Tinkering on the computer, you devise a foolproof system for spotting high-flying stocks *before* they take off. Almost overnight, your portfolio doubles. Triples. Quadruples. Suddenly, you're besieged by Wall Street heavy hitters desperate to learn your secret. Then you wake up.

But this scenario can happen. Harry S. Dent, Jr., a Harvard-educated management consultant, believes the economy's boom-bust cycles are sparked by predictable consumer-spending patterns that drive the economic engines. By using new—and easy-to-grasp—forecasting methods to track these trends, he says the average investor can anticipate approximately when the economy will rebound and identify tomorrow's top stock performers today.

Dent's theories, which he outlines in his book *The Great Boom Ahead* (Hyperion, 1993), are based upon what he calls "age-wave demographics," which give us a snapshot of the future. "Economic boom periods occur as new generations of consumers progress up a predictable curve of earning and spending until they peak in spending between ages 45 and 49," says Dent. "The more people attain the peak of their spending in a given year, the better, generally, the economy will do."

So when leading-edge baby boomers—the largest generation in our nation's history at 80 million strong—begin to hit these magic milestones around late 1994, Dent thinks their purchasing power will spawn an unprecedented period of prosperity that will endure well into the next century. Which sectors of the economy will profit from the coming boom—and which companies are poised to surf on this generational spending wave—will be pretty much determined by the tastes of the boomers.

Now that they're marching lockstep into middle age, distinct trends emerge. They want high-quality, value-added products and services, customization to individual needs, fast response and quick delivery, and personalized service—all of which may be environmentally sound.

Winners in the 1990s will cash in on boomers' predilection for premium quality at value discount prices, like affordable designer clothes, cutting-edge electronic gadgetry that makes life simpler, or nutritious fast foods that are quick but won't kill your colon. On the uptick are outfits that cater to the new Zeitgeist, like Nordstrom's, Ben & Jerry's, Apple Computers, and Gap clothing stores.

Yet obvious picks like Microsoft, which has jumped 1,420 per cent, Wal-Mart, which has risen 468 percent, and Intel, up 723 percent—all since 1987—are already Wall Street favorites. So how can working stiffs compete with the pros—who have every imaginable investment-analysis device at their fingertips—to spot rising stars before the prices of their stocks streak into the stratosphere?

No problem, says Dent. "The key here is to understand the dynamics of innovation, of how new products enter the market and when it's profitable to invest in them," he says. Virtually all products go through a four-stage life cycle, or what Dent calls an S-curve. Sophisticated trendsetters—about 1 percent of the market—adopt costly new technologies first. As the product catches on, prices tumble, generating sales among upper-income influentials, a product's natural niche market. When the 10-percent point of a market penetration is reached, the new technology will be bought by upper-middle-class consumers—the third stage—and sales will explode. Once the product becomes a true mass-market item, the technology has matured.

Often it's not the highest-quality products that become top sellers. What earns points today is user friendliness, convenience, or even a superior sales campaign—witness how VHS clobbered Beta or how Lexus beat out previous quality standard BMW.

For those who can't monitor the market every waking minute, the best way to sift through all these factors to ferret out the hottest prospects is by investing in arenas we understand personally—whether they're connected to our jobs, our hobbies, or the concerns we patronize. "You'll instinctively know which companies are sound," says Dent. "Then find one whose products are on the brink of the ten-percent breakout point."

Harry's hit list: luxury cars, laptop computers, fax machines, ethnic fast foods, custom semiconductor chips, superpremium foods, green industries, boutique specialty store chains

MUSEUMS

CHARTING MEDICINE'S PROGRESS

A broad collection ranges from curiosities to groundbreaking research

By Eric Adams

Going to extremes: from a cutting-edge exhibit on AIDS (above) to hair and bone samples from a dead president (right).

'This is your heart,' says Yvette D. LeGrande, handing over a red, blue, and gray lump of dried flesh that she has just pulled from an ordinary cardboard box.

A researcher in the conservation lab of the National Museum of Health and Medicine (NMHM) in Washington, DC, LeGrande is implementing a revolutionary new tissue-preservation process called plastination, which extracts water from an organ and replaces it with silicon. Reaching into the box again, she retrieves plastinated eyeballs, a liver, a pair of kidneys—and a brain.

Work like LeGrande's has begun to move the institution to the forefront of museum technology and administration, and it also supplies an accurate metaphor for the museum's philosophy: presenting the human body as it really is. Currently available by request, these plastinated organs will eventually go into an exhibit. Then you, too, can see and feel what "your" heart really is like.

The museum, nestled snugly in a corner of the Walter Reed Army Medical Center campus, exists partly to inspire young people to enter the medical profession, says director Marc S. Micozzi, but it also bridges the gap between the medical community and the public.

"I want to bring the information we learn in scientific investigation into a framework that people can use to help understand their own health," Micozzi explains.

When he took over the museum's administration in 1986, Micozzi initiated an internal renaissance that has produced a wave of fascinating new exhibits, including a presentation on AIDS and a powerful documentary film on drug abuse. It has also produced a noticeable change in image.

With its unusual—and sometimes downright weird—collection that features a mummified baby with two heads, and hair and bone samples from Abraham Lincoln, it's apparent how the museum developed a bit of an unconventional reputation. It clearly is not a boring place.

But though administrators tend to shudder at the mention of public perception of their museum as a curio shop, it is indeed pure curiosity that often lures people in. Once inside though, visitors may find themselves enjoyably educated about medicine and the technology that surrounds it. A comprehensive look at early human development greets visitors as they enter the museum. In one large glass case, a row of fetal, infant, and child skeletons stands eerily at attention. And next to the case sits a somber yet compelling collection of malformed human fetuses floating in jars of formaldehyde. Matter-of-fact explanations like 'conjoined twins" and "cyclopia' accompany these dismaying sights in a manner consistent with the museum's objective observation of nature's fallibility.

It is research like LeGrande's, however, that pulls the museum—established in 1862 to help fight illness in Civil War battlefields—firmly into the twentieth century and points it toward the twenty-first. Such work has secured the museum its not-at-all-dubious status among medical-research institutions. Its contributions to medical knowledge include then-curator Walter Reed's work on yellow fever and Frederick Russell's development of a typhoid vaccine.

In fact, many of its exhibits originate from museum research. The plastination process is one. And also likely to reach the exhibit floor once completed is the proposed study of Lincoln's DNA samples to determine if he had the debilitating Marfan syndrome. (Speaking of assassinated presidents, Micozzi has expressed a strong interest in having the museum house and present the autopsy material of John F. Kennedy when it's made available.) These, of course, will not replace the museum's attention-getting staples: the shiver-inducing early dental equipment and the live leeches from the medieval bloodletting exhibit, for example.

Recovering from an involuntary relocation from the National Mall in 1968 that sent attendance figures plummeting and most of the collection into storage, the museum has set its sights on muscling back on the Mall by 1998. To do so, its administrators have enlisted the help of Congress and former surgeon general C. Everett Koop, who chairs the NMHM Foundation and narrates the museum's drug-abuse film.

"What I envision for the future is an interactive museum where children can come in and go into three or four areas and learn about AIDS and cancer and nutrition," Koop says. 'This is the wave of the future. You don't just come in and look; you come in and learn.'

But even though the museum is broadening its mission and moving—which means that many of the more unusual exhibits will be removed—you needn't worry. You still have several years to catch the live leeches and the two-headed baby. OMNI

ELECTRONIC UNIVERSE

EXPLORING THE FINAL FRONTIER

One small step for man, a giant leap for game players

By Gregg Keizer

What with Clinton's cuts getting ready to slash and burn NASA's budget, maybe we'll *never* make it to back into space big time. Space Station *Freedom*? Forget it. Man on Mars? No way.

But you can relive—even rewrite—the glory days of spaceflight on your home PC. Interplay's *Buzz Aldrin's Race into Space*, a simulation of the Cold War contest between the U.S. and the U.S.S.R., is an engrossing experience for anyone who has sat glued to the TV watching rockets lift off from Kennedy Space Center. If you have more than a passing interest in space exploration, you must play *Buzz*.

Loaded with graphics and buttons to click, *Buzz* uses a mouse-intensive interface that's easy enough for kids to operate. It even throws in plenty of window dressing: digitized speech, nifty sound effects like rocket engines burning, and herky-jerky historical film footage.

Having the right stuff-ware: *Buzz Aldrin's Race into Space* allows you to relive the glory days of spaceflight.

Like a lot of other historical simulations, *Buzz* is really a model of resource management. You've only got so much money to spend on hardware and programs, and because this is a race, time is a valuable commodity. Dawdle, and the Soviets (or the Americans, for you can play either side) will surely dash ahead.

The goal, of course, is to be *first*. First to put a satellite into orbit, first to send a man around the world. First to land a man on the moon and bring him back alive wins the game.

You can start the race even with the Soviets or use an historical model that accounts for each nation's advantages and costs. American hardware, for instance, is generally more expensive and more reliable. You also get to pick between a true-to-life astronaut roster or a customized list of your own making. If you never liked Glenn, here's your chance to dump him from the program.

The space-race business is relatively straightforward in *Buzz*, though it quickly gets complicated; there's simply a lot to do. You must build pieces of hardware—unmanned probes, rockets, manned spacecraft and miscellaneous parts like docking modules and EVA suits. You've also got R&D costs, for you can't simply build a booster and let it fly. You've got to assign engineering teams to each piece of hardware to improve its safety level.

You may feel like you've got more work than von Braun had Nazi friends. You've got to recruit astronauts, train them in the fine art of space walking or capsule command, and build boosters and advanced support facilities. You've got to keep an eye on the Russians, schedule missions, assemble launch-vehicle combinations, and decide how you're going to get to the moon.

Simulations being what they are, you can explore space along an it-really-happened line or take a different flight path to the moon. You don't have to build an LEM to get down to the lunar surface, for instance; instead, you can build the *Jupiter*, a four-man ship that lands right on the moon, then lifts off for home all on its own. Science fact meets science fiction.

And sadly, you can cut corners. The result is usually disastrous, with men dying in space or even left stranded on the moon. *Buzz* plays it straight here, too, although a bit on the macabre side—it lets you visit Arlington Cemetery or the Kremlin Wall to view your fallen astronauts.

When your failures get too depressing to bear, take a break, slouch on the couch, and pop *Star Fox* into your Super Nintendo videogame machine. Nothing historical here, just lots of satisfying fireballs where enemy spaceships once flew.

Star Fox is the first SNES game to take advantage of Nintendo's Super FX graphics chip, and it shows—objects are made of the same layered polygons that you see in high-powered flight simulators on the PC. The result is a stunning 3-D videogame of frantic combat and even more frenetic flying.

No matter which route you take—the historical drama of exploding boosters or the fiction of exploding opponents—games are the only way to relive old legends and build new ones.

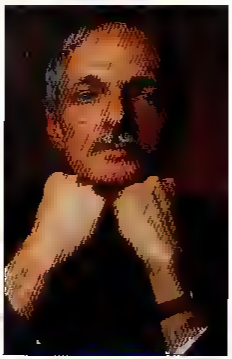
Not even the president can take away *these* glories. ☐

THE MYSTERY OF IBOGAINE.
Can an African psychedelic cure addiction?.

By Steve Nadis

Looking for a new way to get high, Howard Lotsof may have found a way to reduce cravings for several addictive drugs. An hallucinogen used in African rituals may mask withdrawal symptoms and block neural transmitters in the brain's reward centers.

Wild claims have been made about ibogaine, an hallucinogenic substance derived from a shrub, *Tabernanthe iboga*, found in the Congo and Gabon. In West Africa, where it's reputed to permit ritual communication with dead ancestors, it has been called the strongest single force against the spread of Christianity and Islam. Most sweeping of all is the claim that one or two doses of ibogaine can break a person's addiction to heroin, morphine, cocaine, and amphetamine as well as other addictive substances.



Howard Lotsof, president of the Staten Island–based NDA International, is responsible for this pronouncement as well as for bringing the substance to the attention of Western medicine. Lotsof, a former heroin addict, took ibogaine in 1962, looking for a new way to get high. After his 36-hour trip, he no longer craved heroin. Nor did he experience any withdrawal symptoms. He then shared the drug with six other addicts, five of whom lost their desire for heroin.

Lotsof secured patents on the use of ibogaine for treating drug and alcohol addiction. Although about 40 addicts have been treated in the Netherlands since 1990, ibogaine has not been approved for use in this country. Nevertheless, Lotsof managed to persuade several researchers to investigate its potential.

Among those is Stanley Glick, chairman of the Pharmacology and Toxicology Department at Albany Medical College, whom Lotsof met in 1988. "I thought he was a crackpot," Glick admits, "but decided it was worth a few rats to look into his claims." Glick found that after an ibogaine injection, rats with free access to morphine reduced their narcotic intake. In other studies, ibogaine alleviated withdrawal symptoms of rats hooked on morphine. Glick saw that pretreatment with ibogaine curbed the rise in dopamine concentrations seen in rats given the opiate.

The neurotransmitter dopamine is thought to play a central role in addiction. Many abused substances trigger dopamine's release at various sites in the brain, including the nucleus accumbens, the so-called "reward center." It is here scientists think where dopamine elicits the euphoric feeling that drives people and animals to excess. Enhanced levels of dopamine were not seen, however, in the nucleus accumbens of lab rats given an ibogaine cocktail before their morphine fix. Mysteriously, ibogaine's effects seems to vary from rat to rat, sometimes lasting a few days, sometimes weeks. The duration of effects, too, was surprising. Ibogaine may change to a form that stays in the system longer, Glick speculated, although no metabolite has been discovered.

Possibly, ibogaine produces long-term neural changes that are observable with a PET scan or other measurement. "It may be modifying neurons, changing the way a transmitter is stored, released, or taken back into cells," says Henry Sershon, a neuroscientist at the Nathan S. Kline Institute for Psychiatric Research at Orangeburg, New York.

Patricia Broderick of CUNY Medical School has pioneered a technique called in-vivo electrochemistry, relying on implanted miniature sensors that can measure the release of key chemicals in rodent brains. Broderick found that ibogaine blunts effects of cocaine by suppressing dopamine release. Another transmitter is involved. Ibogaine initiates the release of serotonin, which in the presence of cocaine appears to inhibit dopamine cells. This drug, she says, "may help us fathom interactions between the two neurotransmitter systems."

Armed with research papers, Lotsof convinced the National Institute on Drug Abuse (NIDA) to start an ibogaine research effort in 1991. The agency will decide this year about human testing. Meanwhile, scientists at the University of Miami have applied to the FDA for permission to begin clinical trials. "Ibogaine's toxicity has never been tested," cautions Frank Vocci of NIDA. The drug's psychedelic properties, too, are a concern. Glick and a chemist are attempting to synthesize an analog that doesn't produce hallucinations. The big question, Glick says, is "whether you can separate side effects from potential therapeutic benefits."

It may take years to figure out ibogaine's basic chemistry. If and when the drug is approved, Vocci adds, we'll have just a vague understanding of how it works. Nor can addiction be wiped out with a single capsule. Other factors affect drug abuse. Even Lotsof admits his earliest claims went too far. The problem, he says, is "most people who use drugs don't want to stop."

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DIGS

RESURRECTING THE DINOSAUR

The scientist behind *Jurassic Park* moves closer to isolating dinosaur DNA

By Kathleen McAuliffe

Paleontologist George O. Poinar (top) hopes to extract dinosaur DNA from ancient insects that, like this midge (above), have been preserved in amber.

In *Jurassic Park*, Michael Crichton's best-selling novel and the new motion picture, scientists bring to life a menagerie of dinosaurs. They clone the behemoths by retrieving dinosaur DNA from fossilized insects that fed on the dinosaurs' blood.

Farfetched? The concept of sequencing portions of dinosaur DNA could soon become a reality, according to George O. Poinar, a paleontologist at the University of California at Berkeley, whose research inspired Crichton's plot. "We've got a project underway to extract dinosaur DNA from insects preserved in amber samples," he reports. Cloning the long-extinct giants, however, isn't possible yet. Still, he doesn't rule out the possibility that the technology for cloning could become available sometime in the future.

His colleagues have, for the time being, reserved judgment on Poinar's venture. In their view, simply recovering dinosaur genes would be an extraordinary coup. "The DNA molecule normally deteriorates rapidly after the animal dies," points out Michael Braun, a molecular biologist at the Smithsonian Institution's National Museum of Natural History. "The conditions of burial and preservation would have to be just right to salvage genetic material that old."

Until recently, the oldest known DNA came from 18-million-year-old magnolia leaves preserved in an Idaho bog. Researchers have teased other still-intact genes from animal bones protected from degradation in arid desert caves or tar pits. But new research suggests that amber may beat all comers in prolonging DNA's viability. Poinar and other California researchers stunned the scientific community last September by announcing that they had extracted DNA from an extinct 30-million-year-old bee embedded in amber. Almost simultaneously, a team of researchers led by Rob De Salle of the American Museum of Natural History in New York City reported recovering genetic material from another insect encased in amber—this time an extinct termite of roughly the same age.

Amber is essentially fossilized plant sap. A few rare pieces contain flying insects, spiders, centipedes, frogs, the feathers of birds—the remains of virtually any small creature that stepped in the wrong place thousands or millions of years ago, thus becoming entombed in the soft, gooey resin. As the sap hardened with age, the glossy encasement protected the specimen from weathering and biological agents of decay. Small wonder the Egyptians harnessed the resin to embalm their mummies.

Despite amber's remarkable preservative qualities, the feasibility of recovering genes from as far back as the dinosaur era, which ended 65 million years ago, has yet to be demonstrated. But Poinar may just be able to pull it off. He recently detected tiny soft-bodied creatures in 230-million-year-old amber pieces, and he hopes to retrieve genetic material from these organisms, which include a pollen grain frozen at the moment of germination and a protozoan immortalized in the process of ingesting a filamentous bacterium. "We're not talking about an imprint in stone," he stresses. "This is the entire organism that is preserved to the point that we can actually make out cellular structures in exquisite detail, including the nuclei where the genes reside."

To tip the odds in favor of getting dinosaur DNA, Poinar will sort through his ancient specimens, picking out amber insects of the blood-sucking variety that lived at the tail end of the age of reptiles some 70 million years ago. He plans to crack the amber right through the middle so that the specimens fall out. He'll then scrape out the insects' body contents and search for blood cells. If he lucks out and the pest's last meal happened to be a dinosaur, he'll try to isolate from the blood a foreign genetic sequence with the great reptile's telltale signature. "We'll compare the genes to those of dinosaurs' closest living relatives—birds and crocodiles—to see if the mix is a good match," Poinar explains.

If his technique works—a big if—the paleontologist might snare the blueprints for such notables as the mighty *Tyrannosaurus rex* and the triple-horned *Triceratops*—dinosaurs that lived at the same time as the insects trapped in his amber samples. The information encoded in the molecules should speak volumes about the mysterious rise and fall of the dinosaurs.

Poinar's groundbreaking research may also answer questions about the future as well as the past: among them whether the sequel to *Jurassic Park* will unfold on the silver screen or in a scientist's laboratory. ∞

SPACE

ROCKS FOR SALE:
But not just any rocks—moon rocks, the ultimate collector's item

By James Oberg

The British Museum the "attic of empire" contains an amazingly diverse assortment of treasure and junk. In the past, some collectors—from Lord Elgin on down—often weren't any too scrupulous about how they obtained their" treasures. A number of nations have tried for years to get items returned, without success.

With the scope and scruples of the institution in mind, a hopeful negotiator recently approached museum officials with a literally out-of-this-world offer. What would the museum pay, the man asked, for a moon rock?

They may not be much to look at, but moon rocks could be among the world's most valuable stones.

The six Apollo manned expeditions returned to Earth with about 850 pounds of lunar rock and dust. Over the years, much

has been loaned out for scientific study, public exhibition, and other official purposes. Because all the material was obtained during missions financed by the U.S. government, it's illegal for anyone else to possess any of it.

And yet an underground market in lunar material has persisted over the years. In the case of the British Museum, the incident involved a gift plaque holding a sliver of Apollo rock presented by the United States to President Zulfikar Ali Bhutto of Pakistan. During a military coup in 1972, members of Bhutto's family reportedly escaped from the presidential palace with the plaque. The British Museum official told the lunar salesman that the moon rock had "no commercial value at all" because the museum already had another moon rock loaned *gratis* by NASA.

A similar lunar gift plaque was stolen in Nicaragua in 1979 when Anastasio Somoza was overthrown. Years later, several U.S. meteorite dealers were approached by self-styled agents for the current unidentified possessors of the plaque. With federal law in mind, none of the U.S. dealers followed up on the offer.

Many observers have assumed that there are 12 specific men who could well have their own moon rocks as personal souvenirs: the Apollo moon walkers. That widespread assumption has already spread some trouble. *People* magazine reported a few years ago that the engagement ring worn by Buzz Aldrin's new wife sported a chip of moon rock next to the diamond. Federal agents took the report so seriously that they visited the Aldrins to inspect the ring. The magazine report, it turned out, was bogus. No other solid evidence—indeed, no other real rumor—has indicated that any of the men broke the federal statutes.

Apollo samples did disappear, to be sure. One sample shipped to a geologist in the Middle East vanished within a stolen mailbag at a New York airport and probably wound up in a landfill after the thieves removed the bonds they were after.

One other authentic private source of genuine moon dust seems to exist: dirty spacesuits. Upon the Apollo astronauts' return from each mission, NASA shipped the spacesuits to their manufacturer for inspection. According to unpublished accounts, workers sometimes ran loops of scotch tape across them, picking up small amounts of moon dust.

One of those moon-dust tapes, purportedly made off of an *Apollo 14* lunar spacesuit, showed up in a for-sale newspaper ad early in 1992. A man named Steve Goodman had found the tape among the papers of his late father, whose company manufactured spacesuits. After consultation with Goodman and his lawyer, NASA decided it wasn't worth the effort—or the bad publicity—to confiscate the contraband moon-dust sample.

The moon-dust-auction attempt never went far enough to establish the market value of real moon rock. But one dealer, Robert Haag of Tucson, Arizona, owns his own moon rock legally, and he estimates the gem value of the stone at $20,000 per carat. Impacts by space-going objects occasionally blast fragments of rock from the moon, and some pieces fall to Earth as meteorites. The one purchased by Haag fell in Australia.

Only one or two fragments of that size fall to Earth every year, usually into oceans or jungles. Anything on land weathers away to dust in a few centuries, during which it looks like any other ordinary rock. The odds against finding one are cosmic.

Elsewhere in the world, there exists an as-yet-untapped source of lunar material for legal sale. The Russians retrieved a few hundred grams of dust and pebbles on three robotic missions in the early 1970s, and the samples reside at the Vernadskiy Institute in Moscow. Under the current hard economic times, the institute is going bankrupt. The chance to earn dollars for its lunar samples could accurately be called a heaven-sent opportunity. ☐

EARTH

BOMB SHELTER
Warning the future of our lasting nuclear legacy

By Linda Marsa

Picture this. The year is 9993. You're careening at warp speed, absentmindedly piloting your pod on a quick errand from New York to Los Angeles. Five minutes from touchdown, the pod goes down, shipwrecking you in the vast desert that covers much of the southwest corner of what used to be the United States.

Looking around the landscape is fearsome and desolate. Sticking out of the sands is a forest of gigantic granite spikes, frightening totems of a long-lost culture thousands of years old. Horrific faces, partially eroded by time, are carved on the side of the spikes with a series of strange hieroglyphics cleanly etched underneath. Obviously, the ancient peoples who erected these menacing monoliths were sending a signal—a warning perhaps. But what you wonder, were they trying to tell us?

Ensuring that such a message is decipherable to societies in the very deep future was the task a group of experts tackled last year. Gathering at Sandia National Laboratories in Albuquerque, New Mexico, they devised warning systems to alert future generations to the presence of nuclear-waste burial grounds to prevent unwitting intruders from penetrating the site and releasing deadly radioactive materials.

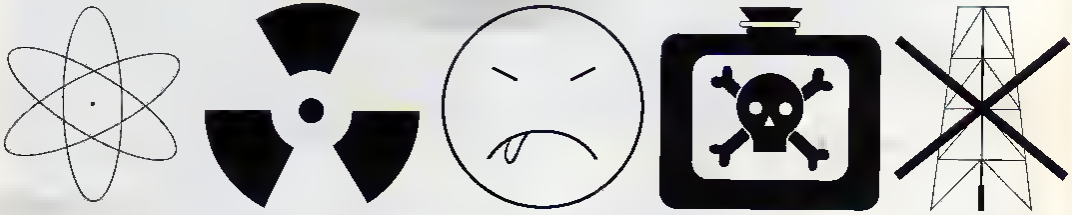
This unusual project is part of an ongoing $200,000 Department of Energy–funded study to determine effective methods of marking the site of the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. There, the government plans to bury 850,000 barrels of plutonium and other contaminated wastes from America's nuclear-weapons programs, which will remain radioactive for possibly 10,000 years. The DOE will seal the drums in salt 2,000 feet underground.

Initial safety studies for the nuclear waste disposal site identified three ways the repository could be disturbed: natural events like an earthquake; normal processes like water flow that would erode the canisters and human interference. Nuclear engineers and geologists were confident they could locate a site where the chances of geological dislocation were minimal and fabricate weather-resistant structures that would endure.

What they couldn't guarantee was that "a bunch of kids 3,000 years hence won't rip open these vaults with their ray guns," says David Givens, a project participant and director of information services at the American Anthropological Association in Washington, DC. So, in November 1991, two interdisciplinary teams—composed of anthropologists, astronomers, an architect, an artist, materials scientists, a mathematical psychologist, and a linguist—brainstormed on how to communicate across the vast chasm of culture and time. Both teams rejected materials like gold, marble, or titanium. Although they're durable and won't corrode, future cultures might steal these treasures like those looted at the Pyramids. High-tech solutions—computerized messages and electrified sensing devices—were also discarded. "Modern technology is fragile," says Givens. "Low tech, like granite monoliths, will last."

After three months, each team, working independently, emerged with surprisingly similar schemes based upon a range of future scenarios: if humankind is blasted back to the Stone Age by a cataclysmic event, if there is a partial retreat to a less-advanced society, or if technology is vastly superior to ours. The teams agreed that there must be redundancy in the messages, in the complexity of the messages, and in the number and types of markers in case vital components are damaged or removed. Both groups suggested constructing rock chambers engraved with pictographs and detailed warning information written in multiple languages—a sort of Rosetta Stone for linguists of the future.

The vaults won't be sealed for several decades, so these proposals will form the basis for further study. "We plan to meet back here in fifty years and have a beer," Givens says. "I'll only be ninety-eight then."



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BOOKS

BLASTS FROM THE PAST:
Two publishers keep the classics of science fiction in print

By Jack Williamson

Publishers are trying to save science fiction's history by reprinting the classics.

We lovers of science fiction are we forgetting our roots? Sometimes I wonder. Many modern readers are too young to know science fiction's history, or even to know that it has a history. And history does matter.

Though H. G. Wells, Jules Verne and Edgar Allan Poe came earlier, American science fiction—as something separate with a name of its own—was born in the pulp magazines of the 1920s. It grew up in isolation, ignored or scorned by everybody else. Now, at last, in spite of the dismissive 'sci-fi' label, it is gaining some respectability as a significant slice of our culture.

Or so we like to think, the teachers and students in the Science Fiction Research Association. Teaching science-fiction classes, we've always had a problem more immediate than the academic skeptics. It's hard to get key texts into the hands of our students. Even the classics by such greats as Asimov, Clarke, and Heinlein are too often out of print.

It's nobody's fault. With new titles flooding the market, shelf lives are short. Publishers tend to pay top money for potential best sellers and let midlist and backlist titles fall through the cracks.

But two enterprising publishers have come to our rescue. Collier Books and Carroll & Graf are reprinting the classics.

Editor James Frenkel says he plans to make his Collier Nucleus program 'the source of our great lost science fiction and fantasy heritage ... with authors as hard-science as Jack Williamson, as altered-reality as Philip K. Dick, as lyrical as Edgar Pangborn, as humanistic as Clifford D. Simak, as pithy and pointed as Fritz Leiber, as feminist as Kate Wilhelm, as psychologically manipulative as A. E. van Vogt, as epic as Brian W. Aldiss, as socially relevant as Wilson Tucker's *The Year of the Quiet Sun*.'

I was delighted to see the lovely Collier trade paperback of A. Merritt's great fantasy, *The Face in the Abyss*. It was Merritt's magic that first enticed me into the genre. I opened the new edition with some unease, afraid the magic had died, and found the Snake Mother still bewitching.

Collier has also brought back two great Simak novels. The dazzling paradoxes of *Time and Again* opened a new era of science fiction. *Way Station* is a simpler and more endearing story—the station is an old Wisconsin farmhouse used as a galactic transit point. The humane warmth of the book comes from Simak's fondness for his native countryside and his love for all his characters, alien or human. He's too good to be forgotten.

Kent Carroll says David Pringle's *Science Fiction: The 100 Best Books* guides his selections for Carroll & Graf's Masters of Science Fiction and Masters of Fantasy series. Running all the way from Brian Aldiss through Murray Leinster to Ian Watson, their backlist includes (among other wonders) five volumes of Philip K. Dick's uneasy probings into his own fractured reality. There's Michael Moorcock's startling *Behold the Man*. There's a whole spectrum of splendors ranging from Ramsey Campbell back to Bram Stoker. The pulp melodrama of Edgar Rice Burroughs' *A Princess of Mars* may have little in common with the 'new wave' sophistication of J. G. Ballard's *Vermilion Sands*, but both are landmarks of science-fiction history.

Carroll & Graf's *The Mammoth Books of Science Fiction* are handsome paperbacks that collect such great short novels as Frederik Pohl's "The Midas Plague" and Theodore Sturgeon's "Baby Is Three," each volume featuring ten selections from each decade, the 1930s through (so far) the 1970s. The 1960s volume is a book of great beginnings. In 'Weyr Search,' Anne McCaffrey is building Pern, her much-loved world of romance and dragons. Gordon R. Dickson's 'Soldier, Ask Not' is an early classic in the Childe Cycle, his multivolume myth of future human evolution. With "The Suicide Express," Philip José Farmer is pioneering his Fabulous Riverworld series.

Science fiction was still 'scientifiction' when I discovered it in Hugo Gernsback's pulp *Amazing Stories*, back in 1926. Renamed in 1929, it has grown enormously in the decades since and spread around the world. And it has changed. I think it has lost the innocence of its youth, the awe of startling discovery that captured me. Travel to the stars, travel in time, alien life. They were true wonders then, adventures I had never even imagined, made magically real.

Most of us were optimists then, intoxicated with our visions of better worlds to come. Nothing is wonderful now, not in the same joyous, innocent way. We fear technology and dread the future. Modern science fiction may have polish and sophistication, but I miss the sometimes naïve intensity that still throbs through the best of the classics.

Call science fiction pure escape or the mythology of science or antitoxin against future shock or cognitive estrangement or speculative fabulation or a mirror upon the human condition or simply a new trend in mainstream literature—or even call it 'sci-fi'!—its past is too precious to be forgotten. Collier Nucleus and Carroll & Graf are helping us remember. ∞

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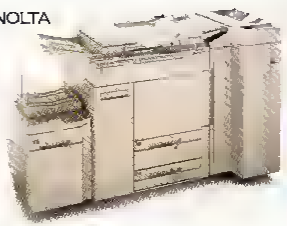

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CONTINUUM

SHAMAN PHARMACEUTICALS

Tribal remedies that work—for everyone. Plus, how sheep can help you garden, and Butch and Sundance—the final chapter

In the early 1800s, the Makushi Indians of Guyana led British explorers through dense jungle to the plant from which they extracted curare for their arrowheads. The Europeans came away with a muscle relaxant that still generates millions of dollars in sales. In return for sharing their secret, the Makushis and other Amazonian Indians never saw a cent.

A few visionary pharmaceutical companies are once again looking to the rain forest for drugs that could yield a windfall. But this time around, the customary practice of "ripping off the natives" is strictly verboten. These enlightened firms insist that cultures whose tribal lore leads to important discoveries be compensated with money, goods, or services.

Why pay for what can be gotten for free? To protect endangered people and plants and—always the bottom line in business—to ensure future profits.

With a juggernaut of ranchers and farmers flattening 115,000 acres of pristine rain forest a day and the indigenous Indians vanishing even faster than the trees, the new brand of conservation-minded business people believe their scheme will provide an economically viable means of preserving the world's richest ecosystem and the people such as the Makushi Indians who know how to manage it wisely.

Rain forest remedies: payback

The company spearheading this new approach is Shaman Pharmaceuticals, a small biotechnology upstart based in south San Francisco, California. Named for the tribal elders who dispense herbal remedies, Shaman sends scientists into the rain forest to study the healing traditions of different cultures and to collect unendangered plants that have promising properties. Drugs derived from these samples are then subjected to testing back in the laboratory. If any of the compounds are brought to market, a cadre of native people are hired to gather the plant for commercial production. In addition to creating local jobs, the company channels a portion of the profits from drug sales back into the community through the Healing Forest Conservancy, its nonprofit arm that supports sustainable development of the rain forest and the recording of medical lore.

In an era in which most major pharmaceutical companies are emphasizing synthetic-drug development, reliance on natural products and the wisdom of witch doctors may seem a sure formula for disaster. But Shaman, now three years old, has already toted up enough successes to show that altruistic conservationism doesn't have to be incompatible with big profits. Through contact with Indians of the Amazon, the company learned of a weedlike tropical plant that produces a potent antiviral compound. According to *Trends in Health Business*, an industry trade publication, the drug may have blockbuster potential. Called SP-303, the agent has proved highly effective in clinical tests against the flu and other respiratory infections—or what could amount to a billion-dollar market. And that's not all. Preliminary trials suggest SP-303 may also help to suppress herpes—another market approaching 1 billion dollars.

The company hopes to get FDA approval to sell SP-303 this year and has another several hundred plants in its lab pipeline, including three more botanical agents that could be ready for commercial launching by the end of the decade.

Beginner's luck? Not in the opinion of Robert Root-Bernstein, a physiologist and historian of science at Michigan State University. "Our high-tech medical establishment pooh-poohs primitive cures as superstitious nonsense," he says, "but treatments used over thousands of years usually are effective." Indeed, roughly 74 percent of the 121 botanical compounds used in mainstream medicine were derived from the traditional treatments of indigenous peoples. A study by Michael Balick, director of the Institute of Economic Botany of the New York Botanical Garden, further highlights the indispensable role of shamans as guides to the jungle pharmacopoeia. During a recent search for botanical agents that have potential against AIDS, Balick found the "powerful" plants of a tribal healer to be four times more likely to show antiviral action in preliminary test-tube trials than plants gathered by random-sampling methods. These kinds of results lead Balick to believe that many more drug companies will soon be scrutinizing traditional remedies for clues to tomorrow's cures. "We're on the verge of an explosion of interest in this area," he predicts.

Trend-setting companies like Shaman Pharmaceuticals have shown the way. Tribal lore can make an immense contribution to medicine and help to sustain sound management of the rain forest—but only if we value this heritage enough to pay for it. —*KATHLEEN McAULIFFE*

CONTINUUM

THE ULTIMATE AMATEUR HOUR

In August 1992, six amateur astronomers received the chance of a lifetime, an opportunity to make observations on the Hubble Space Telescope. All told, the amateurs will get about 18 hours of telescope time in 1993, less than 1 percent of the total observing time available. "Yet some important discoveries have been made on the Hubble with just a single snapshot," says Ray Villard, a spokesman for the Space Telescope Science Institute in Baltimore.

Five amateur astronomers received a similar opportunity in 1989. Riccardo Giacconi, the Institute's former director, started this unique program out of gratitude to amateurs for the help they have given to professionals in the field. "It's like having a standing army out there," Villard says. "You really can't name another area of science where amateurs have made more important contributions. That's probably because the universe is accessible to anyone who looks up with a small telescope or even binoculars. If you're lucky, you might spot a comet or something else no one has seen before."

The program opens the space telescope up to "more speculative kinds of observations," Villard notes. Amateurs tend to be more freewheeling, perhaps because they don't have scientific reputations to worry about." Among the projects selected in 1992 were a plan to look for binary asteroids—entities which may or may not exist—and a proposal to determine whether a quasar and a galaxy might be linked together by a bridge of luminous matter.

It's too late to submit an application for the 1994 group of amateurs, but the deadline for the 1995 group is April 30, 1994. Contact Hubble's amateur astronomy working group, HST AAWG, c/o AAVSO, 25 Birch Street, Cambridge, Massachusetts 02138. —Steve Nadis

A byproduct of sheep—no, not that one—helps gardens grow.

GARDENING WITH WOOL

A tip for gardeners: If you want to boost your yield of cabbages, asparagus, and spinach, try putting wool in your vegetable patch.

Trials by the British-based International Wool Secretariat have shown impressive results by laying woolen blankets in gardens. The blankets—or mulch mats—provide warmth for growing crops, retain moisture, and break down easily in the soil releasing beneficial nitrogen, potassium, sulfur, and other trace elements essential for healthy growth. They also help check the spread of weeds. So far, the researchers have used Karakul wool from South African sheep, in their experiments, it's black-brown and cheaper than other varieties. The council in the Yorkshire town of Barnsley has already laid 450 meters of the matting to help new trees flourish.

The British scientists hope that wool will provide an environmentally friendly gardeners' alternative to peat, which comes from ecologically valuable bogs, and black polythene, a plastic that keeps down weeds. John Pitts, a technologist at the Center, has laid blankets in his own back garden. "My cauliflowers," he reports, "have grown three times faster than normal. The wool takes so much of the hard work out of gardening that I've been left with little to do on my vegetable patch."

The researchers have begun looking at putting wool-mulch matting in hanging flower baskets, where water retention is vital. They've also developed a plant pot made entirely out of wool. —Ivor Smullen

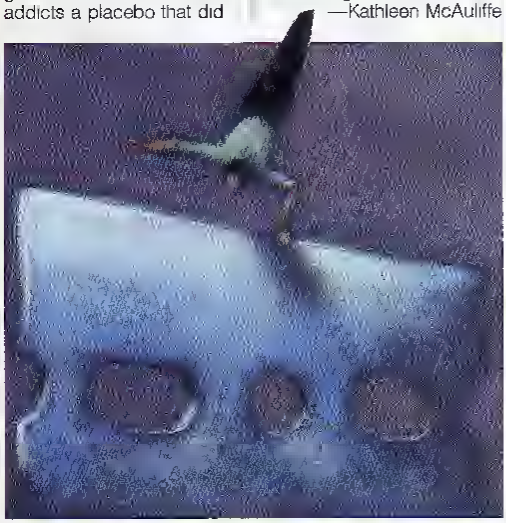
DAMPENING THE DESIRE FOR COCAINE

Long after quitting cocaine many addicts are still tormented by intense cravings. Help may soon arrive. For the first time, researchers at Yale University School of Medicine have shown that a pharmacological substance can lower addicts' desire for cocaine in the laboratory—a development that could presage more effective treatments. The research team, headed by psychiatrist Sally Satel, used a drink deficient in a neurochemical building block to lower production of serotonin, a brain transmitter believed to enhance the feeling associated with cocaine.

In the study, researchers gave 20 male cocaine addicts a placebo that did not alter serotonin levels, followed a week later by the experimental drink. After exposure to the placebo and to the treatment, the addicts viewed a film of people enjoying cocaine. The researchers then asked the subjects to rate their desire for the drug on a 100-point scale. On the day they drank the serotonin-lowering concoction, the addicts reported feeling a significantly reduced urge for cocaine.

"The effect did not bowl the subjects over," Satel cautions. "No one exclaimed, 'Wow, that drink killed my craving!'" Still, she finds the preliminary results encouraging. Further refinement of pharmacological approaches, she predicts, "might eventually be combined with counseling to reduce the relapse rate of recovering addicts."

—Kathleen McAuliffe



Mothers give their children love and tenderness—and cavities

CONTAGIOUS CAVITIES

Next time you get a cavity, blame your mother. Sensitive new DNA tests show that the leading bacteria responsible for tooth decay originates primarily in our mothers' mouths. The culprit, *Streptococcus mutans*, is passed in saliva from mother to child following the eruption of molar teeth at about two years of age. Page Caufield of the University of Alabama School of Dentistry in Birmingham calls that stage "the window of infectivity," because children who are not infected at that time might have up to 95 percent fewer cavities.

Caufield studied 46 children from birth to five years of age and found that 38 of them became infected with *S. mutans* all between 19 and 31 months. DNA typing of the bacteria demonstrated that virtually all the infected children harbored the same germ that colonized their mothers' mouth. By the end of the study, a quarter of these infected youngsters had developed cavities. By contrast, the eight uninfected children showed no signs of tooth decay. Caufield has uncovered further evidence of a window of infectivity from an adoption study now underway. His preliminary data indicate that children separated from their biological mothers at birth are protected from cavities up to at least 18 years of age.

DOLPHINS SLEEP WITH ONE EYE OPEN AT ALL TIMES.

To Caufield, these findings suggest that it might be beneficial for the mothers of young children to get their teeth painted with chlorhexidine, a varnish that helps eliminate *S. mutans* from the mouth. "If we could prevent all mothers from transmitting the germ to children during the critical period," he says, "it might be possible to raise a cavity-free generation."

—Kathleen McAuliffe

CONTINUUM

WHAT DOES YOUR PINEAPPLE PREFERENCE SAY ABOUT YOU?

Which of these two groups of produce do you prefer Oranges, bananas and grapes, or eggplant, corn and tomatoes?

If you chose the first group, you're a strong-minded, ambitious, aggressive, dominant person who's a natural leader. If you chose the second, you're introspective, self-searching, sensitive to others' needs, and not impulsive.

THERE ARE MORE THAN 28,000 DIETS ON PUBLIC RECORD.

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Do you like pineapple chunks or pineapple glaze better? Applesauce or fresh apples? Creamed corn or corn on the cob?

If you preferred at least two of the first selections—applesauce, pineapple chunks, or creamed corn—you're passive, easy-going, and agreeable, and you try to solve problems without raising a commotion. If you liked at least two of the alternates better, you're an aggressive go-getter who works hard, plays hard, and won't take no for an answer.

The foods you prefer can reveal facets of your personality, according to Alan R. Hirsch, neurologic director of the Smell & Taste Treatment and Research Foundation in Chicago, Illinois. Hirsch conducted a study that combined a battery of personality tests with "olfactory tests, gustatory tests, and hedonic scales" to determine which personality traits match certain foods.

The results are "not absolute." Hirsch cautions, because "people are rarely all of one type or all of another—they're mixtures—but their food preferences are a good personality indicator."

Scientists have known for years that certain scents alter alpha and beta brain waves. Now Hirsch's studies show that mixed floral scents also affect brain-wave patterns—even when the scent concentration is too low to be detected by the test subject. Such surprising results "suggest that odors can have a subliminal impact upon the brain itself," Hirsch says.—Peggy Noonan

WATCH, LIZARD, AND THEIR EYES

In olden days, sailors navigated the seas with the help of a sextant, an instrument that calculated direction by measuring the altitude of the sun. Now two biologists have discovered that a species of lizard senses direction in a similar way, using what amounts to an organic sextant in the top of its head.

Barbara Ellis-Quinn and Carol Simon of the City University of New York trekked to the Arizona mountains to study Yarrow's spiny lizard (*Sceloporus jarrovi*). Knowing that this species has a third, or "parietal," eye on the top of its head, the researchers trapped 40 of the animals and then covered each lizard's third eye with a layer of paint. They then put the lizards in bags with 40 of their counterparts whose third eyes had not been painted, and let all the lizards go at a spot 150 meters from their homes. Sure enough, the unpainted lizards began to find their way home within half an hour, while their painted cousins wandered around aimlessly.

A lizard with direction

This part of the experiment confirmed that the third eye is indeed the key to the lizards' sense of direction. To determine the principle on which the third eye operates, the biologists put a group of lizards in a dark room and turned on a light at midnight, which artificially accelerated the lizards' biological clocks by six hours. When the animals were turned loose away from home, they moved purposefully toward home—except that they were actually 90 degrees off course. The conclusion? Like ancient mariners, "these lizards, Simon says, "are using the sun to find their way around."

—Bill Lawren

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CONTINUUM

A scientist inspects human skin cells growing in flasks

REFRIGERATED SKIN

Burn victims and severely injured patients now have a much better chance of recovery thanks to advances in growing human skin for skin grafts. However, laboratory-grown skin begins to degrade in just eight hours, making it difficult to treat patients who live too far from the lab. But now Biosurface Technology of Cambridge, Massachusetts, has solved that problem.

Biosurface produces its natural replacement skin by means of tissue culturing. New skin grows in flasks or dishes containing a nutrient solution that uses, as a base, cells from the person who needs the graft. The process takes 17 to 24 days.

"Each cell makes its own colony, and when the colonies touch each other, they grow upward in layers," until the sheets of skin can be removed, says spokesman Timothy Surgenor.

"Until now, we could cool or freeze individual cells to store them, but not a whole sheet," Surgenor says. The solution to the dilemma proved to be as simple as finding the optimum cool-storage temperature for the sheets of skin, 13 to 23 degrees centigrade. The technique keeps the skin viable for up to 24 hours.

—George Nobbe

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WHO ARE THOSE GUYS?

Butch Cassidy and the Sundance Kid—the names inescapably evoke images from the 1969 movie starring Paul Newman and Robert Redford. In the movie, as in real life, the outlaws fled the United States and the Pinkerton detectives for Bolivia. At that point, reality and Hollywood may—or may not—diverge.

The movie shows them surrounded by the Bolivian army after they steal a mining company's payroll, the scene fades out in a hail of gunfire. But various legends have the pair dying elsewhere or even returning home to live out their lives in obscurity.

Thanks to high-tech science and old-fashioned detective work, the truth behind their demise may finally come out.

Western historians Dan Buck and Anne Meadows have researched the Butch and Sundance story since the mid-1980s. In Bolivia, they "found the judicial and mining company records that actually substantiated for the first time that there had been a holdup and a shootout" in 1908 with two Yankees in San Vicente.

When Buck and Meadows, along with a team including world-famous forensic anthropologist Clyde Snow, exhumed the unmarked graves where local legends said the gringos were buried, they found skulls and intact skeletons from two European or North American males.

One skeleton's leg shows an old injury consistent with a bullet wound Sundance suffered years before his reputed death, and the skull is caved in as if it had been shot between the eyes. Reports have stated that the two didn't want to be finished off by the soldiers, so Butch shot Sundance and then himself. The second skull shows damage matching a self-inflicted gunshot wound.

Buck thinks DNA matching might help determine if

the bones belonged to Butch and Sundance. Such an effort would likely require tracking down the outlaws' descendants to sample their DNA.

Neither Snow nor the other forensic experts studying the San Vicente remains will discuss what progress they've made. They've been sworn to secrecy until a future *Nova* television broadcast reveals the results.

—Peggy Noonan

ARTICLE BY MELANIE MENAGH

HEROES OF HEALTH CARE

"People think we're a welfare program instead of a health-care program," says Dennis Mohatt, director of Menominee County's mental health center.

Margaret Heagarty, Pediatric AIDS Unit, Harlem Hospital: "Nobody on my ward dies alone."

Health care for the homeless: During the 37,000 visits clocked in a year, James O'Connell and the 40-member staff sees it all—AIDS, frostbite, substance abuse, cancer, TB, schizophrenia, pneumonia, diabetes.

"This is my religion: national health care, totally nonprofit," says Marie-Louise Ansak, director of On Lok. "We must believe in taking care of all citizens the same way all over the country."

Linston Young, Heavy Hitters: "We're here to tell you that you have a choice to use and abuse. If you decide to use—you'll go to jail or you'll wind up in a mental institution or you'll die."

It's not a system; it's a mess," Arnold S. Relman, M.D., editor in chief emeritus of the *New England Journal of Medicine*, says of health care in America. It would be tough to find a dissenting voice from Big Sur to Little Rock. The malaise in our health-care system is so complex, pervasive, and well publicized that it hardly needs rehearsing here. What is not so well known is that there are people and programs across the United States effectively solving some of the most intractable health-care problems facing the nation.

Omni drew up a list of five critical issues: substance abuse, care for the elderly, mental health, AIDS, and homelessness. Then we set out to find people who were making important advances in each field. We wanted to find people out in the trenches, roll-up-your-sleeves types tackling serious problems, dealing directly with troubled people.

Linston Young directs a substance-abuse program in Milwaukee. Marie-Louise Ansak founded a facility for the frail elderly in San Francisco. Dennis Mohatt oversees mental health in rural Michigan. Margaret Heagarty developed the pediatric AIDS unit at Harlem Hospital. James O'Connell runs clinics in homeless shelters in Boston. These five are a mixed bag. Some are professional medical people, some are not. One graduated from Harvard, another dropped out of high school. All operate in what are euphemistically called "underserved areas."

The population Dennis Mohatt cares for in Menominee County seems vastly different from Margaret Heagarty's patients in New York City. Mohatt's territory is a sprawling, overwhelmingly white district of sparsely populated farmland in the Midwest. Heagarty's bailiwick is a crowded, primarily minority neighborhood in the biggest, most cosmopolitan city in the country. Yet, when you dig beneath the superficial differences, similarities become immediately, and soberingly, apparent. Harlem and Menominee County both suffer from poor education, a scarcity of good jobs, flight of capable people, substance abuse, ready access to firearms, inadequate and overtaxed social services, endemic domestic physical and sexual abuse—and a profound lack of hope that the future will be much better.

There is a great deal of overlap among issues. Anyone caring for the elderly has to deal with substance abuse. Many participants in substance-abuse programs are HIV positive. Pediatric AIDS doctors must also attend to the children's mental health. Mental illness may have physical repercussions, like car accidents or suicide. Homelessness can be caused by, or the cause of, practically every ailment in the book.

Clearly, the troubles facing American health-care providers are not exclusively medical. In a crumbling inner city tenement or on a bankrupt dairy farm, health issues can't be separated from socioeconomic issues. The finest health-care program can only slap a Band-Aid on the real problem. Unless the nation's social and economic ills

SUBSTANCE ABUSE

- *U.S. portion of global population: 5 percent*
- *U.S. portion of global drug use: 50 percent*
- *Annual costs for untreated drug abusers (loss of income and social services): $40,000*
- *Americans who drink alcohol once a week or more: 21.2 percent*
- *Heavy drinkers: 5 percent*
- *Hard-drug users: 5,881,000 (3 percent of the population)*
- *Arrests for drug violations by state and local police in 1981: 468,056 1991: 1,010,000*
- *Portion of federal prison sentences that were drug offenders in 1980: 27 percent 1989: 49 percent*
- *Drug-related deaths reported in 27 metro areas in 1991: 6,601*
- *Annual drug-related emergency-room admissions: 400,079*

are attended to, the prognosis for curing the health-care crisis is not good. The benefits if we can are manifest. If we don't, the cost—in cash dollars as well as in human suffering—will be enormous.

"Hero," unfortunately, has lost some of its cachet. It's the antihero, from Willie Loman to Dirty Harry, who's been the popculture icon of twentieth-century America. In fact, all the men and women we've called heroes said they felt uncomfortable with the epithet, insisting that whatever successes they have achieved are due to the remarkable teamwork of their staff.

Agreed. The purpose of this exercise isn't to declare that these and only these five are the heroes of our health-care system. We do insist, however, that there are torch bearers, crusaders, visionaries abroad in the land who are performing heroic deeds in these difficult times—a fact often overlooked in the flurry of bad press about America's medical system, which makes it easy to grow skeptical that good is being done anywhere.

This does great disservice to not only the people who are working so hard to right the wrongs, but especially to the people whose care could be vastly improved if some of these innovative programs were replicated around the country. In the following sections, we've collected some of the pertinent statistics on each problem so you may see that despite the mess we've allowed our medical system to become, there are many inspired, inspiring people out there laboring diligently and *successfully* to solve our problems and ease our pain.

Heavy Hitters

Milwaukee is awash in billboards of merry partyers hoisting frothy mugs. Not surprising for a town that revels in its history as brewer to the nation. The Grand Avenue Mall does a brisk business in T-shirts that feature beer logos, brewery tours are a major attraction, the city's most venerable theater is named for a famous family of brewmeisters. Not surprising that in 1991, Milwaukee County (population 959,275) had an estimated 76,000 drug and alcohol abusers. Fortunately, Milwaukee also has Linston Young, 41, executive director of the Heavy Hitters, an inner-city-based grass-roots organization of recovering alcoholics and addicts.

The making of an addict starts early—"It's a family affair," Young says. "When people talk about their addiction, when they get to the nuts and bolts of their problem, it's about the loss of family. It's the loss of the spiritual being and the morals and values that you get in a family setting." Young's checkered past is typical of the Heavy Hitters membership. One of 12 children raised singlehandedly by their mother, he was sneaking beer at age 8, by age 14 he had a $450-a-day heroin habit that he supported by "snatching purses, selling my body, anything I could do." He started a gang, was shot three times and left for dead, went to reformatory school and to jail.

A big bear of a man wrapped in a black satin warmup jacket emblazoned with a crowned lion, Young is hanging at the Friendship Club, a social club complete with darts, jukebox, checkers, videogames—and Orange Crush behind the bar. Poised at the controls of *Checkpoint*, Young feeds the machine another quarter and he's off, attacking video aliens with the assiduity he usually reserves for the formidable foes plaguing his community. "They tell me it's my therapy," grins Young, as another E.T. nemesis bites the dust. "It's also another vehicle of communicating with the kids."

Young says he learned a lot in prison. In fact, the Heavy Hitters credo is to "take the negative and turn it into a positive." They deliberately dress in their lion-logo gear so they'll look like a gang. "We constantly wear our colors, and wherever we go, we go in droves. We give a counter example—we're a gang, but we're positive. Being in a gang is about belonging. If you don't have a family, hanging with the gang gives you an identity. People recognize us around town in our Heavy Hitters clothes, and they want to belong."

The original members met at recovery meetings, but many were drug and alcohol abusers as well as had problems with codependence, overeating, and emotional issues. No single organization had ever tried to tackle all these at once, so in 1989, they began a program for themselves. With a membership that's grown from 12 to 265, Heavy Hitters sponsors support groups, marches, dances and rallies, a teen help line, and the Speakers Bureau, which gives talks at schools, churches, and prisons. The Heavy Hitters message about the consequences of using drugs is simple but powerful. "We're not here to tell you, 'Don't do this, don't do that.' We're here to tell you that you have a choice to use and abuse. We're here to tell you what will happen to you if you decide to use—you will go to jail or you will wind up in a mental institution or you will die—those are the options." Except

CARE FOR THE ELDERLY

- *U.S. population 65 or older: 12.5 percent*
  65 or older: 31 million
  65–74: 18 million
  75–84: 10 million
  over age 85: 3 million
- *Growth among the over-80 age group is increasing exponentially.*
  Population over age 85 in 1990: 1.2 percent
  Increase over 1960: 100 percent
  Increase over 1900: 600 percent
- *Annual average health-care costs in 1987:*
  ages 65–69: $3,728
  over age 85: $9,178
- *Cost of nursing-home care in 1991: $59.9 billion*
- *Number of beds needed to add per day to meet demands by the year 2000: 100*

for Young who receives a modest salary it's an all-volunteer organization.

What makes Heavy Hitters unique isn't what they do—it's how they do it. "We have cultural perspective, we approach the problems of addiction from the minority experience," Young says. "People can't always grasp traditional recovery models. Some are illiterate, there can be language or grammar barriers." It's also *when* they do it. "If you go to an agency they close the door at five o'clock. We're on duty whenever there's a need—a twenty-four/seven operation. We're mobile. We'll come to you." It's a serious—sometimes dangerous—commitment. "If someone calls me from a crack house and says 'Hey man, I'm tired. I'm ready.' Come and get me.' I go get 'em," Young says. "I don't look at it as dangerous when a person is actually screaming for help, there's supposed to be somebody there to help."

A major objective of Heavy Hitters is getting members off welfare and on to productive lives. "There are thousands of people in recovery who are doing well but are not being trained to do what they're capable of," Young says. "We have 60 members who are ready to work as counselors, but we don't have any money to pay them. It's an uphill battle," Young concedes. "They tell you they want you off welfare, but they set up road blocks for anybody who tries to get out of the system." Young is trying to make people know that they're *somebody*—show them there are things they can do, he says. "We try to help every person who has a dream make that a reality."

On Lok

"This is my religion—national health care, totally nonprofit," says Marie-Louise Ansak, executive director of On Lok, a program for the frail elderly (people certified for nursing-home care) in San Francisco. "National health care is a basic right. Everything else has to go." "The insurance industry?" "Forget it. Kick them out. I don't want insurance, that's just another bureaucracy that siphons off money." But what about Washington's infamous inefficiency? "Running health care through a centralized system is *not* a recipe for disaster, because it means that affordable health care becomes the national philosophy. We must believe in taking care of all citizens the same way all over the country. I don't believe in all this states' rights stuff—this is bullshit."

As Ansak makes her way through On Lok's recreation area, she works the room beaming, shaking hands, requesting news of errant grandchildren and uncooperative ligaments. Spend a few minutes soliciting her views, however, and the feistiness which enabled her to have her way with Washington is apparent. At 65 she speaks her mind, her arguments full of fervor and compassion—with the occasional expletive thrown in for emphasis. "Three times we had our own private bills passed by Congress," she notes with satisfaction.

The first piece of legislation permitted On Lok to finance care through a unique scheme combining Medicare (federal funds) and Medicaid (state funds) paying on a monthly per-person fixed rate rather than the usual fee-for-service basis. When the On Lok scheme proved successful, the feds granted waivers to allow the continuation of Medicare/Medicaid payments. Finally, Washington granted waivers for other sites to replicate the On Lok model. Currently there are 12 locations in ten states following in On Lok's wake. "I was adamant about getting funding through Washington," Ansak says. "The frail elderly consume the megabucks, and programs like On Lok can't be funded out of little community systems; the federal government has the large pockets."

Ansak is Swiss, the daughter of two doctors. She came to Chinatown as a social worker and in 1972 was asked to develop a program for the frailest residents. Because of her shuttle diplomacy from Chinatown to Capitol Hill, On Lok lives up to its name—"peaceful, happy home"—for the 350 people enrolled in its adult daycare program. Each morning, On Lok team members roll up in their van at participants' homes to help them get ready and then drive to the On Lok center for the day's activities—medical care, cards, crafts, perhaps a little physical therapy. Some participants volunteer as playground supervisors for local schoolchildren; others may prefer to sit quietly with a book. At the end of the day, the team returns participants home and assists with their nighttime needs.

On Lok enables these elderly people to live in their own homes in their own community—for 5 to 40 percent less than the cost of comparable nursing-home care. In 1992, On Lok spent $32,400 to cover all of each person's medical needs—from occupational therapy to prescriptions to hospitalization. "The participants fiercely want to stay in their community," says Ansak. "It sustains them—it's where their fam-

RURAL MENTAL HEALTH

- *1 in 5 persons suffers a mental disorder in any 6-month period.*
- *1 in 3 suffers a disorder during his or her lifetime.*
- *Annual mental-health-care costs: $273.3 billion*
  Lost productivity: 44 percent
  Treatment cost: 43 percent
- *Annual U.S. mental-health admissions: 5,275,116*
- *Primary-care physicians provide up to 60 percent of mental-health services.*
- *Population living in nonmetro areas: 22.5 percent*
- *Physicians practicing in nonmetro areas: 13.2 percent*
- *Rural population living in designated psychiatric-shortage areas: 34 million*
- *Psychiatrists per 100,000 people: metro: 15.9 nonmetro: 3.6*

ilies and friends and traditions are they don't want to be institutionalized." In fact On Lok has been able to bring some people out of nursing homes and now they're back in the community.

On Lok's participants have fewer hospital visits (3.5 per year) than healthy adults (8.5 per year) of the same age. "We have a team approach," Ansak says. "Everyone from the doctors to the van driver is educated and involved, so we can monitor people all the time. That way we prevent the big breakdowns."

Many of the thorniest problems besetting the older population like substance abuse and suicide are effectively triaged. "When people come to us," Ansak says, "often they are taking ten, fifteen different medications because they have three different doctors. At On Lok doctors confer, and when they assess the participants' needs, very often pill taking is reduced to practically nothing." There hasn't been a suicide attempt in the last four years. "Our people feel less isolated because they stay close to their family and friends," she says. "Our staff knows each patient well and so is a bit more alert when depression sets in, so we can intervene early."

Since On Lok takes care of people to the end, participants are encouraged to create living wills. "When you're close to death, you don't want to go through a lot of pain and have the last two months of your life in utter discomfort or all drugged up," says Ansak. "Once our people understand their options, they usually don't want to die like that. We listen to what the patient wants. It's up to each individual to decide what quality of life is acceptable."

Menominee County Community Mental Health Center

"I have a theory about those thousand points of light," Dennis Mohatt, director of the Menominee County Community Mental Health Center (MCCMHC) in Michigan's Upper Peninsula, comments on an infamous political leitmotif. "Those lights are all red. They're the taillights of people headed out of town." In the last decade, rural America has experienced a crippling exodus. "People who would coach Little League or volunteer at the local clinic leave because there are no skilled jobs," Mohatt says. "As communities deteriorate, the people who were the natural helpers leave, and so at the same time, the proportion of children and adults who need help grows."

Partial to fishing, hunting, and the Grateful Dead, long of limb and ample of grin, at 38 Mohatt has a bit of the corn-fed farm boy about him. In fact, he has experienced the harsh combination of rural poverty and mental illness firsthand. Left fatherless at an early age, he and his brothers were raised in Iowa by a mother who was dependent on welfare. Witnessing the mistreatment she received from the system convinced him to work in rural mental health. "For Mohatt, it's in the blood. My father was a volunteer fireman and died in the line of duty. I grew up believing that being a public servant was an honorable profession."

The farm crisis hit Menominee County hard, with serious psychological repercussions: depression, psychosomatic illness, physical and sexual abuse, and an incidence of schizophrenia well above the national average. The local high school has seen eight suicides in the past two years. On the Potawatomi reservation, there is a 90-percent rate of alcoholism.

At the dedication of Orchard View, a group home for six developmentally disabled adults, Mohatt vies for air time with the buzz of lawn mowers, the thump of a basketball, and a stiff breeze blowing across the high bluff atop which the new ranch-style house sits. "We have come finally to see that people with developmental disabilities have the same rights as anyone: the right to live in their community and not be shut up in institutions; the right to have a room of their own and next-door neighbors."

In 1992, the last of Menominee County's developmentally disabled citizens came home—back to their roots. Today none is in an institution; they've all returned to small group homes like Orchard View. This is only one of the improvements Mohatt has made. Since he took over as director in 1989, he has doubled the annual budget to $4 million, increased staff by over 500 percent, and decentralized services so that they are accessible throughout the county. Aside from their own facilities, MCCMHC staff have struck up partnerships, working in tandem with local physicians at their offices, in schools, at nursing homes, even with Native American healers on the reservation. The program's success has made Menominee a model around the country and made Mohatt president of the National Association for Rural Mental Health.

It's all most gratifying. Mohatt however, is not one to rest on his laurels. "When life looks like easy street, there is

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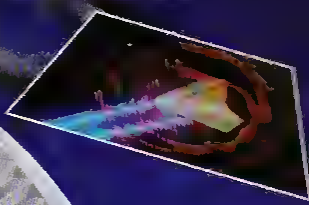

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AIDS

- *U.S. estimate of number of HIV-infected people: 1 million*
- *Reported U.S. AIDS cases: 242,146*
- *U.S. AIDS cases as a portion of world's AIDS cases: more than one-third*
- *HIV-related deaths in 1991: 29,850*
  Increase over 1990: 24 percent
- *HIV-related death rates per 100,000 people:*
  White men: 17.6 percent
  Black men: 50.4 percent
  White women: 1.5 percent
  Black women: 12.2 percent
- *Yearly medical costs for a person with AIDS: $38,000*
  Lifetime costs: $102,000
- *Children (13 years and younger) with reported AIDS: 4,051*
  Due to hemophilia: 5 percent
  Due to blood or blood products: 7 percent
  Born of infected mother: 86 percent

danger at your door," he quips. Despite the huge range of problems MCCMHC faces, there is a constant struggle for funding. "Some people say we're taking care of whiners. They think we're a welfare program instead of a health-care program. The stigma of mental illness really is a hard thing to get around."

At town meetings, Mohatt has to compete with people who want more money for police and roads. "Our clients are not going to stand up and testify about how important our services are," he says. "But it's easy to see our failures—the people who fall through the cracks and cause problems. It's harder to see the people right next door who comply with their therapy and get along just fine. The more successful we are, the more invisible we are."

How would Mohatt spend the extra money? On children. Teachers tell Mohatt that some of their kids are so troubled that to really do something about education, they would have to stop teaching for a couple of years and just deal with the emotional scars. Mohatt's pet project is to teach a high-school class in basic helping skills—problem solving, effective communication, resolving conflicts. "I'd take the cream of the crop and, if I had the money, I'd employ them as helpers working with fourth, fifth, and sixth graders," he says. "It's a critical age—a fourth grader who's struggling needs to have somebody who's a mentor to set up a positive intragenerational relationship."

Mohatt believes the government must pump some serious cash into health care but that Washington's priorities lie elsewhere. "Groups like the insurance industry and defense contractors are viewed as the good guys by politicians," he says. "When we say, 'We need good health care in our community,' we're seen as the ones who want special favors. We speak for persons with developmental disabilities or mental illness who can't speak for themselves. They don't vote. They don't have a lot of money. Yet the Washington politicians view them as a special-interest group."

Pediatric AIDS Unit, Harlem Hospital

"Nobody on my ward dies alone," says Margaret Heagarty, director of pediatrics at Harlem Hospital in New York City. "Early on in the AIDS epidemic, when we didn't know how the disease was transmitted, we were making the morning rounds. We came to a young boy on the ward, and I said to my staff, 'Who has hugged this child today?' They looked a little sheepish—guilt is a powerful motivator. After that, there were hugs for all the children on the ward."

In her mid-fifties, Heagarty has been in the line of helping children for a while. Graduating from the University of Pennsylvania, she has practiced and taught at Harvard, New York Hospital/Cornell Medical Center, and Columbia, arriving at Harlem Hospital 15 years ago. Despite the emotional rigors, she says that developing the pediatric AIDS program has been the most interesting and challenging work she's done. "We've been forced to confront an entirely new phenomenon with virtually no resources," she says, "so we've had to use great ingenuity and creativity."

Aside from hospital care, the program includes outpatient and psychological services, a hospice for infants in a converted convent, and a research arm in conjunction with several medical schools and teaching hospitals in the area. The coordinators of the Harlem Hospital's program have found that the best approach is to assign the doctor treating the child with AIDS to treat the entire family with medical care and psychological counseling. In effect, he or she becomes the family doctor. There have also been cases in which doctors have become family. Heagarty points to a photo of a boy on her bookshelf: "He was one of our patients whose family was 'absent.' When he died, we arranged the funeral for him. Afterwards, we all came back here and spent time together, we went through a period of mourning for the child."

Taking care of children with AIDS presents many special problems and challenges. The disease is as devastating in the young as in adults. AIDS tends to be particularly aggressive in children, often causing neurological damage which results in delayed development. Making matters more complicated, many of these children come from families who are unable to care for them properly. It can be as simple as missing a doctor's appointment or as dramatic as the fact that a seven-year old child, who's the adult in the household—is very sick.

Confirming her reputation as a tough taskmistress, Heagarty is frank about the demands she makes on her staff. "I don't allow burnout on my ward," she says. "I don't believe in it. We have to realize that we cannot cure these children, that the end result of this illness is death. We cannot look on the death of these children as a failure in ourselves or in our ability to prac-

HOMELESSNESS

- *Number of homeless persons in the U.S.: 500,000–600,000*
- *Homeless who are families with children in cities: 23 percent*
- *Homeless families who are women with children: 96 percent*
- *Homeless population in N.Y.C. testing positive for TB: 21 percent*
- *Similar, nonhomeless population testing positive for TB: 8 percent (most cases of active TB were among homeless men with AIDS)*
- *Homeless families using emergency rooms or clinics for preventive care: 35 percent*
- *From a survey of 157 medical directors of homeless clinics, portion reporting problems recruiting physicians: 52 percent*
  Reasons given for problems recruiting physicians:
  inadequate salaries: 78 percent
  doctors' biases against working with the homeless: 63 percent

tice good medicine. We can help them to be happier and healthier longer."

Wrapped in a cardigan with ample pockets, in her office on the seventeenth floor—spectacular view over the rooftops of Harlem to the skyscrapers of mid Manhattan—Heagarty strokes her brow. "It's different from treating the usual pediatric population because all of our patients die. We've been forced to go back to the way doctors and nurses approached treatment in the nineteenth century when so many children died. AIDS is a human problem, and we must 'treat the humanity of these children and their families—not just their medical problems.'"

Heagarty gives a mixed review to AIDS care in America. The scientific establishment, she says, has made enormous strides in understanding this disease in ten years—identifying the agent and designing drug therapies to improve and prolong life. On the other hand, however, she says, "HIV disease in children is a problem of the poor. These children are being seen in large public hospitals which are chronically underfinanced. You have to have the resources for the basics, the infrastructure, and that's lacking in these settings—regularly."

Losing an entire generation of people to this disease will take a tremendous toll on the nation, Heagerty warns. "Heads of American industry today will tell you that one of their primary worries is that there's a shrinking pool of educated, skilled workers in this country. We can't afford to lose any one, no matter what their color is." There is, however, another compelling argument. "This nation claims that we are all created equal. If we turn our backs on these children and their families, that makes us hypocrites. And for our lack of response to this epidemic and to urban poverty in general, I fear that history will judge us very harshly."

Health Care for the Homeless Program

It's check-in time at the Pine Street Inn, and the tiny nurses' clinic is bristling with sound and motion. In the midst of it all, however, is an area of arresting calm, reserved for Pine Street's signature treatment: the evening footbath. Each man sits with feet—often grimly swollen and ulcerated, soaking in a little tub of warm water and green soap, steam curling comfortably about his ankles. Pine Street Inn offers 2,000 meals and 1,100 beds each night to Boston's homeless population. The nurses' clinic is one of the oldest in the country and one of 46 sites in the city of Boston receiving direct services through the Boston Health Care for the Homeless Program (BHCHP).

As James O'Connell, executive Director of BHCHP, greets some of the regulars, his whole person lights up, exhilerated. "I love it here," he says. "It's such a wonderful place to work. Here you are needed, appreciated—all the things you want for your staff." This is probably not the reaction you'd get from the average citizen, but then much about BHCHP, its staff, and its director is quite extraordinary. O'Connell's résumé is a case in point: bartending in Newport, teaching and coaching hoops in Honolulu, philosophy at Cambridge (England), Harvard Medical School.

During the 37,000 visits clocked in a year, the 40 member staff sees it all: AIDS, frostbite, substance abuse, cancer, TB, schizophrenia, pneumonia, diabetes. Statistics show that homeless people have four times as many hospital admissions as the average person, and O'Connell believes that's an underestimation. Doctors, nurses, and caseworkers operate out of clinics in shelters, daycare centers, and soup kitchens. Some staff visit families in SRO hotels, others work the night shift in the van, attending to street people who don't frequent shelters. BHCHP offers primary-care clinics at two Boston hospitals and has just opened a respite unit for patients who are not yet well enough to face life on the streets.

Access is key to the operation. "We bring the health-care providers to the people who need care," O'Connell says. "We're dealing with people whose primary concern is finding the next meal, a bed, some clothes—health care is way down on the list." Because the traditional halls of medicine do not accommodate the lives of an extremely sick, transient population, many homeless people do not use the system. "They don't have time in the struggle for survival," says O'Connell, "and most find the system so bureaucratic and capricious that they can't use it properly—or don't like it."

BHCHP's job was to find ways to lure the homeless back into Boston's medical system. "These people would never go to their primary-care doctors," O'Connell says, "but they would see us in the shelters for a few months, and I could give them my card and say, 'Why don't you come see me at the hospital at nine o'clock on Friday.' That way, they're coming to see me, not some anonymous hospital. We have to respect the rights of the

homeless not dictate to or criticize them, but to let them go at their own pace. When they're treated with dignity, they do respond."

The ability to attract gifted professionals to BHCHP is essential. In many cases, however, the medical community hierarchy makes this difficult. Money plays a part, but it's not the whole story. Equally important, says O'Connell, is the respect of your peers. "Students should be encouraged to work in health centers and free clinics—the front lines," he says, "not because it's good work for the poor or the homeless but because it's good work for a doctor. This is a sick population that traditional medicine has been unable to treat effectively, and medical school deans need to encourage the best and the brightest to work on it."

At Pine Street, another shift comes in for their footbaths. The scene is charged with symbolism: bathing the feet of the poor has a kind of Biblical resonance. "In understanding who these people are and how difficult it is to survive at the margin, you learn an awful lot about your own life and your own society," O'Connell says. Principal lesson? O'Connell considers. What has struck me is that the circumstances which conspired to make them homeless are frequently a very fragile turn of fate, they've encountered so many obstacles to just staying alive. Watching these people deal with that fate, struggling with their inborn disabilities or their chronic illnesses makes them heroic in my eyes."

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The Artist

DESIGNING DINDSAURS: HOW TO BRING JURASSIC PARK TO LIFE

ARTICLE BY
DON LESSEM

The fantasy is so compelling that we can imagine live dinosours in our world.

A keen-eyed, man-sized *Velociraptor* leaps out of the darkness to slash at its victim. A *Triceratops* lies on its side, waylaid by a meal of poisonous berries. Hot-blooded baby dinosaurs grow like wildfire in a computer-controlled hatchery. Ostrichlike dinosaurs sprint through the forest. And lurking ominously in the shadows is perhaps the greatest killing machine ever known to nature or the special-effects industry—a 40-foot-long *Tyrannosaurus rex*.

Welcome to the world of *Jurassic Park* and dinosaurs more alive than at any time in the last 65 million years. "They're the best dinosaurs people have ever made, period," says John R. Horner, the Montana dinosaur paleontologist who was the film's principal adviser. Horner is also, in more respects than anyone alive, the true-life model for *Jurassic Park*'s hero, Alan Grant. Just how good are these dinosaurs?

I first met *Velociraptor*, the most villainous of *Jurassic Park*'s dinosaurs, in its least prepossessing posture, as a skin on a coat rack in the Los Angeles studio of special-effects expert Stan Winston (*Aliens*, *Terminator II*). Still, I did a frightened double take at the sight of what looked like an animal hide looking back at me with an unnerving stare.

Never mind that re-creating *Velociraptor* and his kind took plenty of sculptors, hydraulics, and computers—a budget larger than all the

THEY'RE THE BEST DINOSAURS PEOPLE HAVE EVER MADE...PERIOD.

dollars *ever* spent on dinosaur science—and Steven Spielberg's directorial savvy to make the rest of us suspend our disbelief. And ignore the fact that Michael Crichton's fantasy of dinosaurs reconstituted from fragments of their DNA locked in amber is just that—a fantastic feat of genetic engineering so far beyond present technology and scientific ethics that neither genetic researchers nor Crichton will contemplate its near-term prospects seriously.

Instead, think about living with dinosaurs, with *Velociraptors* or *Triceratops*—as so many kids and paleontologists are happy to do. The fantasy is so compelling, the cinematic trickery so wizardly, that we really can imagine live dinosaurs in our world. But are the hot-blooded and often hot-tempered dinosaurs of *Jurassic Park* behaving as live dinosaurs would? If so, how could we keep ourselves safe from them—and them safe from us?

These questions were very much on the mind of Crichton as they were to Spielberg and a

host of hired dinosaur guns—scientists, artists and special-effects experts—during two years of elaborate preproduction, several months of shooting and in the final generation of computer graphics in postproduction—all under the shroud of extreme secrecy. By hiding the dinosaurs in progress from the press (the models were even cloaked in sheets on the sets between scenes), Spielberg wasn't zealously guarding trade secrets as much as he was wishing to preserve what he calls their "magic"—keeping the media and public focus away from high-tech gadgetry and under the compelling illusion that living dinosaurs do exist, if only on celluloid.

As a writer on dinosaurs, I had several opportunities to visit with the dinosaurs and the director during the laborious process of bringing them to life. On each occasion, Spielberg was eager to talk dinosaurs. He wanted to know: did he have *T. rex*'s proportions right? Dead right—though the arms were a bit long. What did they sound like? He asked that paleontologist David Weishampel send him tapes of simulated duckbill sounds.

The lengths to which the makers of *Jurassic Park* went in order to adhere to science fact and science possibility, not science fiction, were much in evidence during shooting of an opening scene of the film, where paleontologist Grant unearths two dinosaur skeletons from a Montana hillside. A badlands mound in a wilderness refuge in the Mojave Desert was outfitted to resemble a quarry. Horner's Museum of the Rockies and its dinosaur sculptor Matt Smith supplied the cast skeletons. The simulation extended to mounding fake rocks around the fossils.

Paleobotanist Ellie Sattler (Laura Dern) examines a sick *Triceratops* in the fields of Jurassic Park (above). The *Dilophosaurus* (spitter) reacts to a surprise (left).

since a genuine hole couldn't be dug on protected land. Horner sprinted from set to set, ensuring that the tools, the costumes, the dialogue, befit an actual excavation. When I mentioned a niggling error to Spielberg in Horner's absence—that actress Laura Dern was incorrectly referring to a dinosaur skeleton's death-rigor-curled pose as the product of "lots and lots of time"—the director called a halt to the shooting while Dern's lines were redrafted.

But ultimately, *Jurassic Park*, the movie, maintains greatest fidelity not to dinosaur science, but to *Jurassic Park* the book. That book, as its author Michael Crichton freely admits, is at best reasonable speculation. "I imagined that a great deal was known about dinosaur behavior—what these animals looked like, what their coloration was, what their movements were, what their social life was like. In fact, there wasn't any information. There are only educated and not so-well-educated guesses, and those have changed over time."

We may never know what colors dinosaurs were, and they could have been polka-dotted as easily as decked out in the jungle-camouflage tones of the movie's creatures. What we do know and can reasonably speculate about dinosaurs is often, but not always, consonant with their image in *Jurassic Park*. For economic reasons, the cast of dinosaurs—a hodgepodge of animals that have more to do with the Cretaceous period (135 to 65 million years B.P.) than with the middle era of dinosaurs, the Jurassic period—has been reduced to just six.

Tyrannosaurus rex is the king of *Jurassic Park*, as it was in dinosaur times. In *Jurassic Park*, it's a vicious, fast-moving predator capable of crushing Ford Explorers and gripping prey with its prehensile tongue. *T. rex's* banana-sized teeth were capable of puncturing bone and so perhaps crunching metal, but tongues don't fossilize. "Some reptiles have sticky tongues, but I'd bet *T. rex's* tongue couldn't do all that," says James Farlow, a University of Indiana, Purdue dinosaur paleontologist and *T. rex* authority.

Horner himself questions a far larger assumption about *T. rex*—that it was a savage hunter. In his new book *The Complete T. rex*, he attacks the common perception of *T. rex* as a predator. "Most big meat eaters today are scavengers. Even the hunters get most of their food by scavenging. There were plenty of corpses around for *T. rex* to eat. There was no good reason for it to go chasing a lunch." And if it did as in *Jurassic Park*, Farlow points out, "*T. rex* would be pretty stupid to keep chasing these people—four lousy bites—when it could be getting a lot more meat out of one dinosaur in the park."

But another of Crichton's speculative *T. rex* behaviors met with general agreement from dinosaur scientists. *T. rex* would be particularly attracted to moving animals, although motionless prey wouldn't necessarily escape its ravages. "A lot of predators pick up on motion," says Farlow, "toads, birds. It's not a bad guess for *T. rex*." There was logic, too, in the book's speculation that *T. rex* swam, as it did in a scene not adapted to the film, although the filmmakers did call to inquire if *T. rex* could swim. (The answer is probably yes—there are footprint marks pushing off a shore to suggest smaller carnivorous dinosaurs did swim, so *T. rex* may have also.)

While dinosaur paleontologists agree with the portrayal of the gentle plant eaters of *Jurassic Park*, a cowlike *Triceratops* and a treetop-grazing *Brachiosaurus*, a few scientists—Farlow among them—say the small villains are based on fantasy, not fact. In the book, the ten-foot "spitter," a *Dilophosaurus*, fans its cobralike hood and spits poisonous venom. The real-life *Dilophosaurus* was nearly 20 feet long and, like all dinosaurs, left no clue of fans or poison glands.

> "Re-creating *Velociraptor* and his kind took a budget larger than all the dollars ever spent on dinosaur science."

Crichton explains how he made the fantastic leap. "We know there was this great variety of animals that at one time populated the earth, and they must have had an enormous variety of behaviors. I imagined some of them were poisonous and could spit as certain modern-day reptiles can." Farlow isn't persuaded. "Sure cobras spit, and anything's possible." According to some scientists, however, you can't get much farther apart than snakes and dinosaurs on the family tree of diapsids (the evolutionary group that includes animals best known as 'reptiles').

No *Jurassic Park* dinosaur raises more questions among scientists than does its most dastardly dinosaur, *Velociraptor*. These raptors are as big as we are, considerably faster and savvy and dexterous enough to turn a doorknob. Crichton featured the raptors with their size and smarts in mind. "You have certain obligations when casting dinosaurs—a *Tyrannosaurus*, a *Stegosaurus*, a *Triceratops*. Then you choose among the less well-known animals that interest you."

According to Crichton, he was attracted in particular to *Velociraptors* four to six feet tall. "I imagine them to be very quick, very bright—bright as chimpanzees and more vicious," he says. "Compared to body size, they had a larger brain case and so they were more likely to be intelligent, quick moving." Crichton speculates that *Velociraptors* may have hunted in packs, using their terrible central claw—almost six inches long—to rip at their prey. "That they're closer to human size and can go into buildings—that makes them all the more frightening," he says.

Careful research informs Crichton's dinosaur speculations. Paleontologists, however, know *Velociraptor* as a Mongolian dinosaur closer in size to a poodle than a person. In the film, *Jurassic Park*, it's been sized up and confused with its slightly larger North American cousin, *Deinonychus*.

But with their raptors, Crichton and Spielberg weren't bucking science, just presaging it. In 1992, Colorado paleontologist James Kirkland announced the discovery of *Utahraptor*, an earlier and far larger relative of *Deinonychus*. New discoveries of raptors in Mongolia by American Museum of Natural History scientists also show that some raptor dinosaurs grew at least to *Jurassic Park* proportions.

Horner says the dinosaurs in the film "move just like an animal, not too fast or slow." But as Crichton envisaged them, not even sprinter Carl Lewis is a match for *Velociraptors*. Indeed, some scientists have theorized dinosaurs sprinting at 50 miles per hour or more. But most scientific estimates of dinosaur speed—made from measuring the stride lengths of dinosaurs from footprints and comparing those to the animal's size—fall far short of Lewis's 25-mile-per-hour dash. According to the trackway evidence, the top speed so far is 25 miles per hour for what seems to have been a medium-sized ornithomimidlike (ostrich mimicking) dinosaur. However, savants of dinosaur locomotion think some dinosaur speed estimates have been widely overestimated.

And must dinosaurs have been hot in order to trot? The raptors of *Jurassic Park* are raging hot-bloods as are the

other dinosaurs in the film. But new discoveries of dinosaur metabolism suggest only that some smaller, more active carnivores like *Deinonychus* may have been hot-blooded in a manner similar to our own metabolism. Other dinosaurs may have switched strategies as they matured, as their growth slowed and their volume grew to proportions that maintained much of their body heat from their bulk alone—without burning calories as expensively as we do. "Dinosaurs probably kept warm," Farlow speculates, adding that dinosaurs' body temperatures might have been as warm as—or warmer than—ours.

Science does not, however, support the speculation of raptors as quick-witted as the sharpest primates. The smartest dinosaur, a more distant relative of the raptors, *Troodon*, was about as brainy, pound for pound, as an ostrich. That's pretty smart by most animal standards and brighter than our ancestors, the mammals of dinosaur times, but much dimmer than a chimp. "Carnivorous dinosaurs may have been smart enough to pack hunt," Farlow says. "Even some lizards move about in packs." But Southern Methodist University (SMU) paleontologist Louis Jacobs adds, "I can't picture a dinosaur figuring out how to open a door."

If we ever figure out how to open the doors of genetic engineering wide enough to re-create extinct life, then *Jurassic Park*, not just its dinosaurs, becomes a possibility and perhaps a reality with which paleontologists and biologists will have to contend. Says Crichton, "I think it's possible we can make a *Jurassic Park* one day, and I wouldn't be surprised if at some point somebody decided to make one. I hope so. I'd enjoy going very much." So would the scientists who've only been able to study dinosaurs as fossils. "I think it would be pretty cool, though I'd like to see dinosaurs brought back more for study than for entertainment," says Horner.

But just keeping dinosaurs alive, especially on a small island off the coast of Costa Rica, as in *Jurassic Park*, would be a task fraught with problems. Escaping dinosaurs, as in the film, aren't much of a hazard in the eyes of dinosaur scientists or zookeepers of modern-day big animals. "We make *T rex* out to be a raging brute, but I doubt they're much more dangerous than a tiger. After all, you can only get bitten to death once," says Farlow. "Seriously, we've learned to handle other large animals from bears to elephants safely. Why not *T rex*?"

Not everyone agrees with Farlow. Keeping big animals isn't so safe, says Denver Zoo elephant keeper Liz Hooton. "Bull elephants kill an average of one zookeeper a year worldwide." Still, Hooton thinks a *T rex* could be handled. "With positive reinforcement you can teach any animal." SMU's Jacobs recalls seeing crocodiles trained to come for leftovers tossed into a river in Kenya. But Hooton adds, "the trick would be not to allow the dinosaurs to associate us too closely with food." Such handouts could cost a keeper a hand or more.

The closest living relatives of *T rex*, the raptors, and other carnivorous dinosaurs aren't elephants or other mammals or crocodiles—they're birds. A captive-bird expert, Bill Toone, says, "I think we could keep dinosaurs." Toone is curator of birds, including the endangered condors, at the San Diego Wild Animal Park. Rick Carter, production designer for the film, visited the large, mixed species exhibits at the park while researching *Jurassic Park*. But it's highly unlikely Toone suggests that dinosaurs would be allowed to roam widely on a tropical island.

A tropical environment would be the best, says Toone, for growing the food the dinosaurs would require because its

greenhouselike climate would promote the fastest growth. The real herbivorous dinosaurs were native to temperate rain forests and ate conifers and like plants. But getting enough food for them on a small island would present a problem, as Farlow notes. "There isn't room on a Caribbean island for big herbivores to forage. They'd strip the place clean, and importing the food is expensive." Horner suggests "a bigger island, one that's oriented north-south, since it appears the big dinosaur herbivores migrated that way." He'd try New Zealand. "Of course, we'd have to move the people," he says. And what about the sheep already there? "The dinosaurs would take care of them pretty fast."

It's the nature of the food available for dinosaur herbivores as much as the quantities needed that raise doubts in scientists' minds about dinosaurs browsing in a tropical forest. Just as the *Triceratops* gets sick from the berries in *Jurassic Park*, real-life paleobotanist Bonnie Jacobs of SMU worries that dinosaurs wouldn't find many familiar foods. "There were no rain forests as we know them in dinosaur times. We do have plants around from the same families dinosaurs knew—tree ferns, monkey-puzzle trees, cycads, ginkgoes, magnolias—all things dinosaurs might eat." But none of these plants lived in the same communities or environments as they do today.

Malnutrition and vitamin deficiencies could easily do in the dinosaurs in a real-life *Jurassic Park*. Zookeeper Toone suggests keeping the dinosaurs entirely on imported, carefully monitored foods. But even that is no guarantee of health. And Denver zookeeper Hooton says his zoo had an elephant that fell down and never got up. "We didn't realize it had suffered from a vitamin deficiency."

Disease presents another hazard of unknown proportions to keeping dinosaurs. "I'm scared to death of the infection problems," says Toone. "We haven't seen a single infection in 13 years of keeping condors, but we always expect the unexpected." Lots of organisms that present infection problems have evolved since dinosaurs. Big carnivores are especially susceptible to spreading infections since it's hard to get close enough to the animals to check them out.

Carnivorous dinosaurs would likely be kept in small enclosures for training purposes, and in small enclosures waste becomes a danger to health. "No matter how much you swept, they'd be walking in their own waste," says Hooton, who also points out that in close confinement you'd have to keep trimming the dinosaurs' feet, since their nails would probably grow too long from lack of proper exercise. Jack Hanna, director emeritus of the Columbus Zoo, says, "Just cleaning up their crap would be a major problem. With an elephant, it's 40 pounds a day. Who knows how much it would be with a dinosaur. We might have to hire extra keepers just to sweep up." Each flesh-eating dinosaur would be housed individually and only united with potential mates when both prospective partners showed some interest by nest building or courtship behavior. "It could be the male or the female or both dinosaurs who build the nest and tend the babies. That's how it is with birds," says Toone.

For containing dinosaurs in close quarters, Toone suggests double gates, electric fencing, and steel doors such as those used to enclose the 40 odd rhinos at the Wild Animal Park. "With patrolling guards and video, you could keep the dinosaurs from getting out and anything else from getting in." Toone says he'd train the dinosaur carnivores by "only giving them food when they went in the bedroom"—a "squeeze gate" constructed of hydraulically operated movable walls. When rhinos need to be examined by veterinarians, they are temporarily placed in such chutes in order to restrain them without anesthetics. "Anytime you try to tranquilize an animal that big, you risk killing it," Toone says.

So where's the best confined space to keep a live dinosaur? Horner says he'd keep it in a lab. All the safer to do what Farlow and other scientists suggest is the first thing any of them would do with a live dinosaur. "I'd stick a thermometer up it and see how hot it was," says Farlow, thus providing the first experimental proof of a living dinosaur's metabolism.

Perhaps then we'd know how accurate *Jurassic Park*'s dinosaurs really are. For now, neither science nor *Jurassic Park* can tell us what dinosaurs were like or how we might keep them in zoos. However, as Crichton points out, "keeping dinosaurs is just a metaphor in *Jurassic Park*. Science is trying to do something that's beneficial, but it screws up. If we bring dinosaurs or anything else to life, we have a responsibility because we made them this time. They're our animals."

"Aside from that, your lordship, how are you adjusting to life at Greystoke?"

Don Lessem is founder of the Dinosaur Society, author of *Dinosaurs Rediscovered*, and coauthor with John R. Horner of *The Complete T. rex* and *Digging Up T. rex*.

THE FRANKLIN MINT MUSEUM PRESENTS

THE EMPERORS OF THE ORIENT

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FICTION

ENGLAND UNDERWAY

BY TERRY BISSON

Mr. Fox is coming to America—and all of England is coming with him.

ILLUSTRATIONS BY NEIL BRENNAN

Mr. Fox was, he realized afterward, with a shudder of sudden recognition like that of the man who gives a cup of water to a stranger and finds out hours, or even years later, that it was Napoleon, perhaps the first to notice. Perhaps. At least no one else in Brighton seemed to be looking at the sea that day. He was taking his constitutional on the Boardwalk, thinking of Lizzie Eustace and her diamonds, the people in novels becoming increasingly more real to him as the people in the everyday (or "real") world grew more remote, when he noticed that the waves seemed funny.

"Look," he said to Anthony, who accompanied him everywhere, which was not far, his customary world being circumscribed by the Boardwalk to the south, Mrs. Oldensheld's to the east, the cricket grounds to the north, and the Pig & Thistle, where he kept a room—or more precisely, a room kept him, and had since 1956—to the west.

"Woof?" said Anthony, in what might have been a quizzical tone.

"The waves," said Mr. Fox. "They seem—well, odd, don't they? Closer together?"

"Woof."

"Well, perhaps not. Could be just my imagination."

Fact is, waves had always looked odd to Mr. Fox. Odd and tiresome and sinister. He enjoyed the Boardwalk but he never walked on the beach

proper, not only because he disliked the shifty quality of the sand but because of the waves with their ceaseless back and forth. He didn't understand why the sea had to toss about so. Rivers didn't make all that fuss, and they were actually going somewhere. The movement of the waves seemed to suggest that something was stirring things up, just beyond the horizon. Which was what Mr. Fox had always suspected in his heart, which was why he had never visited his sister in America.

"Perhaps the waves have always looked funny and I have just never noticed," said Mr. Fox. If indeed *funny* was the word for something so odd.

At any rate, it was almost half past four. Mr. Fox went to Mrs. Oldenshield's, and with a pot of tea and a plate of shortbread biscuits placed in front of him, read his daily Trollope—he had long ago decided to read all forty-seven novels in exactly the order, and at about the rate, in which they had been written—then fell asleep for twenty minutes. When he awoke (and no one but he knew he was sleeping) and closed the book, Mrs. Oldenshield put it away for him, on the high shelf where the complete set, bound in Morocco, resided in state. Then Mr. Fox walked to the cricket ground, so that Anthony might run with the boys and their kites until dinner was served at the Pig & Thistle. A whisky at nine with Harrison ended what seemed at the time to be an ordinary day.

The next day it all began in earnest.

Mr. Fox awoke to a hubbub of traffic, footsteps, and unintelligible shouts. There was, as usual, no one but himself and Anthony (and of course the Finn, who cooked) at breakfast, but outside, he found the streets remarkably lively for the time of year. He saw more and more people as he headed downtown, until he was immersed in a virtual sea of humanity. People of all sorts, even Pakistanis and foreigners, not ordinarily much in evidence in Brighton off season.

"What in the world can it be?" Mr. Fox wondered aloud. "I simply can't imagine."

"Woof," said Anthony, who couldn't imagine either, but who was never called upon to do so.

With Anthony in his arms, Mr. Fox picked his way through the crowd along the King's Esplanade until he came to the entrance to the Boardwalk. He mounted the twelve steps briskly. It was irritating to have one's customary way blocked by strangers. The Boardwalk was half-filled with strollers who, instead of strolling, were holding onto the rail and looking out to sea. It was mysterious, but then the habits of everyday people had always been mysterious to Mr. Fox; they were much less likely to stay in character than the people in novels.

"We're making close to two knots now," the African said, "England herself is underway."

The waves were even closer together than they had been the day before; they were piling up as if pulled toward the shore by a magnet. The surf where it broke had the odd appearance of a single continuous wave about one and a half feet high. Though it no longer seemed to be rising, the water had risen during the night. It covered half the beach, coming almost up to the sea wall just below the Boardwalk.

The wind was quite stout for the season. Off to the left (the east) a dark line was seen on the horizon. It might have been clouds, but it looked more solid, like land. Mr. Fox could not remember ever having seen it before, even though he had walked here daily for the past forty-two years.

"Dog?"

Mr. Fox looked to his left. Standing beside him at the rail of the Boardwalk was a large, one might even say portly, African man with an alarming hairdo. He was wearing a tweed coat. An English girl clinging to his arm had asked the question. She was pale with dark, stringy hair, and she wore an oilskin cape that looked wet even though it wasn't raining.

"Beg your pardon?" said Mr. Fox.

"That's a dog?" The girl was pointing foward Anthony.

"Woof."

"Well, of course it's a dog."

"Can't he walk?"

"Of course he can walk. He just doesn't always choose to."

"You bloody wish," said the girl, snorting unattractively and looking away. She wasn't exactly a girl. She could have been twenty.

"Don't mind her," said the African. "Look at that chop, would you?"

"Indeed," Mr. Fox said. He didn't know what to make of the girl but he was grateful to the African for starting a conversation. It was often difficult these days, it had become increasingly difficult over the years. "A storm off shore, perhaps?" he ventured.

"A storm?" the African said. "I guess you haven't heard. It was on the telly hours ago. We're making close to two knots now, south and east. Heading around Ireland and out to sea."

"Out to sea?" Mr. Fox looked over his shoulder at the King's Esplanade and the buildings beyond, which seemed as stationary as ever. "Brighton is heading out to sea?"

"You bloody wish," the girl said.

"Not just Brighton, man," the African said. For the first time, Mr. Fox could hear a faint Caribbean lilt in his voice. "England herself is underway."

England underway? How extraordinary. Mr. Fox could see what he supposed was excitement in the faces of the other strollers on the Boardwalk all that day. The wind smelled somehow saltier as he went to take his tea. He almost told Mrs. Oldenshield the news when she brought him his pot and platter, but the affairs of the day, which had never intruded far into her tea room, receded entirely when he took down his book and began to read. This was (as

it turned out) the very day that Lizzie finally read the letter from Mr Camperdown, the Eustace family lawyer, which she had carried unopened for three days. As Mr Fox had expected, it demanded that the diamonds be returned to her late husband's family. In response, Lizzie bought a strongbox. That evening, England's peregrinations were all the news on BBC. The kingdom was heading south into the Atlantic at 18 knots, according to the newsmen on the telly over the bar at the Pig & Thistle where Mr Fox was accustomed to taking a glass of whisky with Harrison, the barkeep, before retiring. In the sixteen hours since the phenomenon had first been detected, England had gone some thirty-five miles, beginning a long turn around Ireland which would carry it into the open sea.

"Ireland is not going?" asked Mr Fox.

"Ireland has been independent since 19 and 21," said Harrison, who often hinted darkly at having relatives with the IRA. "Ireland is hardly about to be chasing England around the seven seas."

"Well, what about, you know . . . ?"

"The Six Counties? The Six Counties have always been a part of Ireland and always will be," said Harrison. Mr Fox nodded politely and finished his whiskey. It was not his custom to argue politics, particularly not with barkeeps and certainly not with the Irish.

"So I suppose you'll be going home?"

"And lose me job?"

For the next several days, the wave got no higher but it seemed steadier. It was not a chop but a continual smooth wake, streaming across the shore to the east as England began its turn to the west. The cricket ground grew deserted as the boys laid aside their kites and joined the rest of the town at the shore, watching the waves. There was such a crowd on the Boardwalk that several of the shops, which had closed for the season, reopened. Mrs. Oldenshield's was no busier than usual, however, and Mr Fox was able to forge ahead as steadily in his reading as Mr Trollope had in his writing. It was not long before Lord Fawn, with something almost of dignity in his gesture and demeanour, declared himself to the young widow Eustace and asked for her hand. Mr Fox knew Lizzie's diamonds would be trouble, though. He knew something of heirlooms himself. His tiny attic room in the Pig & Thistle had been left to him *in perpetuity* by the innkeeper, whose life had been saved by Mr. Fox's father during an air raid. A life saved (said the innkeeper, an East Indian, but a Christian,

not a Hindu) was a debt never fully paid. Mr. Fox had often wondered where he would have lived if he'd been forced to go out and find a place, like so many in novels did. Indeed, in real life as well. That evening on the telly there was panic in Belfast as the headlands of Scotland slid by, south. Were the Loyalists to be left behind? Everyone was waiting to hear from the King, who was closeted with his advisors.

The next morning, there was a letter on the little table in the downstairs hallway at the Pig & Thistle. Mr. Fox knew as soon as he saw the letter that it was the fifth of the month. His niece, Emily, always mailed her letters from America on the first, and they always arrived on the morning of the fifth.

Mr. Fox opened it as always, just after tea at Mrs. Oldenshield's. He read the ending first, as always, to make sure there were no surprises. "Wish you could see your great-niece before she's grown," Emily wrote; she wrote the same thing every month. When her mother, Mr. Fox's sister Clare, had visited after moving to America, it had been his niece she had wanted him to meet. Emily had taken up the same refrain since her mother's death. 'Your great-niece will be a young lady soon," she wrote, as if this were somehow Mr. Fox's doing. His only regret was that Emily, in asking him to come to America when her mother died, had asked him to do the one thing he couldn't even contemplate, and so he had been unable to grant her even the courtesy of a refusal. He read all the way back to the opening ("Dear Uncle Anthony") then folded the letter very small and put it into the box with the others when he got back to his room that evening.

The bar seemed crowded when he came downstairs at nine. The King, in a brown suit with a green and gold tie, was on the telly, sitting in front of a clock in a BBC studio. Even Harrison, never one for royalty, set aside the glasses he was polishing and listened while Charles confirmed that England was, indeed, underway. His words made it official, and there was a polite "hip, hip, hooray" from the three men (two of them strangers) at the end of the bar. The King and his advisors weren't exactly sure when England would arrive, nor, for that matter, where it was going. Scotland and Wales were, of course, coming right along. Parliament would announce time-zone adjustments as necessary. While His Majesty was aware that there was cause for *concern* about Northern Ireland and the Isle of Man, there was as yet no cause for *alarm*.

His Majesty, King Charles, spoke for almost half an hour, but Mr. Fox missed much of what he said. His eye had been caught by the date under the clock on the wall behind the King's head. It was the fourth of the month, not the fifth; his niece's letter had arrived a day early! This, even more than the funny waves or the King's speech, seemed to announce that the world was changing. Mr. Fox had a sudden, but not unpleasant, feeling almost of dizziness. After it had passed, and the bar had cleared out, he suggested to Harrison, as he always did at closing time, 'Perhaps you'll join me in a whisky", and as always, Harrison replied, "Don't mind if I do."

He poured two Bells. Mr. Fox had noticed that when other patrons "bought" Harrison a drink, and the barkeep passed his hand across the bottle and pocketed the tab, the whisky was Bushmills. It was only with Mr. Fox at closing that he actually took a drink, and then it was always scotch.

"To your King," said Harrison. 'And to plate tectonics."

"Beg your pardon?"

"Plate tectonics, Fox. Weren't you listening when your precious Charles explained why all this was happening? All having to do with movement of the Earth's crust, and such."

"To plate tectonics," said Mr. Fox. He raised his glass to hide his embarrassment. He had in fact heard the words, but had assumed they had to do with plans to protect the household treasures at Buckingham Palace.

> "That evening on the telly there was panic in Belfast as the headlands of Scotland slid by, south. Everyone was waiting to hear from the King."

Mr. Fox never bought the papers, but the next morning he slowed down to read the headlines as he passed the news stalls. King Charles's picture was on all the front pages, looking confidently into the future.

ENGLAND UNDERWAY AT 2.9 KNOTS
SCOTLAND, WALES
COMING ALONG PEACEFULLY.

CHARLES FIRM AT HELM
OF UNITED KINGDOM

read the *Daily Alarm*. The *Economist* took a less sanguine view.

CHUNNEL COMPLETION DELAYED;
EEC CALLS EMERGENCY MEETING

Although Northern Ireland was legally and without question part of the United Kingdom, the BBC explained that night, it was for some inexplicable reason apparently remaining with Ireland. The King urged his subjects in Belfast and Londonderry not to panic, arrangements were being made for the evacuation of all who wished it.

The King's address seemed to have a calming effect over the next few days. The streets of Brighton grew quiet once again. The Esplanade and the Boardwalk still saw a few video crews, which kept the fish-and-chips stalls busy, but they bought no souvenirs, and the gift shops all closed again one by one.

"Woof," said Anthony, delighted to find the boys back on the cricket ground with their kites. "Things are getting back to normal," said Mr. Fox. But were they really? The smudge on the eastern horizon was Brittany, according to the newsmen on the telly; next would be the open sea. One shuddered to think of it. Fortunately, there was familiarity and warmth at Mrs. Oldenshield's, where Lizzie was avoiding the Eustace family lawyer. Mr. Camperdown, by retreating to her castle in Ayr. Lord Fawn (urged on by his family) was insisting he couldn't marry her unless she gave up the diamonds. Lizzie's answer was to carry the diamonds with her to Scotland in a strongbox. Later that week, Mr. Fox saw the African again. There was a crowd on the old West Pier, and even though it was beginning to rain, Mr. Fox walked out to the end, where a boat was unloading. It was a sleek hydrofoil, with the Royal Family's crest upon its bow. Two video crews were filming, as sailors in slickers passed an old lady in a wheelchair from the boat to the pier. She was handed an umbrella and a tiny white dog. The handsome young captain of the hydrofoil waved his braided hat as he gunned the motors and pulled away from the pier, the crowd cried "hurrah" as the boat rose on its spidery legs and blasted off into the rain.

"Woof," said Anthony. No one else paid any attention to the old lady, sitting in the wheelchair with a wet, shivering dog on her lap. She had fallen asleep (or perhaps even died!) and dropped her umbrella. Fortunately it wasn't raining. "That would be the young Prince of Wales," said a familiar voice to Mr. Fox's left. It was the Afri-

can. According to him (and he seemed to know such things) the Channel Islands, and most of the islanders, had been left behind. The hydrofoil had been sent to Guernsey at the Royal Family's private expense to rescue the old lady, who'd had a last-minute change of heart, perhaps she'd wanted to die in England. "He'll be in Portsmouth by five," said the African, pointing to an already far-off plume of spray.

"Is it past four already?" Mr. Fox asked. He realized he had lost track of the time.

"Don't have a watch?" asked the girl, sticking her head around the African's bulk.

Mr. Fox hadn't seen her lurking there. "Haven't really needed one," he said.

"You bloody wish," she said.

"Twenty past, precisely," said the African. "Don't mind her, mate." Mr. Fox had never been called "mate" before. He was pleased that even with all the excitement, he hadn't missed his tea. He hurried to Mrs. Oldenshield's, where he found a fox hunt just getting underway at Portray, Lizzie's castle in Scotland. He settled down eagerly to read about it. A fox hunt! Mr. Fox was a believer in the power of names.

The weather began to change, to get, at the same time, warmer and rougher. In the satellite pictures on the telly over the bar at the Pig & Thistle, England was a cloud-dimmed outline that could just as easily have been a drawing as a photo. After squeezing between Ireland and Brittany, like a restless child slipping from the arms of its ancient Celtic parents, it was headed south and west, into the open Atlantic. The waves came no longer at a slant but straight in at the sea wall. Somewhat to his surprise, Mr. Fox enjoyed his constitutional more than ever, knowing that he was looking at a different stretch of sea every day, even though it always looked the same. The wind was strong and steady in his face, and the Boardwalk was empty. Even the newsmen were gone—to Scotland, where it had only just been noticed that the Hebrides were being left behind with the Orkneys and the Shetlands. "Arctic islands with their own traditions, languages, and monuments all mysteriously made of stone," explained the reporter, live from Uig, by remote. The video showed a postman shouting incomprehensibly into the wind and rain.

"What's he saying?" Mr. Fox asked. "Would that be Gaelic?"

"How would I be expected to know?" said Harrison.

A few evenings later, a BBC crew in the Highlands provided the last view of the continent: the receding headlands of Brittany seen from the 3,504-foot summit of Ben Hope, on a bright, clear day. "It's a good thing," Mr. Fox joked to Anthony the next day, "that Mrs. Oldenshield has laid in plenty of Hyson." This was the green tea Mr. Fox preferred. She had laid in dog biscuits for Anthony as well. Lizzie herself was leaving Scotland, following the last of her guests back to London, when her hotel room was robbed and her strongbox was stolen, just as Mr. Fox had always feared it would be. For a week it rained. Great swells pounded at the sea wall. Brighton was almost deserted. The faint-hearted had left for Portsmouth, where they were protected by the Isle of Wight from the winds and waves that struck what might now be properly called the *bow* of Britain.

On the Boardwalk, Mr. Fox strolled as deliberate and proud as a captain on his bridge. The wind was almost a gale, but a steady gale, and he soon grew used to it; it simply meant walking and standing at a tilt. The rail seemed to thrum with energy under his hand. Even though he knew that they were hundreds of miles of sea, Mr. Fox felt secure with all of England at his back. He began to almost enjoy the fulminations of the water as it threw itself against the Brighton sea wall. Which plowed on west, into the Atlantic.

CONTINUED ON PAGE 80

ARTICLE
BY PETER GORMAN

MAKING MAGIC

The night air in the backwater lowlands of the Peruvian Amazon was thick with the incessant buzzing of insects. Overhead, bats flew, their shapes silhouetted by a half moon rising behind the forest across the Rio Lobo. Though the rainy season had begun, the river was

"SEVEN PEPTIDES FOUND IN *SAPO* WERE BIOACTIVE. EACH HAS AN AFFINITY FOR BINDING WITH HUMAN RECEPTOR CELLS."

Rain-forest rituals: *Nu-ae*, an hallucinogenic snuff, induces hunting visions (top, far left); to obtain *sapo*, the Matses tie a *dow-kieti* to four small posts (center) and manipulate the frog's elongated center toe.

In the Peruvian Amazon, the Matses Indians use the secretions of a rare tree frog (previous page) as both a medicine and a magic hunting aid. Until 1986, few Westerners knew of its existence.

still near the low point of the year, and great gnarled tree trunks, swept from the banks during the last flood season, stood out against the water like monstrous sculptures in the pale light. From beyond the jungle clearing of the tiny Matses Indian pueblo of San Juan came the howling of a distant band of monkeys and the melancholy cry of the pheasant-like *paujil*.

In the camp, a handful of Matses children played our flashlights into the village trees, while their fathers combed the branches and nearby brush, hunting for a *dow-kieti*, the frog that secretes *sapo*, a vital element in the Matses' pharmacopoeia. (Although the word *sapo* means "toad" in Spanish, the extract comes from a frog. The Matses' limited command of Spanish doesn't draw a distinction between the two.) The men imitated the frog's mating call, a low, guttural bark, as they moved, and the women nearby giggled at the sound. I was surprised that the *dow-kietis* didn't respond.

The Matses are a small, semi-nomadic, hunting-gathering tribe who live in the remote jungle along the tributaries of the Rio Yavari, on the border of Peru and Brazil. Unlike other tribes in the region, they possess only rudimentary weaving and ceramics skills; they have no formal religion, no ceremony or dance, and they produce nothing for trade. What they do is hunt—with bows and arrows, spears, clubs, and occasionally shotguns when they can get shells. Theirs is the harsh world of the lowland forests and swamps, a world where malaria, yellow fever, and venomous snakes keep mortality rates high. To survive, the Matses have become masters of the natural history of the flora and fauna of the region.

They know the habits and cycles of the animals that share their land, they've studied the plant life that surrounds them, and they've learned to see the jungle as their ally. For the Matses, the earth is a benevolent *ti ta*, or mother, who provides for all of their needs. Neighboring tribes say the Matses can move like the wind and talk with the animals. They say the Matses know the jungle's secrets. *Sapo* is one of them.

I had come to Peru to collect *dow kieti* specimens for researchers at the American Museum of Natural History, for whom I've collected Matses artifacts—mostly throwaway things like used leaf baskets and broken arrows—and the Fidia Research Institute for the Neurosciences in Rome. My reports on the uses of *sapo* had sparked interest and curiosity among scientists who were eager to see a specimen of the frog that produces the unusual material, in part because of the extraordinary experience it produced in me and in part because of my description of its myriad uses. I was eager to see the *dow kieti* as well, because although I'd seen *sapo* used and had experienced it myself, I had never actually seen the frog that produces it.

That Western science took an interest in *sapo* is encouraging: Until recently, most researchers have dismissed the natural medicines of indigenous groups like the Matses. Fortunately, that attitude is changing, but with the loss of an average of one tribe a year in Amazonia alone—to acculturation, disease, or loss of their forest homes—the plant and animal medicines of these peoples are disappearing faster than they can be studied.

The Matses are one of the tribes currently at risk. During the eight years I've been visiting their camps, both missionary and military contact have been steadily increasing, and they're quickly acculturating to a new lifestyle. Camps that planted no more than two or three crops to supplement their diet of game and wild foods just a few years ago now plant a dozen or more. And where most Matses had only a handful of manufactured things when I first met them—some clothing, a few metal pots, a machete, and perhaps an old shotgun—in some camps the men now work for loggers, and the sound of chain saws fills the air. At San Juan, the most accessible camp on the Lobo, most of the Matses not only have new Western clothing, they have begun to refer to Matses who live deep in the jungle as *animales*.

This is a very different group from the first Matses I ran into in 1984. It was my second trip to Peruvian Amazonia—I'd fallen in love with the jungle on my first trip—and I was studying food gathering and plant identification with my guide, Moises, a former military man who specialized in jungle survival. We had been working on a small river called the Auchyako for about a week when we ran into local hunters who said they had seen signs that a family of Matses had moved into the area. Moises, excited by the news, said we should make an attempt to meet them.

I was easily sold on the idea, so, hoping they would make contact, we hiked three days into the jungle and made a camp. Two days later, a young Matses hunter carrying a bow and arrows, his mouth tattooed and his face adorned with what looked like cat whiskers, came into our camp and borrowed our gun.

When he returned later in the day, he was carrying two large wounded monkeys in palm-leaf baskets he carried from his forehead with tumplines. Clinging to his hair was a baby monkey, the offspring of one of the adults. The hunter returned our gun, left one of the monkeys, and then disappeared into the forest. We followed him back to his camp and watched from a distance as he gave the remaining adult to a woman who began to roast it over an open fire, oblivious to its cries. The baby monkey he brought to a young woman who was nursing a child of her own. Without hesitation, she took the monkey and allowed it to nurse at her free breast.

Those dual images represented a combination of cruelty and compassion I'd never imagined and taught me more about the reality of the jungle than anything I had previously experienced. More than that, those images compelled me to return to the Matses again and again.

I first met Pablo in 1986 on my third trip to the Amazon. Moises and I had flown over the dense Peruvian jungle from Iquitos to the Rio Lobo, borrowed a small boat, and made our way to his camp. Pablo was Moises' closest friend among the Matses, an adept hunter who fiercely resisted acculturation. The village, several days upriver and much more remote than San Juan, was home to Pablo, his four wives, their 22 children, and his brother Alberto, who had two wives and six children. Each wife had her own hut,

CONTINUED ON PAGE 93

SCIENCE SERVES THIS GENETICIST'S POLITICS—HER POLITICS INFUSE HER SCIENCE

MARY-CLAIRE KING

"I've learned not to question the motives of bastards. They just do what they do, and you try to stop it," says geneticist Mary-Claire King. Her tool for stopping bastards? The decoding of the human genome is revolutionizing genetics. But tracking strands of DNA and RNA around the globe and even backwards into prehistory has also politicized the old science of heredity. "I've never believed our way of thinking about science is separate from thinking about life. Whether we realize it or not, we are all political animals." Geneticist King turns discoveries at the forefront of her field into tools for the disenfranchised, be they women, AIDS victims, or targets of Latin America's death squads. Genetics in the hands of King is a potent weapon against bastards.

Today King divides her time between the School of Public Health and the Department of Molecular and Cell Biology at the University of California at Berkeley where she heads a lab of 23 researchers. In 1990, she located a gene implicated in familial breast cancer, which affects 600,000 women in the United States alone. She has identified a gene that underlies inherited deafness. King has also unmasked genetic differences in how people with AIDS react to the virus, information critical for developing therapies and a vaccine against HIV.

In pioneering research that hit the cover of *Science* magazine in April 1975, King established that the human and chimpanzee genome is 99-percent identical. Her findings were used to calibrate a molecular clock—the rate at which genetic molecules evolve—establishing that apes and humans diverged only about 5 million years ago. Her other major evolutionary research focused on the genetics of mitochondrial DNA, the hereditary material all of us can

PHOTOGRAPHS BY CINDY CHARLES

trace back through our mothers to a common ancestor, the so-called "mitochondrial Eve," who is thought to have lived as far back as 200,000 years ago in Africa (Mitochondria, cells' energy-producing structures, have their own genetic material that is passed down the maternal line.)

King now directs an international drive to map the mitochondrial DNA sequences of diverse populations around the world. Called the Human Genome Diversity Project, this is a twin to the Human Genome Project to map and sequence the human nuclear genome. The project will study and attempt to safeguard the world's mitochondrial genomes, especially those ancient populations, like the African Pygmies, who face extinction.

King's political engagement began as a graduate student at Berkeley in the Sixties. As an antiwar activist she dropped out of school to work for Ralph Nader. In 1984, the Abuelas de Plaza de Mayo, the Grandmothers of the Plaza of May, asked her to help retrieve their grandchildren, abducted during Argentina's Dirty War in the Seventies. Either sold or given to military families, the children were *disappeared* along with 15,000 other people who were tortured and killed during this fascist reign of terror.

The grandmothers needed evidence that would both expose false families and prove their relatedness to children whom these women could not identify. Using evidence derived from an array of genetic markers, King developed to demonstrate family relatedness, the grandmothers have won 50 court cases reuniting them with their grandchildren. Argentina has established a national genetic databank for resolving such cases in the future.

Born in Illinois in 1946, King—a great puzzle solver and lover of mysteries—studied mathematics at Carleton College in Minnesota before she realized in graduate school that genetics is the most mysterious puzzle of all. She sees herself in scientific and political revolutions that are rapidly changing the world. Her Berkeley office occupies the same command post from which she helped organize student protests against the Vietnam War. King is still fighting bastards, and still doing breathtakingly good science.—Thomas Bass

Omni: How did you finish your Ph.D. when you were so involved in the extraordinary turbulence and antiwar activities of the Sixties?

King: It was impossible to do science when Governor Ronald Reagan closed the University and sent the National Guard to throw us out of the buildings. I was in complete despair. I dropped out and went to work for Ralph Nader, studying the effects of pesticides on farm workers. After a year, I was offered a job with Nader in Washington and was considering taking it when I went to see my friend Allan Wilson, professor of biochemistry and molecular biology at Berkeley. "I can never get my experiments to work," I said, "I'm a complete disaster in the lab." And Allan said, "If everyone whose experiments failed stopped doing science, there wouldn't be any science." So I went to work in his lab.

Omni: What research was Allan Wilson doing?

King: Studying how species evolve with biochemistry and genetics. He postulated that humans and chimpanzees diverged about 5 million years ago. That was much more recent [by as much as 10 million years] than people who looked only at fossil evidence had thought. Allan asked me to look at the genetic difference between chimpanzees and humans. I couldn't seem to find any differences. I'd do tests involving migration rates of proteins, and I'd see a difference in one out of a hundred tests. I was in despair, but Allan kept saying, "This is great! It shows how similar we really are to chimps!" He turned straw into gold, and I wrote a perfectly reasoned dissertation that landed us on the cover of *Science*.

> "Mitochondrial DNA, since it's purely maternally transmitted, is ideal for human-rights cases. But for rapes and murders, the forensics approach has been the nuclear genes."

Omni: Why is Wilson's work controversial even today?

King: With Allan's death [in 1991 at age 56 of leukemia], discussion of mitochondrial Eve fell to people who created the data but lack the same sense of sophistication in interpreting it. The discussion centers on where and when she lived, not whether she lived.

Omni: What are mitochondria?

King: They code for proteins responsible for energy production. Each mammalian cell can hold thousands of mitochondria, which buffer the cell and keep it working at a good clip. Why mitochondria evolved apart from nuclear genes is not clear.

Omni: Explain mitochondrial Eve.

King: For any two individuals, one can always trace back through their maternal lineages to a point where their ancestors shared a mitochondrial sequence. If we trace one lineage, you and I and everyone else can tie ourselves together. So there has to be a common origin for this branching process. Using the molecular clock [the rate of mutations in mitochondrial DNA], Allan estimated that the mitochondrial Eve evolved sometime between 150,000 and 250,000 years ago in Africa. There one finds much more variation in mitochondrial lineages than anywhere else. We can all trace our ancestry to molecules that still exist in Africa.

Omni: So what's the mitochondrial Eve debate all about?

King: It centers on another question: What is the best tree we can draw to show these evolutionary branches? After Allan's death, his students published the best tree they'd found among the hundreds of thousands of possible trees. But it isn't significantly better than the next-best tree. There's so much molecular evidence that the ability to test one tree against another has yet to be perfected. How do you take an enormous number of human sequences or sequences from other species and figure out their common ancestor?

Omni: Couldn't this ancestor be located somewhere other than Africa?

King: If you say to yourself, I'm going to construct a tree that shows the common origin outside Africa, you can push the data in that direction. You cannot show by statistical testing alone that this tree is inferior to certain African trees. However, none of this bears on the question, Why is there so much more variation in Africa? Assuming the mitochondrial DNA changes at about the same rate everywhere in the world—because there's no selective pressure on it to change faster in one place than in another—then it will have changed the most where it's been around the longest. And there's no question where it's been around the most. Africa. All this confusion about statistical testing happened just after Allan died, and, unfortunately, it's muddied his brilliantly simple concept. I've yet to be involved publicly in the debate, but I will be soon because of the Human Genome Diversity Project.

Omni: What is that?

King: A very big deal. But let me begin with some personal history. The two main influences in my life were Allan

Wilson and Luca Cavalli-Sforza [at Stanford] Luca and I have worked together for a dozen years Luca and Allan were interested in the same problems but approached them from competing points of view Allan thought about mitochondrial sequences and constructing evolutionary trees Luca thinks about human population genetics

I became obsessed with the idea that Allan and Luca had to start collaborating And they did—I browbeat them into it They started working on a project to identify ancient populations not yet genetically devastated by invasion or death We hope to study their mitochondrial sequences and nuclear genes to try to get a sense of how variation has evolved and genetic migration has occurred

Omni: What populations have remained genetically intact?

King: Some groups of Pygmies in central Africa, whom Luca has studied since the early Sixties; populations in Siberia, the Anderman Islands off the coast of India the Basques, some Amerindians, even Europeans who've lived in the same place more than 100 years These are recent but relatively stable populations Not like you and me, modern urban people Just as anthropologists record cultures we'll compile a genetic record by asking for hair or blood samples and decoding genes We want to identify genetic diversity in each population and see how this corresponds to diversity in other populations We want to learn what is the relative importance in human evolution of climate, resistance to pathogens, anatomy, migration, mutation, and genetic drift, how is evolution influenced by the size of the population and who marries whom These are the fundamental forces of human evolution The best way to evaluate these forces is to identify people who've remained where they are for a long time They're the ones on whom evolutionary forces have been acting in a pure way

Omni: What happened when Wilson and Cavalli-Sforza got together?

King: Allan was already in the hospital when we launched the project I remember writing it during the Gulf War We were concerned that there might not be a world left to sample One of the groups we wanted to visit, a very isolated population of Iraqi Kurds, has been devastated Our desire for a sense of human variation in many different places led to a tremendous dispute between Allan and Luca, which was great fun to watch Everything I've told you is from Luca's point of view Allan's perspective was that the way to understand the forces acting on human evolution is not to sample diverse populations, but put a grid over the entire land mass of the earth and pick a person at every point on the grid—an indigenous person It you select populations in advance, then all you'll do is confirm what you already know Allan wanted to make many populations of size one, Luca wanted to work with fewer, but larger, populations

Omni: So what are you doing?

King: Using both methods And geneticists, anthropologists, and historians all over the world are involved People are asking, "Why is Basque a unique language? How did Siberians develop their particular anatomical features? Were the Americas settled in waves or streams? What trees are best for studying genetic relatedness? How many people do you have to sample to make a grid? Which populations can tell us the most about human history?" We hope to identify about 400

> "Like others in the prisons, she kept lists in her head of the babies born Janitors, too, were information sources, since the military didn't clean their own torture centers."

Omni: How did Argentina start disappearing its citizens? And how did you come to be involved in looking for kidnapped children?

King: When Peron died, Isabel ruled briefly until the military threw her out and imposed an explicitly fascist dictatorship Its politics and cultural roots were those of the Italian and German fascists who'd migrated there after the war Their sons took charge after the coup, and in 1975 a civil war started in earnest The military picked up and kidnapped vast numbers of people to terrorize the population They garnered pregnant women and women with babies Children old enough to report on what happened to them were killed Pregnant women were kept alive and tortured until they gave birth The babies were sold or handed out for adoption among the military and then the mothers killed

By 1977, a number of human-rights groups, mostly of the families of the disappeared, had formed One group consisted of grandmothers whose daughters and sons had been killed Their grandchildren were born in captivity or kidnapped when babes in arms Some may even have been sold abroad Since no one in these prisons knew anything about obstetrics, a midwife or obstetrician would be kidnapped off the streets blindfolded, and told to deliver the child They were instructed not to speak to the mother, but invariably they did They'd find out her name, deliver the child, and see her taken away The doctor or midwife, after being dumped in town, would report what they'd learned to the grandmothers

Omni: What happened to the mothers?

King: Sometimes they'd be killed outright, sometimes returned to their cells where they'd tell other women whether they'd delivered a boy or girl At the time of the World Cup finals, athletes refused to play in Argentina unless political prisoners were released or at least brought to trial The military went through cells and picked a few people at random, saying they'd been declared innocent and everyone else guilty I know this from a woman released at the time—someone my age, although she looks 60, who is now a lawyer for the grandmothers Like other women who'd been in detention, she kept lists in her head of babies who'd been born Janitors were another good source of information because the military didn't clean their own torture centers

Omni: How did the grandmothers follow these leads?

King: When children appeared abruptly in families where everybody knew the woman hadn't been pregnant, the grandmothers would be called anonymously When the children started kindergarten, the schools had to be presented with birth certificates—and even I can tell when these are forged Again, the grandmothers would be informed By 1983, the time of the Malvinas Falklands War, the grandmothers had information on 144 cases Now we're up to 217 cases Some of the original 144 were killed, but most were not

After the Malvinas War, the grandmothers realized the military was on its way out and that they were going to be able to bring these cases to court Often they had hypotheses about children's identities They also knew it wasn't going to be enough to prove these "imposed" parents were not the real ones The grandmothers needed to prove who the real parents were

In 1983, two of the grandmothers came to Washington, DC, and met with the committee on scientific responsibility at the American Association for the Advancement of Science They

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ANTIMATTER

UFO UPDATE:
Can the poison of anti-Semitism wreck years of pristine research into UFOs?

What do anti-Semitism and UFOlogy have in common? Plenty, say experts like James Moseley, a long-time observer of the UFO scene and publisher of the irreverent newsletter, *Saucer Smear*. Indeed, for almost as long as UFO buffs have searched the night sky, a few outrageous souls have claimed the existence of a superrace of aliens in the image of the Aryan ideal. What's more, some fringe members of the UFO movement have "communed" with aliens prone to trashing Jews.

According to Moseley, anti-Jewish sentiments first crept into UFOlogy in the 1950s when self-proclaimed contactees like George Adamski and George Hunt Williamson described blond, blue-eyed aliens in line with the Nazi ideal. Later, William Dudley Pelley, head of the U.S.-based fascist Silver Shirts, tied his anti-Semitic philosophy to Aryan aliens as well.

These sour notes have crescendoed through the modern-day world of UFOlogy, too. Since 1989, for instance, a bald, nine-and-a-half-foot-tall alien named Hatonn has allegedly been communicating—through a channeler, of course—with West Coast publisher George Green.

The gist of the communiques? Hatonn claims that "so-called Jews are descendants of Khazars, a Mongolian, nomadic tribe." In fact, according to *The Trillion Dollar Lie*, the book supposedly "channeled" by a Tehachapi, California, grandmother named Doris Ekker, Hatonn rants that the horrors of the Holocaust never occurred, at least not in the sense that history books contend. Instead, the alleged Pleiadian, citing as his source the incendiary and highly anti-Semitic piece of *human* propaganda, *The Protocols of the Learned Elders of Zion*, asserts the evils of a group of "elite Zionists" bent on ruling the world.

In fact, although the *Protocols* document was long ago proven to be a turn-of-the century fabrication created by anti-Semitic czarist secret police—it was later used by Nazis to rationalize genocide in Hitler's Germany—George Green insists it's factual. "The adversary only tells the truth up to a point," Green claims Hatonn has told him. Pointing to other "truths" revealed by the blue-eyed, blond-haired alien, Green says that Hatonn has also stated that Hitler escaped to Antarctica at the end of World War II and that the original George Bush was replaced by a synthetic humanoid. (Bill Clinton may be a humanoid, too; however, it's still too soon to tell.)

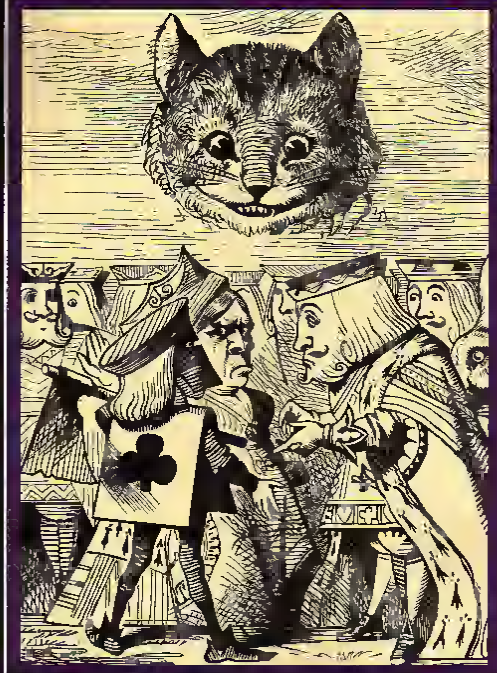
Another suspicious note, meanwhile, has been sounded by conspiracy theorist William Cooper, formerly of U.S. Naval Intelligence. In his book *Behold a Pale Horse* (Light Technology Publishing), Cooper invokes *The Protocols of the Learned Elders of Zion* as proof that organized secret societies, including people of many races and nationalities, are planning to use the invented threat of E.T.'s to help them destroy governments and religions and take over the world.

Needless to say, Alan Schwartz, research director of the Anti-Defamation League of B'nai B'rith, is unimpressed. "Linking *The Protocols of the Learned Elders of Zion* to UFOs and plots to take over the world is bizarre, destructive, hateful nonsense," Schwartz contends. "The notion that *The Protocols* has any grain of truth in it has been refuted by scholars and legal courts around the world."

John Timmerman, vice president of public relations for the Chicago-based Center for UFO Studies, is annoyed as well. "These fringe elements in UFOlogy contaminate a field where we are trying to find pristine information," Timmerman states. "However, serious research has been able to sidestep the idiotic material that is permeating much of the written literature on UFOs. Cool heads, I'm happy to say, will prevail."

—SHERRY BAKER

ANTIMATTER



SECRET OF THE CHESHIRE CAT

Where did Lewis Carroll get his inspiration for the famed Cheshire cat, the wacky feline that vanishes—all except for its grin—during Alice's visit to Wonderland?

The answer, some experts now say, may have been accidentally uncovered by an American tourist visiting the tenth-century St. Peter's Church in Croft, County Durham, where Carroll's father, the Reverend Charles Dodson, preached for 24 years. The tourist was near the altar when he glimpsed a crude stone carving of a cat on a panel wall Moreover, while crouching to kneel, the tourist watched the eight-inch-wide cat gradually disappear from view. By the time his knees touched the ground, all he could see was the strange grin on the animal's face.

The tourist, one of 35 members of the British-based Lewis Carroll Society, was visiting the church for the very first time, according to the Society's membership secretary, Edward Wakeling. While Wakeling says he doesn't yet know what the significance of the discovery will be, he notes that "as you slowly kneel, the stone cat's face disappears, and all you can see is the broad grin, which stretches almost from ear to ear."

The cat's true identity, he added, was probably never pinpointed simply because no one ever bothered to ask.

—Ivor Smullen

ABDUCTEE OPPRESSION

BREAKING THE YOKE OF OPPRESSION: UFO ABDUCTEES NOW CHOOSE WHO THEY TALK TO BASED ON THE RESPECT ACCORDED THEIR FEELINGS AND THEIR BASIC HUMAN RIGHTS.

Harvard psychiatrist John Mack says UFO abductees should avoid debunkers like the plague. "It's fine to study abductees and present a skeptical point of view," Mack says. But those who criticize abductees can be vicious about it, Mack believes—so much so that their verbal attacks amount to abuse. In fact, Mack contends, UFO abductees are a legitimate minority group whose rights are violated at every turn.

Mack is so incensed over the treatment his abductee/patients have received that he suggests they no longer come in contact with debunkers at all. Putting debunkers on TV shows with abductees, according to Mack, "is like interviewing Holocaust survivors along with skeptics who say the Holocaust never occurred."

Still, political scientist and minority-rights expert Opuku Agyeman of Montclair State College in New Jersey hesitates to put abductees in the same class as a legitimate minority. He says that just making people feel uncomfortable for holding a particular view does not violate their rights; it's an example of free speech. Abductees would be considered a bona fide minority, he states, only if their views were called deplorable and unacceptable and if they were punished as a result.

—Paul McCarthy

THE HEALING ART

"With your eyes closed, imagine a white light above the top of your head. Take a deep breath, really letting it flow through your body. Begin to feel the breath in your body, not just the lungs."

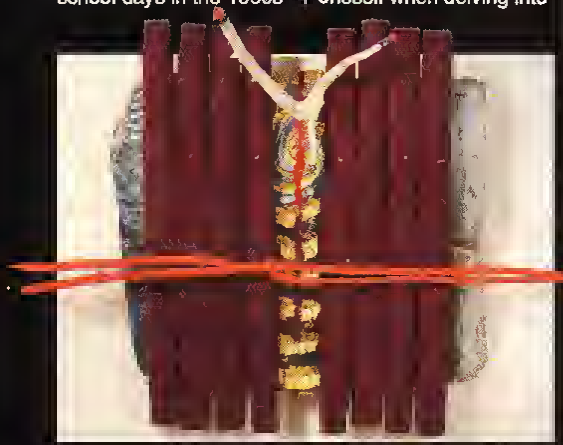
So begins a guided meditation led by artist/psychic Nancy Azara, whose "Art Making as an Act of Healing" workshop helps participants create art through e newly discovered connection with themselves. "The first thing I teach people is that art is about them, not some formula they've learned in art school that has no connection to who they are personally," Azara explains.

A sculptor herself, Azara recalls her art-school days in the 1960s when she decided to work with clay in the classroom while pursuing woodcarving, her true love, at home. "I knew that what I wanted from school was to train my eye, and I could do just as well with clay," she explains. "If I had carved at school, they would have had me treat the wood, waxing it until it became so precious I couldn't have had a dialogue with it. I was interested in listening to the wood the same way one listens to oneself when delving into the unconscious."

> "THE FIRST THING I TELL MY WORKSHOP STUDENTS IS THAT ART IS ABOUT THEM AS INDIVIDUALS, NOT SOME ACADEMIC OR ABSTRACT FORMULA."

Azara's arts and healing workshop is geared to do just that. In one meditation, for instance, she has participants envision their beating hearts and then explore the host of other images that may emerge as a result. She also asks her students to draw what they've experienced and then share their drawings and meditative experiences with the rest of the group. Says Azara, "Teaching these workshops has helped me bring art back to its original purpose—making visual expression from the questions, the ewe, the wonder, and the pain that exist within."

Anyone interested can sign up for Azara's summer workshops at the University of Minnesota in Duluth or in Assisi, Italy.—Judith Bell



COSMIC HENDRIX

"I'm from Mars," Jimi Hendrix once told a reporter. Now Curtis Knight, who played with Hendrix in a group called the Squires in the 1960s, says it may have been true. Stuck in a snowdrift in upstate New York one winter night in 1965, the Squires feared they would freeze to death, Knight claims, until a cone-shaped craft landed, and an alien freed their vehicle from the snow.

Only Knight and Hendrix saw the UFO, Knight explains, because other band members had been summarily "turned off." "I waited years to reveal the encounter," says Knight, author of *Jimi Hendrix: Starchild* (Abelard Productions), "because I figured people would laugh."

—Sherry Baker

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ENGLAND

CONTINUED FROM PAGE 63

With the south coast from Penzance to Oover in the lead (or perhaps it should be said at the bow) and the Highlands of Scotland at the stern, the United Kingdom was making almost four knots 3 8 to be precise

"A modest and appropriate speed," the King told his subjects, speaking from his chambers in Buckingham Palace, which had been decked out with nautical maps and charts, a lighted globe, and a silver sextant. "Approximately equal to that of the great ships-of-the-line of Nelson's day."

In actual fact, the BBC commentator corrected (for they will correct even a king), 3 8 knots was considerably slower than an 18th century warship But it was good that this was so, Britain being, at best, blunt; indeed, it was estimated that with even a half-knot more speed, the seas piling up the Plymouth and Exeter channels would have devastated the docks Oddly enough, it was London, far from the headwinds and bow wave, that was hardest hit The wake past Margate, along what used to be the English Channel, had sucked the Thames down almost two feet, leaving broad mud flats along the Victoria Embankment and under the Waterloo Bridge. The news showed treasure seekers with gum boots tracking mud all over the city, "a mud as foul-smelling as the ancient crimes they unearth daily," said BBC Not a very patriotic report, thought Mr Fox, who turned from the telly to Harrison to remark "I believe you have family there."

"In London? Not hardly," said Harrison. "They've all gone to America."

By the time the Scottish mountain tops should have been enduring (or perhaps "enjoying" is the word being mountains, and Scottish at that) the first snow flurries of the winter, they were enjoying (or perhaps "enduring") subtropical rains as the United Kingdom passed just to the north of the Azores. The weather in the south (now west) of England was springlike and fine. The boys at the cricket ground, who had usually put away their kites by this time of year, were out every day, affording endless delight to Anthony, who accepted with the simple, unquestioning joy of a dog, the fact of a world well supplied with running boys. *Our Day's Log*, the popular new BBC evening show, which began and ended with shots of the bow wave breaking on the rocks of Cornwall, showed hobbyists with telescopes and camcorders on the cliffs at Oover, cheering "Land Ho!" on sighting the distant peaks of the Azores. Things were getting back to normal. The public (according to the news) was finding that even the mid-Atlantic held no terrors. The wave of urban seasickness that had been predicted never materialized. At a steady 3.8 knots, Great Britain was unaffected by the motion of the waves, even during the fiercest storms. It was almost as if she had been designed for travel, and built for comfort, not for speed. A few of the smaller Scottish islands had been stripped away and had, alarmingly, sunk, but the only real damage was on the east (now south) coast, where the slipstream was washing away house-sized chunks of the soft Norfolk banks. The King was seen on the news, in muddy hip boots, helping to dike the fens against the wake. Taking a break from digging, he reassured his subjects that the United

> "At 3.8 knots, Great Britain was unaffected by the motion of the waves, as if she had been designed for travel, and built for comfort, not for speed."

Kingdom, wherever it might be headed, would remain sovereign. When a reporter, with shocking impertinence, asked if that meant that His Majesty *didn't know* where his Kingdom was headed, King Charles answered coolly that he hoped his subjects were satisfied with his performance in a role that was, after all, designed to content them with *what was*, rather than to shape or even predict *what might be*. Then, without excusing himself, he picked up his silver shovel with the Royal Crest, and began to dig again.

Meanwhile, at Mrs. Oldenshield's, all of London was abuzz with Lizzie's loss. Or supposed loss. Only Lizzie (and Messrs. Fox and Trollope) knew that the diamonds had been not in her strongbox but under her pillow. Mr. Fox's letter from his niece arrived a day earlier still, on the third of the month, underscoring in its own quiet manner that England was indeed underway. The letter, which Mr. Fox read in reverse, as usual, ended alarmingly with the words "looking forward to seeing you." Forward? He read on backward and found "underway toward America." America? It had never occurred to Mr. Fox. He looked at the return address on the envelope. It was from a town called, rather ominously, Babylon.

Lizzie was one for holding on. Even though the police (and half of London society) suspected that she had engineered the theft of the diamonds in order to avoid returning them to the Eustace family, she wasn't about to admit that they had never been stolen at all. Indeed, why should she? As the book was placed back up on the shelf day after day, Mr. Fox marveled at the strength of character of one so able to convince herself that what was in her interest was in the right. The next morning there was a small crowd on the West Pier, waving Union Jacks and pointing toward a smudge on the horizon. Mr. Fox was not surprised to see a familiar face (and hairdo) among them.

"Bermuda," said the African. Mr. Fox only nodded, not wanting to provoke the girl, whom he suspected was waiting on the other side of the African, waiting to strike. Was it only his imagination, that the smudge on the horizon was pink? That night and the two nights following, he watched the highlights of the Bermuda Passage on the telly over the bar. The island, which had barely been visible from Brighton, passed within a mile of Oover, and thousands turned out to see the colonial policemen in their red coats lined up atop the coral cliffs, saluting the Mother Country as she passed. Even where no crowds turned out, the low broads of Norfolk, the shaley cliffs of Yorkshire, the rocky headlands of Scotland's (former) North Sea coast, all received the same salute. The passage took nearly a week, and Mr. Fox thought it was quite a tribute to the Bermudans' stamina, as well as their patriotism.

Over the next few days, the wind shifted and began to drop. Anthony was pleased, noticing only that the boys had to run harder to lift their kites, and seemed to need a dog yipping along beside them more than ever. But Mr. Fox knew that if the wind dropped much further, they would lose interest altogether. The Bermudans were satisfied with their glimpse of the Mother Country, according to BBC, but the rest of the Commonwealth members were outraged as the United Kingdom turned sharply north after the Bermuda Passage, and headed north on a course that appeared to be carrying it toward the USA. Mr. Fox meanwhile, was embroiled in a hardly unexpected but no less devastating crisis of a

more domestic nature For Lizzie had had her diamonds stolen—for real this time! She had been keeping them in a locked drawer in her room at the loathsome Mrs Carbuncle's If she reported the theft, she would be admitting that they hadn't been in the strongbox stolen in Scotland Her only hope was that they, and the thieves, were never found

COMMONWEALTH IN UPROAR
CARIBBEAN MEMBERS REGISTER
SHARP PROTEST
BRITS TO BASH BIG APPLE?

The British and American papers were held up side by side on BBC Navigation experts were produced, with pointers and maps, who estimated that on its current course the south (now north) of England would nose into the crook of New York harbor, where Long Island meets New Jersey, so that Dover would be in sight of the New York City skyline. Plymouth was expected to end up off Montauk, and Brighton somewhere in the middle, where there were no place names on the satellite pictures Harrison kept a map under the bar for settling bets, and when he pulled it out after *Our Daily Log* Mr Fox was alarmed (but not surprised) to see that the area where Brighton was headed was dominated by a city whose name evoked images too lurid to visualize

Babylon

On the day that Lizzie got her first visit from Scotland Yard Mr Fox saw a charter fishing boat holding steady off the shore, making about three knots It was the *Judy J* out of Islip, and the rails were packed with people waving Mr Fox waved back, and waved Anthony's paw for him An airplane flew low over the beach towing a sign On the telly that night, Mr Fox could see on the satellite picture that Brighton was already in the lee of Long Island, that was why the wind was dropping The BBC showed clips from *King Kong* "New York City is preparing to evacuate," said the announcer "fearing that the shock of collision with ancient England will cause the fabled skyscrapers of Manhattan to tumble" He seemed pleased by the prospect, as did the Canadian earthquake expert he interviewed, as, indeed, did Harrison New York City officials were gloomier they feared the panic more than the actual collision The next morning there were two boats off the shore and in the afternoon, five The waves, coming in at an angle, looked tentative after the bold swells of the mid-Atlantic At tea, Lizzie was visited for the second time by Scotland Yard Something seemed to have gone out of her some of her

fight, her spunk. Something in the air outside the tea room was different too, but it wasn't until he and Anthony approached the cricket ground that Mr. Fox realized what it was. It was the wind. It was gone altogether. The boys were struggling to raise the same kites that had flown so eagerly only a few days before. As soon as they stopped running the kites came down. Anthony ran and barked wildly, as if calling on Heaven for assistance, but the boys went home before dark, disgusted.

That night, Mr. Fox stepped outside the Pig & Thistle for a moment after supper. The street was as still as he had always imagined a graveyard might be. Had everyone left Brighton, or were they just staying indoors? According to *Our Daily Log*, the feared panic in New York City had failed to materialize. Video clips showed horrendous traffic jams, but they were apparently normal. The King was — but just as the BBC was about to cut to Buckingham Palace, the picture began to flicker and an American game show came on. "Who were the Beatles," said a young woman standing in a sort of bright pulpit. It was a statement and not a question.

"The telly has arrived before us," said Harrison, turning off the sound but leaving the picture. "Shall we celebrate with a whisky? My treat tonight."

Mr. Fox's room, left to him by Mr. Singh, the original owner of the Pig & Thistle, was on the top floor under a gable. It was small; he and Anthony shared a bed. That night they were awakened by a mysterious, musical scraping sound. "Woof," said Anthony in his sleep. Mr. Fox listened with trepidation, he thought at first that someone, a thief certainly, was moving the piano out of the public room downstairs. Then he remembered that the piano had been sold twenty years before. There came a deeper rumble from far away—and then silence. A bell rang across town. A horn honked, a door slammed. Mr. Fox looked at the time on the branch bank across the street (he had positioned his bed to save the cost of a clock). It was 4:36 a.m., Eastern Standard Time. There were no more unusual sounds, and the bell stopped ringing. Anthony had already drifted back to sleep, but Mr. Fox lay awake, with his eyes open. The anxiety he had felt for the past several days (indeed, years) was mysteriously gone, and he was enjoying a pleasant feeling of anticipation that was entirely new to him.

"Hold still," Mr. Fox told Anthony as he brushed him and snapped on his little tweed suit. The weather was getting colder. Was it his imagination, or was the light through the window over the breakfast table different as the Finn served him his boiled egg and toast and marmalade and tea with milk? There was a fog, the first in weeks. The street outside the inn was deserted, and as he crossed the King's Esplanade and climbed the twelve steps, Mr. Fox saw that the Boardwalk was almost empty, too. There were only two or three small groups, standing at the railing, staring at the fog as if at a blank screen.

There were no waves, no wake, the water lapped at the sand with nervous, pointless motions like an old lady's fingers on a shawl. Mr. Fox took a place at the rail. Soon the fog began to lift and emerging in the near distance, across a gray expanse of water, like the image on the telly when it has first been turned on, Mr. Fox saw a wide, flat beach. Near the center was a cement bathhouse. Knots of people stood on the sand, some of them by parked cars. One of them shot a gun into the air; another waved a striped flag. Mr. Fox waved Anthony's paw for him.

America (and this could only be America) didn't seem very developed. Mr. Fox had expected, if not skyscrapers, at least more buildings. A white lorry pulled up beside the bathhouse. A man in uniform got out, lit a cigarette, looked through binoculars. The lorry said GOYA on the side.

"Welcome to Long Island," said a familiar voice. It was the African. Mr. Fox nodded but didn't say anything. He could see the girl on the African's other side, looking through binoculars. He wondered if she and the GOYA man were watching each other. "If you expected skyscrapers, they're fifty miles west of here, in Dover," said the African.

"West?"

"Dover's west now, since England's upside down. That's why the sun rises over Upper Beeding."

Mr. Fox nodded. Of course. He had never seen the sun rising, though he felt no need to say so.

"Everyone's gone to Dover. You can see Manhattan, the Statue of Liberty, the Empire State Building, all from Dover."

Mr. Fox nodded. Reassured by the girl's silence so far, he asked in a whisper, "So what place is this, where are we now?"

"Jones Beach."

"Not Babylon?"

"You bloody wish," said the girl.

Mr. Fox was exhausted. Lizzie was being harried like the fox she herself had hunted with such bloodthirsty glee in

Scotland. As Major Mackintosh closed in, she seemed to take a perverse pleasure in the hopelessness of her situation, as if it bestowed on her a vulnerability she had never before possessed, a treasure more precious to her than the Eustace family diamonds. "Mr. Fox?" asked Mrs. Oldenshield.

"Mr. Fox?" She was shaking his shoulder. "Oh. I'm quite all right,' he said. The book had fallen off his lap and she had caught him sleeping. Mrs. Oldenshield had a letter for him. (A letter for him!) It was from his niece, even though it was only the tenth of the month. There was nothing to do but open it. Mr. Fox began, as usual, at the ending, to make sure there were no surprises, but this time there were. 'Until then,' he read. As he scanned back through, he saw mention of 'two ferries a day,' and he couldn't read on. How had she gotten Mrs. Oldenshield's address? Did she expect him to come to America? He folded the letter and put it into his pocket. He couldn't read on.

That evening BBC was back on the air. The lights of Manhattan could be seen on live video from atop the cliffs of Dover, shimmering in the distance through the rain (for England had brought rain). One-day passes were being issued by both governments, and queues were already six blocks long. The East (now West) Kent Ferry from Folkestone to Coney Island was booked solid for the next three weeks. There was talk of service to Eastbourne and Brighton as well. The next morning after breakfast, Mr. Fox lingered over his tea, examining a photograph of his niece which he had discovered in his letter box while putting her most recent (and most alarming) letter away. She was a serious-looking nine-year-old with a yellow ribbon in her light brown hair. Her mother, Mr. Fox's sister, Clare, held an open raincoat around them both. All this was thirty years ago but already her hair was streaked with grey. The Finn cleared the plates, which was the signal for Mr. Fox and Anthony to leave. There was quite a crowd on the Boardwalk, near the West Pier watching the first ferry from America steaming across the narrow sound. Or was 'steaming' the word? It was probably powered by some new type of engine. Immigration officers stood idly by, with their clipboards closed against the remnants of the fog (for England had brought fog). Mr. Fox was surprised to see Harrison at the end of the pier, wearing a windbreaker and carrying a paper bag that was greasy, as if it contained food. Mr. Fox had never seen Harrison in the day, nor outside, before, in fact, he had never seen his legs. Harrison was wearing striped pants and before Mr. Fox could speak to him, he sidled away like a crab into the crowd. There was a jolt as the ferry struck the pier. Mr. Fox stepped back just as Americans started up the ramp like an invading army. In the front were teenagers, talking among themselves as if no one else could hear; older people, almost as loud, followed behind them. They seemed no worse than the Americans who came to Brighton every summer, only not as well dressed.

'Woof woof!'

Anthony was yipping over his shoulder, and Mr. Fox turned and saw a little girl with light brown hair and a familiar yellow ribbon. 'Emily?' he said, recognizing his niece from the picture. Or so he thought. "Uncle Anthony?" The voice came from behind him again. He turned and saw a lady in a faded Burberry. The fog was blowing away and behind her he could see, for the first time that day, the drab American shore.

"You haven't changed a bit.' the woman said. At first Mr. Fox thought she was his sister, Clare, just as she had been thirty years before, when she had brought her daughter to Brighton to meet him. But of course Clare had been dead for twenty years, and the woman was Emily, who had then been almost ten, and was now almost forty, and the girl was her own child (the great-niece who had been growing up inexorably) who was almost ten. Children, it seemed, were almost always almost something.

"Uncle Anthony?" The child was holding out her arms. Mr. Fox was startled, thinking she was about to hug him, then he saw what she wanted and handed her the dog. "You can pet him," he said. "His name is Anthony, too."

"Really?"

'Since no one ever calls us both at the same time, it creates no confusion," said Mr. Fox.

"Can he walk?"

"Certainly he can walk. He just doesn't often choose to."

A whistle blew and the ferry left with its load of Britons for America. Mr. Fox saw Harrison at the bow, holding his greasy bag with one hand and the rail with the other, looking a little sick, or perhaps apprehensive. Then he took his niece and great-niece for a stroll along the Boardwalk. The girl, Clare—she was named after her grandmother—walked ahead with Anthony while Mr. Fox and his niece, Emily, followed behind. The other Americans had all drifted into the city looking for restaurants, except for the male teenagers, who were crowding into the amusement par-

lors along the Esplanade, which had opened for the day.

"If the mountain won't come to Mahomet, and so forth," said Emily mysteriously, when Mr. Fox asked if she'd had a nice crossing. Her brown hair was streaked with grey. He recognized the coat now, it had been her mother's, his sister's, Clare's. He was trying to think of where to take them for lunch. The Finn at the Pig & Thistle served a pretty fair shepherd's pie, but he didn't want them to see where he lived. They were content, however, with fish and chips on the Boardwalk, certainly Anthony seemed pleased to have chips fed to him, one by one, by the little girl named for the sister Mr. Fox had met only twice, once when she had been a student at Cambridge (or was it Oxford? he got them confused) about to marry an American, and once when she had returned with her daughter for a visit.

Her father, your grandfather, was an Air Raid Warden," Mr. Fox told Emily. "He was killed in action, as it were, when a house collapsed during a rescue, and when his wife (well, she wasn't exactly his wife) died giving birth to twins a week later, they were each taken in by one of those whose life he had saved. It was a boarding house, all single people, so there was no way to keep the two together, you see—the children. I mean. Oh dear. I'm afraid I'm talking all in a heap."

"That's okay," said Emily.

"At any rate, when Mr. Singh died and his Inn was sold, my room was reserved for me, in accordance with his will, *in perpetuity*, which means as long as I remain in it. But if I were to move, you see, I would lose my patrimony entire."

"I see," said Emily. "And where is this place you go for tea?"

And so they spent the afternoon, and a rainy and an English afternoon it was, in the cozy tea room with the faded purple drapes at the west (formerly east) end of Moncton Street where Mrs. Oldenshield kept Mr. Fox's complete set of Trollope on a high shelf, so he wouldn't have to carry them back and forth in all kinds of weather. While Clare shared her cake with Anthony, and then let him doze on her lap, Mr. Fox took down the handsome leather-bound volumes, one by one, and showed them to his niece and great-niece. "They are, I believe, the first complete edition," he said. "Chapman and Hall."

"And were they your father's?" asked Emily. "My grandfather's?"

"Oh no!" said Mr. Fox. "They belonged to Mr. Singh. His grandmother was English and her own great-uncle had been, I believe, in the postal service in Ireland with the author, for whom I was, if I am not mistaken, named." He showed Emily the place in *The Eustace Diamonds* where he would have been reading that very afternoon. "were it not," he said, "for this rather surprisingly delightful family occasion."

"Mother, is he blushing," said Clare. It was a statement and not a question.

It was almost six when Emily looked at her watch—a man's watch, Mr. Fox noted—and said, "We had better get back to the pier, or we'll miss the ferry." The rain had diminished to a misty drizzle as they hurried along the Boardwalk. "I must apologize for our English weather," said Mr. Fox, but his niece stopped him with a hand on his sleeve. "Don't brag," she said, smiling. She saw Mr. Fox looking at her big steel watch and explained that it had been found among her mother's things; she had always assumed it had been her grandfather's. Indeed, it had several dials, and across the face it said "Civil Defense, Brighton." Across the bay, through the drizzle as through a lace curtain, they could see the sun shining on the sand and parked cars.

"Do you still live in, you know—" Mr. Fox hardly knew how to say the name of the place without sounding vulgar, but his niece came to his rescue. "Babylon? Only for another month. We're moving to Deer Park as soon as my divorce is final."

"I'm so glad," said Mr. Fox. "Deer Park sounds much nicer for the child."

"Can I buy Anthony a goodbye present?" Clare asked. Mr. Fox gave her some English money (even though the shops were all taking American) and she bought a paper of chips and fed them to the dog one by one. Mr. Fox knew Anthony would be flatulent for days, but it seemed hardly the sort of thing one mentioned. The ferry had pulled in and the tourists who had visited America for the day were streaming off, loaded with cheap gifts. Mr. Fox looked for Harrison, but if he was among them, he missed him. The whistle blew two warning toots. "It was kind of you to come," he said.

Emily smiled. "No big deal," she said. "It was mostly your doing anyway. I could never have made it all the way to England if England hadn't come here first. I don't fly."

"Nor do I." Mr. Fox held out his hand but Emily gave him a hug, and then a kiss, and insisted that Clare give him both as well. When that was over, she pulled off the watch (it was

fitted with an expandable band) and slipped it over his thin, stick-like wrist. "It has a compass built in," she said. "I'm sure it was your father's. And Mother always..."

The final boarding whistle swallowed her last words. "You can be certain I'll take good care of it," Mr. Fox called out. He couldn't think of anything else to say. "Mother, is he crying?" said Clare. It was a statement and not a question. "Let's you and me watch our steps," said Emily.

"Woof." said Anthony, and mother and daughter ran down (for the pier was high, and the boat was low) the gangplank. Mr. Fox waved until the ferry had backed out and turned, and everyone on board had gone inside, out of the rain, for it had started to rain in earnest. That night after dinner he was disappointed to find the bar unattended. "Anyone seen Harrison?" he asked. He had been looking forward to showing him the watch.

"I can get you a drink as well as him," said the Finn. She carried her broom with her and leaned it against the bar. She poured a whisky and said, "Just indicate it you need another." She thought indicate meant ask. The King was on the telly, getting into a long car with the President. Armed men stood all around them. Mr. Fox went to bed.

The next morning, Mr. Fox got up before Anthony. The family visit had been pleasant—indeed, wonderful—but he felt a need to get back to normal. While taking his constitutional, he watched the first ferry come in, hoping (somewhat to his surprise) that he might see Harrison in it, but no such luck. There were no English, and few Americans. The fog rolled in and out like the same page on a book being turned over and over. At tea, Mr. Fox found Lizzie confessing (just as he had known she someday must) that the jewels had been in her possession all along. Now that they were truly gone, everyone seemed relieved, even the Eustace family lawyer. It seemed a better world without the diamonds.

'Did you hear that?"

"Beg your pardon?" Mr. Fox looked up from his book. Mrs. Oldenshield pointed at his teacup, which was rattling in its saucer. Outside, in the distance, a bell was ringing. Mr. Fox wiped off the book himself and put it on the high shelf, then pulled on his coat, picked up his dog, and ducked through the low door into the street. Somewhere across town, a horn was honking. "Woof," said Anthony. There was a breeze for the first time in days. Knowing, or at least suspecting what he would find, Mr. Fox hurried to the Boardwalk. The waves on the beach were flattened, as if the water were being sucked away from the shore. The ferry was just pulling out with the last of the Americans who had come to spend the day. They looked irritated. On the way back to the Pig & Thistle Mr. Fox stopped by the cricket ground, but the boys were nowhere to be seen, the breeze being still too light for kiting, he supposed. "Perhaps tomorrow," he said to Anthony. The dog was silent, lacking the capacity for looking ahead.

That evening, Mr. Fox had his whisky alone again. He had hoped that Harrison might have shown up, but there was no one behind the bar but the Finn and her broom. King Charles came on the telly, breathless, having just landed in a helicopter direct from the Autumn White House. He promised to send for anyone who had been left behind, then commanded (or rather, urged) his subjects to secure the kingdom for the Atlantic. England was underway again. The next morning the breeze was brisk. When Mr. Fox and Anthony arrived at the Boardwalk, he checked the compass on his watch and saw that England had turned during the night, and Brighton had assumed its proper position, at the bow. A stout headwind was blowing and the sea wall was washed by a steady two-foot curl. Long Island was a low, dark blur to the north, far off the port (or left).

"Nice chop."

"Beg pardon?" Mr. Fox turned and was glad to see a big man in a tweed coat, standing at the rail. He realized he had feared the African might have jumped ship like Harrison.

"Looks like we're making our four knots and more, this time."

Mr. Fox nodded. He didn't want to seem rude, but he knew if he said anything the girl would chime in. It was a dilemma.

"Trade winds,' said the African. His collar was turned up, and his dreadlocks spilled over and around it like vines. "We'll make better time going back. It indeed we're going back. I say, is that a new watch?'

"Civil Defense chronometer." Mr. Fox said. "Has a compass built in. My father left it to me when he died."

"You bloody wish," said the girl.

"Should prove usetul," said the African.

"I should think so,' said Mr. Fox, smiling into the fresh salt wind, then, saluting the African (and the girl), he tucked Anthony under his arm and left the Boardwalk in their command. England was steady, heading south by south east, and it was twenty past four, almost time for tea. DC

MAKING MAGIC

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so there were several in the pueblo. When we arrived, we were invited to climb the steep and muddy riverbank to the pueblo. There, Pablo's main wife, Ma Shu, served us a meal of cold roast sloth and yucca.

After dinner, Pablo produced an old brown beer bottle and a hollow reed tube. From the bottle he poured a fine green powder into his hand and worked it into one end of the tube. Alberto put the other end of the tube to his nose and Pablo blew the powder into his nostrils. They repeated the process several times. Moises explained that the powder was *nu-nu* and that Matses hunters used it to have visions of where to hunt. He said that after the visions they would go to the place they'd seen and wait for the animals in the vision to appear. I told Moises he was dreaming, but he insisted that was what happened and pressed Pablo to give me some. A few minutes later, the tube was put to my nose.

When the *nu-nu* hit, it seemed to explode inside my face. It burnt my nose and I began to choke up a wretched green phlegm. But the pain quickly subsided and I closed my eyes. Out of the blackness I began to have visions of animals—tapir, monkey, wild boar—that I saw more clearly than my limited experience with them should have allowed. Then suddenly the boars stampeded in front of me. As I watched them thunder past, my field of vision several began to fall. Moments later, the visions faded, and a pleasant sort of drunkenness washed over me.

Moises asked what I saw and whether I recognized the place where the vision happened. I told him it looked like the place where we'd eaten lunch earlier in the day. He asked what time it was in the vision, and I told him that the sun was shining but mist still hung from the trees. He put the time between 7 and 8 a.m. Despite my suspicion that I'd invented the entire vision, Moises told the Matses what I'd seen.

At dawn the next morning, several of us piled into our boat and headed toward the spot I'd described. As we neared it, I was astounded to hear the thunderous roar of dozens of boars charging across the river in front of us. We jumped out of the boat and chased them. Several ran into a hollow log, and Pablo and Alberto blocked the ends with thick branches while the others made nooses out of vines. Holes were cut into the top of the log with a machete, the nooses slipped through them, and the boars strangled. We returned with seven boars, enough meat for the entire village for four days.

Improbable as it seemed, the scene was close enough to what I'd described that there was no denying the veracity of the vision. I later asked how *nu-nu* worked, and Pablo explained—in a mix of hand signals, Matses, and pidgin Spanish—that *nu nu* put you in touch with the animals. He said the animals' spirits also see the visions and know what awaits them.

The morning after the hunt, I was with Pablo, sitting on the bark floor of Ma Shu's hut, pointing to things and asking what the Matses words for them were. I made notes, writing down the phonetic spelling of things like bow, arrow, spear, and hammock. Pablo was utterly bored with the exercise until I pointed to a small leaf bag that hung over a cooking fire. "*Sapo*," he said, his eyes brightening.

> "A little smaller than the palm of my hand, the frog had an extraordinary electric-green back, a lightly spotted white underside, and deep black eyes."

From the bag he pulled a piece of split bamboo, roughly the size and shape of a doctor's tongue depressor. It was covered with what looked like a thick coat of aging varnish. "*Sapo*," he repeated, scraping a little of the material from the stick and mixing it with saliva. When he was finished, it had the consistency and color of green mustard. Then he pulled a smoldering twig from the fire, grabbed my left wrist, and burned the inside of my forearm. I pulled away, but he held my wrist tightly. The burn mark was about the size of a match head. I looked at Moises. "*Una nueva medicina*," he said, shaking his head. "I've never seen it."

Remembering the extraordinary experience I'd had with *nu-nu*, I let Pablo burn my arm a second time. He scraped away the burned skin, then dabbed a little of the *sapo* onto the exposed areas. Instantly my body began to heat up. In seconds I was burning from the inside and regretted allowing him to give me a medicine I knew nothing about. I began to sweat. My blood began to race. My heart pounded. I became acutely aware of every vein and artery in my body and could feel them opening to allow for the fantastic pulse of my blood. My stomach cramped and I vomited violently. I lost control of my bodily functions and began to urinate and defecate. I fell to the ground. Then, unexpectedly, I found myself growling and moving about on all fours. I felt as though animals were passing through me, trying to express themselves through my body. It was a fantastic feeling but it passed quickly, and I could think of nothing but the rushing of my blood, a sensation so intense that I thought my heart would burst. The rushing got faster and faster. I was in agony. I gasped for breath. Slowly the pounding became steady and rhythmic, and when it finally subsided altogether, I was overcome with exhaustion. I slept where I was.

When I awoke a few hours later, I heard voices. But as I came to my senses, I realized I was alone. I looked around and saw that I had been washed off and put into my hammock. I stood and walked to the edge of the hut's unwalled platform floor and realized that the conversation I was overhearing was between two of Pablo's wives who were standing nearly 20 yards away. I didn't understand their dialect, of course, but I was surprised to even hear them from that distance. I walked to the other side of the platform and looked out into the jungle. Its noises, too, were clearer than usual.

And it wasn't just my hearing that had been improved. My vision, my sense of smell, everything about me felt larger than life, and my body felt immensely strong. That evening I explained what I was feeling with hand gestures as much as language. Pablo smiled. "*Bi-ram-bo sapo*," he said, "*fuerte*." It was good *sapo*. Strong.

During the next few days, my feeling of strength didn't diminish. I could go whole days without being hungry or thirsty and move through the jungle for hours without tiring. Every sense I possessed was heightened and in tune with the environment, as though the *sapo* put the rhythm of the jungle into my blood.

I asked Pablo about *sapo*'s uses and discovered there were several. Among hunters, it was used both to sharpen the senses and as a way to increase stamina during long hunts when carrying food and water was difficult. In large doses, it could make a Matses hunter "invisible" to poor-sighted but acute smelling jungle animals by temporarily eliminating their human odor. As a medi-

cine. *sapo* also had multiple uses, serving as a tonic to cleanse and strengthen the body and as a toxin purge for those with the grippe.

The women explained that they sometimes used *sapo* as well. In sparing doses applied to the inside of the wrist it could establish whether a woman was pregnant or not. And during the later stages of pregnancy, it was used to establish the sex and health of a fetus. Interpreting the information relied on an investigation of the urine a woman discharged following the application of the medicine. Cloudiness or other discoloration of the urine and the presence or absence of specks of blood were all evidently indicators of the fetus's condition. In cases where an unhealthy fetus was discovered, a large dose of *sapo* applied to the vaginal area was used as an abortive. There was no way for me to verify what they said, though there was no reason to doubt them.

When I asked Pablo how the Matses learned about *sapo*, he said the *dowkiet!* told them. Whether he meant the frog told them through their study of its behavior and habits or whether he believed he was in communication with it on some level, I don't know.

When I returned to New York, I was surprised to find that my description of *nu-nu* was old hat to the anthropologists I spoke with at the American Museum of Natural History—several tribes evidently employed similar snuffs for shamanic purposes. What did surprise them, however, was my account of *sapo*. None of them had ever heard of it, and while several South American tribes have hunting myths about frogs, there were no records of the Matses or any other tribe utilizing a frog's secretions in the way I described. But while my report was considered interesting, it was also inadequate, as I had no photographs of the frog and no samples of the medicine.

The following year I returned to Pablo's village and discovered that *sapo* was also used as a shamanic tool. It was spring and the lowlands were flooded. Game had retreated deep into the forest to seasonal lagoons, so hunting was difficult and even *nu-nu* failed to produce hunting visions. When I arrived, the Matses hadn't eaten meat for several days.

Pablo explained that when the river was so high, it was trapping season and that he was about to set a *tem-po-te!*, a tapir trap. He had been giving himself five *sapo* burns each morning and night for three days in preparation for the task and would continue until the trap was successful. Pablo explained, as well as I could understand it, that *sapo*, used in such large doses, allowed a hunter to project his *animas*—his spirit—to his trap while he slept. The *animas* would take the form of a tapir and lure real tapir to it.

The day after we arrived, Moises and I went into the jungle with Pablo and Alberto. We walked for almost two hours before Pablo found a suitable site and began to construct the trap, a simple spring device set between two trees. Pablo called to the tapir while he worked, telling it what a special path he was making. He called to the other animals as well, warning them to stay away, to leave this place for his friend. When he finished the trap, he chewed handfuls of leaves and spit them out across the trip vine, both to cover his human scent and as a signpost so that his *animas* could find it at night.

As we were returning to the puebla, Alberto explained that traps were only set when there was no other way to get meat, because once a trap was set, no other animals could be hunted. When I asked why, he explained that animals talk to each other and that killing them provokes their spirits, ruining the trap. Seeing that I didn't understand, Pablo added that when he sent out his *animas* masquerading as a tapir, the provoked spirits would warn the prey that what they saw was not a real tapir but a Matses' *animas* in disguise. Exceptions to the taboo were large river turtles and sloth—the turtle because it doesn't bother to talk to other animals and the sloth because it speaks so slowly that by the time it says what's on its mind, the river has fallen and trapping time is over.

During the next two days, Pablo never returned to the trap, although he continued using massive doses of *sapo*. But on the morning of the third day, he awakened us before dawn and said he had a *nu-nu* vision that the trap was about to be sprung. He was insistent that we hurry.

The Matses moved through the forest effortlessly, almost at a jog, and the women chided me for having to struggle to keep up. But as we neared the trap area, everyone stopped and grew absolutely quiet. Pablo's eyes blazed. "*Petro*," he whispered to me excitedly, "*tian-te, tem-po-te!*" A tapir was about to be trapped.

We waited about ten minutes, then heard a sharp snap, followed by an agonizing animal scream. Suddenly everyone began running toward the trap. The wounded and disoriented tapir crashed through the brush, bellowing in pain, then fell into a stream bed. The women caught up with it, killed it and began to cut it up. While they did,

Pablo brought me to the sprung trap and gave me the bloody spike

Back in camp we feasted. Afterwards, I asked Pablo for a sample of *sapo*, but he'd been using so much to prepare for the hunt that he had none to give me. So once again I returned to the states with no hard evidence of the existence of the *dow-kiet!*

It took two more trips to Peru before I finally managed to secure a small amount of *sapo* and when I finally did, I gave half of the stick to Charles Myers, the curator of the museum's Herpetology Department, who passed it on to John Daly at the National Institutes of Health. Having finally produced the material I'd frequently talked about, my reports began to circulate and prompted a letter from Vittorio Erspamer, a pharmacologist who worked with the Fidia Research Institute for the Neurosciences. He wondered whether *sapo* might not come from one of a number of frogs he'd randomly collected in Amazonia several years earlier. Research done on the chemicals found in their skin had shown that several produced peptides—proteins—that were similar to peptides produced by humans. If it could be shown, he wrote, that one of those frogs was already in use by humans, it would be an important scientific breakthrough. I wrote back and offered to provide him with a specimen if I ever managed to collect one.

A year after Erspamer's letter reached me, I traveled back to the Lobo with Moises. We hiked across the jungle to Pablo's discovered his burned camp, and moved down the river where happily we found him at San Juan. "*Malo casadores.*" Moises snarled, after we'd been watching the men of San Juan trying to find a *dow-kiet!* for nearly an hour. "Bad hunters. Everything is changed with them. They're finished." He was still grumbling about the state of the Matses when I heard Pablo calling me. "*Petro! Dow-kiet! Petro?*" He was standing on a hill at the back of the puebla with Pa Mi Shua and two of his children. "*Bi ram-bo, Pablo!*" I laughed. "*Bi-ram-bo dow-kiet!*" Yes, I would like a *dow-kiet!*

Pablo laughed and began to bark out the frog's mating call. The other men in the camp stopped their hunting and watched him. Between the guttural barking noises he was making we could hear him berating the frogs for making the hunt so difficult. Pa Mi Shua and his children, walking alongside him on the path toward the center of camp, roared at his antics.

Suddenly Pablo stood and stiffened. From the grasses on the side of the path came the same sound Pablo was making. He barked again and again; his call was returned. Then a second frog joined the first and a third, and suddenly the whole camp seemed to resound with the barking of *dow-kiet!s*. Pablo bent down and picked one up. "*Mas dow-kiet! Petro?*" More, Peter? I laughed and said yes. He bent down and picked up another. "*Mas? Bastante sapo, Petro?*" More? Did I want a lot of *sapo?*

I told him two were enough, and he came into the camp, a frog in each hand. He gave one of them to me. It was beautiful. A little smaller than my palm, it had an extraordinary electric-green back, a lightly spotted white underside, and deep black eyes. It grasped my fingers tightly, and in seconds I could feel my blood begin to heat up as the *sapo* it was secreting began to seep into the small cuts that covered my hands. I quickly put it down.

> "I could go days without being hungry or thirsty. Every sense I possessed was heightened, as though *sapo* put the rhythm of the jungle into my blood."

Pablo giggled with delight, then broke a small branch from a tree and placed both *dow-kiet!s* on it, hilariously imitating my reaction.

One of the Matses men collected four sticks and stood them in the ground, making a small square. Another pulled apart some palm leaves, stripped out the fibers and rolled them into strings against his leg. He handed four of them to Pablo, who tied one to each of one frog's legs, then tied the free ends to the four posts, suspending the animal like some strange green trampoline. Once the frog was secure, Pa Mi Shua knelt and gently began to manipulate the frog's elongated center toe between her fingers, stimulating it to secrete *sapo*. It was an unexpectedly sexual image, and the men joked about it. Pa Mi Shua blushed and told them to be quiet.

The man who had placed the sticks in the ground disappeared into his hut for a moment, then returned with a piece of split bamboo. He began to scrape the suspended frog's sides and legs, collecting *sapo*. When the stick was covered, he dried out the secretions over our tiny kerosene lamp and then gave the stick to me.

That night both frogs were tied by one leg to a low tree branch to keep them from escaping, and in the morning, the *sapo* from the second frog was collected. Neither was hurt by the process, and if I hadn't been taking the two specimens back to the States, they would have been set free.

One of the frogs died shortly after I returned home, and I gave its skeleton along with part of the *sapo* sample and some photographs to the Natural History museum. The healthy *dow-kiet!* along with a second *sapo* sample and similar photos was sent to Erspamer in Rome. Six months later, I received his report. He was very excited.

He identified the *dow-kiet!* as a *phyllomedusa bicolor*, a rare arboreal tree frog. The *sapo*, he said, is a sort of fantastic chemical cocktail with potential medical applications. "No other amphibian skin can compete with it," he wrote. "Up to seven percent of *sapo's* weight is in potently active peptides easily absorbed through burned, inflamed areas of the skin." He explained that among the several dozen peptides found in *sapo*, seven were bioactive—which meant that each has an affinity and selectivity for binding with receptor sites in humans. (A receptor is like a lock that when opened with the right key—the bioactive peptides—triggers chemical reactions in the body.) The peptide families represented in the *dow-kiet!* include bradykinins, tachykinins, caerulein, sauvagine, tryptophyllins, dermorphins, and bombesins.

Based on the concentrations and functions of the peptides found in and extracted from the *sapo* sample I sent, Erspamer was able to account for all of the physical symptoms I described as *sapo* intoxication. On the peripheral effects, Erspamer reported: "Caerulein and the equiactive phyllocaerulein display a potent action on the gastrointestinal smooth muscle and gastric and pancreatic secretions. . . . Side effects observed (in volunteer patients with postoperative intestinal atony) were nausea, vomiting, facial flush, mild tachycardia (heart palpitations), changes in blood pressure, sweating, abdominal discomfort, and urge for defecation."

Phyllomedusin, a new peptide of the tachykinin family, strongly affects the salivary glands, tear ducts, intestines, and bowels, and contributed to the violent purging I experienced. Sauvagine causes a long-lasting fall in blood pressure, accompanied by severe tachycardia and stimulation of the adrenal cor-

OMNI EMPORIUM

OMNI EMPORIUM

tex which contributed to the satiety, heightened sensory perception and increased stamina I described. Phyllokinin, a new peptide of the bradykinin family, is a potent blood-vessel dilator and accounted for the intense rushing in my blood during the initial phase of *sapo* intoxication.

"It may be reasonably concluded," Erspamer wrote, "that the intense peripheral cardiovascular and gastrointestinal symptoms observed in the early phase of *sapo* intoxication may be entirely ascribed to the known bioactive peptides occurring in large amounts in the frog material."

As to *sapo*'s central effects, he wrote, "Increase in physical strength, enhanced resistance to hunger and thirst, and more generally, increase in the capacity to face stress situations may be explained by the presence of caerulein and sauvagine in the drug." Caerulein in humans produces "an analgesic effect ... possibly related to release of beta-endorphins ... in patients suffering from renal colic, rest pain due to peripheral vascular insufficiency (limited circulation), and even cancer pain." Additionally, it caused in human volunteers a significant reduction in hunger and food intake."

The sauvagine extracted from *sapo* was given subcutaneously to rats and caused "release of corticotropin (a hormone that triggers the release of substances from the adrenal gland) from the pituitary with consequent activation of the pituitary-adrenal axis." This axis is the chemical communication link between the pituitary and the adrenal glands, which controls our flight-or-fight mechanism. The effects on the pituitary-adrenal axis caused by the minimal doses given the laboratory rodents lasted several hours. Erspamer noted that the volume of sauvagine found in the large quantities of *sapo* I described the Matses using would potentially have a much longer lasting effect on humans and would explain why my feelings of strength and heightened sensory perception after *sapo* use lasted for several days.

But on the question of the "magical" effects I described in tapir trapping, Erspamer says that "no hallucinations, visions, or 'magic' effects are produced by the known peptide components of *sapo*." He added that "the question remains unsolved whether those effects—specifically, the feeling that animals were passing through me and Pablo's description of *animas* projection—were due to "the sniffing of other drugs having hallucinogenic effects, particularly *nu nu*."

With regard to *sapo*'s uses relating to pregnancy, Erspamer did not address any of the issues but abortion. "Abortion ascribed to *sapo* may be due either to direct effect of the peptide cocktail on the uterine smooth muscle or, more likely, to the intense pelvic vasodilation and the general violent physical reaction to the drug."

From the medical-potential point of view, Erspamer said several aspects of *sapo* are of interest. He suggested that two of its peptides, phyllomedusin and phyllokinin, have such a pronounced affect on the dilation of blood vessels that they "may increase the permeability of the blood-brain barrier, thus facilitating access to the brain not only of themselves, but also of the other active peptides." Finding a key to unlocking the secret of passing that barrier is vital to the discovery of how to get medicines to the brain and could one day contribute to the development of treatments for AIDS, Alzheimer's, and other disorders that threaten the brain.

There is also medicinal potential in dermorphin and deltorphin, two other peptides found in *sapo*. Both are potent opioid peptides, almost identical to the beta-endorphins the human body produces to counter pain, and similar to the opiates found in morphine. Because they mirror beta-endorphins, however, *sapo*'s opioid peptides could potentially function in a more precise manner than opiates. Additionally, while dermorphin and deltorphin are considerably stronger than morphine (18 and 39 times, respectively), because of their similarities to the naturally produced beta-endorphin, the development of tolerance would be considerably lower and withdrawal less severe than to opiates.

Both phyllocaerulein and sauvagine possess medical potential as digestive aids to assist those receiving treatment for cancer. Other areas of potential medical interest in the peptides found in *sapo* include their possible use as antiinflammatories, as blood-pressure regulators, and as stimulators of the pituitary gland.

The only report thus far on *sapo* from John Daly's team at the National Institutes of Health (written with seven coauthors, including Katharine Milton, who recently discovered the use of the *phyllomedusa bicolor* among several tribes closely related to the Matses) was recently published in the *Proceedings of the National Academy of Sciences* (November 14, 1992) and concentrates exclusively on a newly discovered peptide found in *sapo*. One of the chemical fractions Daly's team isolated is a 33-amino-acid-long peptide he calls *adenoregulin*, which may provide a key

to manipulating cellular receptors for adenosine, a fundamental component in all human cell fuel. "Peptides that either enhance or inhibit binding of adenosine analogs to brain adenosine receptors proved to be present in extracts of the dried skin secretion," Daly wrote. According to an interpretive report on the Daly paper written by Ivan Amato and published in *Science* (November 20, 1992), "Preliminary animal studies by researchers at Warner-Lambert have hinted that those receptors, which are distributed throughout the brains of mammals, could offer a target for treating depression, stroke, seizures, and cognitive loss in ailments such as Alzheimer's disease."

Of course, medical potential only infrequently results directly in new medicines. Science may not be able to isolate or duplicate the peptides found in *sapo* or side effects may be discovered that would decrease their value as medicines. But even if *sapo*'s components do not eventually serve as prototypes for new drugs, *sapo* will become an important pharmacological tool in the study of receptors and the chemical reactions they trigger. Certainly the study of the unique activity of *sapo*'s bioactive peptides will advance our knowledge of the human body. Additionally, as possibly the first zoologically derived medicine used by tribals ever investigated for Western medical potential, *sapo* will help open the door to a whole new field of investigation.

Unfortunately, while science catches up to the natural medicines of tribal peoples, time is running out. That Pablo was the only man at San Juan still able to draw a response from the *dow-kiet!* is an indication that most Matses no longer rely on it. And we have no way of knowing how many other medicines the Matses—and others—once used but have abandoned, which might also have been valuable to us.

We do know that nearly 80 percent of the world's population relies on natural medicines for its primary health care. Investigations into a small portion of them have already provided us with hundreds of drugs, from aspirin and atropine to digitalis and quinine. Fully 70 percent of the antitumor drugs used in the treatment of cancers are derived from traditional medicines as well. Yet our investigations have hardly begun. Obviously, there is much to learn from peoples like the Matses before acculturation strips them of their knowledge. It remains to be seen whether the discoveries that have begun to be made in connection with *sapo* spark the interest of investigators—while there is still time to learn it. OQ

INTERVIEW

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said, 'Send us a geneticist.'" The AAAS got in touch with Luca Cavalli and asked him, "Is it possible to prove a child's relatedness to its grandparents?" Luca did the statistics and said, 'This is a perfectly reasonable hypothesis.' Specific genetic markers—such as human leukocyte antigens (HLA) and variations in DNA sequences—enable grandpaternity to be proven with a high degree of certainty. In reality, though, you have to genetically type all the people involved. The only way to do that is to go to Argentina. "I don't have the energy to get involved with Spanish-speaking grandmothers my own age," he said, "but I know just the person." So they asked me, and of course I said yes.

Omni: So you went to Argentina in June 1984?

King: Yes, with forensics experts whose job was to help identify remains so cases against the murderers could be brought to court. They ultimately trained a remarkable group of Argentinean forensic anthropologists who were then just kids in college. I worked with grandmothers trying to identify living children and reunite them with their relatives. We found a lab in Buenos Aires that could do HLA typing.

The method works like this: Blood samples are taken from people who might be related. Their cells are tested for matching HLA combinations. Thousands of individual combinations exist in any one population. HLA proteins distinguish "self" from "other," making them important for matching organ-transplant recipients—and matching grandparents and lost children.

The HLA test we developed was first used in the case of an eight-year-old girl, Paula Eva Logares, who was living with a former police chief and his Uruguayan girlfriend. They claimed in court that Paula was their biological daughter. The grandmothers said they were lying, that she was kidnapped from her parents when she was 23 months old and the parents never seen again. We proved with 99.9-percent certainty, on the basis of HLA testing and blood groups, that Paula was a descendent of the three living grandparents who claimed her. When she went back to her grandparents' house, which she hadn't seen since she was two, she walked straight to the room where she'd slept as a baby and asked for her doll.

Our first cases were relatively easy, because we either had all four grand-

parents still alive or could reconstruct their genotypes from their surviving children. We got very good at this, and things happened. Many more families came forward. The Argentinean parliament passed a law establishing a voluntary national genetic databank, so anyone who'd lost a child could have a blood sample taken. We'd construct a pedigree, and as children came to light, test them against the families in our genetic bank and look for a match.

With hundreds of families to test against every child who came forward, we ran into some matches by chance—true matches that didn't reflect biological relationships. We needed a better test. Eventually we turned to mitochondrial sequencing, which has proven a highly specific, invaluable tool for reuniting the grandmothers with their grandchildren. The cases resolved genetically are about 50. We've found another 12 children who were kidnapped but have yet to identify their families. This leaves 150 children yet to be found.

Omni: Joel Cohen at Rockefeller University frequently testifies in court against genetic fingerprinting. What do you think of his arguments?

King: I just finished a stint on the National Academy of Science's committee of DNA and forensics with another population geneticist, Eric Lander. We tried to set down guidelines for doing the mathematics of DNA identification. What does the evidence mean statistically? How common is this genotype? What is the population? Many of us have spent years trying to answer these questions, and there's no mathematically rigorous way to do it, because we don't have the entire human species samples.

Still, we established a set of guidelines for how to calculate the frequency of an arbitrarily determined genotype in a population. Some mathematics types don't like our method. Eric and I don't like it. It's not as precise as it could be, but we and the panel decided to be prudent rather than precise.

Omni: How do you make these calculations on genotype frequency?

King: Suppose we test four genes. We determine the genotype in each four loci on a blood sample from a victim. We do the same thing for the defendant: everything matches. Each gene has two alleles [alternative forms of a given gene]. Knowing how common each allele is at each of the four loci is critical. One way is to determine from which population the defendant comes and make an estimate based on that population. But in America, where most of us are from mixed populations, knowing the frequency of every allele is impossible. So now we use a ceiling principle. Before a case goes to trial, one consults a databank of populations that are different from each other. Since the four loci will have been typed in each isolated population, we hope to bracket in a broad way the likelihood of finding each gene type.

Suppose allele A of gene 1 is found in Basques at a frequency of 1 percent, in Lapps at 3 percent, and in Mexicans of Mayan ancestry at 10 percent. We'll assign a frequency of 10 percent to this allele, regardless of the ancestry of future defendants. Now it doesn't matter what population the suspect comes from, since no people in the world have higher frequencies than the ones we're using. We don't care if the defendant is white, black, Hispanic, Native American, or whatever, since the whole world is in the calculation.

Omni: Your original project with breast cancer involved 1,579 women. What were you trying to determine?

King: Whether a subset of breast cancer is inherited, and if so, from what gene. Inherited breast cancer accounts for about 5 percent of the disease. It's transmitted by a dominant gene through mothers and fathers, although fathers are not affected. One woman out of 200 will get breast cancer because she has inherited susceptibility to it. It's important for these women to know they have an inherited genetic disease. It's even more important to the other 95 percent of breast-cancer patients because if we can identify the gene inherited in altered form and it turns out to be the same gene that's vulnerable to other cancers, then this will be critical for diagnosis and treatment of all women facing breast cancer.

Omni: How did you find this gene?

King: It's been clear as far back as the Romans that some families have high rates of breast cancer. I decided in 1975 when I was learning about cancer epidemiology that I'd try to identify genes responsible for breast cancer. This was dumb, no work was being done at the DNA level then.

We still haven't identified this gene, but we know where it lives on chromosome 17 down to a million base pairs, a tiny region of the human genome. We've identified families with inherited breast cancer, then identified genetic markers situated on all the different chromosomes and determined which markers are inherited with breast cancer, family by family. It's a very systematic approach, but when I undertook it, it was not systematic at all. I had to develop the markers as I went along.

Omni: Was the research aided by the Human Genome Project?

King: It took 15 years from the time I began trying to identify genes responsible for inherited breast cancer until I knew the approximate locale of the gene in question. In 1991, when we decided to isolate the genes responsible for inherited deafness, the same process took two months. Today we just have more tools. The next step is to clone a gene for inherited breast cancer, which we're doing now and use it to develop an early diagnostic technique.

Omni: What is the AIDS project you're working on?

King: Some people infected with AIDS progress rapidly to full-blown AIDS and die, while others progress more slowly, living with the disease for years. Variation in immune-response genes could make some people more resistant to the virus. We have identified some of these genes. Identifying these genes allows you to understand the interaction between the virus and the HLA proteins made by the genes. In AIDS, we look at how the protein folds and how the virus attaches to it. Knowing that some of these attachments work better than others is helpful if you're trying to develop a drug that prevents attachment or a vaccine that protects HLA proteins against the virus or an innocuous molecule that will mimic the virus.

Omni: Is this photograph on your desk of your daughter?

King: Yes. It was taken when she thought she might become a ballerina. She was very good, but she had to decide when she was 14 whether she wanted to go to school or dance, and she decided to go to school. She's studying to be a constitutional lawyer, not a scientist. She correctly perceives that the limitations to human rights are not in science but in having a constitution and making sure it's applied. She wants to do human-rights law. But girls her age I know in Argentina tell me they're going to become geneticists. It all comes out in the wash. ∞

"My daughter wants to do human-rights law. But girls her age I know in Argentina tell me they're going to become geneticists. So it all comes out in the wash."

GAMES

I HAVE A THEORY

Competition #54 explained global warming and missing socks

By Scot Morris

Last November we asked readers to create original theories in the "Silly Science" style of the *Journal of Irreproducible Results*. I promised that one grand-prize winner would receive $100, four runners-up $50 each, and all five a one-year *Omni* subscription. Marc Abrahams, editor of *JIR*, helped to pick the best.

Many chose to explain familiar everyday events. The most common subject was the sock problem. Thaddeus P. Rosen of Bakersfield, California, proposes that clothes dryers produce a tunneling effect that throws socks into an alternate universe. Scientists, he writes, should use this effect to dispose of nuclear waste. Just put chunks of it into socks and set the timer for 40 minutes.

Readers attacked the big problems, too. They figured that global warming was caused by the increased adoption of daylight-savings time or the popularity of jalapeño peppers. One positive result of all the warming, wrote Gustavo Wilches-Chaux of Popayan, Colombia, was an end to the Cold War.

GRAND PRIZE WINNER. When a cat is dropped, it always lands on its feet, and when toast is dropped, it always lands with the buttered side facing down. I propose to strap buttered toast to the back of a cat; the two will hover, spinning, inches above the ground. With a giant buttered cat array, a high-speed mono rail could easily link New York with Chicago. —John Frazee, Kingston, New York.

RUNNERS-UP. If an infinite number of rednecks riding in an infinite number of pickup trucks, fire an infinite number of shotgun rounds at an infinite number of highway signs, they will eventually produce all the world's great literary works in Braille. —John A. Banker, Show Low, Arizona.

Why Yawning Is Contagious. You yawn to equalize the pressure on your eardrums. This pressure change outside your eardrums unbalances other people's ear pressures, so they must yawn to even it out. —Bruce Wiegert, Baltimore, Maryland.

Communist China is technologically underdeveloped because they have no alphabet and therefore cannot use acronyms to communicate ideas at a faster rate. —Nancy Payton, Bakersfield, California.

The earth may spin faster on its axis due to deforestation. Just as a figure skater's rate of spin increases when the arms are brought in close to the body, the cutting of tall trees may cause our planet to spin dangerously fast. —Robert Hinckley, Towanda, Pennsylvania.

HONORABLE MENTIONS. Birds take off at sunrise. On the opposite side of the world, they are landing at sunset. This causes the earth to spin on its axis. —Steve Forzula, Isle of Cumbrae, Scotland.

The reason hot-rod owners raise the backs of their cars is that it's easier to go faster when you're always going downhill. —John Haas, Hillside, New Jersey.

The quantity of consonants in the English language is constant. If omitted in one place, they turn up in another. When a Bostoner "pahks" his "cah," the lost *r*'s migrate southwest, causing a Texan to "warsh" his car and invest in "erl wells." —Randy Smith, Wichita Falls, Texas.

A design flaw in the solar-powered flashlight has prevented it from performing as well in the field as it did in tests during business hours. —Mike Guida, Peoria, Arizona.

TV remote controls have raised the public intelligence level by lowering exposure to commercials. —Edward E. Ness, Akeley, Minnesota.

When subjected to extreme feminine heat and pressure, male hydrocarbons will often produce a diamond. —R. E. Swapp, Fairview, Utah. DO

Got a theory of your own? Give a call! **1-900-407-4494, ext. 70102.** Your theory will be recorded and may appear in an upcoming issue of *Omni*! The cost for the call is 95 cents per minute. You must be 18 or older. Touch-tone phones only. Sponsored by Pure Entertainment, P.O. Box 166, Hollywood, California 90078.