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OMNI

MAY 1994

**BUTTERFLIES
AND WILD
SCIENCE:
COMPLEXITY
IN SANTA FE**

**HURRICANES
AND HEALTH**

**LUCY'S
FATHER:
EVOLUTION
REVEALED**

**NEW
TECHNOLOGY:
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FIRST WORD

BIG ENERGY IN THIN AIR.

The how, what, when, where, and why of wind

By Bill Nye

As I looked past my sneakers, I saw a lovely picture of a big green field complete with miniature cows and barbed-wire fences a few hundred meters below me. I was grateful that my parachute was wide open. If you've ever done this, you've experienced air molecules working their way around your canopy and keeping you from "landing" too fast. The forces at work are astonishing.

Jumping out of a perfectly good airplane into thin cold air is not something I had ever really thought much about doing. But it occurred to me to be the perfect way to list our television audience know that today's show would be about wind. I am the host of a science show for kids (of all ages) called *Bill Nye the Science Guy*.

(That would be me.)

So, when we were talking about falling toward the earth and being held up by air, we're talking about gravity. It pulls us down, and it slows us up, because gravity is what holds the air and us on the earth.

Imagine painting a baseball. That's about how thick our atmosphere is compared to the earth. Even though the atmosphere is thin, near sea level there's roughly a ton of air molecules over our heads. When you're hanging over a field or watching the wind rustle the leaves on a tree it strikes you that the air in our atmosphere is pretty wild.

Most of the time we don't think about air. We breathe it automatically (ahh) and we look right through it (hmm), unless we're noticing clouds or smoke or the pasture coming toward us (whoa!). Birds, blizzards, bats, thunder, planes, and parachutes all conduct their business in the atmosphere. It's a word from Greek that means "ball of air." So, weather is happening in a great big shell, and it's not quite smooth. It's full of huge bumps and waves. All those hurricanes, tornadoes, snow storms, and good kite days are powerful pickups of air.

Imagine a glass baking dish full of water, with one-half of the dish sitting on a stove burner and the other half on a hot potholder. When the burner is on, the water circulates. It rises over the burner and sinks over the potholder. The same thing happens on our planet. Energy from the sun makes the air at the equator rise. The sun is the burner, the ice caps and night are the potholder. Our air moves in huge circuits or Hadley cells, named for the scientist who first proposed them as the reason for trade winds.

Every hour of every day, almost 200 billion megawatt-hours of sunshine land on the earth—enough energy to power every city on Earth about 10,000 times over. That's the energy that puts rainwater behind dams. It can make a lot of wind. It's no wonder boats can easily sail anywhere they like on the sea.

The only thing over the atmosphere is nothing—space. So the air sloshes and surges, forming enormous bulges and depressions. Air flows from the thick parts of the atmosphere to the thin parts. It moves downhill. Can you blame it? The big sloshing is what makes wind and weather.

Okay, heating and cooling of the atmosphere make wind, but what makes spinning storms? Where do all those swirling air masses and steadily breezes get their direction? It's not all north and south, for crying' out loud. Get a piece of paper or card stock (manila folder material), and spin it around a thumbtack. Stick it to a cardboard box or kitchen table suitable for the kind of o' uh, "research." If you have a photograph record player, that's better yet. Try drawing a straight line. You can't. Straight motions curve on turning things. Let's say you're an air molecule and you're moving in a big wind cell. Well, the earth is turning, so you end up moving in a curve. If there are enough molecules, we get a storm. This curving motion is called Coriolis motion. It's named after the mathematician who first figured it out.

With all that energy coming here from the sun and all that energy in the earth's spin, it's no wonder sailors can see the world, kite strings can tug kites, and planes and parachutes turn into the wind to land. It's energy from the sun. Take a deep breath and thank it over. Wind is wild. **DD**

Bill Nye the Science Guy left his day job as an engineer, put on his lab coat, and took to the airwaves because he wanted to show kids some fun.



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READERS' WRITES

Questioning race matters, misguided intentions, and the impassable icons of science

I'm Rubber, You're Glue

Greg Meyerson's unremitting pessimism (First World, February 1994), apparently anticipating a continuation of today's admittedly unsatisfactory racial situation, is depressing. I would hope that even the most ardent supporters of affirmative action will some day be willing to state what criteria must be met to render this practice unnecessary. And, although I may be misinterpreting what Meyerson is saying, his apparent support of Santa Souza's position that "Blacks can't be racist because they don't have the power of White supremacy" overlooks the fact that racism usually comes from feelings of fear and inferiority. Many of the most overt racists in America are "losers" filled with feelings of inferiority—and all the more vicious as a result. "Supremacy" is in the eye of the beholder.

John Michael Kittross
Acton, MA

You've got to be getting back at me for watching Rush Limbaugh. Nearly 100 percent of Americans do not think the American flag is a symbol of imperialism, Meyerson scoffs. He looks like a kid. He wasn't even born yet when I helped liberate Europe from the Nazis. Does he know that at the end of WWII we had mobilized nearly a hundred industry divisions? Does he know that we were the only nation that possessed atomic weapons and had the means to deliver them to any target anywhere on Earth? We could have taken the whole shebang. Our latest venture, the Persian Gulf—did we confiscate one barrel of oil? Imperialists, he says. "White people don't get lynched by the thousands." Maynard goes on. I've read the L.A. Times and haven't seen one reference to a lynching of a Black person by a White person. Blacks shoot down whites in car-jackings. Blacks assassinate Korean merchants. Blacks blot away at one and all in drive-by shootings. If any Whites are out there lynching Blacks, it's got to be the best kept secret in L.A.

George H. McCarty
Highland, CA

From The Trenches

Dr. Francis Crick's achievement in molecular biology cannot be ignored (Interview, February 1994). However, his ability to muse on the existence of the soul is shortsighted. His rationalizations are almost zany and remind me of a right-wing authoritarian scientist whose religion is logic and who has lost his abstract thinking. It's the entrenched old timers like Crick who wear the double mask of far scientific thinking when in reality they don't give credence or time to other fields. On the contrary, these "very lower icons" act more like "Seniors" than the ministers of wisdom they could be.

Kevin Frischeng
Saugerties, NY

Guilt by Administration

"Unhealthy Alliances" by Linda Marsa (February 1994) is factually correct but ends with a cure worse than the disease. The disease is the FDA. Ms. Marsa concludes that the cure is more power to the FDA. The FDA does a very poor job of policing and handling large companies as evidenced as far back as the thalidomide debacle where firms hid the evidence of birth defects. More power to the FDA will not make the FDA more courageous in fighting against the big guy, the drug companies. The FDA does a Draconian job of persecuting the little guy who wants nothing more than to sell vitamin supplements. Some doctors have actually been put in jail for being vitamin advocates. The cure is an ombudsman outside the FDA, empowered to protect the little guy—you and me.

Mervin L. Lewis
Philadelphia, PA

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PROGRESS AND PREHISTORY:

Urban paleontologists find rare fossils in the wake of bulldozers

By Martin Hill

Paleontologist Brad Riney (far right) and colleague Richard Condit helped excavate a nodosaur skeleton found in a trench in May 1987.

In May 1987, Brad Riney climbed into a pipeline trench being dug in Carlsbad, California, and came nose to hubble with a dinosaur. The nearly intact skeleton of a nodosaur was a remarkable find; scientists had never turned up nodosaur remains west of the Rockies.

Riney, a paleontologist with the San Diego consulting firm PaleoServices, would probably never have made his discovery but for a small section of the California Environmental Quality Act (CEQA) and "salvage paleontology"—a form of urban fossil hunting that in the last two decades has literally filled warehouses with the remains of California's prehistoric past.

Salvage paleontology involves following earth-moving equipment at construction sites, looking for promising signs of fossils. The heavy equipment uncovers thousands, sometimes millions, of cubic yards of unweathered, fossil-bearing rocks in a relatively short time. "A bulldozer can expose in a day what it would take Mother Nature a hundred years to reveal," explains Tom Deméré, curator of paleontology at the San Diego Natural History Museum and a co-founder of PaleoServices.

Finding fossils at construction sites is not a new phenomenon. But with CEQA's passage in the early 1970s, California became the first state to require builders to assess excavated areas and then hire certified paleontologists if needed to salvage fossil remains prior to building.

The CEQA provisions were first put to use in 1972 when former Los Angeles County Natural History Museum paleontologist Paul Kirkland was hired as a "paleo monitor" by a developer in Orange County. Paul was one of the very first people to go to a



construction site to collect fossils," notes Mark Roeder, part owner of the Costa Mesa consulting firm Paleo Environmental Associates. "He really paved the way for others to follow."

Southern California experienced a building boom in the 1980s, speeding the spread of salvage paleontology throughout the state. The results have been startling. San Diego County, for instance, was never considered a prime hunting ground for vertebrate fossils. But Deméré, forging his first construction site, turned up the Pliocene-age remains of ten species of baleen whales, 11 species of tooth whales, two species of walrus, and 40 different species of sea birds, making it one of the most diverse finds for that epoch.

The amount of salvage paleontology now being done in the state is mindboggling, says Steve Conklin, a paleontologist with LSA Associates, an environmental analysis firm in Orange County. A prestigious center like the Smithsonian Institution, for example, may have three or four vertebrate paleontologists who go out on digs perhaps three months a year. In Orange County alone, Conklin says, 35 certified

paleos "constantly collect fossils twelve months a year."

Most of that material goes to local museums. In San Diego, salvaged fossils fill dozens of shelves and drawers at the natural history museum. Yet Deméré's paleos spend so much time just collecting fossils that they haven't had time to write many papers on their findings—just 15 to 20 papers so far.

Fossils found in Orange County, which doesn't have a staffed natural history museum, get stored in, among other places, a 10,000-square-foot warehouse, which Conklin says is "completely full. You can't roll carts into the building anymore."

A subcommittee within the Society of Vertebrate Paleontology recently drafted guidelines to regulate how much cleaning and cataloging developers and their paleo consultants must do before turning fossils over to a museum. Too much of that costly work is currently left to organizations unable to afford it.

"The point is to save the fossils," explains Bob Reynolds, a paleo with the San Bernardino County Museum. "You're not saving the fossils if you just dump them in a parking lot." □

GOOD GUYS AS BAD GUYS

The temptations of the undercover cop

By Janel Bladow

A scene from *Flash*, a film about a narcotics agent in trouble. "Undercover," claims psychologist



Michael Girodo, "an agent often acts out fantasies not in elements of power, domination, and love."

In the movie *Flash*, the female undercover narcotics agent sits curled up in a corner so stung out on heroin she can't tell what's real or hallucination. She's a police officer doing her job, she tells herself. Or, is she what she looks like?—a wasted drug addict. When did she cross the thin line that distinguishes the good guys from the bad?

That fine line—and what makes an undercover cop cross over it—is territory Michael Girodo has explored in a 15-year study of more than 200 under-

cover agencies because people who enjoy these risks make the best undercover officers. It's up to the cop's style and sets to get him- or herself in with the criminals and stay in. People adaptable to a wide range of roles seem to have "a native talent for misrepresentation and guile," he says. "For this small but noteworthy percentage of agents, the undercover field offers rich opportunities to indulge natural inclinations to con."

The agent gathers information before criminal activity takes place, seeing it unfold before his eyes. While other cops come in after the act, the undercover officer has a hand in making the crime happen. "He becomes one of them," Girodo continues. "But the criminals get caught, while he gets away with buying and selling drugs, sex, and the government sanctions it."

After these situations happen over and over again, the agent may start believing his own lies, thinking the criminals are his friends, confusing right and wrong. "To sustain the insults he gets, maintain his motivation, he often has lots of money, clothes, liberty. He's reimbursed for his alcoholic expenses. It's a heady experience, especially if he's rewarded for it," says Girodo. Paradoxically, he needs that arrogance and self-confidence to be convincing. As he commands increasing influence, he dreams of speaking on 60 Minutes and having a movie made of his adventures. He feels entitled to special favors, treatment, and dispensations. There are outbursts with bosses, abuses in relationships.

Psychologists might say this character has a personality disorder, but these components are nurtured and developed in undercover work. The work pre-

dicts misconduct. "The longer you're on the job, the greater the odds that you're going to get into trouble," Girodo says. "At the same time, no vice commander is going to let some skilled, valuable resource go. The agent is the asset they need." So the personality continues to change.

After the cowboy comes the prima donna. Then, lost visibly, he begins to develop his own laws. The exception becomes the norm. Since he's scamming all the time, he begins to think everyone has a scam. So enamored of a role, he may refuse to abandon it. Girodo recounts a classic case: "An undercover officer about to retire was to go into a counterfeit money operation, flash a roll of \$80,000, and 20 minutes later get back out. He went in without a wire and was to signal his support team. The guy stayed in the room two and a half hours. The bosses were frantic. When he finally came out, he explained, 'This was my last job. I didn't want to give up my role. They enjoyed me. They really liked me!'"

There are no precise figures on how many undercover agents are corrupted, says Girodo, "but I do know the number is far greater than what police and the public are willing to accept. And it's increasing all the time."

How can an agent avoid the temptations? "Beet is a solid home life, of course," says Girodo, who is creating programs to train agents to become more aware of psychological risks inherent in their personalities and work. "We get them to slow down, take greater cognitive responsibility for their actions. I. They also make 'public confessions' in front of other agents. 'No one wants to do something stupid in front of his or her peers,'" he adds. **DD**

ELECTRONIC UNIVERSE

DANGEROUS GAMES

A ratings system for electronic entertainment may only be the easy way out

By Gregg Keizer

Trying to discern the line near the sex and violence that's legal in videogames targeted at kids.



Industry officials split for self-censorship in the form of a ratings system. But such a move may prove to be a double-edged sword.

They're the best evidence yet that the apocalypse is upon us. They promote violence among kids, they play to our most prurient interests: they have less socially redeeming value than a 24-hour stretch of MTV.

No, we're not talking about Beavis and Butt-head. We're talking about videogames, the things that put Sonic and Mario on school lunchboxes.

Digital fun and its impact made the news, big time, late in

last December: game publishers got ratings religion. Faced with the prospect of government controls, a coalition of publishers and dealers proposed a regime of self-censorship: a ratings strategy that for all intents and purposes mirrored what Sega had established earlier in the year. Games would be rated GA for a general audience, MA-13 for a more mature audience over 13, and MA-17 for those over 17. Even that wasn't enough to mollify Senator Joseph Lieberman (D, Connecticut), one of the committee's co-chairs, who called it "the least the videogame industry can do: not the best it can do."

The furor stems from the fact that—right or wrong—electronic entertainment is perceived as a kid thing. Ratings aren't enough, so the line goes, to keep violence- and sex-heavy games from poking phosphors through kids' eyes. Lieberman was adamant about that: "It would be far better for parents and kids if the industry simply kept the gory violence and sex out of their games," he said.

The senator's missing the point. Computer games and videogames are not just for kids any more than movies are just for preteens. Nor is a tamed ratings structure that caters to children's concerns a long-term solution, since—unlike relatively stable forms of entertainment such as film and music—digital games are a moving target. The market may be powered by videogames for kids now, but it won't be for long. Thanks to games on CD—on computers, for the more expensive machines like 3DO and SegaCD—and, when it comes along, to digital entertainment delivered over cable or phone lines, adults will soon be devouring sales.

This is not to say there aren't

games unfit for kids. There are. But there is a better way to handle the problem than a lock-step ratings system that, at best, is inconsistent and misleading. How else are we to describe a system that gives a shoot-'em-up like *Soldiers of Fortune* a GA but hands an MA-13 to a straightforward boxing game like Sega's *Prizefighter*?

Instead, publishers and retailers and parents' groups should get together and nail down one label: "NC"—not for children. Games carrying adult themes and adult stories should be so marked. Retailers should enforce the rating, as theaters do now, by refusing to sell such games to anyone under 18.

As for other games, publishers should note content of their wares with clear phrases like "graphic violence" and "adult language" and be smart enough to advertise such games honestly. That means running ads in forums other than those aimed at kids—as are many videogame magazines and cable channels like Nickelodeon. It means being up-front in presentation, packaging, and box copy, not hiding a killing fest inside cartoon graphics, expecting the violence to be somehow less objectionable. That means providing some real information to anyone trying to determine what is or is not objectionable material for themselves or their children.

It may not be a perfect system, but it does spread out the responsibility and make everyone—from publishers to parents, pay attention. It's not the easiest way out—that would be to just let someone else decide what's good and what's not—but it's the best way to ensure no one gets cut out of the electronic entertainment of today. And of the future. **DD**



1993. Whether it was in the cold and often uninformed questioning of a Senate hearing or in the after-Christmas-sale-style rush of publishers to defend their products, the face of censorship peeked through the pixels of electronic entertainment.

When the going got tough before the Senate Judiciary and Government Affairs Committee



STYLE

WHAT TO WEAR. A look into the future of fashion

By Jessica Cohen

Science fiction may not have a great track record at predicting developments in technology or politics—nobody, for instance, foresaw the rapid miniaturization of computer power—but it has an even worse record when it comes to fashion. The futuristic uniforms portrayed on *Star Trek* and in endless SF movies amuse fashion forecaster Haysun A. Hahn, creative marketing director of Promostyl USA. "You'd think we'll all be wearing uncomfortable molded rubber outfits," she laughs. Rather, she predicts, "clothes will express individuality and be flexible enough to do whatever we want whenever we want. Fabric will be pliable, liquid, a material that responds to our imagination so you can wear fuzz in the summer, no coat in the winter. We won't need so many clothes."

That vision might seem elusive, but several social, economic, and technological trends point toward an increasingly comfortable, versatile clothing style that evades narrow fashion dictates. The election of President Bill Clinton is both an omen and a reinforcement of this emerging Zeitgeist: according to fashion pundits. "The emphasis on a casual lifestyle has to do with a broad democratization that's been going on throughout the century. There's been a societal trend not to place as much emphasis on clothing to express status and formality," says consumer behavior specialist Gerold Schmitt, associate professor of business at Columbia University.

So it was that the voters ousted incumbent George Bush and elected Bill Clinton, who sports a more casual style. According to Tom Julian of the Fashion Association, "Clinton is showing that

you can loosen up, wear a softly constructed suit with no vents, besom pockets, low notched lapel, and feel good in it. The guy has a very strong presence when you're looking at him in a sea of traditionally out blue suits." Julian adds that market surveys show that where five years ago men's retailers sold two suits for every sport coat, today it's two sport coats for every suit.



The spirit of the Clinton Administration may be reverberating in women's fashion, too. Though Hillary Clinton's apparel choices are sometimes primed, her attitude foreshadows the working women's future according to Larye

Watson, fashion historian at Parsons Institute of Design. "She goes to people she trusts, gets serviceable clothes in wonderful colors, wears them over and over, and doesn't spend a lot of time on it. That's what thinking women are doing."

Ruth P. Rubenstein, a professor of sociology at the New York Fashion Institute of Technology, provides a broader view of current fashion trends set by the First Lady. She describes the look as "power dressing"—that is more professional, less vulnerable, and less revealing. "If you look at the vocabulary of images accumulated in Western society," she explains, "you'll note that when people feel powerless or vulnerable, their bodies are more exposed."

The future may see much less differentiation between men's and women's fashions as well. Crossovers in fabric and color reflect the changing roles of men and women in our society. And with the emphasis on versatility and comfort, new synthetic fabrics will become increasingly important. Promostyl USA's Hahn expects to see fabrics that "function on their own."

For example, "mod fabric," now in development, has beads woven in that adjust heating and cooling to body temperature. She also foresees clothes that won't need finishing seams when sewn nor drying when washed, stretch materials that fit all, and even fibers with stress fragrance.

Future fashion? It may not be Star Trek uniforms, but hey, we don't have to dress like George Bush either. **DC**

The Clintons look like good news for fashion. While Bill brings a retrovive change of pace to men's wardrobes, Hillary shows that power dressing for women doesn't have to be dull.



WI-HEELS

HERE COMES THE SUNGO

Solar cars juice up their engines and take to the road

By Jeffrey Zygmunt

Seasoned automobilist that I am, I nonetheless fell for romantic fallacy that a drive in a sun-powered car would strip away layers of intrusive mechanism, revealing a mystically serene, simple and direct association between energy and motion.

Instead, my first trip in a solar car proved as thrilling as pushing a 400-horsepower internally combusting Corvette around a race track. The excitement stems from a subliminal sense of terror from the perception of motion far faster than your limbs are designed to take you.

Cruising at only 25 miles per hour in Sungo, the leaf-shaped, two-seat commuter built by students at New Hampshire Technical Institute, I still felt the thrill of near danger. Its aggregate-thin fibreglass foam body let in decibels of road noise, while its go-cart seats suspended me just inches above the street. Sungo's electric motor and drive belts whined, rumbled, and groaned behind me, while the ka-chunk of the suspension rattled my ribs. The noise compounded with the inner-car impulse to hold on tightly as the car tossed around corners and to brace with my legs as it pitched to a stop—all told, a cacophony of sensations aggregating into as much fun as a person can have in a vehicle, no matter how it's powered.

None of that should deter Sungo. The car placed second in the commuter category of the 1993 American Tour de Sol, a combination road rally and demonstration program sponsored by the Northeast Sustainable Energy Association.

Sungo's shortcomings spread across the entire solar-car field. The daunting challenges of collecting enough energy from the sun, providing batteries to hold it, converting it to motive force, and carrying everything on a lightweight, manoeuvrable platform leave scant resources for the amenities the motoring public expects in automobiles. To anyone who harbors hopes of ever using full solar power for personal transport, the hazards and temperaments of today's experimental models present rather high hurdles.

The cars don't begin to meet the Federal Highway Safety Standards that stipulate, for instance, that an auto's front end must absorb the full impact of a crash at up to 30 miles per hour.

"Solar racers are about as safe as aerial gliders," says Michael R. Seal, director of the Vehicle Research Institute at Western Washington University. "They're quite large [providing surface area for solar panels], and they're incredibly light."

Even though they're shaped for sun exposure, solar electric recharge their batteries very slowly, limited by the energy available in sunlight. Seal explains that solar energy at the earth's surface equates to one kilowatt per square meter, and the efficiency of the best solar cells allows them to collect only about a fifth of it. Consequently, cars with ungainly collector panels, exposed to ten hours of sunlight, will still only acquire a maximum of ten horsepower hours

worth of energy, he estimates—enough for about an hour of driving. "Even if you park it in the sun all day in Arizona," says Seal, "it's not going to bring in that much energy."

And when the sun doesn't shine, forget it. Full-solar racing entries in last May's American Tour de Sol were allowed to plug into wall outlets at night when cloudy weather plagued the seven-day event. If they hadn't used power from the commercial electricity grid, they would never have finished on schedule.

Pragmatists, including Seal, concur that the most we'll get from the sun for transportation is supplemental energy. Already you can buy a Mazda 626 with a solar collector providing power for a fan that ventilates the car when parked. During cold weather, the electricity recharges the automobile's battery.

Sun worshipers who expect the technology to do more than add comfort to luxury sedans can take heart in work underway in thermal photovoltaics at Western Washington and elsewhere.

Building on its solar program and incorporating research by former Boeing engineers, Western Washington expects to produce a thermal photovoltaic car by early 1996. It will use a burner to combust natural gas about 2 to 2.5 inches from photovoltaic cells, exposing them to the equivalent of 1,000 suns, says Seal. It's not that the low-emission, steady-state burner is more powerful than of sol, but the 93-million-mile trek diminishes sunlight power.

Transportation is not a gift from Ra or any of the other gods. It's a wholly human enterprise, a product of our ingenuity and determination. Anyone who doubts it should hop in for a spin in a sun car. **DC**

It may not be the fastest car on the track, but the Sungo is everything that a car should be—great fun!



MEDICINE

TROPICAL DELIGHT, DISASTER, AND DISCOVERY: Finding cures among the wreckage of a hurricane

By Nina L. Diamond

For those who look for the proverbial silver lining in the cloud of disaster, Hurricane Andrew's devastation may have something going for it after all.

When the storm hit back in August 1992, Fairchild Tropical Garden lay right in its path. The 83-acre botanical paradise, home to 13,000 individual plants and trees from tropical regions

restored can now be studied."

In this one-stop shopping spree, medical researchers strip bark and take leaves, roots, and growing tips from the plants toppled by the storm. They can get samples of exotic species from one convenient location instead of hunting them down across a handful of continents. Normally, botanical gardens wouldn't sacrifice an entire tree to science, especially a rare one, but that ethical dilemma was removed by high-intensity winds. Within days of the hurricane, scientists converged at Fairchild to have a look at the debris.

"Scientists study how plants and trees wall off disease and heal their wounds," says Klein. "In the hope of applying what they learn to humans."

Medicine has long looked to nature for healing. Penicillin, for instance, comes from bread molds, and aspirin, though now synthetically produced, originally derived from extracts of the willow tree. To emphasize the medicinal value of plants, Klein states that "some 25 percent of prescriptive pharmaceuticals used today are derived from plants."

Scientists are always looking to up that percentage. That's one of the reasons so many are outraged by the destruction of the rain forests and other unique habitats. "Of the 250,000 species of flowering plants in the world that have been classified, only about 3 percent have been sufficiently studied to know what's in them," says Klein. "And there are another 50,000 or more species out there not even classified yet."

The discovery and study of these plants can have a profound effect upon medical research. When University of Illinois botanist Dr. D. D. Soejarto, working in conjunction with the National Cancer Institute,

found an anti-AIDS compound in the sap of a tree growing in a Malaysian rain forest a couple of years ago, scientists were elated. The compound, Calenalside A, was found to block the growth of HIV. However, when Soejarto returned to the Malaysian forest for more sap, he found that his precious tree had been cut down. Samples from other trees of the same species have not



produced the same HIV-blocking activity.

"That's the story of our life—or death," Klein says, lamenting the loss of the Malaysian tree: cut down by loggers who had no use for it but who cleared an entire area in order to claim the trees they did want. "The cure that needs to happen is the cure for human greed."

Klein hopes that Fairchild Tropical Garden's loss to Hurricane Andrew will be our gain. "We're open to any scientists who want to come in and do research," he says. Scientists would have to travel the world for years to find what Fairchild can offer now—thanks, oddly enough, to Hurricane Andrew. **DD**

The Fairchild Tropical Gardens before and after the high winds of Hurricane Andrew. Once shady groves and now fertile ground for the search for medicinal compounds.



all over the world, had long been considered one of the premiere living collections on the planet, featuring the world's largest collection of palms and cycads and many one-of-a-kind specimens. Ten percent of Fairchild's plants were so badly damaged by the storm that they couldn't be replanted, but fortunately, there is more to nature's bounty than meets the eye.

"Once you strip away the beauty of the garden," explains William Klein, director of Fairchild, "you realize the real value of these plants. This is like a biological library. All the 'books'—the plants—have been checked in here over a 60-year period, and those that couldn't be

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BOOKS

DARWIN, DINOSAURS, AND DNA

Current reflections on the theory of evolution

By Robert K. J. Kilheffer

One hundred thirty-five years ago, Charles Darwin published his monumental work *On the Origin of the Species by Means of Natural Selection* and thereby launched one of the most profound transformations of our culture. The basic concepts of his theory of evolution (or "the transmutation of species") have spread their influence as wide as Johnny's apple seeds. Darwinian ideas crop up in the way we think about society, history, personality, and even art and literature.

Still, despite its broad impact, half of the American public claims not to accept evolution as an explanation of the origins of life or humanity. How can such an important scientific idea—such a vital conceptual breakthrough—remain unappreciated by so many?

One reason—perhaps the most tenuous—dates back to Darwin's time. Many people find evolution too cold and impersonal, a concept and fact that strips our lives of grandeur, drama, and meaning. Obviously, to reach those people, the theory of evolution must be presented not merely as the most plausible scientific view, but as emotionally satisfying as well.

Two recent coffee-table books may go some way toward bringing evolution home to more people. Take a look, for instance, at *From So Simple a Beginning: The Book of Evolution* by Philip Whiffeld (Macmillan, 1993, \$40.00). Full of colorful illustrations as well as detailed diagrams and charts, this book makes a strong case for Roger Lewin's claim in the foreword that

Darwinian evolution is "the most profound text that can be written about the nature of life." Whiffeld begins with a look at the development of the concept of evolution—from Darwin's time and before through more recent discoveries in genetics and biochemistry—and proceeds from there through the rise of life from simple organic chemicals and the appearance of simple microorganisms and sea life on up to land-roving amphibians, early reptiles, dinosaurs (of course), and ultimately ourselves. Along the way, he describes the process of fossil formation, the biochemistry of evolution and mutation, and more, and he confronts various controversial issues such as the pace of evolution (is it a Darwinian process of gradual change or one of sudden bursts of mutation?), the role of mass extinctions (such as that which wiped out the dinosaurs)

and the ethical questions raised by genetic engineering. All in all, Whiffeld does an admirable job of communicating the excitement Darwin felt about evolution when he declared, "There is grandeur in this view of life."

Stephen Jay Gould, the foremost contemporary popularizer of evolutionary thinking, edits a volume that takes a somewhat different tack. *The Book of Life: An Illustrated History of the Evolution of Life on Earth* (W. W. Norton, 1993, \$40.00) includes chapters by leading experts on topics such as early ocean life, mammals, and dinosaurs, accompanied by engaging illustrations done specifically for the book. With Gould at the helm, this book, surely the "pageant" of life on Earth with verve and accuracy, highlighting controversial issues, but it's also concerned with examining the scientific process itself through the case of evolution. Gould emphasizes how cultural assumptions and social goals influenced the ideas of early paleontologists and illustrators; he's particularly interested in what the "iconography of ancient beasts"—images of dinosaurs or early life in the seas—reveals about the culture from which it comes. Gould even points out that *The Book of Life* itself cannot escape from such socially dictated ways of seeing, that the future will probably look back on us as quaint in some ways. This reflective approach makes a sophisticated complement to Whiffeld's less self-conscious book.

Evolution isn't just for scientists. It's a shame that many find no excitement or interest in it. But with books such as these to persuade, perhaps a few will recognize and embrace the grandeur at the heart of Darwin's vision. **DD**

THE BOOK OF LIFE

An Illustrated History of the Evolution of Life on Earth



Taken for granted by many and condemned as heresy by others, Darwin's revolutionary theory of evolution still provides our-lishing food for thought.

EARTH

WHEN SCIENCE IMITATES NATURE

Using artificial photosynthesis to harness solar energy

By Hunter Whitney

In the September 27, 1912, issue of *Science*, the Italian chemistry professor Giacomo Ciamician proposed an alternative to dependence on coal. He envisioned industrial colonies "without smokestacks" where "forests of glass tubes will extend over the plains." Inside these translucent reactors, sunlight would drive processes that were once thought to be "the guarded secret of the plants."

Ciamician's dream, after some 80 years, finally seems plausible. Researchers are currently working on artificial photosynthetic systems based on green plants and purple bacteria, attempting to understand and mimic the photochemical wizardry that trout larvae, pond scum, and potted plants perform every day. Their work may yield new ways to generate clean, renewable energy as well as solar-powered manufacturing techniques.

Whether the fuel is a loaf of bread or a gallon of gasoline, the energy that keeps your heart pumping and your car running ultimately comes from the sun shining on plants. The green pigment chlorophyll uses sunshine to transform

acquired chlorophyll molecules to absorb solar energy; developing artificial systems would be fairly simple. However, electrons excited by light soon return to their customary positions and discharge the energy as useless heat. In order to circumvent this problem, plants shuttle their displaced electrons down a chain of acceptor and donor molecules, keeping the positive and negative charges apart long enough for the energy to aid in the formation of desired carbohydrates.

Researchers have had some

view, it's much better to develop materials that can function well in solids. "You wouldn't necessarily want a solar cell in your calculator to be sloshing around," he observes. Plants have found a way to get around this problem—their photosynthetic systems function quite well in their solid form—but human science hasn't gotten past it yet.

Scientists have suggested several different approaches for harvesting solar energy using photosynthetic models, including developing photosynthetic pigments that would generate

electricity or high-efficiency fuels. "I think in the future we will see photochemical production of hydrogen gas or other clean-burning fuels from nothing but water, carbon dioxide, and sunlight," says Wasielewski. Synthetic molecules might also serve as photosensitizers in the solar-driven manufacture of plastics and other materials—for example, a process that currently requires baking chemicals for several hours might be performed far less expensively by using special pigments and abundantly cheap sunlight.

For now, Ciamician's dream remains something of a long shot, but the current research is laying the foundation for new applications of our solar resources. As John Connolly, principal scientist at the National Renewable Energy Laboratory, notes, "Whether research in this area will be applied on an industrial scale is going to depend on a lot of factors—accidents, serendipity, and many other things. But that's one of the more delightful aspects of science and the human condition." □



Mimicking the process that plants use to obtain vital energy, researchers hope to generate photosynthetic energy.

water and carbon dioxide into oxygen and carbohydrates, which the plant can use as food. Light energy excites one of the chlorophyll molecule's electrons, causing it to jump onto a neighboring acceptor molecule. The migrating electron separates positive and negative charges that can then be harnessed to perform useful work, such as fueling the chemical reactions necessary to build the carbohydrates the plant needs.

If photosynthesis is only re-

successes in developing artificial photosynthetic molecules in the lab, but it's been harder to produce photosynthesizers stable enough for practical applications. "Typically, we'll design a molecule that functions just marvelously floating around in solution," explains Dr. Michael Wasielewski of the Argonne National Laboratory. "When we prevent the molecule from moving around, though, the efficiency of the charge separation drops like a rock." From a practical point of



CONTINUUM

READING ANCIENT DNA:
The Windover people. Plus, bad weather on Pluto, and a magazine
for the truly suffering artist

When the bits of brain reached William Hauswirth's molecular biology laboratory at the University of Florida, they were 8,000 years old. But he is now "reading" these ancient neurons, deciphering clues about the lives of prehistoric Floridians. In the process, he's advancing a new science: molecular archaeology. As a spinoff, he may shed light on modern diseases.

Contractors building for the Windover housing project near the Kennedy Space Center unearthed skeletons; archaeologists eventually dug up more than 170 skeletons. The bodies had been buried 70 to 80 centuries ago under water, held down with crossed sticks. Archaeologists determined that this swamp had served for a thousand years as a prehistoric community's cemetery.

Amazing luck. The skulls still contained intact brains. More luck. The pond's peat was unusually free of acid. "Acid is death on DNA," says Hauswirth.

Archaeologists sent him samples from 81 brains in 1984 and 1985, when molecular archaeology—the analysis of ancient DNA for clues to past societies—was still in its fetal stage. That was a cumbersome technology required him to inject samples of the prehistoric DNA into bacteria. As the bacteria reproduced, they cloned the samples. The process was painfully slow. It also required undamaged source material—and ancient DNA is virtually always damaged.

Then, in the late 1980s, molecular biologists acquired a powerful new tool: PCR, or polymerase chain reaction. Using enzymes from bacteria that live in boiling-hot springs, researchers found that they could select a snippet of DNA and produce millions of exact copies. Instead of months, it would take hours. And PCR doesn't require perfect materials. In fact, it repairs damaged DNA segments. Hauswirth is studying a sequence of DNA that encodes immune-system proteins. He also has found that the Windover people's mitochondrial DNA, inherited solely from the mother, changed little over 50 generations, which suggests that wom-



An ancient burial ground provides insight into the workings of prehistoric brains.

en were isolated in their villages. DNA from living Native Americans suggests the Americas were populated by four groups of Asian immigrants. Hauswirth has now found that the Windover people seem closely related to most if not all four groups. Interestingly some of the evidence suggests the possibility that these might have been other founding populations.

Hauswirth also hopes to determine whether the Windover people possessed DNA coded for repelling certain infectious diseases, such as smallpox. If not, it would suggest that some diseases hitchhiked to the New World in the bodies of Europeans.

Hauswirth believes molecular archaeology may prove useful in a variety of other disciplines, too. For instance, DNA from the Windover brains represents 50 generations. "So we can ask, how does a species change in 1,500 years?" he says. "It's a real tool for studying short-term evolution."

Ancient tissues might even spotlight what industrial pollution does to us. "One theory of aging is that unrepaired damage to our DNA accumulates after age 35 and is a function of the environment," Hauswirth says. "These preindustrial tissues may help us determine if today's pollutants contribute to DNA damage."

He worries about contamination of his samples with modern DNA. An excavator's sneeze would do it. But Hauswirth says the new field is developing safeguards, such as insistence that findings must be replicated by other researchers. Also, since PCR works with only snippets of ancient DNA, findings based on long sequences of genetic material are automatically suspect. And a computer database can now sound an alarm if a key bit of "ancient human" DNA is actually from a bacterium or a nonhuman entity.

Don't expect to see a living Neanderthal cloned from a fossilized knut, but molecular archaeology may yet reify our ideas of prehistory. As Hauswirth puts it, "This science is still an infant—it's only in its first week of life!"

—RICHARD WOLKOMIR



CONTINUUM



TESTOSTERONE: WHOSE TURN-ON?

Most of us think of testosterone as the quintessentially male hormone—a tiny, internal squirt of it turning men into ruffing, sex-crazed. You got the idea. Now Georgia State University psychologist James Debbis says testosterone may actually play more of a role in sex for women than for men.

Debbis asked four heterosexual couples in their twenties to collect saliva samples twice a day for a couple of weeks—once after dinner and once before going to sleep. On the pre-sleep sample, the couples indicated whether they had

made love between dinner and bedtime. When Debbis and his colleague Suzanne Mohammed subsequently measured the amount of free testosterone in each sample, they found

CA/GUT DOESN'T COME FROM CATS. IT'S MADE FROM THE INTESTINES OF SHEEP AND HOGS.

that while both sexes showed higher testosterone levels after sex than before, the woman's levels increased for more than the men's: 42 percent to 7 percent.

Explanation? "There are

just guesses," Debbis says, "but it could be that sex has a more lasting effect for women. Or it could be that the hormone is more arousing for women than for men."—Bill Lawrence

SEASONS AT THE EDGE OF THE SOLAR SYSTEM

A map of Pluto—which took more than six years to complete—reveals that the distant, diminutive planet undergoes seasonal changes. With this surprising finding, Pluto joins Earth, Mars, and Triton—Neptune's moon—as the only bodies in the solar system known to experience seasons.

Massachusetts Institute of Technology planetary scientists Richard Binzel and Eliot Young observed Pluto from 1995 through 1999, using three telescopes at the McDonald Observatory in Texas. Pluto is so far away—30 to 50 times farther from the sun than Earth is—and so tiny—only two-thirds the size of our moon—that Binzel and Young couldn't have probed the surface at all were it not for a chance alignment of Earth, Pluto, and its satellite Charon that occurs twice during Pluto's

THE AMOUNT OF GOLD DISSOLVED IN THE OCEANS IS ABOUT 100 TIMES THE AMOUNT OF GOLD BUG IN MINES IN THE ENTIRE HISTORY OF HUMANITY

348-year swing around the sun. During the six-year observation period, the apparent brightness of Pluto changed as Charon passed in front of and behind it. These fluctuations enabled the scientists to determine the reflectivity, or "albedo," of the planet's surface. Their calculations pointed to a bright cap on the south pole, believed to consist of either methane or nitrogen frost.

How, the scientists wondered, does the frosty layer stay so shiny when one might expect it to become tarnished with space grime? The MIT pair came up with a theory. During its elliptical orbit, Pluto periodically

comes closer to the sun and then moves farther away. As Pluto recedes, its south pole is plunged into shadow and the entire planet grows colder. Methane or nitrogen condenses from the atmosphere, blanketing the south pole in a fresh layer of snow.

The current weather forecast for Pluto: "It will start snowing in twenty to thirty years and last for about a decade," Benzel says. "Then there'll be a two-hundred-year cold snap. 'Til summer comes around."

—Steve Nadia

ART AND MEDICINE

Why do drummers sometimes urinate red? Why do orthodontists' eyes light up when they see a kid with a violin? The answers to these and other burning questions appear in the new French magazine *Méde*.



one *des Arts*, perhaps the first journal devoted solely to medical problems peculiar to artists.

Artists have occupational diseases just like coal miners (bad lungs) and supermarket checkers (bad wrists), explains the magazine's founder, French physician André François Arcier. Arcier has collected more than 4,000 items on the ravages of art. Beating on hand drums, for example, ruptures red blood cells, releasing hemoglobin that finds its way into the urine. "In parts of

IT TAKES 364 KILOGRAMS OF COAL TO EQUAL THE FUEL ENERGY IN THE MANURE PRODUCED BY A COW OVER THE PERIOD OF ONE YEAR

Africa," Arcier says, "people say a drummer doesn't play well unless he has red urine. Hours of violin playing can displace the chin, sometimes requiring heavy orthodontia."

All this and more can be found in the pages of *Médecine des Arts*, the first issue of which appeared in September 1992. Actually, Arcier has even bigger ideas: He wants to use the quarterly magazine to launch the new field of art medicine—the *artiste's* version, he says, of sports medicine.

—Bill Laurien

"It is remarkable how often our complaints reflect our own shortcomings."

—Dick Caverton



Clones of a fast-growing member of the paulownia family of trees may help meet the ever-growing demand for hardwood.

GROW A CLONE, GROW A CLONE

A combination of the ancient and the modern could provide the answer to the insatiable global demand for hardwood, which the timber industry now sells an estimated 140 million trees yearly to meet. An Asiatic species of hardwood called the paulownia, which grows to maturity in seven years, fits the ancient side of the equation. The modern part is cloning technology, which turns out more trees in less time.

The paulownia clone grows from a seedling to a ten-foot tree in six months, according to George Bland, president of Tree Technology International in Mexico, North Carolina. The company's scientists worked for ten years to develop the tissue-culturing technique needed for the cloning process.

"We guarantee a sixteen-

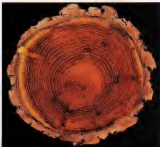
foot butt log length, and we have a ninety-nine percent success rate with tissue culturing," Bland says.

"With seeds, who knows what the success rate is?" World demand for hardwood timber has reached 200 cubic meters yearly and rises about 3 or 4 percent annually—as does the price—destroying for reds far faster than nature can replace them. The paulownia clones, which can rapidly produce what arborists call a "mother stock," could help solve a demanding resource, Bland says.

Another advantage of the cloned paulownia—named after a daughter of the Russian Czar Paul I—is that a cubic foot of its pale-colored timber weighs between 14 and 18 pounds, compared to the 60- to 70-pound weight of conventional hardwood. Less weight means lower harvesting and transportation costs.—George Nobbe



CONTINUUM



Researchers can now use satellite pictures to find old-growth trees rather than hunting for them on foot.

OLD GROWTH'S SIGNATURE

Scientists trying to find stands of old-growth trees in high-country forests have traditionally had to do it the hard way, lying on their hiking boots and strapping on their binoculars to look

lead in the race to find ancient trees before they're sold to timber companies.

The age of a tree stand determines how much light it reflects in various bands of the electromagnetic spectrum. An instrument on the Landsat satellite detects these energy reflections and

it reflects less light in several areas of the spectrum, and mottled, because it has a multilayered canopy.

She continued her study to the Flat Tops Wilderness Area in northern Colorado but thinks the technique can be used virtually anywhere. Other groups have used a different kind of

remote sensing to detect old growth, but Nel's method is cheaper and quicker.

"It's not a magical technique to find all the old growth in the world," Nel explains. "But for groups like the Forest Service, it's a fast and cheap way to start an old-growth inventory."

—Teresa Szalay

AT LEAST IT'S SAFER THAN TOTAL RECALL

Attention, astronaut wannabes: Frustrated because you'll probably never get to visit Mars in your lifetime? Check up: A new computer program can take you there, virtual-reality style.

With VistaPro, you can explore the valleys and canyons of Mars, choosing the view angles and lighting of scenes as if you were shooting the surface with a camera. The program uses NASA data to build its images and allows you to select the Martian features you want to explore. "It's so if you've

driven your Jeep down and you're looking at it," says Lance Woodley, president of Virtual Reality Laboratories, VistaPro's manufacturer.

And for forward-thinking Mars buffs, VistaPro, which retails for \$129.95, allows users to add trees and other terraforming motifs to the landscape. The program's details are so realistic, Woodley says, that Arthur C. Clarke used VistaPro to help write his upcoming book on terraforming Mars.

Virtual Reality Laboratories will soon introduce a new virtual-reality program featuring Venus.

—Deena Pincus

MALE EMPEROR MOTHS CAN SMELL A FEMALE SEVEN MILES AWAY—AND EACH FEMALE CARRIES LESS THAN A MILLIONTH OF A GRAM OF ATTRACTANT

for them firsthand. Now, satellites are making their work considerably easier. A Rocky Mountain researcher has discovered that old-growth leaves a "spectral signature" that can be spotted by satellites, giving conservation groups a

emissions from surface features. University of Colorado researcher Elizabeth Nel used a computer to translate that data into a series of pixels, or picture elements. She found that old growth appears darker in the pixel display because





CONTINUUM



KEEPING A COOL HEAD

Long before the warnings about skin cancer and the vanishing ozone layer, farmers wore hats to protect themselves from the sun. However, the hat of choice for today's farmers—baseball caps—leaves something to be desired, according to experts at the National Farm Medicine Center in Marshfield, Wisconsin.

Baseball caps don't protect such vulnerable areas [against skin cancer] as

A CUCUMBER IS NOT A VEGETABLE BUT A FRUIT. SO ARE PUMPKINS AND SQUASH.

ear tips, temples, and the back of the neck," says Barbara Lee, a registered nurse and the center's assistant director. Last summer, Lee and some colleagues field-tested 11 different hat styles on farmers in Wisconsin and Minnesota to find headgear capable of

SKIING ON STEEL

When Hank and Buddy Kashiwa tried selling their idea for making snow skis out of everyday ordinary steel, they were laughed out of some executive suites. Metal seemed passé in an industry that employed the most high-tech of materials.

The brothers may soon enjoy this last laugh. Their company, Volant of Boulder, Colorado, is entering its fifth season as a David amid the Goliath of established ski makers.

The Kashiwas claim that Volant skis represent the first truly new-concept skis developed in nearly two decades. Their secret is a one-piece stainless-steel cap that covers the ski's top and wraps down the sides. Though scarcely as thick as two business cards, the steel cap accords disproportionate strength from its shape.

Layers of spring steel inside the skis combine with the cap—plus some conventional ski materials—to capitalize on properties

of the metal that improve downhill performance. The design using the steel resists twisting and allows even weight distribution from ski tip to tail. Accordingly, stability improves, turning becomes both easier and snappier, and edges grip icy surfaces more securely.

Hank Kashiwa, Volant president and one-time Olympic skier, lists the ski establishment for supplying engineering with flash on, embracing exotic materials primarily for bragging rights. "Since the mid 1960s, there's been nothing new in ski design," he argues, "but in the interim, marketing has taken over."

Ironically, the Kashiwas themselves cloned the latest downhill vogue: caps. "When we introduced the design in 1989, people jumped on the bandwagon," Hank says. "But there's no real structural advantage to a composite cap." Its patents leave Volant the only ski company exploring the advantages of steel. —Jeffrey Zygmunt

providing adequate sun protection that farmers would actually wear.

A stiff hat with a brim that extends out like a pith helmet proved to work the best, according to Lee. But such a hat isn't practical for farmers because it can pop off too easily. The farmers preferred a Foreign Legion-style hat with a brim like a baseball cap in the front and a flap that covers the ears and

neck in the back. There's no need to spend a lot of money on such a hat, Lee says; a bandanna tied under a baseball cap will do the job just as well.

Copies of the report, including pictures of the hats, farmers' comments, and buying sources are available free from NFMG, 1000 North Oak Avenue, Marshfield, Wisconsin 54449.

—Francesca Lunzer Krutz



LUCY'S FATHER

Article by Sharon McAuliffe • Photographs by Donald and Lenora Johanson

It had been 14 years since Donald Johanson led a major expedition to Ethiopia. War, drought, famine, and finally a decision by the government's Ministry of Culture to ban all foreigners from fossil hunting had locked him out of the country. But at last, in 1982, this world-renowned paleoanthropologist, the man who had discovered 3.2-million-year-old "Lucy"—humankind's earliest two-footed ancestor—was once again taking a caravan of Land Cruisers out of the capital city of Addis Ababa.

Johanson's destination: the Hadar, a remote spot in far northern Ethiopia with some of the richest fossil deposits in the world. Here, these pieces of the earth's crust meet, shifting back and forth with geological slowness and in the process pushing long-buried bones to the surface. As his scientific team drove along, Johanson, his hair now graying at both temples and brow, found himself elated to



Sunrise across
Hadar finds paleoanthropologist
Donald Johanson back
in Ethiopia amid new evidence
of human origins.

Donald Johanson sifts patiently through the dust of time and culture.

be back, yet apprehensive about what they would find. "We didn't know who among our old friends would be dead or alive," he says.

It takes three days of tough driving to reach the Hadar. But word traveled quickly among local Afar tribesmen, and soon it seemed that almost everyone knew the *ferenji* (foreigners) were back looking for *mona gohale* (fossil bone). As the scientists pulled into the tiny village of Elowato—their last stop before heading off into the bush—they were greeted with an amazing sight: Dato Ahmedu, an elder of his clan and an old, valued member of their original field team, stood waiting for them by the side of the road. Children ran underfoot, herds of goat and sheep moved all about, and trucks kept barreling by, but through all the commotion, Dato let the team know that he had stumbled upon something important out in the desert. "You could see in his eyes," Johanson



*Dato, an Afar
tribesman, leads Johanson
to a discovery that
allows us to imagine what Lucy
might have looked like.*

recalls. "The absolute thrill and excitement of being able to tell his good American friends that he had found something."

And found something Dato had. Later that evening he would lead them to a little piece of apes that he had used to mark the position of the left half of a fossilized lower jaw—with four teeth still in place. The jaw was definitely from a Lucylike hominid (the scientific term used to distinguish the early human ancestors who stood up and walked erect from our more distant apelike relatives who moved about on all fours). But more important than this particular find, Dato had led the team to a new, highly productive area full of hominid fossils. In the next few weeks, they would pull out another jaw, a partial male skeleton, and the most covered scientific prize of all: a nearly complete skull of Lucy's species, which bears the tongue-twisting name *Australopithecus africanus*. "This is something we've searched for for years and no one's ever found," says Johanson. "It's the oldest, most complete skull we have of a hominid, and it gives us a glimpse of what this early, primitive species must have looked like."

These are exciting times for Donald Johanson, president of the Institute of

Human Origins (IHO) in Berkeley, California, and best-selling author of *Lucy and Lucy's Child*. He has now made dozens of new hominid discoveries in Ethiopia, just published *Ancestors*, a popular science book, and hosted his own TV series for Nova, which aired on PBS earlier this year. Titled "In Search of Human Origins," the series covers the grand sweep of human evolution—tackling close to 4 million years of history in just three hours. In the tradition of Kenneth Clark's "Civilization" and Jacob Bronowski's "The Ascent of Man," this documentary series puts forth Johanson's perspective on some of the most hotly debated issues in early human research. Why did our ancestors stand upright? How did they make a living? Were they noble hunters or wily scavengers? What actually happened to the Neanderthals? What is the fossil evidence, and how do we interpret it? In short, what is it that Johanson believes makes us essentially human and who we are today?

On camera, Johanson is handsome, worldly, and well spoken, as he takes the audience on a truly epic adventure with stop-offs in Africa, Europe, Australia, and the Middle East. He is a master science popularizer, translating his own enthusiasm for paleoanthro-

pology into colorful words and images. "Don knows how to tell a good story and make it really interesting to an audience who knows nothing about it," says Paula Aspell, executive producer at Nova. "This one of the few scientists who can talk to the public without being too technical." Off camera, Johanson is equally engaging and charming, a wonderful raconteur who is knowledgeable about not only fossils, but opera, wine, and German poetry as well. Johanson is also known, however, to be an extremely ambitious and driven man—a demanding perfectionist who pushes himself and others hard. According to geologist Bob Walker at IHO, who's worked with Johanson for nearly 20 years, "Don's funny, witty, intelligent, and personable, but he can also be caustic and biting. He can be your best friend and your worst enemy—all these things wrapped up into one. He's just an incredible dynamic personality with a laser-sharp mind, who retains everything from arcane scientific information to jokes."

Johanson was catapulted to fame in the mid-1970s when as a young Ph.D. he roamed the scientific world with his remarkable hominid discoveries and his startling interpretations of what they meant for human evolution. First came

the partial female skeleton, Lucy, in 1974—named for the Beatles song "Lucy in the Sky with Diamonds," which played over and over again at the camp celebration the day she was unearthed. With an incredible 40 percent of her bones still remaining, Johanson was able to see that upright walking, or "bipedalism," was the key feature that distinguished early humans from their apelike forebears. Until that point, most scientists had presumed that a bigger brain had preceded this change in posture. In fact, Lucy with her small apelike brain, is often described as being a chimpanzee from the neck up and a human from the waist down. Or as Johanson puts it, "For all her apeness, Lucy walked beautifully."

A year later at the same site in Ethiopia, Johanson uncovered the remains of some 15 other individuals who appeared to be related to Lucy. He lived to be the oldest evidence of human ancestors living in groups, the National Geographic Society dubbed this fossil collection the "First Family." And finally, in January of 1979 came the famous theoretical paper in *Science* with co-worker Tim White, where Johanson rewrote the human family tree and declared both Lucy and the First Family members of a new

species, *Christened Australopithecus africanus*, Johanson and White positioned the new species at the base of the tree—as the earliest human ancestor from which all others were thought to be descended. "Johanson and White were absolutely right to create a new species," says Ian Tattersall, chairman of the anthropology department at the American Museum of Natural History. "But at that time, it was a very, very unfashionable thing to do. There hadn't been a new species created for over ten years. When Louis Leakey and colleagues named *Homo habilis* and got into all kinds of hot water."

The controversy and debate that followed were very public and very bitter, especially between Johanson and Louis Leakey's son, Richard, who had since become a distinguished paleoanthropologist in his own right. Johanson and Richard Leakey had once been good friends, vying each other's digs, stopping by to show each other their latest fossil finds, even sailing together off the coast of Kenya. But the sparks began to fly in newspaper and magazine articles, culminating in a belated debate on the science program, *Walter Cronkite's Universe*, where Johanson presented his version of the family tree on a poster board and

Leakey crossed it out with a big X and a question mark. That was back in 1981, and they haven't spoken since. "We had a head-on collision," says Johanson, "and neither one of us was going to budge one centimeter. Unfortunately, I don't think that's repeatable."

In essence, Leakey thought there were at least two parallel paths of human evolution—that the one leading to true humans went back millions of years independent of *Australopithecus*, which he considered an interesting side branch in the human family tree (or "bush," as he likes to call it that eventually withered and died off). At the time, Leakey believed he had the hominid fossils to prove his point. "It turned out that Leakey's material is a lot younger than Johanson's stuff from Hadar and therefore was not in such direct competition as it first appeared to be," says Tattersall. "But back then the fossils were thought to be about the same age and therefore the difference in interpretation was significant." The end result was not just the destruction of a personal and professional relationship, but a real split in the field of paleoanthropology. There's been the whole development of the Leakey camp and the Johanson camp, and if you're in

Continued on page 11

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Article by
Joel Siles

Why do birds
flock? Why
do bees swarm?
At SFI, com-
puter scientist
Christopher
Langton (near
right) and
his colleagues
have come
up with a pro-
gram called
"Swarm" that
imitates the
actions of birds
and bees in
order to clarify
at what
point intelligent
behavior



COMPLEXITY

Walking through the corridors of the Santa Fe Institute (SFI) it is not uncommon to hear the assertion $2 + 2 = 5$, which initially caused a moment of consternation on my part, as the Institute, located on the outskirts of Santa Fe, New Mexico, has become a gathering place for a number of eminent scientists, leading economists, and an international crop of graduate and post-graduate students researching topics from evolutionary biology to linguistics. But SFI is an institution based on the idea that the sum of the parts doesn't



emerges in such
a system.
They think that
their work
will eventually
help find
glitches in more
complicated
systems. Langton
does his
groundbreaking
work at
the Santa Fe
Institute
where vice presi-
dent of
economic affairs
Mike Simmons
(near left)
oversees the
research
on the nature of
complexity.

necessarily add up to the whole and is dedicated to the study of what has become known as the science of complexity.

As it stands, complexity is more a way of doing science than a science itself. It's an approach that looks for patterns in what scientists at the Institute qualify as complex systems (CS) or complex adaptive systems (CAS). The scientists analyze these systems from the bottom up—tracing the actions of antibodies in the immune system or fluctuations in the stock market—in order to understand the system as a whole. **PHOTOGRAPHS BY DAVID MICHAEL KENNEDY**

**Terry Jones
(right) works
with ecologist
Jim Brown
to model a real-
life ecosystem
experiment that
uses "The
Eco Model," an
all-purpose
complexity pro-
gram devised
by the Institute.**



IN CASE they often find "emergent behavior" that is the surprising resultant of the equations—when groups of antibodies organize to eliminate an invader or the stock market crashes. At the core of complexity is the conviction that complex systems share similar behavior: so what you learn from one system, like the immune system, you can apply to another, like the economy—which explains the conglomeration of people who are in some way affiliated with BRI, wading the halfway with a cup of coffee and suffering what seems to an outsider a sort of professional identity crisis. There are physicists turned computer scientists, computer scientists turned biologists, biologists turned economists. They come to the desert from Stanford, from the University of Illinois, from the Salk Institute, from industry; they come from Ecole Normale Supérieure in Paris and Göttingen's Max Planck Institute, from as close as Los Alamos National Laboratory and from as far as the

Westman Institute in Iowa.

I came from the coast of North Carolina to participate in the Institute's Complex Systems Summer School to see if I could get, in the famous New Mexican light, a glimpse of complexity. I came in search of a definition or at the least a metaphor.

BRI vice president of academic affairs Mike Simmons often lectures on the science of complexity and the Institute itself. He is good humored and philosophical a manner I found indicative of the atmosphere at BRI, where the scientists take their work seriously but are not, on the whole, self-absorbed. He opens his lecture with a caveat for me: "There is no agreed-upon definition of complexity, even within the Institute," he says. "It's a lot like the Supreme Court's definition of pornography: it's very hard to define, but you'll know it when you see it."

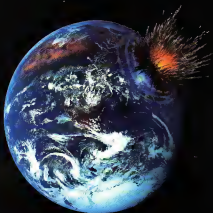
Before you start looking you need to understand that some systems are "simply complex," particularly physical systems,

like the formation of a snowflake or smoke rising from a cigarette, while others are "complex and adaptive," like the immune system, the economy, or human societies, because they learn and modify behavior. It's the overlap from the hard sciences to economics and the social sciences that makes complex adaptive systems intriguing: "Complex adaptive systems are different, their problems system specific," says Simmons, "but they are able to evolve and, in some cases such as the AIDS virus, trade imbalances and conflicts in society, do evolve. Until recently, scientists thought many of the problems related to CAS's were intractable—how an ecology can be sustained or an economy kept in balance, how the AIDS virus evolves in a population, how conflicts evolve in a society."

The ant colony is a popular model for describing a complex adaptive system. Because while individual ants may only be able to perform two to three dozen tasks, their aggregate behavior enables the colony to operate almost as a single organism. There is no leader or boss, no chain of command. The colony works from the bottom up. Some ants will spend a full day moving larvae around the nest to keep them cool or "waspapering" the walls of the nest with discarded cocoons to keep the humidity down. Others forage for food, sending out chemical signals to their colleagues when they find a food source. Ants adapt, collectively, to accommodate the colony, relocating the nest in the event of famine, attack, or flooding, or simply adjusting their work schedule contingent to the weather.

But adaptation doesn't necessarily mean evolution,

THERE GOES THE NEIGHBORHOOD.

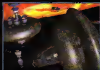


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Simmons warns, "It doesn't necessarily mean improvement either," he says. For instance, during a flood the ants might relocate to enemy territory. Moreover, systems sometimes identify false regularities, which can be a source of trouble. Superstition is an example of humans operating as complex adaptive systems identifying false regularities, according to Simmons—as in the case of the baseball player crediting his hitting streak to a pair of socks. "If he wears the socks for the next month," says Simmons, "he may continue to hit above 300. But on a rational basis, it's hard to believe the socks have anything to do with it."

The Santa Fe Institute itself was conceived in the early Eighties, the brainchild of a group of senior fellows at Los Alamos National Lab who saw a need for an institution devoted to interdisciplinary studies that didn't adhere to the demands of traditional research universities. SFI's mandate is simple: collaboration, computing, and multidisciplinary research. Today, there is no permanent faculty; no departments, no tenure. Researchers retain affiliation with their primary institutions and come to SFI to work on less conventional projects. The Institute has also made two other decisions. Long-term participants must

raise their own funds, and all must leave their bookers at home. At SFI, the closest thing to a lab is the small kitchen where staffers stash their lunches.

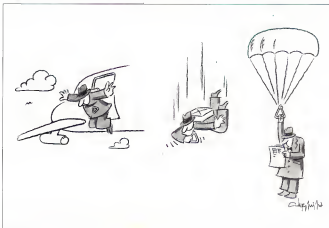
Researchers at SFI use computers the way biologists use microscopes to get a microscopic view of complex adaptive systems, analyzing the behavior of each agent in a system. Such modeling supplements and in some cases replaces analytical computation or the lab-in-studies of the human immune system or natural ecologies or economies. They build controlled environments in which variables or agents—representing, for instance, antigens in a biological system or a species in an ecology—can be manipulated using sophisticated computational techniques such as classifier systems, neural nets, cellular automata, and genetic algorithms. Classifier systems are loosely based on concepts from economics of competition and cooperation of the marketplace. Neural nets crudely simulate the actions of the neurons and synapses of the brain and are also used as stand-ins for artificial intelligence.

Cellular automata work on a lattice, each "cell" of the lattice changing contingent on what it knows about itself and what it learns about its neighbors.

They have been utilized to simulate processes like crystal growth or the intricate patterns seen on mollusk shells. Genetic algorithms are founded on ideas of natural selection and sexual reproduction and are inspired by the notion that nature, through evolution, is the consummate problem solver.

Such is the belief of University of Michigan computer scientist, psychologist, and engineer John Holland, who began the development of genetic algorithms in the 1960s (as well as classifier systems). The algorithms mimic the behavior of biological chromosomes, making copies of themselves and recombining with other chromosomes to produce, ideally, more "fit" strings. But instead of biological traits, the algorithms are made up of strings of attributes representing characteristics needed to solve a given problem. For example, if you're designing a robot, attributes might include the kinds of movements—forward, backward, sideways—it must perform. It's the coordination of these movements that the algorithms optimize.

Engineers have used genetic algorithms to design jet turbines, because the design of such systems involves at least 100 variables, each of which can take on a different range of values and



have numerous constraints. The pressure, velocity and turbulence of flow inside the turbine must cohere; the turbine itself must have a certain curvature and smoothness.

Using techniques such as genetic algorithms to replace or gain insight into costly experimentation is something scientists at SFI hope to do with all their computer models. "The current development of the science of complexity depends very much on the rapid development of computers," says Simmons. He points out that the growth over the last 20 years of techniques for mathematical analysis of nonlinear systems such as the weather has coincided with, and benefited from, the availability of powerful computers. "There has been an important interplay between the increase of new computational power and new computational techniques and new mathematical techniques," he says.

Indeed, as soon as computers became available, scientists began using them to emulate problems in the natural world. In the early Sixties, meteorologist Edward Lorenz hoped to use a computer model in combination with mathematics to take the guesswork out of long-term weather forecasting. Instead, he stumbled across what would become a crucial factor in the development of chaos theory. He found to his surprise that if even a minute change was made in the initial conditions—say if the number representing humidity in his model was rounded off by one one-thousandth—weather patterns could diverge dramatically.

By the Seventies, the phenomenon became reduced to the phrase "sensitive dependence on initial conditions" and known in terms of the "butterfly effect"—that a butterfly flapping its wings over Cuba in August could influence the course of a hurricane headed inland in September. On a small scale, Lorenz's findings provoked a new modesty among scientists working on long-term weather forecasting; on a large scale, the consequence was a cross-disciplinary shift in the sciences away from Newtonian determinism, or the idea that the world unfolds in a predictable manner. "Many people have rethought their approach to science and the mathematical assumptions they made about the systems under study," says Simmons. "It's not that the old ideas were wrong, it's just that there's more to it than that."

Researchers in complexity write programs to mimic the behavior of CASs—the economy or an ecology—that allow them to manipulate variables in the environment or initial conditions

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With these simulations, scientists look for regions of stability—a stable population of predators and prey in an ecology—or regions of instability—where an increase in predators depletes a population of prey contributing to the extinction of a species. By analyzing these scenarios, scientists build mathematical models of the system, often based on intuition or an educated guess. "There's a kind of interplay," says Simmons, "and it's very much like the interplay between experiment and theory in the real world. If you conduct an experiment and find some important effect is there, then you set about adding the underlying theory. The insight gained by the experiment helps in solving the theoretical problem."

To conduct these experiments, SFI computer scientists are working on programs that will provide a general framework in which scientists can work—a digital lab of sorts, suitable for use by scientists from many disciplines. John Holland calls his the Echo Model (as in echoing an ecosystem) and compares it to a flight simulator where scientists can troubleshoot problems or test hypotheses without setting up a physical experiment. Holland hopes Echo will also be used by scholars and policymakers in numerous fields, from anthropology to politics.

Holland's former student, Australian Terry Jones, has the challenging task of implementing the program, which he's working on at all hours in a small office tucked behind the Institute's library—or, on a bad day, Jones jokes, from under the desk. "You find in complex systems some sort of high-level phenomenon," he explains, "some big overall behavior that we haven't had very much success in predicting, like a stock-market crash or the extinction of a species. The idea at the Institute is that maybe there are some commonalities in these systems that can be gotten at, perhaps through mathematics perhaps through modeling."

Jones is working with University of New Mexico ecologist Jim Brown modeling one of Brown's real-life experiments to verify Echo. "In the early Seventies, Brown lopped off patches of desert and systematically removed species to see what effect the absence of a desert rat or ant would have on the ecosystem," Jones says. "It's the kind of situation we can easily model in Echo. Start it up, run it for a while, then stop it and take out all of the agents with the same string of symbols. Start it up again and see what happens." The value in running the experiment is that there is already two decades of data with which to work, allowing Jones and

Brown to compare the results of the Echo model with the actual data. Once they have confidence in the model they can use it to predict what will happen in the future. "The patches haven't stopped changing," Jones says. "In some cases, there have been dramatic changes—desert land turned into grassland."

Across the courtyard from Jones' computer scientists Christopher Langton and David Hiebeler contemplate a series of figures on a chalkboard. Lines of ones and zeros. Officially employed by the Complex Systems Group of the Theoretical Division at Los Alamos, Langton spends most of his working hours at SFI. Hiebeler is a graduate student in applied mathematics at Harvard. Just now they are working on a computer modeling program called "Swarm"—as in a swarm of bees—that will be used in a similar fashion to Echo but with broader applications. "Swarm is much more general than Echo," Langton says. "Echo has many specific assumptions about the nature of the agents and the nature of the world built in. Swarm, however, assumes almost nothing about the agents or the world. One could easily implement Echo in Swarm but not the reverse."

Langton sketches a series of circles on the chalkboard to help me understand the architecture of Swarm. He talks about traffic, birds, and ants. "What do all these groups have in common?" he asks. "There is no central authority, no central organization." In a swarm you have a large collection of agents interacting with each other, each following an often simple set of rules—as is the case of birds flocking where obvious patterns emerge from each bird following a few basic rules, primarily that they should keep a certain distance from their immediate neighbors. "Each bird is an agent," Langton says, "acting locally, but creating a global dynamic."

Using Swarm, Langton and his colleagues hope to imitate such complex collective behavior and thus clarify the point at which intelligent behavior emerges. Ideally political scientists might use it to understand the collapse of a government, or telecommunications engineers might be able to anticipate a glitch in a switching system, both are problems that have a number of agents but no central authority dictating group behavior. "We've all been in traffic jams that don't seem to have a cause," Langton says. "The jam disperses and you realize there was no accident, no roadwork, no apparent reason for the tie-up. The same thing can happen in a switching system."

Much of the work at SFI is wrought in pure mathematics and theory—foundations of spatial computation, computation in natural systems, relationships between computation and physics, quantum computation—concepts hard to discuss in simple terms, but essential to complexity. One of postdoc Chris Moore's jobs is to find alternative methods of computation and make them applicable to the physical world, which is much like trying to find a new flavor for ice cream that might replace vanilla. Moore is philosophical about his work and the work of the institute. He is animated yet relaxed, enjoying a beer in the courtyard during a Friday afternoon reception at the Institute. He talks about his work with the Green Party, how it balances his assignment at SFI because the results are so tangible. Reflecting on SFI, Moore says, "What we do here is like ballet, or an opera sung in a language that only 2,000 people understand."

Learning the language as scientists like Dr. Maureen Hoffman, assistant professor of pathology at Duke Medical Center and director of the hematology lab at the affiliated Veterans Administration hospital in Durham, North Carolina. Hoffman, a fellow student at last year's summer school, came to the In-

stitute to learn how to build a model that could emulate the coagulation system. "We have a lot of information about the parts of the blood-clotting system," Hoffman says. "but there are a lot of parts. It's hard to put them together into one model." A number of protein factors in the blood participate in forming a normal clot, but it's not clear how changing the combination or amount of factors affects clotting. Moreover, the behavior of the system is hard to predict, a hallmark of a nonlinear system. "You can't say that if you have more of a certain factor, then your blood is going to clot faster," she says. What information Hoffman and her colleagues have collected comes from patients with clotting and bleeding disorders. Researchers already know, for instance, that if you are missing factor VIII or factor IX, you are a severe hemophiliac. But even if you have 10 percent of the normal value, you can be fine. In fact, Hoffman explains, half the people missing factor XI have a bleeding problem and half don't. "In our case, we have the information on the what," she says, "but not the why."

Hoffman's team in Durham has built an *in vitro* model in which they add varying amounts of coagulation proteins to isolated blood cells. She went

to Santa Fe to learn how to build mathematical (computer) models that would allow the team to predict what would happen when it changed some of the factors in the *in vitro* model. "If you have a computer model, you can change all these factors any way you want and get an idea of what it would do to the overall clotting," Hoffman says. "We can do a little of that in the *in vitro* model, but it takes all day to do an experiment, and it's expensive."

Hoffman was able to find two fellow students to help her write the appropriate mathematical formulas and do the programming needed to build a computer model. "I went to Santa Fe knowing what I wanted to do, but not how to approach it," she says. "I think a lot of physicians and biologists have the same problem. You know there ought to be a way to approach these sorts of problems in a computational way, but we don't have a lot of experience in math."

SFI doesn't have a monopoly on the study of complex systems, but has become as a research and teaching institution an oasis for people interested in the science of complexity. Researchers such as Hoffman can discuss their projects with heavyweights including Nobel laureates Murray Gell-Mann and Kenneth Arrow, Los Alamos mathemat-

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can Erica Jari, physician-turned-evolutionary-biologist Stuart Kauffman, Peter Schuster of the University of Vienna, Stanford economist W. Brian Arthur, and both Holland and Langton. And as much import is given to the younger researchers and postdocs at SFI like computer scientist Melanie Mitchell, a former student of Holland. Today she heads the Adaptive Computation Program at SFI and is collaborating on no less than four projects, many of which use genetic algorithms or other computational systems that mimic DASs. Or the work of Stephanie Forrest, also a former student of Holland, now a professor at the University of New Mexico, who is working on foundations of genetic algorithms and modeling the immune system.

SFI seems to have a near infinite potential for growth. As Dan Stain, University of Arizona physicist and co-director of the summer school, points out, "Complex systems abound in the real world and reflect its inherent messiness." Like Simmons, Stain emphasizes that there is no universal agreement on a definition of complexity. "It's almost a theological concept," he says. "Many people talk about it, but nobody knows what it is. Certainly there are some common themes in

what has been dubbed complexity research: a synthetic approach to problems as opposed to a reductionistic one; a strong cross-disciplinary emphasis; and a choice of problems that includes some of the best-known intractable issues in science."

Whether or not SFI researchers agree on a definition of complexity, the Institute, through its summer-school program, publications, and public lectures, is certainly becoming a force within the scientific community. It has even reached moderate financial stability with funding from the Department of Energy and the National Science Foundation, consistent support from a number of corporations and foundations, including Citibank and the MacArthur Foundation, and a regular flow of private contributions. The "Santa Fe Approach," based on the tenets of complexity, has already been incorporated into mainstream economic thought in large part due to the work of Brian Arthur, who had been thinking in complex terms about the same time the Los Alamos senior fellows were convening of the Institute. Simmons anticipates SFI will be doing more research in the biological sciences, particularly theoretical immunology and neurobiology and continued

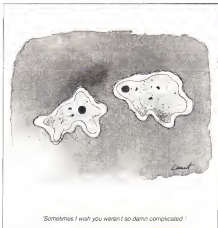
growth of the Artificial Life program, which, led by Langton, has gained international attention (see *CNN* interview, October 1991).

Recently the Institute initiated a program on the evolution of human culture as the first step toward working with the social sciences. "I don't think the Institute should own these programs," says Simmons. "I think it should act as a catalyst for change, encouraging the movement of these kinds of research programs into the mainstream of the great research universities."

But it's not just the universities that researchers at SFI hope to influence. The agenda is much larger than that and aimed ultimately at policymakers on a national and international level—those who can make a single decision and affect millions of people. Policy tends to be made on the basis of argumentation," says Simmons. "Someone asserts on the basis of known or suspected facts that a proposed action will have certain effects. When you start to build a mathematical or computational model of a system of any sort, especially a complex adaptive system, you find that you have to be extremely careful about precisely what you mean by each term and how each effect is linked to each other effect. Running a model might convince someone that there are some things they don't understand." You may not be able to predict the future of the economy, but you can explore ways to keep it stable.

For now, scientists working with complexity have a task rather similar to that of the poets of the early twentieth century who abandoned formal poetry for free verse. They understood it wasn't enough to forsake punctuation or eschew rhyme; the poets had to find the right combination of variables and rules, in enumeration, enjambment, or alliteration, to make the words work as a poem.

How close are they at SFI to making complexity work as a science? "I think we have all the right questions," says Simmons—questions that linger in the hallways of the Institute, spawning an unusual combination of urgency and patience, eagerness and caution, as everyone goes about their two to three dozen individual tasks and waits for the answers, the sum, the whole, to emerge from the bottom up. As for the impact of the answers? Simmons says, speaking for himself, his colleagues, and ideally the policymakers: "If nothing else, confronting the difficulty of predicting the behavior of these model complex systems should make us humble about trying to predict real-world systems." **DO**



"Sometimes I wish you weren't so damn complicated."

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ARTICLE BY DENNIS STACY

COSMIC CONSPIRACY:

SIX DECADES OF GOVERNMENT UFO COVER-UPS

Shortly before midnight of July 19, 1962, air-traffic controllers at Washington National Airport picked up a group of unidentified flying objects on their radar screens. Over the next three and a half hours, the targets would disappear and reappear on their scopes. They were visually corroborated by incoming flight crews. At 3:00 in the morning, the Air Defense Command dispatched two F-64 jet interceptors, which failed to make contact with the targets.

The following weekend, the same scenario virtually repeated itself. Unknown targets were picked up on radar and verified both by incoming pilots and ground observers. This time, the hurriedly scrambled jets did manage to make visual contact and establish a brief radar lock-on, and the general public joined in the hoopla as well. According to *The UFO Controversy in America*, by Temple University historian David Jacobs, "So many calls

Editor's note: This is the second of a six-part series investigating UFOs and government secrecy through the years. The decade under scrutiny here is the 1950s.

ILLUSTRATION BY SHIGERU NOKURA



came into the Pentagon alone that its telephone circuits were completely tied up with UFO inquiries for the next few days." In several major newspapers, the 1952 UFO flap even bumped the Democratic National Convention off the front-page headlines.

The so-called "Washington Wave" also resulted in at least two events that have been debated ever since. On July 25, in an attempt to quell public concern, the military held its largest press conference since the end of WWII. Press conference heads Maj. Gen. John Samford, director of Air Force Intelligence, and Maj. Gen. Roger Ramo, chief of the Air Defense Command, denied that any interceptors had been scrambled and attributed the radar returns to temperature inversions.

In addition, the Washington sightings led directly to the CIA-sponsored Robertson Panel, so named after its chairman Dr. Harold P. Robertson, director of the Weapons Systems Evaluation Group for the secretary of defense. The Panel's basic mandate was outlined in a document later retrieved under the Freedom of Information Act (FOIA):

In that crucial document, a 1952 memorandum to the National Security Council (NSC), CIA director Walter Bedell Smith wrote that "a broader, coordinated effort should be initiated to develop a firm scientific understanding of the several phenomena which are apparently involved in these reports, and to assure ourselves that [they] will not hamper our present efforts in the Cold War or confuse our early warning system in case of an attack."

In line with this mandate, the panel that finally convened in Washington DC, in mid-January of 1953 consisted of some of the best scientific minds of the day. Members included a future Nobel Prize laureate in physics, Luis Alvarez, formerly of Berkeley, physicist Samuel Goudsmit of the Brookhaven National Laboratories, and astronomer Thornton Page of Johns Hopkins University, later with NASA.

Yet for all of its scientific expertise, the Panel's major recommendations fell mainly in the domain of public policy. After a review of the evidence, the Panel concluded that while UFOs themselves did not necessarily "constitute a direct threat to the national security," the continued emphasis on the reporting of these phenomena does [threaten] the orderly functioning of the protective organs of the body politic."

Panel members recommended that "national security agencies take steps immediately to strip the UFO phenomenon of its special status and eliminate the aura of mystery it has acquired." Perhaps a public-education program with the dual goals of "training and debunking" could be implemented? In this context, the Panel suggested that the mass media might be brought to bear on the problem, up to and including Walt Disney Productions!

More interestingly, the Panel also recommended that pro-UFO grassroots organizations be actively monitored "because of their potentially great influence on mass thinking if widespread sightings should occur." Mentioned by name were two organizations that had arisen in the wake of the Washington Wave: Civilian Saucer Intelligence of Los Angeles and the Aerial Phenomena Research Organization of Sturgeon Bay, Wisconsin, both now defunct.

Is there evidence that such surveil-

lance apparently there is or was an Air Force Project Aquarius that dealt with UFOs? Goudie states: "Their own Project Aquarius, they said, did not, but they refused to say what it did deal with. They did admit it was classified top secret and that the release of any documents would damage the national security. The Air Force denies the existence of their own Project Aquarius, and the NSA now says it was mistaken. They ought to get their stories straight."

"It's almost impossible to confirm that any individual action was directly dictated by the Robertson Panel," agrees physicist and UFOlogist Stanton Friedman, co-author of *Crash at Corona*, "but was the subject deluged at every available opportunity per its recommendations? You bet!"

Friedman points specifically to a press release issued on October 26, 1955, by the Department of Defense, chaired by secretary of the Air Force Donald Quarles. The occasion was the release of Special Report 14, issued by

Project Blue Book. The Air Force agency publicly charged with investigating UFOs. Quarles said there was no reason to believe that any UFO had ever overflowed the United States and that the 3 percent of unknowns reported the previous year could probably be identified with more information.

As Friedman sees it, however, Special Report 14 was the best UFO study

ever conducted. Interpreting the report for *Omni*, Friedman says it showed that "over 20 percent of all UFO sightings investigated between 1947 and 1952 were unknowns, and the better the quality of the sighting, the more likely it was to be an unknown. The press release failed to mention any of the 240 charts and tables in the original study, adds Friedman, "nor did it point out that the work had been done by the highly respected Ballistic Memorial Institute under contract to the Department of Air Force. It's a classic case." Friedman says "if the government having two hands and the left one not knowing what the right one is up to."

Whatever the truth about UFOs, however, the government tried mightily to conceal information suggesting mysterious origins, about "for a population already shaky over nuclear armaments, cold war and communists under every bush, officials may have reckoned that the notion of visitors from beyond, even imaginary ones, might just have been too much to bear."

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lance was conducted or that the Robertson Panel recommendations influenced government policies? "The paper trail is sketchy at best," says Dale Goudie, a Seattle advertising agent and information director for the Computerized UFO Network or CUFO, an electronic bulletin board specializing in UFO documents retrieved under the FOIA. "What we know is that some agencies tend to keep some old UFO files while throwing out or mysteriously losing others. For example, we know the FBI kept a file on George Adamski, a famous UFO contactee of the Fifties, perhaps because they thought he was a communist, and that the CIA had communicated with Maj. Donald Keyhoe, later one of the directors of the National Investigations Committee on Aerial Phenomena.

"When it comes to their own programs, however, the agencies are a bit more absent-minded." An example, says Goudie, is Project Aquarius. "The National Security Agency (NSA) admitted in a letter to Senator John Glenn



FICTION BY
GARRY KILWORTH

"SO what you want to do is take Marcia's personality and put it with the body of a bird?" said Steve.
"What are you trying to create, some monster freak? Some creature that'll think, like . . . like Marcus?"

We were at dinner, just the three of us, in a small restaurant off Mody Road in Tsim Sha Tsui. My brother Steve and his girlfriend Marcia were flying out of Hong Kong the next day. They were going on a business holiday, to some

PAINTING BY
WIKTOR SADOWSKI

**BLACK
DRONGO**



remote place in the Philippines, which was incidentally Marcia's homeland.

I explained patiently "I'm not transferring her psyche. Steve! there are laws against that. All I want to do is copy Marcia's persona and superimpose it upon that of the dragon's."

"Okay Einstein, what's the difference?" he said.

"Her persona is simply her personality. A psyche is someone's conscious and unconscious, someone's mind or self if you like. I'm not allowed to screw around with psyches, although it is possible to make a transfer under controlled conditions. Only the GRL, the Government Research Lab, are permitted to dabble in that. This won't hurt her in the least, and she'll have the satisfaction of knowing she's furthering my studies of behavior patterns in wild birds."

"What if I don't want you to mess around with my girl's persona?"

"Steve," said Marcia, in that soft voice she has, but he cut her off with "No, wait. I want to hear what Einstein here has to say about it. You just keep quiet for a minute. No, I'm sorry Marcia this is for me to decide whether it's right for you to do this or not. You don't understand these things like we do."

Steve can be a real pain in the ass when he wants to be, which is most of the time, but he is my brother and I put up with him because I love him. He is unbelievably insecure,

and this manifests itself in hostility and aggression. Tonight he was being nice. Any other time he would have blown his stack and started throwing things around the room. He always mellowed a little prior to travel, gradually becoming as pliant as he would ever be with Marcia, or any woman.

Men could take him better than women. They recognized the apprehensive hunter-gatherer in him as something they had within themselves though often not to the same extent. Steve was one of those people who believed you had to prove yourself all the time, against the competition. If you didn't, you would be taken advantage of, and eaten alive. They would tell you like jackals while you were exposed to them. You had to keep your defenses up, show them you were a man to be reckoned with, never let them see your vulnerability.

He played squash as if to lose would mean the guillotine. He was merciless against business rivals. My older brother was still living in a world where

you clubbed a man senseless and took his meat and his woman and made sure you felt damn good about it. Any weakness in you would be exploited and you would become cannon for the victor's use.

I did not consider Steve a bad man, and most other men liked his company, many women too if they were the kind who preferred being told what to do but there were others who considered him an aggressive thick-skinned bull.

I hadn't told Steve that the reason I wanted Marcia's persona, as opposed to any other, was because of my observations of their relationship. Steve had always been the bully, and the person who took the brunt of his obnoxious behavior was Marcia. She, on the other hand, had soaked up his abuse with not a flicker of annoyance or retaliation. I used to sit and watch her being verbally attacked. Steve imposing his will on her with unbelievable insensitivity, and yet she took it all calmly letting it all wash over her, leaving her un-

quick description of a Western businessman living on the China coast, out of touch with reality, holding on to out-of-date values, talking in clichés.

There are Chinese businessmen like Steve who exploit the local labor, but they don't make excuses for the poor pay they offer; they simply do it. Steve thought the Thatcher-Reagan years of the last century were wonderful, but of course he only went to Britain and America for business conferences, a few days, nothing more.

Is that what you think?" said Steve, his tone belligerent. "Well, okay. I'll leave the decision to her, but I'm going to come along. I only have her best interests at heart."

Marcia was the immovable object who took all he had to throw at her and remained intact, without reprisal, without going under. She was a small woman, even for a Filipino with a gentle smile. She withstood the storms and remained undaunted. The Filipino malds, fifty thousand of them in Hong Kong, were an accommodating group. Most of them considered a little abuse worth pursuing the romantic dream of marrying out of the terrible poverty which was their cultural heritage. Even if the man be a boorish old fart like Steve, twice her age and with a body ravaged by too many girls.

"That's what I think, Steve."

In the end, I had my way

and Steve even drove us to the lab in his new Mercedes, chatting quite amiably on the journey under the forest canopy of neon branches that grow from buildings either side of the street. The night watchman was a little surprised to see us, at eleven in the evening, but he let us in, and stood by the lab door in that guarded manner of the Cantonese security worker dealing with the unusual, wondering whether he is going to get into trouble for allowing someone to enter the building after hours, even if that someone was perfectly entitled to be there. The Cantonese like to live lives of complete order within a vast sea of chaos.

Marcia went into the scanner cubicle a little nervously, though it is one of the newer devices produced by Walker and Quintan, in which the subject stands upright, rather than one of the more common horizontal coffin affairs of Stebbing. Ino Steve chatted to the night watchman, while I took the reading, then when everything checked out, proceeded to take a facsimile of

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MAN SENSELESS AND TOOK HIS WOMAN.

moved. She wasn't submissive, not in a way that was viable; she just allowed it to happen while seemingly unimpressed.

"I think it's for Marcia to decide, not you Steve. I'm not asking you for your persona, and Marcia is a grown woman. She doesn't need your permission."

"Yeah, but she's my girl, Pete. I got to look after her interests."

"You don't need to do anything of the sort. She's a capable person."

Steve was typical of many expatriates living in a Far Eastern enclave concerning mostly of other expats. He was conservative, thoroughly conventional, and about a hundred years behind the times. His passport said he was an Amer-european, but in truth we had long since left our original nationalities behind and had become something else. I'm not sure what. *Globalist* I suppose, which is the Cantonese term for all Caucasians living in their society. Literally it means *foreign dev*, but language is dynamic and it has become a

12 August

Heroic nudes watched with envy from the wall. And as the smell of rich coffee killed the air, it happened. Conceptual improv. Everyone exchanging ideas, intelligent perspectives. The issue didn't even matter. I wondered, though, conversation like this the exception and norm? Are we so mentally-saturated with sensational crap that with value has to take a number and wait in line? Am I the only one who cares? Another sip of coffee and a look at my old radio made me feel better. And reminded me that there is one place where good dialogue still exists.



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Marcia persona on disk.

"When I had finished with Marcia, I asked Steve to step into the cubicle."

He stuck out his jaw.

"Why? What do you want my personality for? I thought you considered it pretty shitty?"

"Don't make a fuss, Steve. I'm not going to hurt you."

He struck at the core of his manhood, as I knew it would. I went straight into the cubicle to prove he was not afraid of anything, even if his brother was a mad scientist.

"Okay, he growled from within. 'But if I start growing hairs on the palms of my hands, Pete, I'm coming looking for my little brother to eat.'"

It was all over by twelve, and we went for a final coffee at the glitzy Peninsula Hotel on Nathan Road, with its string quartet.

I saw them off at the airport the next morning, Steve plunking at the taxi driver most of the way, because he wasn't driving fast enough, and Marcia talking to me in that soft tone quite unlike the voice she used when talking at "tagalog" to her fellow Filipinos. Steve was definitely more mellow now. In the old days he would have taken time out to snap at her and ask me what I found so interesting in her "drivel" but that day he simply gave her one or two side glances, not without a trace of fondness in them. They were to be gone for the whole of July and August, the tempest months in Hong Kong.

A week after they had left I began my experiment.

The Chinese government had employed me as a lecturer on Animal Behavior at the University of Hong Kong, but I was permitted, even expected, to carry out my own research. Any findings would of course be credited to the university as well as myself, thus gaining face for my Chinese employers.

My specific interest at this time was animal aggression. What I wanted to do was to superimpose a placid persona on an aggressive wild creature, in order to study the reactions of the creature to its own kind and to see whether there was any change in their behavior toward the subject, and indeed whether the subject showed any signs of reverting to type.

The creature I had chosen was a black drongo (*Dicrurus macropterus*), a bird about the size of a jackdaw. It is a quarrelsome creature, known in India as King Crow because of its habit of mobbing the much larger members of

the Corvidae family. It fights amongst its own kind for scraps of food though there are no recorded combats ending in fatalities. The black drongo has an unusual catlike hissing call, which is quite disturbing to other birds.

I had three black drongos, caught on the Ma Po Marshes of what used to be the New Territories, when Hong Kong was a colony. The marshes, founded as a bird sanctuary in the last century by a man called Peter Scott, is a resting place for thousands of migrating birds on their way to and from SE Asia. The black drongo and hair-crested drongo are summer visitors, however, and stay in the area for breeding. The other birds must breathe a sigh of relief when the drongos leave for other parts at the end of the hot season.

I chose a female for the subject (for no other reason than Marcia was a female) and called her Yat Ho, or Number One. The other pair were of course Yi Ho and Sam Ho—Two and Three. Marcia's persona overlaid that of Yat

cert, they began to attack and bully her, shouddering her out of the way of food, pecking, hissing and treating her with disdain. Sam Ho was particularly vicious and treated Yat Ho with utter disdain, as if she were some kind of eater to her kind.

She did nothing. True to Marcia's persona, she took everything they had to give her and remained unmoved. The students were terribly excited by this, never having witnessed anything like it before in their golden days of learning. They could talk of nothing else but the drongos for the next six weeks, as 'fat Ho continued to survive simply by showing no reaction to the bullying—simply by being.

I must have been pretty boring too as a date. My girlfriend, Xia, a Han Chinese from the north, is normally fairly tolerant of my enthusiasm, but I think those first few drongo weeks stained even her elastic patience.

Then something remarkable began to happen, which I should have expected but which actually surprised me. The resilience of Yat Ho began to wear down the energy of the other two birds, especially Sam Ho, the main contender for bully of the season. She simply took what they had to offer in the way of violence, but when she remained seemingly unaffected by their aggressive behavior they gradually ceased to attack her. They still fought

amongst themselves, but in their dealings with Yat Ho they were almost nauseatingly friendly.

They even bring her bits of food, cried Penny Lau, one of my students, "and she takes the pieces as if she deserves them."

It was true. They were courting her friendship, trying to get her to like them, forgive them for their earlier treatment of her. I was fascinated. What on Earth was going on here? I couldn't get my notes on tape fast enough.

One evening, about the seventh week, I was sitting outside the aviary on my own, idly watching my three drongos. The students had all gone out for the evening. It was a holiday Liberation Day, and they were out celebrating. Suddenly, something horrible occurred in that artificial world behind the glass screen.

Sam Ho was perched next to Yat Ho, their scapular feathers touching, when she turned and deliberately pecked through his right eye into his brain. Sam Ho fell to the ground, fluttering

THE CREATURE I HAD
CHOSEN WAS A BLACK DRONGO. IT IS A
QUARRELsome CREATURE,
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ITS OWN KIND FOR SCRAPS OF FOOD.

Ho, and I introduced the subject back into the aviary, while my students pit themselves in charge of the video cameras, ever eager to record experiments and pore over the results. They are a good bunch, this year. Some undergraduates spend much of their student life in the gaming halls of Wan Chai district, risking failure for the sake of glitz, but then many of them are from remote villages in the north, and the sleeping and prying of the gaming machines in the neon-lit halls act like arena on them.

At first, the expected happened. Yat Ho's strange docile behavior kept the other two birds at a distance. The unusual was distrusted, and it was doubtful whether they actually recognized and identified her as a drongo. Its possible they thought she was some other kind of bird, and it puzzled them that she looked, sounded, and smelled like one of them. They fought amongst themselves and were wary if she approached.

Then suddenly, as if working in con-

I replied: "It's not really relevant to my studies, but I would like to know."

Birds are not people," were his final words, and then he got up and left leaving the remainder of his lunch.

This is the kind of thing that can happen in a university with no fences. The staff are suspicious of one another, and they like to keep things close to their chest. There are a lot of politics, always in the wind, and people are insecure. You can be indispensable to the faculty one term, and out on your ear the next. So if someone from another department comes to you with a request, suggestion, idea, anything, you listen, but give nothing whatsoever in return.

I remained very worried about the situation in the Philippines. Steve, once terribly aggressive, had been tamed by me. When he was in the scanner cubicle the night before he left with Marcia for the Philippines, I had superimposed the personality of a dove over his own. He was now to my way of thinking, vulnerable. He had in effect been transformed from a drongo to a dove, and I wanted to make sure that everything was all right, for Marcia's sake as well as my brother's.

In the evening, I telephoned Steve. It took three attempts, but I finally had him on the line.

"How are you?" I asked guardedly.

"Me? Couldn't be better, why?" he said in a pleasant voice. "Anything happened?"

"Nothing, nothing really. I just hadn't heard from either of you, and . . . well, I heard something about rebels in the north."

Steve laughed.

"There's always some trouble with the north, you know that. Look, I'm due to meet someone. Pee—business, you know. Was there something specific?"

"No. Maybe I could have a word with Marcia, before I ring off. Is she there?"

"What about?"

"Mind your own goddamn business," I said with mock aggression. He laughed again and the next voice that I heard was Marcia's.

"Hello?"

"Marcia, how—how do you feel?"

"I'm fine, thank you."

"Good, good. How's Steve. How are you getting on with him over there?"

She said in that calm voice of hers: "Well, the Philippines must be good for him. He's so nice to me. I can't believe it really."

"You don't mind that?"

"Of course not," still no real expres-

sion in the tone.

"You don't find it . . . irritating, or anything?"

There was a long pause, then, "No. Look, Peter, I have to go. Steve's calling me from the lift. Bye."

Marcia . . .

She had hung up on me.

I bit my nails. Well, they sounded all right. I supposed Steve was docile of course, but otherwise okay. And Marcia? I just didn't know. Yet Ho had exploded all at once, without warning. How could I tell? Marcia might wake up in the middle of the night and realize that this aggressive beast who had tormented her in the past was now at her mercy, look down at his eyes, vulnerable, exposed. She might get out of bed, find a pair of scissors, and plunge them . . . It just did not bear thinking about.

How could I tell her that it wasn't Steve I was worried about, but her—that there was a potential murderer locked up in that sweet personality she

on the Waterloo Road.

All this reflected on me and my position at the university, and I lit on the idea of taming him, calming him down. Of course, I would never have got him to the doctor, and even if I had, he would have refused any treatment. So I hit on the idea of overlaying his persona with that of a dove, which would encourage the exposure of his real but far-softer self underneath. I didn't want Steve suspecting anything, so I planned to get him into the laboratory by using Marcia as an excuse.

After my phone call with Steve and Marcia, I went back to the lab, where, yet Ho awakened me. I placed her under the scanner and removed the superimposed persona, then put her back in the aviary with two more drongos.

She quarreled with them, fighting over perches and food, but there were no combats resulting in injury or death. I stayed there for twelve hours, studying the creatures, and in the end went home convinced that she had returned

to her old self, a nasty backering bird like all the other black drongos in the world, but with no desire to kill.

There was no change in the situation over the next two days, and I waited on hot bricks for my brother and Marcia to arrive back in Hong Kong.

The day arrived when they were due in from the Philippines and I drove down to Kai Tak airport to

STEVE WAS AT THAT
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ASSAULT CHARGE, FOR PUNCHING A TOILET
ATTENDANT AT A HOTEL
FOR SPLASHING HIS TROUSERS WITH WATER.

showed the world? How could I explain she had a demon made her, waiting for the moment when Steve no longer psychologically presented a frightening formidable monster to her, but instead revealed the pathetic creature underneath, the real Steven, who required reassurance, support, love. How could I tell her that there was a strong possibility she would then regard him as her victim?

Two months ago, when Steve introduced me to Marcia, I had formed an alliance with her. Steve was at that time heading for all sorts of trouble. He was up on an assault charge for punching a toilet attendant in a hotel for splashing his trousers with water. There were complaints at his club about his behavior after he had been drinking, and people were asking for him to be thrown out. There was some business about a scrape with a Porsche, the owner maintaining that Steve had bumped him from the rear on purpose, presumably because he had overtaken Steve's Mercedes

most them with a charming stomach. Was Steve all right? Was Marcia still the sweet lovable woman she had been on leaving Hong Kong? Was I in fact being unnecessarily stupid in thinking that the behavior of a bird might reflect the behavior of a human being? Perhaps. Yet Ho was just a strange drongo given to bursts of violence anyway? Animals and birds have their marital problems too. My mind was like a maelstrom, spiraling the thoughts round and round, and dredging them back up again.

I waited at the bottom of the ramp in the airport concourse for my brother and his girlfriend to appear. Kai Tak was, as usual, memorably crowded with thousands of Chinese milling around waiting for relatives and friends, amicably managing to avoid touching each other—a personal contact they dislike intensely—though I would have had difficulty in slicing a piece of paper down the spaces between them. My heart was beating against my ribs, and for the first time in many years I was

smoking again. I glanced at the labels on the suitcases, as passengers came down the ramp for Philippine Airlines' labels and soon they began filing past me.

Then suddenly, there they were amongst the sea of black heads, at the top of the ramp. The relief flooded through me, and I kicked myself for being so paranoid. What an idiot. To think that a sweet girl like Marcia was capable of killing someone! Now that they were home, safe and sound, the idea seemed ludicrous, even heinous. I vowed never to tell them of my fears.

I signaled, made myself visible to Steve, then went to take a place in the queue for taxis.

Steve reached me just as I was coming to the head of the queue. Marcia was nowhere to be seen. I had assumed because she was so small she had been down below the crowd.

"We shook hands and I said, 'Didn't I see Marcia?' Steve shrugged and smiled.

"She wanted to stay on for a few days to see some relatives."

That sounded reasonable. Her family was out on one of the many smaller islands, while she and Steve had been staying on the main island.

On the taxi drive to Steve's club,

where he intended to leave his suitcase and have a meal, I studied my older brother. He seemed calm and relaxed, and in quite a good frame of mind considering he had been through the stress of travel.

Still, so long as there was no harm done, what did it matter now?

He seemed distracted, however, so I did not press him with questions until we were actually sitting down to a meal in the club dining room.

"How was the trip?" I asked.

"Oh fine."

He played with his table napkin as I spoke, rearranging it carefully on his lap, although this had been done once by the waiter.

"No problems business-wise?"

"No, everything went according to plan."

And Marcia? She enjoyed the break?" He nodded.

"So far as I know."

The soup arrived at this point, and I ceased probing. He certainly looked well enough, but there was something about his manner which worried me. He was too distant, even for someone who was a little jet-lagged, and I wondered if his business had really gone well. Then a thought struck me. What if Marcia had attacked him, and he

being a strong male, had prevented her from injuring him? Perhaps my concern for his safety was justified after all, but he had successfully protected himself from the kind of deadly attack I had witnessed from my black drongo. Yai Ho.

I was about to say something, when three people walked through the door. One was a small, olive-skinned man with a blunt chin and determined look. He was flanked by two uniformed Hong Kong policemen, an inspector and a sergeant. They spoke to a waiter who pointed towards our table. The trio then made their way through the dividers to stand behind my brother.

The man in civilian clothes spoke and I knew then that he was a Filipino.

"Mr. Steven Bordas?"

Steve turned, his head, wiping his chin with his napkin at the same time.

"Yes."

"I am Sergeant Callita. You are under arrest."

I must have heard any words that followed, but their memory is lost in the buzzing of shock that overcame me. Steve looked at me and gave me a tight smile, which said, "We both knew that one day I would do something like this."

I grabbed the Filipino policeman's sleeve.

"It's not his fault; it's mine."

It was so clear to me now, now it was too late. Yai Ho had not killed because of the change in the other two drongos, but because of the unnatural suppression of her own aggression. I had overlaid her real personality with a placid one, effectively sealing it off. The drongo persona had bubbled underneath, unable to find a safety valve to relieve the pressure, and finally she had exploded. I should have been comparing Yai Ho with Steve, not with Marcia, having done the same thing to my brother's natural aggression.

He had murdered Marcia!

Steve was taken away and I called to him that I would get his lawyer on the phone. He waved his hand over his shoulder, as if he did not really care what I did.

I sat in the restaurant, stunned by what had happened. Poor Marcia. I thought. Poor sweet innocent Marcia. I had been instrumental in her death, as they say, by experimenting on my own brother. It was a terrible thing to do. I was determined that it should all come out at the trial. I would defend my brother with the truth. Poor Steve.

While these thoughts were running through my head, Marcia walked into the room, saw me, and waved. She crossed the floor and took a chair op-

CONTINUED ON PAGE 37





MARGIE PROFET

If five years ago you asked Margie Profet what she did, she would toss back her long blonde hair, laugh and say in that breathless voice of hers, "Oh, I'm just being a bum." And if she'd told you what she really was doing—working part-time jobs in San Francisco but mostly

hanging out, thinking and reading in her apartment—you'd probably agree.

Two centuries ago Profet, who holds bachelor's degrees from both Harvard and Berkeley, would have been called a natural philosopher. But late-twentieth-century big-time science, with its super-

INTERVIEW

**AN
UNCONVENTIONAL
BIOLOGIST
OFFERS THEORIES
THAT MAY
CHANGE THE WAY
WE THINK
ABOUT WOMEN'S
BODIES.**

**PHOTOGRAPHS
BY
TOM ZIMMEROFF**

colliders and genome projects, has little place for a natural philosopher. Yet Profet, with neither formal academic credentials nor a university position, has persevered, driven by her desire to know answers to one of the biggest questions why humans evolved the way they have.

Her recent life sounds like a Cinderella story. Beginning in the mid Eighties, Profet practiced her solitary scholarship in a Berkeley studio modeled on a medieval garret complete with stucco fireplace and heavy wooden ceiling beams. A cadre of squirrels and scrub jays roamed the



AGE:
35

RECENTLY WON:
MacArthur Award, 1993

CREDENTIALS:
None

FORMER OCCUPATION:
People used to ask, "What do you do?" You said: "Oh, I'm thinking," so you say, "Oh I'm being a bum," because even if you don't say it, they treat you like a bum who's wasted a life

PRESENT OCCUPATION:
Now that I've won the MacArthur, people ask if I'm going to get a Ph.D. Why on Earth? I won

BEING WRITTEN:
Protecting Your Embryo

apartment with impunity, seeking the peanuts she kept ready as Profet troubled out evolutionary explanations for such riddles in human physiology as why women menstruate and how allergies have affected our survival. Then last spring, her price arrived in the form of a \$250,000 MacArthur grant that finally freed the 35-year-old researcher to devote herself entirely to some of the most daring and useful thinking in evolutionary biology today.

Profet focuses on three areas of evolutionary physiology, all with powerful clinical applications. Her first work, proposing that pregnancy sickness prevents mothers from eating foods that might damage their fetuses, has steadily gained acceptance in the medical community. An early article explores how allergies shield us from

toxins in plants and venoms. Recently, she gained national attention by suggesting menstruation serves to cleanse the uterine walls of sperm-born pathogens.

Deep into the books and papers of evolutionary biology but lacking any formal training in it, Profet one day found herself listening to several pregnant relatives gripe about morning sickness. She asked herself, Did pregnant women of the Pleistocene avoid certain foods that brought on nausea? "Pregnancy sickness was curious," Profet recalls thinking. "It only lasted for a while but was strong. The food made them sick, so it must have some bad things in it. I started to think about whether it made sense just for fun."

Insight does not equal proof, so Profet spent months buttressing theory with extensive research in

the literature. Her arguments were so persuasive that a leading journal in the field published her paper. A recent article constituted the greater part of last September's issue of the *Quarterly Review of Biology*.

As a child growing up in the suburban aerospace community of Manhattan Beach, California, she saw little appeal in the so-called normal lifestyle. "I remember looking at people going to the office every day and housewives doing this and that, and thinking at age 7, Life is really boring," says Profet, the child of a physicist father and engineer mother. Life grew more interesting when she entered Harvard and majored in political philosophy. "My brain grew a lot. When you're working hard at philosophy you take ideas that on the surface don't seem connected and go a level

deeper," she says. While spending two years in Germany working as a computer programmer, she began to see that political philosophy had no answers for questions that intrigued her. Despite a distaste for regimented learning, she returned to school this time to Berkeley, to study physics. But physics also couldn't satisfy her lust to know why.

She decided to just think supporting herself with a string of part-time jobs. "Even with my Harvard degree and physics degree people would be really insulted when I applied for jobs because I was different," she remembers. Eventually toxicologist Bruce Ames [Omni interview, February 1991], whom she says "collects eccentrics," read her allergy paper and offered her a part-time research job in his lab.

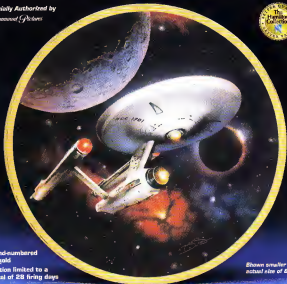
A few months after getting the MacArthur, Profet gave herself a sabbatical, leaving behind her squirrels and silver view of the bay. Now in Seattle, she continues her work on allergies and is converting her research on pregnancy sickness into a book, *Protecting Your Embryo*. Interviewer Shan Rudinsky first visited Profet shortly before she moved. As the tame squirrels interrupted periodically to agitate for peanuts, Profet shared her provocative thoughts on science, medicine, and academia.

Omni: Your work seems to depict the body as engaged in a constant battle with toxins and pathogens in the environment.

Profet: Well, parts of the body. We're in a co-evolutionary race with a zillion organisms out there. Bacteria and viruses want to exploit us the way we exploit other

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animals. We eat plants, animals and kill our neighbors. So an awful lot of what our body does is geared toward defense against other organisms. Some defenses haven't been appreciated as such. These anomalies in particular, macroscopic enough that anyone can see them, interest me.

Orr: Allergies, you write, evolved as a last defense against environmental toxins. How do allergens and toxins differ? **Profel:** The allergen—the molecule your immune system actually targets—may be a tiny toxin or a much larger protein commonly associated with it. Compared to a toxin, the protein's a big target for the immune system. Say somebody eats a peanut at age 10 and suddenly becomes allergic to peanuts: this allergy was probably caused by a toxin, either a natural peanut toxin or one from a mold that had infected the peanut. Your immune system says, "Aha, a toxin! And this protein is associated with that toxin. No more of that protein." Because it's a better target that protein is now an allergen.

Orr: Why did you look at allergies? **Profel:** I have a lot of allergies to shampoo and soap. Lying in bed late one night scratching, I thought, What the hell is this for? I knew allergies were caused by this one highly specialized

class of antibody so they must have a function. Well, what are the symptoms of an allergy? You're either scratching something off, vomiting, having diarrhea, tearing, sneezing or coughing. It seems you're trying to expel something immediately, not three days later, like a bacterial infection or virus. What is so immediately dangerous that you have this dangerous mechanism which can lead to anaphylactic shock? Viruses and bacteria give you these reactions only if you've got load poisoning. I wondered if allergies evolved to protect against toxins.

Orr: Why do people show such capriciousness or variety in the kinds of things they're allergic to?

Profel: Our different genetic compositions give us different sets of enzymes. Because of our different life histories you and I also have different levels of enzymes induced. Enzymes break down toxins, rendering them nontoxic and excretable. If you lack sufficient enzymes for a particular toxin and it's an irreversibly binding toxin it keeps circulating in your bloodstream and you'll probably develop an allergy to it. It depends on the quality and type of toxin, which enzymes you have and don't have, the inducibility of your enzyme systems and your genetics.

Orr: How does your theory stack up against the competing helminth hypothesis? [The helminth hypothesis, or "little worm theory," suggests the immunoglobulin E (IgE) response originally evolved as a coping mechanism against parasites. In our society where parasite loads have lessened, IgE incorrectly targets other substances, leading to an allergic reaction.]

Profel: Unfortunately if you read a review article on the helminth hypothesis you'll get glowing reports of all the evidence in support of it. But then you look at the primary literature and there's no evidence and much against it. If you're living in Gambia and have a filarial infection—little worms—you're actually much better off without a strong IgE response. People with strong IgE responses to filarial worms often have elephantiasis—an enlarged scrotum, enlarged thighs—or terrible chronic pulmonary disease. IgE levels have no correlation with a person's ability to expel these worms.

Now the thinking among some immunologists and parasitologists is, "Well, maybe IgE evolved to protect against helminths but doesn't now because these worms have gotten so sophisticated." The really dangerous part of this is that researchers now want to find a vaccine to induce a strong IgE response in people who have worms. They're going to kill people right and left if they do! And the people they'd be trying this out on will be Third World people with no legal recourse.

Orr: Your theory contradicts the accepted immunological canon. Do you have problems getting people to consider that the standard thinking might be wrong?

Profel: The comments I got on my *Quarterly Review of Biology* paper represent what's wrong with much of the thinking. I put a sentence from one reviewer's comment next to my bookshelf to remind me never to become like that. There is much greater acceptance in the immunological community of the idea that IgE-mediated responses have evolved to deal with parasitic infections. Thus, there is not the pressing need to find another reason for IgE. People still say things like that. **Orr:** Why do you think people are so attached to this hypothesis which you claim has "impeded parasitology for three decades"?

Profel: I can't figure it out. My forthcoming article argues that it's much more likely that the helminths are manipulating the IgE system for their own benefit. Look at the other things we get allergic to: venoms, certain drugs, carcinogenic metals, foods, pollens—all

are toxins or contain toxins. The helminth people just ignore this. They found a pathogen they've sometimes correlated with high IgE levels, and so they think IgE evolved to fight helminths. All the other cases of IgE they seem to think are just mistakes in the immune system. The common thinking is "Long ago, we all had such heavy worm burdens that IgEs were kept busy doing what they were supposed to do. But now, we don't have a lot of worms, and so these IgEs are busy looking around for something else to do, they target innocent molecules." [sighs] The thinking is so warped if the body's IgE system must be permanently at war with worms to function properly, it must not be good at expelling worms, because people have these infections for 20 years.

Omni: Has your theory affected the way you deal with your allergies?

Probst: Definitely. I tend to find one thing I like and pig out on it for weeks and weeks—just what you're not supposed to do. You're supposed to diversify your diet. I love strawberries, so of course I may come along and I ate two baskets at once, and of course these happened to be mold in them. I could taste it and spit some out, but I also swallowed some. The next time I had a whole basket, I became nauseated, and soon, with only one strawberry, I was out for a couple of hours.

Omni: Why are chronic respiratory allergies so common today?

Probst: Historically, they appear fairly new. What precipitated this? People are too miserable. You can't live a normal life always being on antihistamines, sneezing, coughing, tearing, and itching all the time. There are certainly correlations with the number of particles in the air, but the main thing is the number of viral respiratory infections you get while young. In a hunter-gatherer society you're probably in contact with a few hundred people your entire life. As a modern child going to daycare, by the time you're 6 you've had an average of 22 colds. That's not normal in an evolutionary sense. A child with so many infections may have a lot of temporary lung lesions, so it may be easier for a pollen toxin to get more deeply embedded and so trigger production of IgE. That's my guess.

Omni: Are people without allergies at a disadvantage?

Probst: Somebody with the full capacity for allergies but has none is probably very healthy. But if you don't have capacity for allergies, or you have a low capacity, then you may be in trouble.

Omni: What was it that led you to link

morning sickness to diet?

Probst: A lot of siblings and siblings-in-law were going through pregnancy sickness, and I started wondering whether Pleistocene women couldn't eat when pregnant. I read Marjorie Shostak's book *Absa*, and one way a Kung-San woman knows she's pregnant is by a sudden dislike of foods and things tasting bad. Knowing it is basically confined to the first trimester, I wondered if various poisonous plants were especially likely to harm the late, rapidly differentiating embryo. I went on a detective hunt—looked at journals, books on plant toxins, pregnancy organogenesis, teratogenesis, and discovered the online services. There are weird things in early pregnancy. People usually don't connect a sensitivity to smells to morning sickness but look on it as a bizarre byproduct of the hormones of pregnancy.

Omni: Do most women get pregnancy sickness in the morning?

Probst: It's any time of day. Some women do mostly in the morning, some mostly at night, some have a constant level of nausea throughout the day. Generally they have strong aversions to foods and odors whenever they come in contact with them. I think the area problema, the brainstem nucleus that samples the bloods for toxic constituents, becomes recalibrated in the first trimester so that almost any food or odor may trigger some nausea.

I think some women do get it in the morning because the digestive system slows considerably during the first trimester. A woman digesting her meal when she's asleep is digesting very slowly. Since sleep inhibits vomiting when she wakes up, she just has to vomit. Also, since you're not urinating in the night or so frequently, you're not flushing as much stuff out. Women may get sick in the morning but have the aversions whenever.

Omni: Why is the variability of this phenomenon so great?

Probst: Well, there's a question within that question. If this is an adaptation why hasn't natural selection been more precise? Why has it allowed such variability? The answer may be that benefits conferred and costs are tied. The greater your degree of morning sickness, the greater protection your embryo will have. But the greater the protection, the greater your nutritional costs will be also. In extreme pregnancy disease, you can't eat anything, you throw everything up, and you die, so your benefits drop to zero. At the other end—having no morning sickness—the cost is zero, but the benefits are also zero. Your embryo is more

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likely to develop birth defects. Then there's the wide middle range where benefits and costs will trade off.

Qwe: What are the medical ramifications of pregnancy sickness?

Prolet: Almost all pregnancy advice in popular books is geared toward second and third trimester. But because every major birth defect occurs in the first trimester, the priorities for the embryo are very different than. As it's forming limbs, heart, liver, eyes, the early embryo is most susceptible to damage by toxins. Its nutritional needs in terms of raw calories are slight. It weighs only a few ounces at the end of three months, not even that. The body's priority is getting from one cell to a perfectly formed three-month fetus. During the second and third trimesters, the fetus has its basic organs. While more susceptible than an adult, it's not terribly susceptible to toxins. At this time the fetus is growing rapidly, so the real priority is nutrition: protein, getting the calories. Look at the dietary advice that women get. Eat lots of broccoli. You should not eat lots of broccoli in the first trimester. Broccoli's got wonderful nutrients, but it's also got many natural toxins. The pregnant woman finds broccoli nauseating for good reason. You don't want to inflict those toxins on

your developing embryo.

I get phone calls from all over the country. When women say they had no apparent pregnancy sickness whatsoever, I usually don't believe it and start grilling them. Could she eat Chinese food, certain spices? Usually they admit, "Oh, I did throw up on mushrooms once" or, "Okay, I threw up on coffee." After you interrogate them, you find out they really did have pregnancy sickness. But one woman didn't, and she ate everything—onions, spices, all that stuff you shouldn't during the first trimester. Her baby was born with a suite of developmental defects. She called me because she was two weeks pregnant with her second child and wanted to know what to do to avoid inflicting toxins on her baby.

Qwe: How did you counsel her?

Prolet: I said go bland. Nothing bitter, nothing pungent. Only the freshest meat and dairy products. You may want to cook the vegetables a lot to get out the toxins. No barbecued anything. Lots of ripe fruit, but avoid unripe fruit.

Qwe: Why do we need an evolutionary explanation for pregnancy sickness?

Prolet: There are plenty of implications when you project a Pleistocene mechanism onto modern society. Pleistocene woman had pregnancy sickness that

pretty effectively deterred her from eating toxins in her environment. She didn't need to know the purpose of morning sickness, but we do to consciously alter our behavior to avoid inflicting those things on our embryos. We're not in a natural environment; we're exposed to toxins that lack the cues of natural toxicity because we bypass the taste or smell receptors by swallowing or injecting them. Or they're an evolutionary novel, like alcohol, and we haven't developed mechanisms to protect the embryo against them. Take chocolate. Its been incredibly bitter, but we mask the bitterness with lots of sugar. That's the kind of thing you want to avoid during the first trimester.

Also, to evaluate, you need a threshold of fat or calories. You usually can't conceive a baby in famine conditions. To conceive, you've stored up vitamins from this diversity of vegetables and fruit. The liver can store four months worth of folic acid. A folic-acid-deficient woman has a greater risk of giving birth to a baby with neural tube defects. But if you routinely pig out at McDonald's, you're not getting sufficient levels of folic acid. You may be nutritionally depleted of certain things, but still be able to conceive.

Qwe: Do we have an increased rate of birth defects from teratogens?

Prolet: A lot of people are born with nongenetic developmental birth defects, and certain natural teratogens cause birth defects. In one famous case where the family goats were grazing on lupine, which is full of toxin, both the kids of a pregnant goat were born with crooked limbs. The woman gave birth to a boy with three limb defects, and a litter of puppies was born with this defect. And thalidomide is a terrible teratogen. Women took a tiny bit of that in pill form to mask the bitterness. If they took it within a 20-day or so time span when their babies' limbs were forming, the babies were missing limbs. Hamsters fed a high level of potatoes, which have high levels of toxins, sometimes come out with neural tube defects. Many naturally occurring plant toxins are known to cause horrible birth defects, but people haven't asked, "What are the thousand things you ate and was your baby born with birth defects?"

Qwe: [A squirrel comes in.] Does her diet change when she's pregnant?

Prolet: She seems a little more persnickety when I think she's pregnant. When Peanut was a baby, she wouldn't touch roasted peanuts, but her mother would—like our babies don't like vegetables but learn to tolerate them. You don't want a kid out grazing on plants.





ANTIMATTER

UFO UPDATE:

The rise, fall, and afterlife of Erich von Daniken's theory of extraterrestrial gods

A little more than 25 years ago, the manager of a first-class Swiss hotel wrote a worldwide best seller titled *Chariots of the Gods?* Its author, Erich von Daniken, captured the public imagination with a dramatic presentation of the idea that extraterrestrials had left physical traces of their presence throughout the world. Chances held, for instance, that the giant stone faces on Easter Island off the coast of Chile were probably constructed with the help of extraterrestrials; the long Nazca lines, crisscrossing the plains of Peru and only visible from the air, von Daniken said, were probably landing strips for their craft.

By the late 1970s, however, von Daniken's "ancient astronaut" theory was crumbling under an avalanche of criticism from archaeologists and astronomers. Today, few believe these extraterrestrial gods ever existed. But don't tell that to the 350 people who met in Las Vegas last August to attend the twentieth-anniversary conference of the Ancient Astronaut Society, or to any of the Society's 10,000 members

in 93 countries worldwide. Twenty speakers, including numerous Ph.D.'s, engineers, and writers gave presentations that touched on everything from the "spaceships" of the Biblical prophet Ezekiel to the notorious "face on Mars."

Von Daniken's largest base of support, however, is not in the United



States, but rather in Germany and other nations of Europe. In 1993, for instance, Europeans saw von Daniken star in a 25-part biweekly TV series titled *On the Trace of the Almighty*. And touring the cities of Europe, von Daniken still manages to fill 2,000-seat auditoriums. His last nine

books, all best sellers in Germany, have also appeared in Italy, France, Holland, Spain, Greece—everywhere, it seems, but in the United States, England, and Australia. "I must be blacklisted in America," says the 58-year-old author with a chuckle.

Despite such slights, von Daniken's belief in the ancient-astronaut theory remains firm. "Each and every one of my books has had to be better than the one before," he says. "We have had to come up with stronger proof each time out."

Of note are the new translations of some ancient Asian Indian texts von Daniken has commissioned. "They describe gigantic space cities that surrounded our planet thousands of years in the past," he says with great enthusiasm. "And from these cities, extraterrestrials used small vehicles to descend to Earth."

Carl Sagan, a major critic of von Daniken in the 1970s, says he has not changed his mind. One of Sagan's original objections was the underlying assumption that our ancestors were apparently too stupid to create the monumental architecture of our past.

"But it's never been my idea," von Daniken objects, "that ancient astronauts had constructed great buildings and temples. Mankind did. But why? Mythology and religion say they were dealing with the teachers that had descended from heaven."

Von Daniken's protestations are unlikely to sway his critics. "The whole ancient-astronauts hypothesis was based more on pseudohistory and pseudoarchaeology than any reasonable hypothesis about extraterrestrial intelligence," says Kendrick Frazier, editor of the *Skeptical Inquirer*. "I just don't know anybody who takes this seriously anymore."

—PATRICK HUYGHE





ANTIMATTER



VAMPIRE CAPITAL

Los Angeles is more than the City of Angels—it's also the city of vampires. At least that's the claim of self-proclaimed vampirologist Stephen Kaplan, who says 10 percent of American vampires moved to L.A. in 1982, making it the U.S. vampire capital. "Vampires are beautiful, charming, charismatic, and sexually dominating, so they fit right in with the L.A. lifestyle," Kaplan says. "Also,

people wear less clothing there, so vampires can see more accessible areas."

Kaplan, who founded the Vampire Research Center in Queens, New York. In 1972, believes 20 blood-craving vampires call L.A. home, 20 more live elsewhere in California. Thirty vampires make Florida the second most popular among the "undead," while New York ranks third, with 25 vampire citizens. There are more than 850

vampires worldwide, adds Kaplan, who came up with these figures after being contacted by alleged vampires and using a questionnaire to weed out "the mentally ill, hoaxers, blood cultists, and other would-be Draculas."

"Real vampires have a

don't leave fang marks, rather, they bite very gently or use a cutting device."

According to Paul Barber, author of *Vampires, Bats and Death Folklore and Reality* (Yale University Press) and a research associate at

VAMPIRES ARE BEAUTIFUL, CHARMING, CHARISMATIC, AND SEXUALLY DOMINATING, SO THEY FIT RIGHT IN WITH THE L.A. LIFESTYLE AND SINCE PEOPLE IN L.A. WEAR LESS, VAMPIRES CAN SEE TARGET BODY AREAS.

physiological need to drink a few ounces of blood several times a week," Kaplan states. "They rarely kill, and most are nice. Unlike their fictional counterparts, real vampires can tolerate daylight if they wear a sunscreen, and they

UCLA's Fowler Museum of Cultural History, there's no evidence that vampires are prowling L.A. or anywhere else. "It's like proving there's an Easter bunny," he states. "You can't prove the nonexistent."

—Sherry Baker

FACING REALITY

When the Mars Observer went missing last August, there was much speculation about the reason for its sudden silence. Did faulty transistors cause the communication breakdown? Or did the craft blow up during preoccupation of the rocket's fuel tanks? Protesters outside the Jet Propulsion Laboratory in Pasadena had a different theory: NASA blacked out the mission to

conceal evidence of a Martian civilization. Proponents of this view say we need look no farther than the notorious "face" on Mars—photographed by the Viking lander in 1976—to realize the truth.

In the face of this theory, University of Rochester psychologist David Williams offers a simpler explanation: "Our visual system is always looking for things it's familiar with," he says. "It's always trying to find

LIZARD LOVE

You're a woman, and it's that time of the month. You steel yourself for what's probably in store: bloating, cramps, mood swings . . . and an attack by your pet iguana?

According to Freddie L. Frye, former clinical professor of medicine at the University of California, Davis, and co-author of a new book on iguana care from Krieger Publishing, more than 30 women have reported male lizards that become sexually aroused enough to attack the women when their monthly menstrual periods begin or when they ovulate. "Some of the bites have required plastic surgery," says Frye.

Take Helen L. Benton, secretary of the mid-Ohio Herpetological Society.

Benton has been attacked by her 40-inch-long iguana, Rocky, whose assaults occur when she's menstruating and he's in season, from mid July until late October. "When I open his cage door, Rocky grabs my arm or my hand with his teeth and holds

on as juveniles, Frye notes, and many showered with their owners and were even fed at the family table. What's more, in virtually all the cases, adult human males were not part of the household at the time of the attack. Scientists are still investi-

cues as if they were secreted by the female of their species."

Benton solves her problem by plunging a pacifier into Rocky's mouth when he lunges at her. "He thinks he's got me, and that calms him down," she says. But Frye suggests the solution may be neutering the iguana, as pet owners neuter cats and dogs. "Neutered iguanas," he says, "are loving and good."

Benton says she may consider this alternative for Rocky if the pacifier doesn't continue to work. "Rocky's just a sweetheart," she says, "when his hormones aren't surging out of control."

—Anita Baskin

ROCKY'S ASSAULTS OCCUR WHEN HIS HUMAN OWNER IS MENSTRUATING AND HE'S IN SEASON, FROM MID JULY UNTIL LATE OCTOBER. A PACIFIER USUALLY CALMS HIM DOWN. SOME EXPERTS SAY HE SHOULD BE NEUTERED.

me down," says Benton. "If I try to pull away, he'll bite. If I become submissive, he mounts me and masturbates."

Frye's investigation of this incident and others has turned up some surprising similarities. Most of these lizards were ob-

scure the underlying cause of this "lizard love." Says Frye, "We think they could be responding to chemical cues, or pheromones, produced by menstruating or ovulating women. Male iguanas may respond to the

patterns. If you look at enough patterns, you can find so-called faces just about anywhere."

Indeed, faces are turning up in the strangest places. A recent issue of the medical journal *Radiology*, for instance, published computer tomography photographs showing face-like images in the stool of a patient's intestine. The caption read: "Facies of Facies."

Another face turned up in the ultrasound images

of a woman's cervix taken by Michael Maman, a radiologist in Hayward, California. The features were made up of small cysts. Maman jokes that if people had noticed the face of the Virgin Mary, they might have turned his ultrasound room "into a shrine." What's more, he adds, "if we had scanned that cervix upside down, the whole thing might have gone unnoticed."

—Steve Nadeau



"Cervical features" Ultrasound equipment reveals faces in the folds of cervical cysts.



LEAKEY'S LIVES

In 1989, Richard Leakey relinquished his focus on fossils to lead a campaign against elephant poaching, leaving the bulk of field research to his wife Meave, head of paleontology at the Nairobi Museum, and Johns Hopkins anatomist Alan Walker, who discovered the black skull at West Turkana. Leakey himself remains the highly visible spokesperson on the subject of human origins. *Origins Reconsidered*, Leakey's and Roger Lewin's sequel to their best-selling *Origins*, was published by Doubleday in 1992.

Leakey's approach to conservation over the years has been as controversial as some of his fossil discoveries. Poachers have been shot on sight, and he has fired hundreds of employees in the Kenya Game Department to root out corruption. He has received several death threats, been accompanied by armed bodyguards, and has often used decoy vehicles to veil his movements. Some feel sabotage might explain the loss of power. Leakey's Cessna experienced shortly after takeoff on June 2, 1992, with four members of the Kenya Wildlife Service on board. Leakey radioed a Mayday and hoped to make an emergency landing. But as he coasted the plane toward the ground, he did not see "one stout old mango tree." His Cessna lost a wing, and two passengers were thrown out into a fluid as the plane rolled over. Everyone survived, but Leakey's leg bones were shattered and his foot mangled.

One of Leakey's first visitors in the Nairobi Hospital was Kenya president Daniel Moi, who ordered an investigation into the crash. (No evidence of sabotage was found, but the cause of engine failure remains unknown.) As soon as Leakey was out of Intensive Care, he held meetings with the KWS staff in his hospital room, requesting the advice of friends, family, and doctors to move to a

British hospital. All feared that infections might endanger Leakey's 1979 kidney transplant, a gift from his brother Philip. Leakey's right leg was operated on, but bacteria continued to work on the bones. A week later, after being convinced by British surgeon Dr. Christopher Colton that his injuries were life threatening, Leakey was transferred to a hospital near Nottingham, England. A series of operations—including bone and skin grafts—continued, but in July 1993, his left leg was amputated below the knee.

"He's been wonderful about the whole thing," Meave Leakey wrote. "Somehow he manages to keep his spirits up and the jokes flowing even after nine weeks on his back." In August, he returned to Kenya in a wheelchair, reporting for work at his KWS office. But back in England for additional surgery in September, the decision was made to amputate the right leg below the knee as well. For a man who covered miles of arid terrain at a brisk pace and loved to swim and sail, moving about with two prostheses has posed a challenge. But recently he walked 100 yards on them unassisted, tossing his cane away triumphantly.

Another challenge is medical bills estimated at \$250,000. Leakey has no health insurance because of his transplanted kidney, but a medical fund has been established by his United States representative, and movie rights to his life story have been optioned by Columbia Pictures. Whether or not the movie will feature his career as a fossil finder or a conservationist is unknown, but, as Leakey suggested in his autobiography *One Life* (1984), the script writers have several lives from which to choose. His skills as a pilot suggest he may have the proverbial nine—another pilot who saw the wreckage told him "It's unbelievable that anyone survived." —Debra White



LUCY'S

CONTINUED FROM PAGE 20

one, you don't usually work in the other," admits Johanson. "It's been very counterproductive, and I don't think that's good for the science."

At this point, *afanerals* is widely accepted as humanity's closest ancestor even among most of Leakey's supporters. But Leakey himself remains entrenched in his earlier views. In his latest book, *Origins Reconsidered* (1992), he writes, "A decade of debates convinced most anthropologists that Don and Tim had, after all, been

correct... but not me. I have held tenaciously to the minority position over the years." In the same book, Leakey says that he will not discuss publicly what actually happened to end his friendship with Johanson. But he seems to hint at having been "manipulated" into the *Universe* confrontation and refers to the "audacious move" of Johanson and White in citing some of the discoveries of Mary Leakey—his own mother—in supporting their claim of a new species. Many believe that the real clincher for Richard Leakey was Johanson's first book, *Lucy*, with its insider view of paleoanthropology and intimate, gossip-y tone about the

field's star players. The Leakey family, Johanson himself says, "Richard had this perception that the book that I did and the ideas that Tim White and I came up with were specifically designed to embarrass him and his family. And they weren't. This was the state of the art at the time."

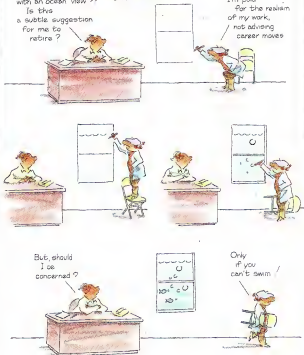
At 50, Johanson has calmed and mellowed somewhat. Five years ago he met and married Lanora, his third wife, whom he calls "a very important guide in my life." Lanora is the self-described "anchor and stable force in the family" who often talks her more volatile husband down from "his high stress points." She is also a talented under-

The Artist

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water photographer and filmmaker in her own right who served as the producer on the second program in the *Nowa* series and as Johanson's co-author on *Ancestors*, the companion book.

Johanson feels most alive, he says, on expedition in Ethiopia, where he is affectionately known by the people as Lucy's father. "There is great national pride in Lucy," Johanson explains. "And of course she's back where she belongs now in the national museum in Addis. Lucy's Ethiopian name is Dinkinesh, which means 'wonderful thing'; it's a word they sometimes use for very special women. After being kept away for so many years, he can hardly believe that his team was finally allowed back into the country to make so many important finds. "There are 50 new hominid discoveries from Hader in just three short field seasons," says Johanson. "We have almost doubled our collection now of fossil hominids. It's a kind of burst of discovery that we haven't even had time to sit down and study in detail."

Besides finding a new *Australopithecus* and partial male skeleton, what excites Johanson most are the new younger areas in the Hader that his team is beginning to explore. Last year, anthropologist Gerry Eck struck out into the Gona, a place where stone tools had once been unearthed back in the 1970s. The discovery of these artifacts was an indication that a more sophisticated and recent ancestor of humans than *Australopithecus* may also have dwelled in the Hader. But at the time of that expedition, no fossils were found. Now Eck has returned with a horse fossil in hand—the genus *Equus*, which (as far as we know) didn't get into Africa until 2.3 million years ago. With Lucy and the first Family now firmly dated at 3.2 million years, that would mean there are fossil deposits spanning almost 1 million years at Hader—five times what was previously thought to exist, a remarkable increase. It also means that we've got fossils during the period when I think the missing link between *Australopithecus* and *Homo* (later human) will be found," says Johanson. "Someone was making those stone tools, so this is a potential place to crack one of the big remaining questions in human evolution."

What makes Johanson such an exceptional hominid finder and his expeditions so successful? "Don has a great eye," says INH's Bob Walker. "He can find a fossil and recognize instantly what it is. It takes imagination, a person with a three-dimensional kind of mind to be able to look at something lying on the ground a few feet away, twist it in-

ternally and see it for what it is. He has this capacity to visualize a fragment of bone and not only recognize what larger bone it fits into, but also how that bone fits into the skeleton. It's a very rare trait." Many of the teams finds are actually made by the local nomadic Afars, who wander about this landscape their entire lives. The Afars know the terrain intimately when they go fossil hunting; it is in effect like looking for something in their own backyard. But it was Johanson himself who spotted the first piece of the new partial male skeleton lying on the ground. "It was an ulna—an elbow—which was exactly the same first bone I found of Lucy," says Johanson. "Of course people say plently 'Well, elbows stick out."

All the logistics involved make an expedition difficult to pull off. Each field season, Johanson's team sets up its own small, self-contained village on the banks of the Awash River. Every day some 40 people must be fed, cared for, and protected. There's a kitchen crew, a camp nurse, and Afar natives to help with the digging. Gallons and gallons of river water must be processed into something to for drinking and washing.

The science is not the only work, says Bill Kimbel, director of paleoanthropology at INH, who along with Walker bears much of the responsibility for running and organizing the camp. "We have a lot of very different cultural personalities out there," Western scientists Afar Muslims, and Christians from the highlands of Ethiopia who come from the Ministry of Culture. "We all work together, but it's a challenge to keep everyone happy."

And the conditions at Hader are definitely trying. "It never cools down—you're always hot and sweating," says Johanson. And then there's the chance of being bitten and killed by a snake, catching malaria, or turning over in a Land Rover. I almost always come back with some kind of illness. I had very severe fever in the 1970s that was never diagnosed. So physically it takes its toll." But—and this is an important but—he adds, "I love it." Some of the best times are at night when team members finally just get to sit and relax, listening to the African toads croaking in the background and hippo sounding off upstream. "A real intimacy develops between people," Johanson reports. "It's just an opportunity to be out there under the stars, smoke a cigar, and talk for two hours a night after dinner. When we get back home, we're lucky if we have dinner together three times a year."

Johanson was bitten by the Africa bug quite early in his life. As a child, he

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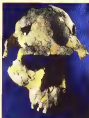
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THE 444 SKULL

Every time an early human fossil is discovered on a Johanson expedition, Tel Aviv University paleontologist Yoel Rak turns up his portable stereo and blasts the camp with a recording of Beethoven's Ninth Symphony. And that is just how Johanson felt learned that Rak himself had made an important new find: a nearly complete skull of *Australopithecus afarensis*, humanity's earliest ancestor.

It took weeks of arduous work to clean, identify, and glue all the hundreds of skull pieces that Rak had found: the barest slivers of bone proving sometimes crucial to the reconstruction. The result was the 444 skull (named for the number of the Hadar fossil site where it was found) from a large male who died in his thirties some 3 million years ago. That makes 444 about 200,000 years younger than his older "sister" Lucy, the most famous member of this species.

Scientists have had fragments of *afarensis* skulls before, but this specimen is 75 to 80 percent complete with upper and lower jaws, a number of teeth, much of the face, and the top, back, and bottom of the skull still remaining. "It has very pronounced markings for substantial



chewing muscles that we had no evidence of before," says Johanson, "and a number of teeth are worn down so heavily—right down to the dentine—that it suggests he was eating very tough, fibrous foods—that *afarensis* was mostly a plant eater."

On first appearance, 444 is a massive skull, but it still has the small, ape-like brain characteristic of *afarensis*. Johanson fears, however, that its special combination of features may once again generate intense debate as to the real position of this species on the family tree. "Some people may pick up on the enormous face, the large flaring cheekbones, and the bone shell" that

reflects the massive size of the chewing muscles," he says, "and view these traits in isolation. They may suggest they are typical of only the robust branch of the human family [that died out] and not the one that led to man." But Johanson points to the fact that a number of later skulls on the Homo side of the family—the one that did evolve into human beings—also have massive faces and considerable muscle markings. "We still feel comfortable," he says, "seeing *afarensis* as the trunk of the human tree." —Sharon McKulife

was befuddled by a remarkable older man—a German anthropologist and scholar named Paul Leiser. Leiser was a bachelor who lived down the road from Johanson and his mother in Hartford, Connecticut, and became, in Johanson's words, "my mentor, my surrogate father" (Johanson's own father had died when he was just two years old). Johanson was fascinated, he recalls, by Leiser's apartment "because it was really literally, books from floor to ceiling in every room. Anthropology was something totally foreign to me but I got very interested in it because I found books on fossils and natural history. And Paul would go off on these exotic trips to Africa, so naturally I wanted to go and see what this place was like."

Before his recent return to Ethiopia, Johanson devoted more than ten years of his life to launching the Institute of Human Origins—his own nonprofit, independent "think tank" devoted to the study of early origins and geochronology. According to Clark Howell, an anthropologist at the University of California at Berkeley and Johanson's adviser and friend from graduate school on, "This was a very very gutsy

undertaking. Johanson had a dream and he chased it. This was never easy for him and it's still a struggle. He gave up a permanent, guaranteed job with a paycheck every month for something uncertain." Johanson describes leaving behind his curatorship at the Cleveland Museum of Natural History and moving to California as "another one of those times in my life when I stepped off a cliff and didn't realize how far it was to the bottom. But I was committed to the Institute and wasn't going to turn around and give up."

Today IHO has more than 25 staff members and is backed by the National Science Foundation and National Geographic Society as well as a group of wealthy contributors that includes Ann and Gordon Getty of the Texas oil dynasty and David H. Koch. But back in the early 1980s funding was so meager that Johanson spent many sleepless nights worrying where the next \$10,000 would come from. "There was a period of time when I actually bankrolled the Institute," he recalls. "I didn't take a salary for six months so the scientists and secretaries could get paid. That is not something I want to do again. I had very high anxiety."

To keep IHO successful, Johanson spends much of his time in the public eye, giving lectures, writing popular science books, and most recently hosting the Nova documentary series. Since the early 1980s, with all the media attention surrounding his dispute with Leakey and the great success of his first book, *Lucy*, Johanson has often been derided by fellow scientists as a "publicity hound" and "populizer." He thinks, however, that they miss the point: that public understanding of paleoanthropology is crucial for its support. "Why should they fund some guy to go off to Africa and find answers that are millions of years old?" Johanson argues. "If people understand the excitement, the magic, the challenge of this kind of endeavor, they'll be more apt to back it—to embrace the idea that, yes, it does need financial support."

In the Nova series, Johanson takes the audience out on one of the Hadar expeditions to see the excavation of the partial male skeleton. This is not a recreation, but real science in the happening. You are there watching while pieces of the skull are pulled from the ground and carefully fitted together.

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When Johanson discusses why these ancestors walked upright (he believes there were reproductive advantages which were also associated with living together in social groups and food gathering) and whether later, more intelligent species survived by hunting or scavenging, he spends several days walking through the woodlands in South Africa testing out his ideas. With fellow scientist Rob Acromb (science from Rutgers University, Johanson demonstrates just how feasible he thinks the scavenging hypothesis is: "Rob shows me how to break open kung berries and get plenty of marrow out of them, a great source of calories and fat, and how it also takes intelligence to be a scavenger. You've got to know where predators are and how to avoid them, where their kils are, and what kinds of things are left on those animals. It's a lovely romantic view that our ancestors were mighty hunters, but it looks like we really came from opportunistic, clever little scavengers."

When it comes to Neanderthals—the brawny Homo species with the heavy brow ridge that is often badly depicted in old caveman movies—and the great debate about whether they actually died out or evolved into Homo sapiens (modern humans), Johanson comes

down clearly in favor of extinction: "I am really convinced now that Homo neanderthalensis could not breed with Homo sapiens and that they were eventually displaced into much less fertile areas by Homo sapiens moving into Europe after the height of the last Ice Ages."

And finally, the series tackles that last step that made us fully human: the evolution of culture. For years, France was viewed as a kind of finishing school for humankind. It is the place where art and symbolism were thought to have first emerged, as reflected in the wonderful animal pictures discovered on the cave walls of Lascaux. But now it turns out that cave paintings done by Australian Aborigines date back 40,000 or 50,000 years—nearly three times older than those at Lascaux. Some depict human-animal hybrids; others are topographic maplike pictures that show how to walk, move, and operate in the harsh Australian landscape. In the Nova series, much of this Australian cave art appears on film for the first time. "My view is no longer Eurocentric," says Johanson. "It's more global and robust. The last revolution happened everywhere humans went—in Australia, Africa, Europe and I think Asia, if we had good caves there. This

was a shared explosion. And as I talked with archaeologists and anthropologists who dealt with cave art, I became convinced that it was an articulate symbolic interactive language. As we speak now, that allowed our ancestors to do this."

Johanson is particularly proud of the look and feel of the series as produced by Peter Jones, the filmmaker and responsible for "Cave of Tomorrow" (one of his popular "Islands of Life" series). Johanson's series is packed with beautiful natural wildlife footage, including a rather dramatic fox kill during which Johanson and Jones come dangerously close to being eaten themselves. "We were in an open car and our guide, a professional hunter, had his gun out," says Johanson. "And he said to me, 'Keep that light shining in [at the lion's] eyes, or she's into the car.' And Peter, who's behind me in the back seat, is saying 'That's enough, we've got to stop,' while my wife, who's filming everything from the other car, is going 'Don't talk! It's moving! Move the light a little. Keep shining. Good.' A number of good-looking special effects are used in the series to bring Lucy back to life. Actress Ailsa Beek appears on camera in an incredibly realistic and (Johanson threatens) "anatomically cor-

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root" head-to-toe alienness suit. "We were down at the edge of a lava flowing. Aika as she scooped up a handful of water, and it was almost as if I were back 3.2 million years ago. I realized this is the closest I'll ever get to Lucy."

After two years of hopping planes all over the world—squeezing in "stand-ups" to camera with his research work in Ethiopia—he and Lenora are finally back home again in the Berkeley Hills. Their schedules are so hectic that after living in their house for more than a year, they still haven't found the time to put in a dining-room light and must eat, when home, by candlelight. A flagpole in the front yard keeps the neighbors alerted to their international comings and goings. Whenever one of the Johnsons is abroad, the other raises the flag of that country until he or she returns. Before they moved in, reports Lenora, "there hadn't been an Ethiopian flag sold to someone in Berkeley in probably ten years."

When quizzed about their neat project together, the Johnsons mention the possibility of another book or documentary and their hope of soon being able to give something back to Ethiopia by setting up a school in the Hadar for local Afar children. They have both been deeply touched by the African people and have even talked about taking time off to join the Peace Corps. "It's probably totally impracticable because of my responsibilities here," Johnson admits, "but the urge, the thought, is there." Closer to home, Lenora brings up the idea of beginning their own family. "Don has been saying to me, 'How are you going to travel to Africa and have a baby?' Tell me how?" And I said, "Well, it's not easy, but women just do it." So what did we find on our last trip to Lake Tanganyika but a young couple with a seven-month-old baby making an underwear film. And they're living on the shores of the lake and she's out diving every day. I didn't say a word. I just looked at him and smiled." **BB**

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CONTINUED FROM PAGE 66

posate me. "Something terrible happened," she said, as I sat there open mouthed, staring at her. "Steve told me to stay in Manila, but I caught the next flight out, after he. There are police men after him."

"I know," I said in a shaky voice. "They arrested him. But what's he done?" She told me then and though Steve was still in a lot of trouble, I sensed a sigh of relief. It was bad, but not as bad as I had first envisaged, thank God.

They had been in a waterfront bar and Steve had had too much to drink. Marcia went to phone a taxi, to take them back to the hotel. When she returned, all hell had been let loose. It appeared that Steve had suddenly exploded in a fit of violence and had proceeded to lay about him without warning. The clientele of that particular bar were no angels themselves and dockers, fishermen, and wharf rats began to pile into the mad gwaio with boots, fists, and one or two knives. Steve retaliated in kind, stepping up his attacks on the opposition, cracking heads and throwing the smaller Filipinos around like dolls.

Chairs were broken, jaws were broken, mirrors were broken. There were three unconscious bodies slung about the floor and Steve was swinging a bottle at a fourth, just as Marcia entered. The barmen had pulled out a revolver and was screaming to Marcia in Tagalog that she'd better get her boyfriend out of there, or he was going to blow the fucking madman's head off. Marcia managed to bundle Steve through the door and into the taxi, whereupon he collapsed in moody silence in the corner of the cab.

"He my fault," I said to her. "I've got to help him."

Steve stood trial in Hong Kong, there being a Far East Area Criminal Court in Kowloon. His lawyer picked off the various charges against him, but he still ended up with "Assault with intent to cause grievous bodily harm." He was sentenced to a year in the Far East Central Jail, of which he would serve about eight months, the lawyer said.

So now I sit in my cell, with three other convicted felons for company. I couldn't let Steve serve his sentence. I'm doing it in his place. While Steve was out on bail we extended our illegal activities to swapping psyches. I am now in Steve's body and he in mine. It's

really only fair that I do his time for him when the whole thing was my fault anyway. I'm tempted at this point to quote the words at the end of *A Tale of Two Cities*—"It is a far better thing I do now..." but I can't remember the whole bit.

I've taken a year's sabbatical from the university and Steve has taken my body to Thailand with Marcia for a long holiday. She was a little confused at first but doesn't seem to mind, so long as I don't care and Steve is happy. We've explained to her what we've done and have assured her that everything is fine with both of us.

Just a quite interesting reality if you haven't got a lifetime to serve, but Far East prisons are tough. You need to be a hard man to survive in here. Obviously Steve, the old Steve, would have been in his element being an obstinate, tough bully. His aggressive attitude and pugnaeous personality would have ensured he was left well alone.

However, Steve isn't in here—I am. I am fairly timid by nature and a natural wimp. My own body being more suited to an effete academic. I doubt I could survive on my own. The mental thugs in here would destroy a mild gwaio like me in very little time at all, these Chinese triads and Vietnamese gangsters. So I borrowed another personality. So I came in, superimposed it upon my own. It seems to work. I can scrap with the best of them, assid their food before they rob me of mine, intimidate them, put them in their places, establish a pecking order with me at the top. They fear me for my inherently fierce nature, my vicious character, and either stay out of my way or suck up to me.

Why not? Someone's got to be the king pin, so why not me?

With the help of an overpaid persona of course—that of the most belligerent black dragon I could find. **Yat Ho GO**

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INTERVIEW

CONTINUED FROM PAGE 74

You want them to learn which ones they tolerate without getting sick or dying. People learn to smell and taste gingerly like any mammal that eats a wide variety of vegetation. If a deer comes to a novel food source, it will eat the first bit so gently. If it doesn't get sick, it will come back and eat more.

Omri: Will your theory have psychological and social impact?

Prolet: Women have been blamed for pregnancy sickness. For much of this century, severe pregnancy sickness was considered an oral attempt at abortion—a loss of femininity, your husband, or sexuality. Freud did not help matters. In the Thirties and Forties, physicians sometimes would isolate women who vomited excessively in early pregnancy from friends and family in hospital rooms and take away their vomiting tubs so they had to vomit on themselves and wallow in it. Even up-to-date books on pregnancy that discuss severe vomiting say, "Think about what it is in your pregnancy that you can't stomach." Many women with severe pregnancy sickness are treated in a condescending fashion by hus-

bands or parenting partners like, "Oh, this is in her head. She's not coping well with her pregnancy." Women are told they should feel lucky if they have almost no pregnancy sickness. Well, you weren't lucky if you didn't.

Omri: When did you start working on menstruation?

Prolet: When I was seven I learned I was to undergo this monthly bleeding. I was disgusted, not because of the blood, but by the design—that our bodies were so inefficient they couldn't do anything better with the blood. I never bought the explanation.

Omri: In a *Kekulélike* statement, you credit a cat for inspiring your paper on menstruation by waking you up from a dream. What was that dream?

Prolet: Gelato was a shiny, very smart cat. I loved this animal for some dumb reason. He'd always meow in the middle of the night to go out and hunt. He was so persistent, he always won. One night he woke me at 3:00 a.m. Earlier I'd had a conversation with my sister about variability in menstrual flow. Who knows why—you know, sisters talking. And I had a vision in my dream of a cartoon from grade school. The girls watched menstruation films and boys sports films. The boys were always so envious because we were learning the

secrets of nature. The films little images showed ovaries, the uterus. During the month, the uterus builds up this rich lining. But if it doesn't get a fertilized egg, then it doesn't need that lining, and it just comes out as blood.

I saw the pale yellow menses and realized lining of the uterus, and the red was flowing out of the cervix. But there were all these tiny black triangles with pony tails embedded in the uterus and they were coming out with the flow. As soon as Gelato woke me up, I knew the black triangles were pathogens. And I said, "Oh, so that's why" and went back to sleep. The next morning putting around the house, I thought, Didn't I have some weird dream last night? Then I thought, How would pathogens get up there, the only thing that gets up there is sperm. Maybe pathogens ride on sperm. In my first literature search, I found tons of articles. This is not some obscure fact—it's blatantly out there. That's why I gave Gelato the acknowledgment.

Omri: Do species other than humans menstruate?

Prolet: Most books say it occurs only in humans and higher apes, no primates, nothing else. I suspect virtually all mammals menstruate. Mammals from many different orders have been shown to menstruate if you dissect them at the right times. They may reabsorb the blood or just a trickle comes out and is absorbed in their fur or lodges in their mucus. You do vaginal or cervical swabs or dissect them to find out. Go back to the nineteenth century when biologists picked their species and target organ and then dissected 130 of those, and you find all these studies where they dissected monkeys or tree shrews and find, yeah, they're menstruating, albeit "covertly." People were surprised, but covert menstruation is fundamentally the same mechanism as overt menstruation. The difference is in the amount of blood.

Humans probably have the most copious degree of menstruation, and we are the only species known to have ovulation that can't be detected except by modern technological methods. Since we have sex throughout the cycle, soon after menstruation, you're getting sperm up into the uterus and oviducts. Well, pathogens hop on and can replicate many times before the next menstrual cycle. The cervical mucus is most receptive to sperm during ovulation and least receptive post-ovulatory. But it's sperm-receptive early in the cycle because your estrogen is rising. So maybe you're getting pathogens up early in the cycle, three weeks before your next menstruation. That's a



"Better put that away" some wildlife photographers are coming

long time for bacteria to replicate. So in humans you'd expect a large degree of menstruation, whereas, depending on the species, wild animals generally copulate only during the few days or hours of the cycle in which the animals are in estrus.

Qeni: How do menstrual cramps and PMS fit into your interpretation?

Prolet: The uterus is always having minor contractions, because it's shedding the mucus through the vagina. Those contractions are more synchronized and stronger during menstruation. That's what is thought to cause the cramping. With PMS and severe cramping, it's hard to say. Hunter-gatherer women experience some anovulatory cycles in their early teens, then get pregnant, lactate for years and have no menstruation, have a few cycles, get pregnant again and so on. Women in our society undergo many menstrual periods and so much hormone buildup. We're not aware of all the signals the chronic cycling tells the body. The body is saying, "Gee, is something wrong? She's gone through 82 cycles and she's not getting pregnant?" Does the body respond by increasing the number of receptors for different hormones because you're giving the body the message that you're not pregnant, and it's trying to change its parameters, recalibrate things? Some women today do get these dramatic premenstrual symptoms and terrible cramping, and we don't know how natural that is.

Qeni: You challenge the view in many cultures that menstruating women are "unclean." Your theory says women cleanse themselves of pathogens introduced by dirty sperm.

Prolet: It's not like it's anyone's fault. The sperm may be vectors, but most of the pathogens they're carrying are from the vagina and cervix. The transfer of pathogens to the uterus and oviducts is an unavoidable concomitant of internal fertilization. I'm not sure anyone likes menstruation. Why would they? But one way my theory may help is that many men held a disdainful attitude toward menstruation and of women as having to go through this bizarre, wasteful, grisly thing. Maybe now they'll have a little more respect for it, though I personally anticipate getting every menstruation joke in the book. My grandpa made the first one, and he's 84 years old.

I never set out to prove menstruation is there for a purpose. Menstruation has always been one of the little annoying things, but it's not a major thing in my life. Undergoing something often enhances your insights about it. But that's not a feminist perspective. Al-

lergy is a male-female phenomenon. I'm interested in these anomalies, these things that on the surface don't seem to make sense whether they occur in males or females.

Qeni: How did your undergraduate work in physics and political philosophy lead you to research in evolutionary biology?

Prolet: As an undergraduate, I wanted a classical philosophy training. I wanted to read, think, write a few papers. Philosophy was great training for thinking, but I didn't feel I had the knowledge or power to get answers. To understand any question about nature, even human nature, you really have to know science, because any question about nature is a scientific question. Physics is extremely elegant, a beautiful thing to understand. But I was so turned off by the negativities of the classroom that by my last year of physics, I felt I was sleepwalking most of the time. I liked why questions but figured the questions I liked in physics—like why is the speed of light what it is—I wouldn't have the foggiest idea how to solve. So I decided to read whatever I felt like in the universe and gravitated toward evolutionary biology.

Qeni: What do you hope to achieve with your work?

Prolet: I hope it will have major clinical implications but in a broader sense will start to change the approach to medicine. If there is a physiological phenomenon, the first question should be, Does it have a function? Look for the evidence of adaptation and then figure out what the function is. Only then can you understand whether you should treat the symptoms, what the costs of treating or not treating are, and what it means to have this mechanism in a modern society versus the Pleistocene environment in which it evolved.

Qeni: Does your perspective stem from the fact you're out of academia?

Prolet: It's because I'm not locked into it and refuse to allow myself to be. Many people think what's important is to get the credentials. No, what's important is the science. The way you judge your own life and the way you will be judged is by the work. When you die, who's going to care what credentials you accumulated? If you spend your youth getting credentials and you're not excited about what you're doing, you're missing the great time for science. I defied all the supposed rules. I have zero credentials in my field. I have no Ph.D. in anything. I don't dress or look like a professor. I don't give talks, I'm hermitlike. I don't do those normal things, but my stuff gets published. **Q**

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GAMES

CRACKING THE LISTS

What's the logic of these word sequences?

By Scott Morris

LIST 1

bouquet
Peeping
zealing
Teelism
quey
pharmacy
jeolier
Nevajo
eye
gashure
chorus
W-shaped
gracelp
comptroller
toblesu
hicrough
cue
colonel
centurion
possed
ewe
thereof
one
wrecks
wise
xylophone

LIST 2

teest
deubt
indict
handsome
half penny
game
rhyme
kailer
marijuene
know
folk
meemerie
kyme
leopard
psychology
claq-zeab
ferocastle
Island
oftea
bulld
flvapeace
onswar
toblesux
preyer
rendezvous

LIST 3

aphid
blessem
computer
Denish
of Eden
fritter
green
harvest
ice cream
joch
hnocher
liqueur
Macintosh
nouget
amelet
pollaher
quiche
ripseer
zeed
tree
upside-down cohe
vinegar
whiskey
xenogamy
yogurt
zahagilene

LIST 4

orses
Christ
yourself
payment
Perón
vessence
police
retirement
on eye
E. Chaucer
Sutherland
leather
als
sir
population
relief
tickets
Ashe
Williams
mation
la
la France
a match?
breakfast
mistress
Marx brothers

LIST 5

stable
crabcake
McDonald
mede
left
flag
enough
ship
Fiji
joke
folklare
palm
menepely
menepely
menepely
perquetry
quest
cers
peet
estuary
ultraviolet
vew
wax
foxy
analyse
pizze

LIST 6

schue
spiet
three
grist
chere
fleur
zeecu
flich
riese
garnes
cease
reech
maire
beaux
zeewe
engut
latro
ester
eckee
exist
zeenbe
about
edieu
eight
outside
oiled

A few months ago, we asked readers to figure out the logic behind a word list that began frame, movie, clump, day, mast, stop, string, bomb. It turned out that each word could be paired with an alphabet letter to make a common phrase: A-frame, B-movie, C-clamp, and so on.

Above are some additional word lists. See if you can deduce the logic governing each list. Let us know if you come up with any improvements on the specific words chosen for these lists. The answers begin next.

ANSWERS

List 1 is an "invisible alphabet" by Devin Borgmann. Letters are represented only by their sounds—an 'a' sound in bouquet, a 'b' sound in Peeping (now commonly spelled Peeping), a 'c' sound in zealing, and so on—and do not actually appear in the spelling of the words in the list.

List 2 is based on another alphabet by Borgmann called the "silent alphabet." The 'a' is silent in teest, the 'b' is silent in doubt, the 'c' is silent in indict, and so on.

List 3 is the 'A' is for

apple' alphabet by Nyr Indictor. The list reads: A is for apple aphid, B is for apple blossom, C is for Apple computer, D is for Apple Danish, and so on.

List 4 is an English "come alphabet," playing on: A for 'B' for 'C' to make familiar words or phrases. "A for 'orses' sounds like 'hay for horses' in a cockney accent. Then comes: Before Christ see for yourself, defer payment, Eva Perón, effervescence, chief of police, age for retirement, eye for an eye, Geoffrey Chaucer, Kiefer Sutherland,

hell for leather, emphasis on force, overpopulation, pee for relief, queue for tickets, Arthur Ashe, Esther Williams, T formation, euphonia, viva la France, Trouble you for a match?, eggs for breakfast, wife or mistress, and see four Marx Brothers.

In List 5, the letters a and b appear in stable, b and c in crab cake, c and d in McDonald, and so on. The letters always appear in alphabetical order, although not always adjacent.

The answer to List 6 will appear next month. ☐

Paranoid population.
Psychotic criminals.
Power hungry corporations.
Big Brother government.
Haves and have nots.

America?

Close.

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LAST WORD

VACATION ON THE MOON

Travel of tomorrow with all the drawbacks of today

By Peter Callahan

The Dixons were excited about the "five days and four nights of lunar bliss" promised in the brochure. When people first started vacationing on the moon around the turn of the century, they brought back glowing reports of its breathtaking beauty, its pristine landscapes, its wonders to behold.

Then it became popular. By the time the Dixons embarked on their trip to the moon, the shuttle set who had first made it trendy had moved on to sun-splashed Mercury, where the crowds were thinner and the tanning easier. In fact, among a certain class of traveler, the moon was considered downright frosty—little more than a galactic tourist

trap that had long ago been eclipsed by hipper destinations. But the Dixons had ignored the naysayers, dismissing them as snobs, and set off with high hopes and expectations.

From the beginning, it was a nightmare. "recalls Matt Dixon, an antique-tax-machine dealer from Hastings-on-Hudson, New York. 'An asteroid shower had closed Armstrong Shuttleport, and we ended up orbiting for three days with nothing to do but swirl the complimentary Tang they kept pushing on us.'

In the terminal things got worse. While down in the baggage area, watching all these suitcases floating around," Matt's wife, Liz, remembers, "when we realize our luggage is missing. So to fill out a report, we have to wade through all these lunar-rock peddlers from the Unification Church, who seem to have some sort of monopoly going up there. Turns out our stuff had been sent to Venus."

"Then we get to the rental place," Matt chimes in, "and our rover isn't ready. Annie, our seven-year-old, is whining by now—you know, this planet sucks, and all that—and then she lets go of her doll—which I told her not to do—and the thing drifts away. So she's crying, and Liz is getting cranky from a nasty case of shuttle lag."

"Excuse me?" Liz interrupts. "I had the shuttle lag? How was the one crying about the altitude?"

"Yeah, right," Matt says, annoyed. "It's always me. I'm the bad guy." Matt glares at his wife. "Anyways...when we finally get to the hotel, it's like a zoo. It's Spring Break or something, and the place is packed to the rafters—literally—with these spaced-out college kids chugging moonshine."

"Why don't you tell him about

the suits?" Liz prompts, an edge in her voice.

"Oh, now that's my fault, too?" "Did I say it was your fault?" Liz asks. "Just tell him about the suits, dear."

"Well, talk about a report!" Matt goes on. "It turns out you can't leave the hotel without these spacesuits. The travel agent forgot to mention that part. So we gotta rent the damn things, and of course they don't fit. Plus they got a helmet law up there now, so you gotta rent those, too. Were broke before we even step out of the hotel."

"So we decide to go to see the flag those first astronauts planted," says Liz, "which we thought would be nice, seeing a part of history and all. And on the way over, Mario Andrei here drives right into a crater."

"I got out of it," Matt protests. "Oh, c'mon," snaps Liz. "You were checking out that wet-spacesuit contest they had going by the side of the road."

"Yeah, right," Matt sulks. "It's always me. I'm the bad guy. Blame Matt for everything."

"Anyways..." Liz continues, "about two hours later, we finally get there. And guess what? Some lunatic has replaced the flag with this huge Ohio State banner." Liz shakes her head in disgust. "Kids today."

"Basically," says Matt, his voice filling with bitterness and regret. "We spent all this money to be miserable at some cheesy resort. It was like the Jersey shore with weightlessness."

"Oh, well," Liz says. "I guess there's always next year. I hear Jupiter's the new 'in' planet. Old Man Jagger has a place over there, and it's supposed to be real unpopulated."

"Well, see how long that lasts," sighs Matt. "This whole universe is becoming commercialized."

OC



Callahan has never been to the moon, but he has visited the Jersey shore once or twice, and he feels sure it can't be all that different.



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