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Intuition isn't just for women anymore; everybody's got it. Tapping into it is the hard part. Chris talked to people who've not only learned how, but use intuition to make a living. (See "How to Develop Your Intuition," page 102.)

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# FIRST WORD

"DEATH—THE UNDISCOVER'D COUNTRY"

What is needed to give death its proper place in life?

By Mary Catherine Bateson

**M**useums give careful thought to the ending of their compositions. Artists locate every brush stroke in relation to the edges of the canvas. But those who attempt, through the many choices and transitions that arise in the course of a life, to make of that life an aesthetic whole are only now beginning to claim the right of elective closure, the affirmation of completion. The current demand for *Final Exit: The Practicalities of Self-Deliverance and Assisted Suicide for the Dying* by Derek Humphry (published by the Hemlock Society), which gives dosages of barbiturates and recipes for the proper use of plastic bags, is proof of need and anxiety but more is needed in order to give death its proper place in life.

Death no longer comes naturally. Just as we foresee a society in which every birth is chosen and brings forth a wanted child, so we can foresee a society in which death comes in chosen ways and seasons, freeing energies for living. If you look around at clear skin and straight teeth, at parents who have not had to face the death of children, at energetic elders working and play-

ing to average ages never before known, you recognize that what we call health and regard as natural is in fact an artifact of culture, an extension of human choice based on increasing knowledge. This is the human pattern, and the time has come to decide how to bring death within that pattern along with the amelioration and extension of life.

A new affirmation of death implies ethical and policy changes. The medical system is unlikely to shift to supporting health and quality of life as long as it remains locked in a heroic battle against death. The life that physicians struggle to sustain needs to be aware, participative, fully human, with death as one of its significant moments. There is a direct connection between the pattern of medical care that all too often prolongs unwanted life, the definition of death as medical failure, and the rising tide of litigation.

Current attitudes toward death contribute to an increasing dissonance between generations. Traditionally, a full life was one in which parents both expected the care and support of their children and enjoyed contemplating what they were handing on to them. It is important that a parent be able to say to a child, "Someday this will be yours." It is also important that the labors and expense we dedicate to caretaking contribute meaningfully to a parent's welfare. It is one thing to support the decision to go on living, even with pain and discomfort and dependency; as long as that choice can knowingly be taken. Those are costs we must find ways to meet. But the proportion of medical costs devoted to futile and expensive interventions on those already dying or no longer conscious is inappropriate.

Cross-generational tension occurs not only within individual

families, but in society at large, which supports heroic medical interventions for the very old at the expense of investments in the future: prenatal care, education, expanded industrial capacity, and jobs. Generations compete for resources, social security moves toward crisis, and many of the elderly feel betrayed by children unwilling to take on their care. The covenant between young and old, which is under threat today, must be premised on sustained quality of life for both generations and a due acceptance of death that includes the expectation of full information, discussion, and planning.

This dissonance between the generations is intimately connected with the need for value changes that will allow the moderation of consumption and population growth so as to conserve the integrity of an already threatened biosphere. A familiar slogan asserts that we do not inherit the world from our parents, but borrow it from our children. It is interesting that in many traditional societies where death comes earlier and is more intimately experienced by families, trees are planted and terraced and irrigation systems maintained over centuries. An awareness of approaching death does not seem to inhibit caring and careful thought about the future nearly as much as the determination to deny the necessity of death. In rejecting death, we set our face against nature.

Having finalized with the process by removing many of the natural causes of death, we should accept the fact that the cost and glory of technical progress is to require choice: choice of how much and when to reproduce, choice of how to die. Claiming this possibility of choice gives one more way to shape lives of grace and affirmation. ☐

Bateson. *Most of us today reject cultural traditions that subordinate life to death. Death is not the goal. But neither is death always the enemy,* she continues.





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# FORUM

READ ANY GOOD SCIENCE BOOKS LATELY?

Here are more good books about science and all of its flavors.

By Keith Ferrell

**S**cience literacy we hear daily is on the decline. Ironically, the literature of science is on the upswing.

We are living in a golden age of science writing, exemplified on the world's coffee tables and newsstands by *Omni*, and in our bookstores and libraries by a veritable flood of well-researched, carefully and beautifully written, ambitious books about the process of science, the history of science, the people who are doing science around the world. Beginning with Carl Sagan's *Cosmos* a decade or so ago, followed by the recent stunning success of Stephen Hawking's *A Brief History of Time* (Bantam), the number and quality of good science books has increased every year. The 1990s may well produce more good science books than all the years before them.

The books are getting attention. Occasional *Omni* contributor Dennis Overbye last year published *Lonely Hearts of the Cosmos* (Hyperion) and has been rewarded not only with ample sales, but also with the first of what will likely be many nominations for major literary awards. Overbye's book tells the story of modern cosmology through the eyes and experiences of Allan Sandage, a true pioneer of the discipline. It's a moving, at times heart-breaking, story of the excitements and frustrations of breaking new scientific ground, pursuing largely if not ultimately questions, and doing so in the midst of sometimes sordid political maneuverings and machinations. In other words, it's a very human book about real people, fully realized on the page. *Lonely Hearts* is a marvel and a marvelous example of book-length science writing at its best.

Another *Omni* regular, Arthur C. Clarke happens not only to be

one of the world's truly great science-fiction writers, he's also one of the most insightful writers about the nature and consequences of our Information Age and the part telecommunications plays in creating and shaping modern times. From his Sri Lankan vantage point, Clarke has this year taken off enough time from fiction—and articles such as 'Equid' which appeared here in January—to assemble the best of his telecommunications writings, along with a fair amount of new prose into a book called *How the World Was Won* (Bantam), due out in early summer. As always, Clarke is clear and optimistic, a champion of the triumph of idea over ignorance. In this book, perhaps more clearly than ever before, Clarke presents his vision of the partnership between humans and their technologies, and the world

of peaceful plenty that partnership, properly managed, can create.

A few years ago, Timothy Ferris published *Coming of Age in the Milky Way*, a thoughtful history of science's relation to and understanding of the cosmos. His new book, *The Mind's Sky* (Bantam), inverts that relation, showing how our brains and thought processes are themselves reflective of the workings of the universe. The book is witty as well as profound and, like everything Professor Ferris writes, its grace is a match for anyone writing nonfiction prose.

Some scientists make fine historians. Certainly that's true of Isaac Asimov, but then Asimov has proved himself capable of handling virtually any literary challenge he sets himself—and he's set himself plenty of challenges. Now he's taken on the entire history of the world in *Asimov's Chronology of the World* (Harper-Collins). Asimov's approach is that of the chronologer, the maker of time lines. He weaves disparate strands of world history together all but effortlessly, showing the relationship of science and technology to the progress of civilization, the rise and fall of individual nations. His time line is enormous, beginning at the Big Bang. A shrewd interpreter as well as storyteller, Asimov cuts off his time line in 1945, at the moment when science delivered the destructive power of the atom into human hands. That moment, he argues, changed the nature of history forever.

And this is just a handful of recent titles, reflecting my own tastes and preferences. Stop by a bookstore or library and scan the shelves for yourself. I guarantee you'll find something that captures your imagination, intrigues your curiosity, piques your desire to learn. That's what good science writing does. **DK**

The joys of reading about science can match those of reading even the most exciting novels.





# FUNDS

## PERSONAL FINANCIAL-MANAGEMENT SOFTWARE

Putting sophisticated analytical and speculative tools in your hands

By Patric Helmman



The eighth edition of Andrew Tobias's *Managing Your Money* further extends the program's ability to interact electronically with financial institutions.

Maybe it's the increase in computer power that has accompanied decrease in price. Maybe it's the recession. Maybe it's just time. Whatever the reason, more and more people I know are using their personal computers as money-management tools.

It used to be a joke, and not all that many years ago, the PC as the world's most expensive checkbook manager. In the early days of personal computing—all of a decade or so ago—the file carried a hundred accuracy. Software could help you balance your checkbook, extend mortgage amortizations, and calculate investment growth at varying interest rates—fairly simple calculations usually accomplished with an adding machine or calculator and performed without much more difficulty via pencil and paper. Hardly a reason to sink several thousand dollars into a PC.

Well, PCs are a lot less costly and a lot more capable today. The capabilities of financial-planning and money-management software have increased dramatically as well. The best programs can, indeed, balance your checkbook, but they can also generate insights and even advice.

Consider the latest version (num-

ber 8) of Andrew Tobias's *Managing Your Money* (MEGA Software). I've used the program for years, to my benefit, and I've benefited as well from its growth over that same period. Tobias's software has several things going for it, not least Andy Tobias himself.

For one thing, Tobias is a real financial writer, not a programmer. Tobias's journalistic experience informs many aspects of his software. Manuals and onscreen instructions are clear and easy to read; there are occasional flashes of wit and elegance, and everything is tailored to the average person, not computer wizards.

For another, Tobias and his staff of programmers/designers have understood since the first version of the program that financial modeling can be as valuable to individuals as it is to corporations. Just as VisiCalc, Lotus 1-2-3 and other spreadsheets put what-if and linked-assessability scenarios in the hands of financial officers, so do the best personal-finance software programs place substantial speculative and analytical tools on your desk.

Andy Tobias understands that most of us keep our financial records in a shoe box or oversized envelope, and he uses that metaphor throughout his product line that includes dedicated portfolio managers and a tax-preparation package—TaxCut 2040—that brings a fairly high level of artificial intelligence to your IRS forms. Think of the software as a shoe box, he advises, and toss your receipts, checks, dividend amounts, and so on inside. The software does the rest.

Thus in *Managing Your Money*, your checking accounts, savings accounts, credit cards, mortgages, investments, and debts all are linked, enabling you to derive complex and thorough portraits of your total worth—or lack thereof.

Couple the links with sophisticated analytical tools and what-if generators thrown in electronic notepads and calculators, and you have a powerful and multi-capable tool. Some shoe box.

None of these features to be frank, are all that unusual today—there are quite a few good financial programs available, including Quicken by Intuit and WealthStarter and WealthBuilder from Reality Technologies. Even mighty Microsoft has weighed in with a program called simply Money. There are quite a few tax-preparation packages on the market, and even more stock-market/portfolio managers.

Led by Tobias and Quicken, personal financial software takes increasing advantage of the opportunities presented by telecommunications. A computer that is not connected to the world is a crippled computer, especially when dealing with financial information. You can file tax returns electronically, via telephone lines move funds through a modem, monitor the stock market in real-time, place buy and sell orders, letting your computer dial your broker's number and use information services to obtain backgrounds on possible investments.

Money is information, existing electronically, in scattered locations throughout the larger world. Now software tools are available to let you participate, interactively in that larger cyber-economy without leaving your own probably tax-excludable home office and keyboard.

If you haven't looked at personal-financial-management software in a few years, you've missed a revolution. If you haven't considered using a personal computer to assist you in managing, analyzing, and improving your financial picture, you may be missing the boat. **OO**

# WHEELS

## PICK-'EM-UP TRUCKS:

They're not just for cowboys, carpenters, and good ol' boys

By Jeffrey Zygmont

**E**ven when she's not acting, Janine Turner plays a commanding Meggie, the spunky bush pilot in the CBS sitcom *Northern Exposure*. Off the set in Seattle, she sports about in a GMC Sierra, an imposing black pickup truck with dark-tinted windows and a monster engine. Urbane, genteel, a far cry from the rough-and-tumble of American trucking, Turner represents the growing social acceptance of a vehicle that for decades embodied the rebellious, do-it-yourself aspect of American culture.

"There used to be a stigma if you were seen in a truck," says Ed Schoener, assistant segment manager for Chevy pickups. "Now you find them in driveways of affluent neighborhoods."

Yet even with wider acceptance, the pickup remains a man's destination of the pioneer ethic: go anywhere, do anything vehicle that promotes nomadic self-sufficiency. With their long beds and open backs—perhaps with an optional towing package—pickups can be loaded on the run. Cargo can hang out any which way. Even the extra seats next to the driver seem an afterthought.

There's simply no other way to use the space. Thus a pickup is the ultimate personal car, made for its driver and the ton or so of possessions the owner can heap in the back.

No wonder then that full-sized pickups—sold by Ford, Dodge, and GM's Chevrolet and GMC divisions—are made only in America, where self-reliance remains a primary virtue. About 1.75 million Americans bought pickups in 1991. In better years, the industry sells 2 million, about 15 percent of the light-vehicle market.

"It signifies the rugged individualism of all Americans," says Mike Ould, a burly but playful 42-year-old salesman and sometimes welder from Dearborn, Michigan. Ould has owned a pickup since he began driving 25 years ago. He just traded his 1984 F-250 Ford for a smaller 1990 Ford Courier pickup, hoping to save on gas while he looks for a job. "You're much more independent in a pickup than you ever could be in a car," he says.

Full-sized pickups, the pickups of lore, are still the most popular, accounting for about 80 percent of trucks sold. But they're grow-

ing less representative of U.S. truckers, especially as trucks soften their edges to let more people into the fold. "The distinction between cars and trucks is not as great as it used to be," says Chet Kuzemko, chief marketing strategist for Ford, which has been making pickups for 75 years.

The change began in earnest when compact pickups appeared about a decade ago. Once called minipickups, compacts are generally at least two feet shorter than full-sized trucks. They carry much less cargo. They handle more like cars. First both Ford and Chevy imported little pickups from Japan. Then Chevrolet really lacked things off in 1982 with its American-made S-10 minipickup. Ford's Ranger followed in about a year. Today there are also minis from Toyota, Nissan, Isuzu, and other Japan-based manufacturers, accounting for less than 1 percent of pickups sold in the U.S.

More than anything, the compact pickup brings today's youth to the pickup fraternity. Because they're relatively cheap, "a lot of young people buy them," says market analyst Dukes. About \$10,000 buys a new Ford Ranger with a custom interior, air conditioning, aluminum wheels, and a cassette deck—more than you'll find on any new automobile of like price.

But even if compact pickups start out as car substitutes, they seem invariably to find the nomad in their owners. Consider Liz Longworth, a writer and editor living on Boston's North Shore. She bought a 1988 Chevy S-10 after her 1984 Volvo wore out. The truck has already earned its keep by hauling her mountain bike. "I like the independence of loading up my life and moving it around," she says.

"You can go wherever you want, be self-sufficient, sleep in the back if you want to." □

**'Pickup owners  
are a different type of  
person,'**  
says Tom Dukes,  
a market  
analyst at J.D.  
Power &  
Associates. "They  
give their  
trucks names.  
They treat  
them like a part of  
the family."



# POLITICAL SCIENCE

WHOSE LIFE IS THIS, ANYHOW?  
Science, religion, and RU 486

By Tom Dworetzky

**W**hen science bangs against religion, they both lose. Hold the problematic view of the universe long enough and you find your knowledge surpassed by those who don't. Since history shows that true scientific knowledge will win out, it's none that this chilling effect on the freedom of thought is ultimately futile. Now ideas relentlessly make their way from other parts of the world where doctrines prohibiting chastity and celibacy hold no sway—in secret, through word of mouth, via smuggled manuscripts, and in new technology: the advances wrought from free

its mind, and you may disagree with it—but it's American.

Right to "whose life"? Instead of lying down in front of abortion clinics and hassling women who legally and morally have a right to decide what to do with their bodies, why don't you get up and take out your checkbooks and say to each as she walks through the door, "Excuse me dear but may I support you and your child until that child reaches the age of majority?" How about, at least, taking a vocal stand on the role of men in pregnancy? Women don't get pregnant—couples do. What about mandatory paternity testing and a tough stand favoring male support of children they father? What about leading the fight for prenatal health care, schooling and support for women with dependent children, and more contraception and sexual health education (starting with high school programs)? If men responsible for killing children—and those of you who'd strip women of their right to choose—don't want to pay the piper, then they shouldn't dance to the tune.

Moreover, thanks to the so-called "life" movement sick, non-pregnant women in the United States suffering from a variety of illnesses may well die this year. Why? Because hormone-related drugs like RU 486, that cause abortions, can also save lives. These drugs cause all kinds of changes in body chemistry. Vanguard foreign research shows that the hormonal changes they bring about may offer powerful therapies for cancers such as breast cancer (now hitting epidemic proportions among women); and Cushing's disease, just to name a few. What about these women's right to life?

The problem with religion, for me, is that taking it too religious-

ly provides all the answers—and the only answers. That's not just intolerance, it's also irrational, bad science.

Then there are the social and economic issues surrounding the antiabortionists' frenzy over RU 486. A large-scale study of the drug's usefulness in treating women with breast cancer recently went to Canada, not U.S., researchers. Why? Privately scientists in this country have confessed to staffers of Oregon Congressman Ron Wyden's D.C. office that they don't need the threats and harassment. Stepping over people lying in front of the lab is not the way to get good science done. Add to that the appalling FDA, hasty last year when the administration buckled to antiabortion pressure and issued an import alert against RU 486. On the list with this proven medication are a raft of phony and fraudulent items like tamoxifen.

What's also sad about this whole misguided affair is that thanks to the antiabortionists, the United States will lose the lead in medical research concerning an entire new class of substances, and with this an entire approach to life-saving therapies—and a profitable market. Our friends in Japan and Europe will not so encumber their scientific community with antiquated, luddite misconceptions. So in due time we will be importing these life-saving drugs to treat a wide variety of hormonally related diseases (such as many cancers). The good news for those who think this country is founded on individual rights. Once the drugs are approved for nonabortion uses, physicians will be able to prescribe them to pregnant women choosing to have an abortion. In the privacy of their offices, no one will be able to stop them. ☐

Instead of  
protesting at  
abortion  
clinics, perhaps  
right-to-lifers  
could offer to



Raise unborn  
children or lead  
the fight for  
abortion and  
support for  
unborn mothers

thinking take hold and finally prosper. You eventually find yourself stagnating in the intellectual—and economic—backwaters.

Keeping this in mind, there are two ways these days to look at the health-care cost crisis. It's taking a bigger and bigger chunk of the GNP, and that's bad; or, it's one of the few boom industries left in which we've got a global lead, and that's good. Except that thanks to a vocal minority—the religious antiabortionists—we stand a good chance to lose that lead. I'll briefly digress here to express my opinion about the so-called "right-to-life" movement.

The problem with religion, for me, is that taking it too religious-

# SPACE

## ONE FOR ALL AND ALL FOR ONE

Are the world's space powers ready to go to Mars—together?

By John Elder

A team recently laid out a workable plan to put a manned spacecraft on Mars by 2017. But the scheme was devised not by NASA or the European Space Agency. It came from 137 students from 26 countries who completed the project as part of their course work at the International Space University's 1991 session.

Founded in the mid 1980s, the university convenes in a different country each summer for just ten weeks. It immerses its diverse students—typically aerospace professionals, lawyers, research scientists, journalists, and graduate students—in graduate-level space related courses and assigns them a challenging project: the planning an international mission to Mars.

For the students, such an expedition raised questions that the space agencies probably hadn't had to consider. To begin with, not all of the students agreed that going to Mars was worthwhile. And others, such as Tanzanian robotics engineer Duncan Heale wondered why their countries should participate.

That was quite a shocker for the American L5 Society students who "thought everybody behaved," says design project coordinator Wendell Merendell of the NASA Johnson Space Center in Houston, Texas. "And it was a learning experience for Third World people who had never thought about this exploration as having a meaning for them and their countries."

Deciding on a spacecraft design provided the major technical challenge. The trip should be as short as possible to minimize the astronauts' exposure to radiation. And since the effects of long-term exposure to low gravity are still unknown, the students wanted their spacecraft to have artifi-

cial gravity, created by continually spinning the spacecraft.

But the fastest spacecraft design could spin to maintain gravity on the return trip. It relied on the propellant's weight, which would greatly decrease on the journey back to Earth to keep the craft balanced and spinning. So the students compromised and decided on nuclear electric propulsion, a slower system whose greater mass would make it possible to sustain artificial gravity throughout the trip.

The project finally reached the inevitable bottom line: How much will it cost? The students estimated the total cost of their mission at roughly \$200 billion. However, they could only project some \$150 billion in funding, a shortfall they hoped could be remedied by changes in the costly way Western space agencies currently do business.

Who will take charge of the mission? The students had some innovative ideas about that. They created a group called the International Space Exploration Organization, composed of national space agencies like NASA, and international intergovernmental bodies like the European Space

Agency to oversee the mission. Rather than collecting funds from members to then be distributed among them as payment for services, ISEO will simply contract tasks out to the members best able to complete them.

Inevitably the learning experience extended beyond the technical and political. Quebec born law clerk Celine Levesque, who had never felt very Canadian, was surprised to find herself speaking up when she felt Canada was being left out due to its small space budget. And near the end of the session, territorial reality intruded. As CNN showed us the coup in Moscow a Soviet scientist asked me to write out the phrase "civil disobedience" and hurried off to a meeting.

A shock like that could have reduced the Mars mission to an unsatisfying game of "let's pretend." But everyone had worked too hard, especially at the slippery task of cooperating despite so many differences. It may be the prospect of going to Mars together, however much harder that makes it, that justifies one participant's description of the mission as "a launch window for the evolution of the human spirit." **OD**

*Before the ISU students could choose a way to get to Mars, they had to decide if they even wanted to go.*





# CONTINUUM

THE DUTY OF GENIUS AND THE LIMITS OF SCIENCE;  
Killer asteroids: first the dinosaurs, now Mars' atmosphere;  
plus, office workers see the (nonfluorescent) light

What did John Keats, Somerset Maugham, William Carlos Williams, and Gertrude Stein have in common besides a certain way with words? They also shared secret and not-so-secret scientific ambitions. And if Stein never actually received her degree, well, I guess a doctorate is a doctorate.

At first glance, science and poetry may seem like an oxymoron. The image of stern, white-coated scientists feverishly searching black holes of their souls to determine the perfect word to rhyme with quasar just doesn't fit with our Byronic romanticism. Scientists themselves seem to be somewhat embarrassed about aesthetic skeletons in the closet. The late entomologist Loren Eiseley spoke of letting the long suppressed vice of poetry out of the basement: "in a letter to his friend W.H. Auden (at left). But as the world becomes more and more complex, it will be the poets who once again (as they did in ancient Greece and Rome) explain "it all." Eiseley suggests that the writer's creativity is to open man's eye to the human meaning of science."

Science works on the premise that there is an answer for everything, and that may explain why scientists have, throughout history, turned to poetry to address the ultimately unanswerable questions. Sir Ronald Ross, a nineteenth-century bacteriologist who won the Nobel Prize in 1902 for his discovery that malaria was transmitted by mosquito, wrote poetry that expressed the doubts and frustrations encountered in his work with the oppressed in India. "In contrast, at the time, Europeana had a kind of overwhelming optimism. They believed everything could be solved with a bit of common sense



Eiseley abandoned his medical practice to follow his Muse



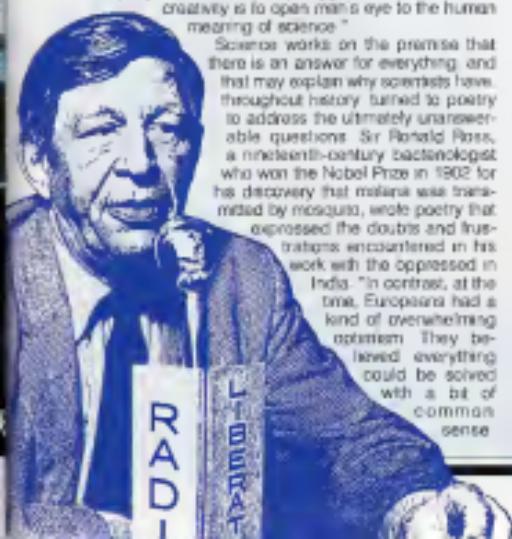
This was the time of Sherlock Holmes—look and you will find," says Shyama Bagchee, who is writing a book about Ross supported by the Bhatia-Indo Canadian Institute and the University of Alberta Central Research Fund.

The inability of science to solve basic human problems is often the subject of poems by scientists. Ross wrote "The Ecce to preserve his balance of mind to come to terms with the polyism of his day and the horrible reality of the disintegration of Indian civilization," Bagchee says. More recently, Gregory Benford, a physicist at the University of California, writes of humankind fumbling with simple clear latches while "our crisp reason loops lepton-lightly over radii of quarks." Says Benford, "We know that the mind's abilities are interrelated. The simplification of right-brain/left-brain is outdated. Scientific thought uses both, and so does poetry."

According to Jonathan Post, poet and aerospace engineer, "Poetry often works within a rigid structure in which inspiration makes the difference between the mundane and the beautiful." There's an aestheticism in science that drives you to the right answer just as a certain elegance inspires you to choose one word over another in poetry. You get that poetic experience when you think that a portion of the universe has revealed itself to you.

William Carlos Williams, arguably one of the best poets America ever produced, was perhaps the most famous scientist-poet. An extremely successful doctor, he often relied on his experience as a physician for material for his poems. The beauty and pain of birth, the suffering of illness and death are described so that the artist's perception of the world blends with the physician's, allowing us to see beyond the facts that the practitioner relates and understand an intangible truth.

Balance between reason and imagination is perhaps the key. What causes a scientist to take that leap of faith that propels him past the intelligence of his peers and allows him to make a discovery is the same intuitive skill that compels him to create poetry. Without intuition and the ability to use fact and structure as well as imagination, scientific revelations from Einstein's theories of relativity to Fleming's discovery of penicillin may never have been discovered.—LESLIE O'CONNOR





# CONTINUUM

## BETTER VISION, BETTER VISIONS

Some terminal cancer patients occasionally smoke mariju- juana, pain- caused by their illness. Now a University of the West Indies pharmacology professor has discovered another medical benefit of *Cannabis sativa*: enhanced night vision.

Marley West had often heard Jamaican fishermen boast that using marijuana gave them the superior night vision that enabled them to guide their boats through narrow inlets and around barely submerged coral reefs without compasses or lights. But only after an extended nighttime fishing trip with a captain who had drunk a potent extract of rum-soaked marijuana leaves did West become convinced that this Jamaican fish tale was true.

The nocturnal expedition sent the professor back to

his laboratory at the Kingston, Jamaica, university to search for the cause of the marijuana-induced enhancement. He and ophthalmologist Albert Lockhart eventually claimed Canasol, a nonpsychoactive marijuana extract that West claims leads to a "significant improvement in night vision."

Canasol also alleviates glaucoma symptoms by reducing fluid pressure in the eyeball. West says, but he's unsure whether the same effect causes the improved night vision. Because Canasol isn't even mildly intoxicating, the drug could be used safely in a wide variety of nighttime situations, he adds.

However, Canasol probably won't be available in the United States anytime soon. West lacks the money to fund tests to prove the drug's safety. "You have to be a millionaire to get any drug approved these days," he says.—Timothy Walker

## GETTING KIDS AND SCIENCE TOGETHER

"Curiosity Takes You Everywhere"—that's the theme of this year's National Science and Technology Week (NSTW), to be celebrated from April 26 to May 2. Overseen by the National Science Foundation, NSTW promotes science awareness by playing upon kids' natural curiosity to show them that science is patriotic and even fun.

Demonstrations and activities sponsored by local communities play a large part. Last year, for example, the entire town of Peoria, Illinois, pulled together for a science scavenger hunt involving local businesses, libraries, parks, medical centers, and the zoo, while Cornell University in Ithaca, New York, invited area students to tour its labs, meet professors, and participate in experiments.

"Local observances of National Science and Technology Week illustrate our program best," says

Mary Bullock, the project's coordinator.

This year's NSTW will concentrate on sports science as well as curiosity. Tennis great Arthur Ashe will kick off the celebration at the NSF's partner school, Banneker Academic High School in Washington, D.C. In addition, athlete Bill Demby and Edwin Moses will appear in a new NSF film, *A Team*; books; and a *Curiosity* that tells inner-city youths that science can take them anywhere. The athletes show how science has played a crucial role in their careers, from the technology that makes Demby's artificial legs flexible and sturdy to Moses' degree in physics.

Local science museums,

**THE ANCIENT SUNG  
WAS, IN EFFECT,  
A PREHISTORIC PISTOL,  
ENABLING PRIMITIVE  
HUNTERS TO THROW A  
STONE AS FAST AS  
60 METERS A SECOND**

schools, and community centers are already planning activities. For more information on National Science and Technology Week contact your local science museum or write to the National Science Foundation, NSTW, Room 527, Washington, D.C. 20550.—Beth Asay

"I don't know if there are men on the moon, but if there are, they must be using Earth as their lunatic asylum."

—George Bernard Shaw

Jamaican fishermen attribute their extraordinary night vision to marijuana.



**Psycho killer** Why do some psychotics like Charles Manson obey the voices they hear?

#### VOICES FROM THE ID

Psychotics—people who lose touch with reality, often hear voices. When do they obey these voices, and when do they ignore them? John Junginger, a psychologist at Louisiana State University received a two-year grant in 1990 from the National Institute of Mental Health to answer these questions, which will help determine which individuals pose a threat to themselves and others. Most expert testimony presented on the subject in courts is a fraud. "Just based on impressions," he claims. "We're trying to get actual data."

Preliminary results following a pilot study with 51 subjects, show that the content of the command bears no relationship to compliance. "A person will comply at the same rate, whether he is told to turn on the TV or to go kill someone," Junginger says.

Those who obey commands do so unquestioningly and without hesitation. One woman, for example, heard a voice telling her to jump out the window. She did so, right in front of her lawyer. Fortunately, she survived to relay the story to Junginger.

Psychotics are more likely to comply when they can recognize the voice, no matter whose voice it is. Junginger says. They also tend to obey if the voice fits in with particular delusions they have. However, the greatest risk of dangerous behavior appears to stem from persecutory delusions, in which the subject fears that people are out to get him or her. Junginger speculates that such delusions lead to more frequent compliance because the psychosis is more systematic. "Everything seems to fall into place. There appear to be logical connections, even though the delusion is patently absurd." —Steve Nadic

#### BITING BACK AT MOSQUITOES

Virtually no one likes mosquitoes, those pesky little creatures that buzz around porch lights and bite anyone foolish enough to step outside. So most people will be delighted to learn that two molecular biologists at Memphis State University have hit upon a new way to kill the little buggers that doesn't require either a fly swatter or insect sprays.

Randy Murphy and Edward Stevens, Jr., spliced genes from a common soil bacterium, *Bacillus thuringiensis*, into the genetic material of a blue-green algae on which mosquito larvae feed. The genetically altered algae produces a toxin fatal to mosquitoes and black flies but harmless to other organisms.

"The most common approach to mosquito control these days is to spray malathion, which can cause all kinds of health problems to people," Stevens says. "This is a way to achieve the same result without using toxic chemicals."

So far, this approach has been tested only on the Culex mosquito, which transmits elephantiasis and other diseases. Murphy and Stevens need to conduct further tests to see which of the more than 200 known species of mosquito eat blue-green algae and whether the *Bacillus* toxin kills them. The scientists are particularly eager to determine the technique's effectiveness against the malaria-carrying *Anopheles* mosquito.

ISAAC NEWTON'S ONLY RECORDED UTTERANCE WHILE HE WAS A MEMBER OF PARLIAMENT WAS A REQUEST TO OPEN THE WINDOW

THE SEVERED FINGERTIPS OF A YOUNG CHILD CAN REGENERATE IN ABOUT 11 WEEKS

FIES HAVE 1,500 TASTE BUDS—ALL LOCATED ON THEIR FEET

If successful, the new mosquito-control technique could affect people all over the globe—even the folks back home in Memphis. There are 48 species of mosquito right here in Shelby County," Stevens says. "Years ago, yellow fever killed off so many people that the city almost lost its charter."

—Steve Nadic



The way to a mosquito's vital organs is through its stomach



# CONTINUUM



## LACKING IN ATMOSPHERE

Here on Earth, scientists speculate that the impact of an asteroid millions of years ago wreaked such immense environmental havoc that it killed off the mighty dinosaur. Now Ann Vickery, assistant planetary scientist at the Lunar and Planetary Lab, located at the

University of Arizona in Tucson, theorizes that similar impacts on Mars by asteroids, comets, and other space-going objects may have done away with most of that planet's atmosphere.

Projectiles rained down furiously on Mars initially, their impacts releasing their own gases and those within the planet, helping to build Mars' atmosphere. Vickery considers that toward the end of the bombardment, the strikes grew less frequent but more energetic. "As the planet grew in mass and increased in gravitational pull," she says, "the impacting objects struck at higher velocities."

Vickery developed increasingly complex computer models that used such data as the mass of an impacting body, impact velocity, and mass and

velocity of atmospheric gases. The results showed that such powerful hits could create vapor plumes. "A sizable portion of the vaporized object and part of the planet," capable of essentially tearing away a tenth of 1 percent of the atmosphere at a time. While Mars isn't as massive as Earth and Venus, held fast, their higher masses making it more difficult for asteroids to rip away the atmosphere.

The erosion of Mars' atmosphere by impacts could also explain how the red planet lost its atmospheric pressure, precipitation, and surface water. "The existence of what look like ancient river valleys on Mars suggests that its early atmosphere was quite different from its present atmosphere," Vickery says.

—Patricia Barnes-Svarney

that tasted more like regular milk when reconstituted.

We're not sure why that should be, but we have taste tests to prove it," says program manager Robert D. Jethress. He and colleague Amessi Amanath suspect the reason could be that heat

**A DOG SPORTS 17 MUSCLES IN EACH EAR WHICH CAN BE USED TO RAISE AND LOWER THE EAR OR SWIVEL IT.**

**EVERY FOUR SECONDS, SOMEONE IS INJURED IN AN ACCIDENT IN THE UNITED STATES. EVERY SIX MINUTES, THE ACCIDENT IS FATAL.**

**A SHRIMP'S HEART IS IN ITS HEAD**

breaks down milk proteins and cold preserves them.

Also, the scientists say, skim milk produced by freezing may contain far less lactic acid, which should cheer those allergic to milk.

EPR has begun commercial tests of the freezing process at the Galloway Milk Company in Fond du Lac, Wisconsin. The Institute estimates that the process could save a typical dairy \$100,000 yearly on energy bills. —George Nobbe

"A man's feet should be planted in his country but his eyes should survey the world."

—George Sandoyana

## SKIMMING PROFIT

Sometimes serendipity can be a scientist's best friend. The researchers at the Electric Power Research Institute (EPRI) in Palo Alto, California, wanted to make reconstituted skim milk taste more like whole milk. They wound up with a process that achieves that goal and saves energy to boot.

Dairy factories currently manufacture powdered skim milk by heating liquid skim milk to drive off the water. The EPRI scientists tried freezing the skim milk instead. They filtered out the resulting ice crystals, producing a frozen concentrate



Skim milk is regaining some of that fresh-from-the-cow taste

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# CONTINUUM

## KEEPING AN EYE ON TIRED METAL

A tiny five-legged device the size of a matchbook could be the elusive early warning system long sought by structural engineers working a foolproof way to detect the metal fatigue that precipitates catastrophic failure in bridges, oil rigs, and even aircraft.

The device, called a fatigue fuse, consists of five parallel legs attached to a

level, according to Robert M. Bernstein, president of Tersodyne in Los Angeles.

Each of the fuse's legs is designed to have a different fatigue life, representing a specific percentage of the structure's fatigue life. When the structure reaches, for example, 40 percent of its fatigue life, the corresponding leg snaps. Thus, the fuse provides, Bernstein claims, a continuous series of warnings that a microscopic fracture is developing, long

**STROKING A CAT'S FUR GENERATES ELECTRICITY, ABOUT 9,200,000,000 STROKES WOULD PRODUCE ENOUGH POWER TO LIGHT A 75-WATT LIGHT BULB FOR EXACTLY ONE MINUTE**

flat metal frame. Each leg bears a series of notches designed to mimic the condition of the metal structure to which it is attached with epoxy resin. Much as an electrical fuse cuts out when its circuit receives too much current, the legs on the mechanical fuse snap, one by one, as the cumulative stress history on the structure it monitors exceeds preset

levels it becomes a dangerous macronack.

The fuses cost about \$400 each, and about 200 would be used in a highway bridge. They require no electricity and could be integrated with a microprocessor-controlled remote monitoring system, Bernstein says.

"The concept is fundamentally acceptable," says Michael Cassano, a professor of civil engineering at the

Experts believe that metal fatigue caused the fuselage of this Aloha Airlines jet to rip off during flight in 1988.



$$a^2 + b^2 = c^2 - I \text{ think.}$$

## MATH MEMORY

If you left math behind in high school, chances are you're not much good at it today. But if you took calculus or more advanced math courses during college, you can keep your math chops intact for up to 50 years—even if you rarely use math in your daily life, according to a study conducted at Ohio Wesleyan University in Delaware, Ohio.

Psychologists Harry Bahrick and Lynda K. Hall

administered high-school-level algebra or geometry tests to 1,534 volunteers, all of whom were roughly equal in native math talent and had taken high-school algebra and geometry. Those who had not taken college math courses scored a dismal average of 30 percent on the algebra test, while those who had studied higher math in college scored an average of 90 percent. Even people who had taken their last college math courses some 50 years before scored a highly respectable 80 percent!

Bahrick finds the results quite upsetting. Most of us, after all, do not take college math courses. The educational establishment has paid little attention to the "disappearing knowledge" phenomenon, he contends. "It's absolutely appalling," he says. "We spend all the money trying to impart knowledge and we've never looked at how long it lasts." —Bill Lawlor

reasonably well."

—George Nobbs

"Develop your eccentricities while you're young. That way, when you are old, people won't think you're going crazy." —David Ogilvy



# CONTINUUM

## GOOD DAY SUNSHINE

Like some cheerful sun-light in your murky office cubicle? Sure you would. There's just one problem: You don't sit near a window.

Now the window can come to you. Developed by researchers in California, holographic diffractive structure technology bends natural light, bounces it off a designated spot on the ceiling, and diffuses it into the room's dark areas.

The technology involves coating window glass with a substance that reacts with light much as three-dimensional holograms do, according to holographic engineer Richard Ian-Freese, a project manager for the Advanced Environmental Research Group in Davis. The holographic window works best in direct sunlight, preferably in a building that



Holographic window technology won't make your office as sunny and spacious as Grand Central Station, but it will brighten things up.

faces south, southeast, or southwest exposure.

Two laser beams etch a light-wave interference pattern on a photographic emulsion that is used to make a master form to replicate the window coating a plastic that can also be suspended between sheets of glass. The microscopic

lines on the coating redirect incoming light much the same way a Venetian blind does when its slats are turned, Ian-Freese explains.

Just how the coating reflects sunlight to the same spot on the ceiling, winter or summer, is a closely guarded secret. Prototype testing will begin later this

year, Ian-Freese says, and the specially coated windows could be available in large multistory buildings by 1994.

—George Nobbs

Disney, of course, has the best casting. If he doesn't like an actor, he just casts him up.

—Alfred Hitchcock



## TO HO HO AND A BARREL OF OIL

Old shipwrecks have been hurting the Pacific Northwest coast, but their visitations have taken more harmful forms than moaning white specters rattling chains, and their victim has been the environment.

The Environmental Protection Agency (EPA) has cited ten shipwrecks on the bottom of Washington State's Puget Sound as potentially hazardous because they hold thousands of gallons of fuel and chemicals. One of them, an oil tanker, sank in 1984 with

more than 72,000 gallons of very heavy-grade petroleum. The EPA has also shown concern about wrecks elsewhere in the area, such as the barge that sank in 1984 with 4,600 barrels of a highly toxic substance called mazutane mud.

When small oil slicks recently washed ashore near Port Townsend, Washington, the EPA discovered that a converted Navy freighter that sank in 1960 was responsible—high waves or winds flushed petroleum residues out of the wreck.

The EPA generally leaves a wreck alone unless it

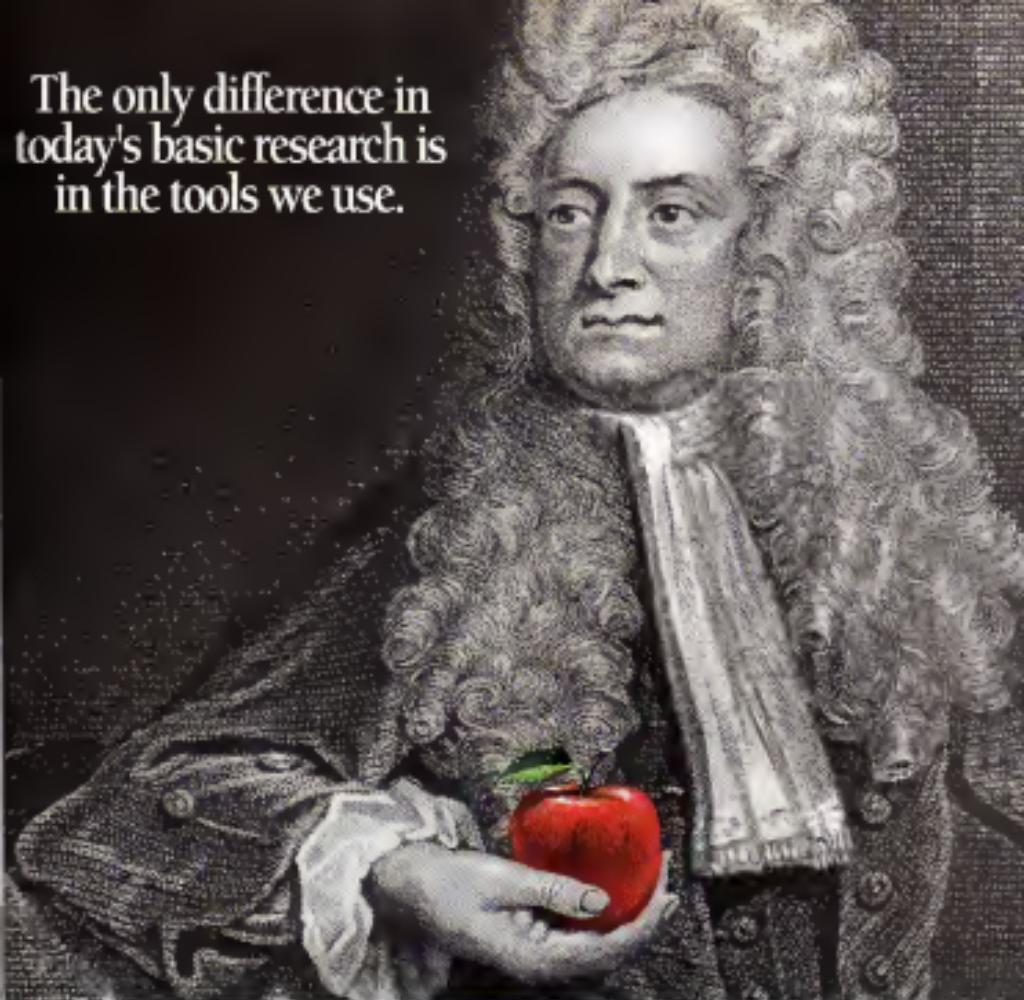
poses an immediate problem, hoping that as the ships start collapsing on themselves, sediment will naturally cover their cargo.

"When dealing with a shipwreck nearly 30 years old whose structural integrity is unknown, it could be more risky trying to salvage the cargo than just letting it leak out slowly," says Mike Ryko, a marine biologist at the EPA's Office of Coastal Waters in Seattle.

How many shipwrecks carry contaminated materials? "It's hard to say exactly," Ryko admits, "but there are an awful lot down there." —Cynthia L. Pollock

More than treasure is slopping with the tides.

The only difference in today's basic research is in the tools we use.



In the 1600's, Sir Isaac Newton led the scientific revolution with breakthrough discoveries in optics, mathematics and physics using little more than his incredible mind. Today, America is about to provide scientists with a basic research tool that promises to expand our knowledge as never before.

The Superconducting Super Collider (SSC) will propel subatomic particles at near the speed of light. Head-on collisions will shatter the particles to reveal the constituents of matter. Such basic research will provide scientists at the SSC laboratory with answers to some of our greatest questions.

And that's only the beginning. Because once we possess this information, the resulting applications for medicine, computers, materials and a host of other technological areas will exceed our wildest dreams.

Obviously, much has changed since Newton's time. Yet, the driving forces that have taken us so far still remain the same. Our hunger for knowledge and our need for basic research.

**GENERAL DYNAMICS**  
*A Strong Company For A Strong Country*

## PORTRAIT OF A PROPHET

By Deidre Sullivan

A scientist reveals the secrets of the super conscious mind.

Photograph  
By Tom Zimberoff



**I**t's 8:00 a.m. In Tokyo, the chairman of a large Japanese trading company has called a board meeting. Executives enter; he tells them to take seats on one side of a highly polished table. Sitting across from the dressed American businessman who had never stepped foot in the headquarters of the corporation

scheduled board meeting. They have never studied the corporation's books. They do not know how the company operates.

The order of the two, Bill Kautz, briefly introduces himself as a scientist and founder of the Center for Applied Imagination (CAI), an organization based out of Santa Cruz, California. He then adds quickly, just as other Charles Nunn, explains that he works with CAI as an "expert statistician" and that he will answer any questions the executives might have about their company.

Taking the lead, the chairman poses a question about the relocation of a manufacturing plant. Nunn provides information on possible sites and offers his suggestions. The VIPs, stunned at Nunn's responses, begin to question him. Who is this man? What is his source of answers? Is it possible that a relationship with a particular London-based firm? How can the Okawase office be made more profitable? Nunn answers each question in detail while Kautz, the more grandfatherly of the two,

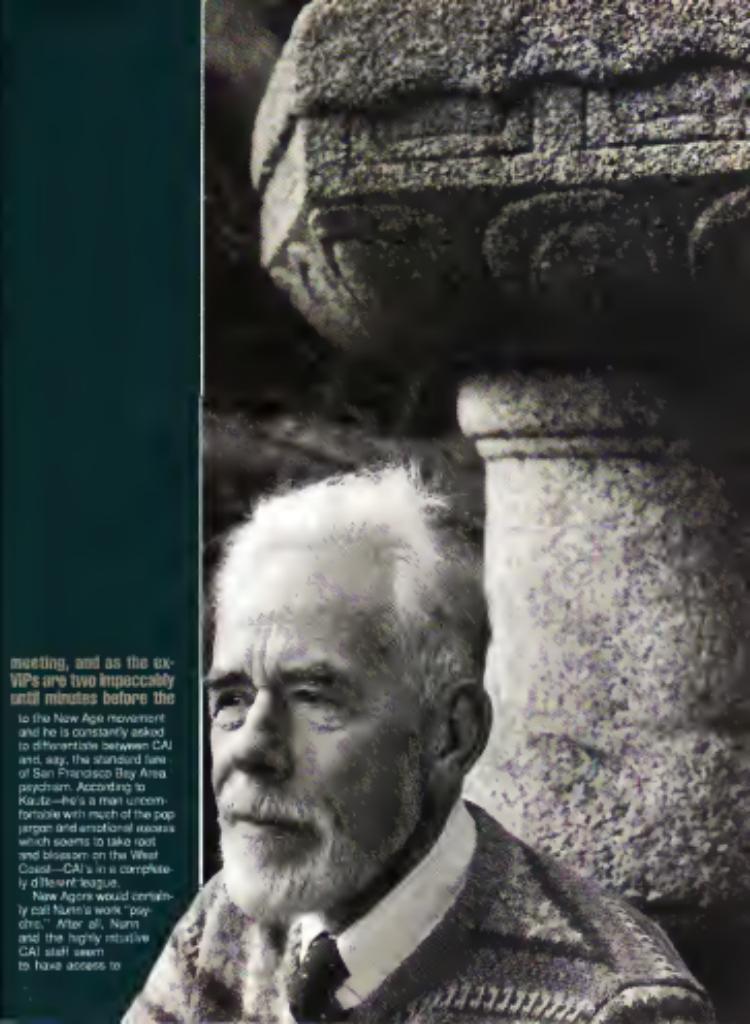
looks on. Kautz is pleased. After the meeting, Nunn asks the chairman to call him at his hotel from a pay phone. When they speak later that evening, the chairman is shocked by Nunn's revelations: One board member is working for a bank, government, the office phones are tapped. Within days, an investigation proves Nunn's hypotheses—his intuitive responses—had been confirmed.

For Kautz and Nunn, the morning board meeting's been, well, just business as usual. CAI provides individual

meeting, and as the six VIPs are two impeccably until minutes before the

to the New Age movement and he is constantly asked to differentiate between CAI and, say, the standard fare of San Francisco Bay Area payment. According to Kautz—he's a man uncomfortable with much of the pop jargon and amateurish excess which seems to take root and blossom on the West Coast—CAI is in a completely different league.

New Age would certainly call Nunn's work "psychic." After all, Nunn and the highly intuitive CAI staff seem to have access to



## Kautz cautions not to get hung up on the method from which intuition flows. It might come in a dream, from a gut feeling, as an insight, through trance channeling. A specific mode doesn't make the information any less credible.

actually, however, penning down the concept is like tackling a greased pig. Slithering in and out of the pursuer's grasp, the animal defies capture, wriggling free from every headlock. "Intuition is that inner knowing process by which we acquire knowledge," Kautz says, trying to grab the elusive "creature." He cautions not to get hung up on the method from which it flows: "It might come in a dream, from a gut feeling, as an insight or a hunch. It might come through what some people call channeling. A specific mode doesn't make the information any less valid or credible."

Asked for examples of the intuitive process, Kautz says intuition manifests itself nonverbally to artists and composers through sounds and symbols. "When doctors or people in the helping professions just seem to know where the problem is and then go there and apply

their natural skills, that's intuition at work. I'm more concerned about the nature of the information than about how it gets here," Kautz reiterates.

For Brendan O'Regan, vice-president for research at the Institute of Noetic Sciences in Sausalito, California, intuition is "a welling up into awareness of data that doesn't appear to derive in a linear fashion from normally perceived data." An intuitive person, he says, pays attention to nontrivial aspects of thoughts and feelings about complex problems. O'Regan maintains, however, that the word *intuition* has become a cover term for what in the seventies used to be psychic research. "I simply don't consider trance channeling and clairvoyant activity *intuition*."

It is no secret, of course, that psychics claim they can predict the future, and many traditional psychics glibly

market their abilities as such. CAI intuitives, Kautz says, do not predict the future as such. "Most people are afraid that their future is preset and psychics will reveal what's going to happen to them," Kautz says sympathetically, adding that he believes natural events can be predicted, but a human being's freedom of choice—the ability to decide—is inviolate. "We create our own world through the complex process of decision-making, both individually and collectively."

Whenever Kautz takes his intuitives into a corporate setting, the question, Can you predict the future? invariably comes up. "We're not people who predict, although that may be a byproduct of what goes on," Kautz says. "Much of our work involves pointing out alternatives. We're more like Old Testament prophets or social engineers who see the way society is moving and identify the forces which are behind the movements. We recognize the critical role a person's choice plays in affecting what's going to happen in the future. We present options. That's the real nature of prophecy."

With his deep-set eyes and gray beard, Kautz looks like he'd be more comfortable in a classroom than in a sweat lodge. A graduate of MIT with degrees in electrical engineering and mathematics, he defies New Age stereotyping with his ultracentric background and experience. Before he got involved in intuitive studies, Kautz was a staff scientist for over 35 years at the prestigious Stanford Research Institute (SRI) in Menlo Park, California, where he worked with a team of scientists to develop the first mainframe computer for the banking industry.

extrasensory knowledge, often gained through trance channeling. To Kautz, however, the term *psychic* is misused and misleading. His CAI staff are not psychics, he says; they're "expert intuitives." Similarly, Kautz doesn't use the word *reading* when he describes what Nunzi does. Instead, he prefers *sensation*. Even the concept *extrasensory* is problematic. "What has traditionally been labeled as extrasensory or as parapsychology is a universal human capacity which most people haven't chosen to exercise or develop," he says.

There are a number of differences between hiring a psychic and working with CAI. Kautz claims, "Many psychics don't understand the processes they are dealing with," he says. "They are neither skilled nor responsible." And like psychics, he asserts, see their work in the context of broad social concerns and problems. "At CAI, we are professionals, committed to studying and analyzing the intuitive process."

Like many New Age ideas, intuition seems easy to define—at least at first. In



Charles Nunzi once had a "straight" career as a corporate consultant.

# ACCESSING YOUR INTUITION

According to Bill Kautz, every human being has intuitive abilities. Most people, though, haven't consciously chosen to develop their skills and use their intuition only sporadically. A good parallel is physical fitness. Developing your intuition and cultivating qualities like receptive sensitivity and good listening skills is like getting in shape. It's something everyone can do and they can do it in different ways.

When counseling students on how to improve their intuitive skills, Kautz presents a working model of the mind so that students will better understand the ways in which direct information flows. The conscious mind is the arena for reasoning and focusing attention. The subconscious mind is a storehouse of impressions, feelings, fears, memories and incomplete experiences.

## “WHEN DEVELOPING INTUITION, THE GOAL IS TO CREATE WAYS TO ALLOW INFORMATION TO FLOW FROM THE SUPER CONSCIOUS TO THE CONSCIOUS.”

ences. What Kautz calls the super conscious mind is a universal reservoir of knowledge transcending time and space. When developing intuition, the goal is to create ways to allow information to flow from the super conscious to the conscious. To tap into the reservoir, try the following exercises.

MIND SET: Think of learning as an acquisitive process: something you go out and

get, an acquired skill like learning to speak Spanish. Developing intuition depends less on adding new material to your mind than on removing material that is already there but no longer needed.

DREAM WORK: One way of removing obstacles—"housecleaning"—the subconscious—is to interpret your dreams. Like Jung, Kautz sees dreams as a source of intuitive knowledge and he suggests keeping a notebook by your bed to record your dreams and become familiar with the symbols and messages of your subconscious world. Read books on dream theory. Take a dream workshop.

PALACE OF MEMORIES: Most people don't try to remember unless they're forced to recall a memory. When people forget where they've put the keys or

sets of how intuitive information is received.

REACH OUT AND TOUCH: You've probably picked up the phone and known who is at the other end of the line. Don't wait for those moments haphazardly. When the phone rings, relax and tell yourself who is calling. The more you do this, the more comfortable you'll be with unlocking your intuitive capabilities.



when they can't remember someone's name, they utilize short-term memory, but usually ignore what's been stored in the memory bank—all the experiences of the past. Try remembering a specific time in your childhood. Relive the day, the color of the sky, the smells, what people said, how they acted, how you felt. Practice this exercise daily. How people remember a smile to the person

SENSORYUM: Sit quietly and tune into what's going on around you at the moment. A door shuts down the hall, a car horn honks, a dog barks, smell the aroma of fresh-ground coffee beans, notice the waft of Chanel as the boss passes your office. This exercise brings what was once background information forward into your conscious mind. Perform the same exercise

with the other senses—sight, smell and touch. Focusing on each of the five senses helps re-orient the way you perceive reality and heightens receptivity. BE HERE NOW: One of the best ways to "lubricate" intuitive channels is through the practice of meditation. There are a wide range of meditative practices and no one "right way" to meditate. If you don't have time to investigate the different forms, try spending five minutes a day sitting quietly. Let your thoughts come and go, observing them as if you were watching a movie. Don't "attach" yourself to any one particular thought or thoughts.

OBJET TROUVE: Take an everyday item like a coffee cup, safety pin, or computer disk. On a piece of paper, write down a question such as: What is the purpose of

my life? or How can I get along better with my coworkers? Look at the object—reshape, color size—and listen to what it tells you. What does its shape "say" to your question? Does the object's function parallel an attitude in your life? This is an excellent exercise in thinking metaphorically and is a good way of getting used to the symbolic language of the super conscious.

It's simple to see why Kautz and expert intuitives like Nunn work well together. Nunn is as non-New Age and pragmatic as Kautz. Before getting involved professionally in intuitive work—an avenue he had studied on the side for over a decade—Nunn had an equally "straight" career both as a corporate consultant to manufacturing companies and as the head of two start-up companies in the South. Semi-retired and in his mid-fifties, Nunn now lives on a 10,000-acre ranch in northern California near the Oregon border where he rides motorcycles and raises cattle.

Like Kautz, he has little regard for New Age jargon and social excess.

From corporate America's point of view, Nunn represents the respectable side of CM. He accesses information and talks with ease about budgets and strategic plans. Not only does Nunn speak the language of business but he dresses the part as well—details which are very important to business people in the Far East. "I wear a suit and carry a briefcase," Nunn says. "I don't use a crystal and I don't wear beads. I never use what might be considered New Age jargon. For most busi-

ness executives, here and abroad, that kind of talk is a turnoff."

Other CM expert intuitives, however, are trance channels who summon forth entities—nuggets from another dimension—with exotic names like Etheron, Nitron, and Ecton. "No entity talks through me," Nunn says. "I don't channel. I simply take a few moments to become quiet and the information comes to me."

That Kautz, a former SRI scientist, utilizes trance channeling to access what he calls intuitive information upsets a host of individuals, from his less-open-

# INTUITION QUOTIENT: A TEST

Understanding and experiencing your intuition can change your life. Start by answering your gut feelings about intuition. Then see if measuring how intuition operates in your life. Thirty sets of questions, designed by Bill Kautz and the staff at the Center for Applied Intuition in Foothills, California, will help you evaluate different aspects of your intuitiveness. Before you take the test, take a couple of minutes to relax and clear your mind. Enjoy the moment. (For answers and scoring instructions, turn to page 50.)

## I. MIND MATTERS

The True or False statements (1-10) test your knowledge about how intuition operates.

1. Intuition is a relatively rare ability which a few gifted persons are able to utilize. (True or False)
2. Women have a greater capacity for intuition. (True or False)
3. Children are highly intuitive, especially around age 4 or 5. (True or False)
4. The major roadblocks to developing your intuition ability are due to societal beliefs. (True or False)
5. Intuition is the mental capacity responsible for psychic performance. (True or False)
6. You cannot have others with the information you obtain through intuition. (True or False)

7. People with telepathy tend to be more intuitive. (True or False)

8. Intuition and knowing work hand in hand and interplay what most people would describe as thinking. (True or False)

9. Exceptionally intuitive people such as psychics and channelers usually obtain their most accurate information when in a trance or unconscious state. (True or False)

10. Many people experience intuition as something physical. (True or False)

11. Alcohol impedes the flow of intuitive information. (True or False)

## II. HEART MATTERS

Questions 12-16 describe situations in which you do rely on your intuition. Evaluate how you would respond in each circumstance.

12. When the doorbell or phone rings unexpectedly, do you know who it is? A: Never; B: Rarely; C: Sometimes; D: Frequently

13. Do you ever dream about unusual events which actually occur later? A: Never; B: Rarely; C: Sometimes; D: Frequently

14. When you meet someone after talking with them on the Internet, - does your image of them turn out to be accurate, even down to the most minute details? A: Never; B: Rarely; C: Sometimes; D: Frequently

15. Have you ever been compelled to tell your boss only to find out later that your reasoning wasn't correct? Although your answer was:

A: Never; B: Rarely; C: Sometimes; D: Frequently

16. Have you ever thought about someone you haven't thought of for months and then received a letter or phone call from that person? A: Never; B: Rarely; C: Sometimes; D: Frequently

17. When you have made an error in judgment, have you ever looked back and recognized an inner impression or hunch that would have prevented the error if only you had listened? A: Never; B: Rarely; C: Sometimes; D: Frequently

18. Do your first impressions of people tend not to be accurate? A: Never; B: Rarely; C: Sometimes; D: Frequently

## III. COMRADES IN ARMS

Although every individual's unique styles show that certain personality traits, attitudes, and habits are directly linked to the development of intuitive abilities and skills. Questions 19-30 match aspects and attitudes in your life to those of highly intuitive people.

19. Do you play a musical instrument or engage in a form of artistic expression? A: Mostly as a child; B: Occasionally; C: Frequently

20. Are you currently单身 (single)? A: Yes; B: No

21. Does your work involve working with numbers?

22. Are you a pilot, engineer, mechanic, broadcast analyst? A: Yes; B: No; C: Occasional

23. Do your family members or co-workers describe you as an inspired "dreamer"? A: Frequently; B: Sometimes; C: Not usually

24. At work, are you more of a team player or a leader? A: Team-player; B: Leader; C: Combination of both

25. How important is it for you to spend time alone? A: Very important; B: Somewhat important; C: Not that important

26. Did you have an imaginary playmate(s), as a child? A: No; B: Yes

27. Do you worry about being the victim of a crime? A: Often; B: Occasionally; C: Rarely; D: Never

28. How many hours is the television turned on in your home each day? A: More than 5 hours; B: Between 3 and 5 hours; C: Between 1 and 3 hours; D: Less than 1 hour of never

29. Are you comfortable dealing with metaphor or simile? For instance, do you score well on the analogy sections of aptitude tests or readily understand the symbols in a poem? A: Yes; B: No

30. Do you ever feel that there just isn't enough time in the day? A: Often; B: Occasionally; C: Rarely; D: Never

31. Are you currently involved in an intimate relationship? A: Yes; B: No

minded fellow scientists to evangelical Christians who see trance channeling as a Trojan Horse for the demons. How Kautz defines intuition, how he gathers intuitive information, and what he represents—a scientist working in the realm of the nonmaterial—inevitably seem to provoke curiosity, concern, and, at times, derision.

But CAI hasn't suffered for clients. Hundreds of people—many of whom are Japanese—happily pay CAI intuitives to answer questions such as: Where should we allocate our research and development dollars? Prices for ses-

sions vary. Private counseling sessions cost \$200. Half-day corporate sessions cost \$600. This year, CAI will begin to offer services in Europe. Co-written with Melanie Brandon, Kautz's first book, *Channeling: The Intuitive Connection*, has been translated into French, German, and Italian. In fact, the French translator became so interested in Kautz's work that he's running CAI's operation in France.

Kautz's intuitive life began very interestingly. In the early seventies while working at SRI, Kautz became increasingly interested in the ways human beings inte-

grate knowledge. Where do ideas come from? How do people discover something new or find a solution to a vexing problem? These questions became increasingly important to him as a scientist working on complex computer-related problems. His wife, a social worker, steered him toward books and thinkers who over the centuries addressed this issue.

"I was surprised to find out that many bright ideas were not the result of a lot of rational thinking and that scientists who made great breakthroughs usually got their crucial ideas in a flash," concluded CAI's Kautz.

# INTUITION QUOTIENT: ANSWERS

## I. MIND MATTERS

1. False. Intuition is a universal human capacity and not the gift of a few philosophical people.
2. False. Both men and women have the same capacity for intuition. Women traditionally have been more open to using their intuition.
3. True. Children typically behave very intuitively in their early years, but their intuition "goes into hiding" and stops developing when adults do not accept their early demonstrations of intuitive knowing.
4. False. The major obstacle to intuition are due to personal belief systems.
5. True. Intuition is the mental process which underlies many kinds of exceptional behavior including psychic performance.
6. False. Intuitive capacity is benign, but just as with any powerful ability individuals vary in how they choose to

sharpen or how intuition operates. This awareness is essential to the development of intuitive skills. 5-7. Intuition answers. Your potential is strong but probably underdeveloped. If you are interested in learning more about how intuition functions, you may want to read about the topic or enroll in an intuition class. G-I: correct answers. You may be noticing the dilation of intuition and relying too heavily on your rational faculty.

## II. HEART MATTERS

- For questions 12-18, the following scores apply:
- A: Never = 0
  - B: Rarely = 1
  - C: Sometimes = 3
  - D: Frequently = 5
12. Knowing who is at the door or on the phone is a good indicator of intuition at work.
13. Although dreams are often

shrouded in mystery, they are usually more intuitive.

18. Your ability to "read" people can be partly attributed to intuition and is a sign of intuitive potential.
- SCORE: 26-30 Your intuitive ability is unusually strong. Most skilled psychics and channels have abilities like yours. You might want to consider developing them further under the personal direction of an experienced teacher. 15-24 Your intuitive skills are above average. 0-14 At though it may seem that intuition is not working in your life, it is more likely that it is functioning "behind the scenes" and you are simply not aware of it. Pay attention to potential opportunities for intuition to function freely. For example, when the doorbell or telephone rings, or when you're talking with someone new on the phone, listen carefully to your first impressions and notice how you feel when your first guess(es) turn

out to be correct.

24. A: 8 points; B: 4 points; C: 1 point; D: none. If intuition finds time alone, it's a good indication that he is comfortable in the quiet of his own mind and more receptive to inner knowing.

25. A: Five points; B: 0 points. Adults who exhibit strong intuitive skills have sometimes had imaginary playmates as children.

26. A: 0 points; B: 2 points; C: 5 points; D: 8 points. Fair (if any kind) is the strongest block to the flow of intuitive understanding.

27. A: 0 points; B: 1 point; C: 3 points; D: 5 points. Those who try heavily on outside stimulation such as television tend to be less intuitive.

28. A: 5 points; B: 0 points. Intuitive communication is often symbolic in nature resembling the language of metaphor.
29. A: 0 points; B: 1 points.

## ALTHOUGH IT MAY SEEM THAT INTUITION IS NOT WORKING IN YOUR LIFE, IT IS MORE LIKELY THAT IT IS FUNCTIONING 'BEHIND THE SCENES'.

### use intuitive knowledge.

7. True. As individuals become more rational faculties often deteriorate, allowing bursts of intuitive knowledge to come forth.
8. True. Thinking is a complex process which engages all aspects of human consciousness to varying degrees.
9. False. The favored state of consciousness varies from one intuitive to another. Many excellent intuitives work best when they are fully conscious.
10. True. Intuitive knowledge in the form of a physical sensation is very common. Some people call it gut feeling. The scientific term is kinesthetic sensibility.

11. True and False. Although alcohol temporarily softens the barrier that impedes the flow of intuitive knowledge, it also diminishes awareness so that accuracy and communica-

bility are weakened.

SCORING: B-11 correct answers. You have an excellent under-

- standing of intuitive knowledge.
12. COMPANIES-IN-ARMS
- Questions 19-30 are scored individually.

19. A: 6 points; B: 3 points; C: 0 points. Musical ability indicates a predisposition for symbolic non-verbal communication which has much in common with the way intuition typically manifests.
20. A: 3 points; B: 0 points. Studies have shown that people with an entrepreneurial bent tend to be more intuitive.
21. A: 8 points; B: 4 points; C: 0 points. Studies indicate that people who perform diagnostic procedures as part of their work tend to be intuitive.
22. A: 5 points; B: 3 points; C: 0 points. Listening to others—and to yourself—is one of the most important aspects of listening to intuitive information.
23. A: 0 points; B: 2 points; C: 4 points. Good leaders tend to be more self-reliant and trusting of their own intui-

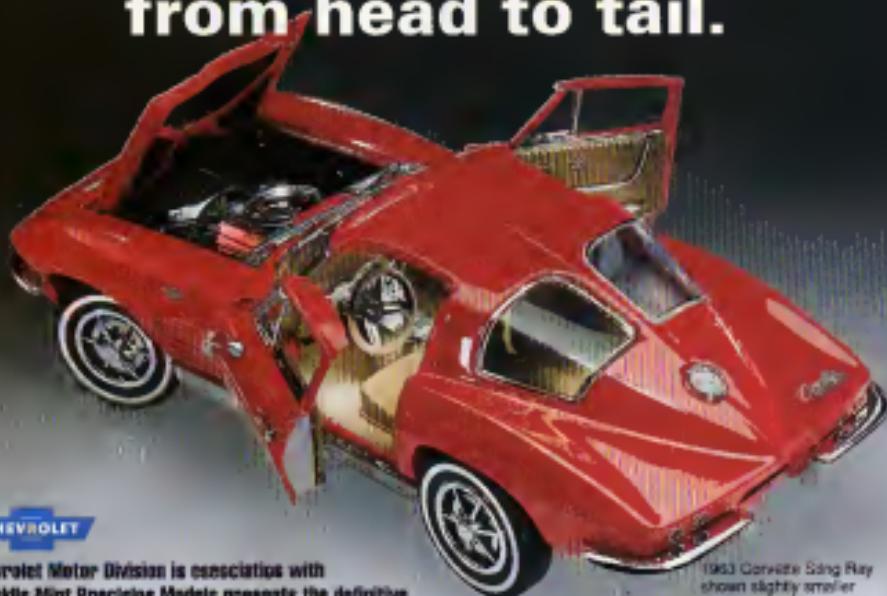
tive gifts.

24. A: 3 points; B: 5 points. If you're too busy or harried, it's probably a sign that you are relying on outside forces to provide order and meaning to your life. This attitude is antithetical to the clear flow of intuitive knowledge.

25. A: 5 points; B: 0 points. Studies show that the most successful relationships are those in which there is a clear and honest bond of communication. These same characteristics are essential if intuition is to manifest.

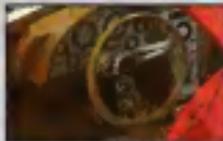
SCORE: 50-65. Certain aspects of your life and personality indicate that you have strong intuitive potential. 0-29. Don't despair. You may be your own type or in your own category, not following the statistical patterns of others.

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I sometimes dream that a million years from now an alien ship has discovered our solar system and finds it deserted. What happened to us? No one knows. We may have left for far afield, taken up the life of mobile habitats, or transformed ourselves through technologies into a different species. Alien explorers take an inventory of our planet and find vast libraries filled with intellectual and artistic artifacts, great decaying architectures of stone, steel, buckyballs, music, and thought.

What do they think of it all? Shakespeare bothers their epistemology, our science seems primitive, but perhaps they see some promise in relatively quantum mechanics and chaos theories. Finally, I like to imagine, they find what is to them the supreme artifact: Gödel's proof. It speaks to them as nothing else can. Why?

In 1931 Kurt Gödel published a proof that claimed to reveal the kind of universe we inhabit. Surprisingly this proof did not involve either an observation or an experiment in the usual sense. Instead, it harked back to the ancient philosophical notions of apriori reasoning, to the Platonic ideal that we might attain knowledge of reality through the powers of mind alone rather than through a positivist method involving observations, measurements, and controlled physical experiments. No other example of human thought is as far-reaching as Gödel's proof, yet the consequences of it for our understanding of the universe and the human mind are rarely discussed outside of technical journals—and even

here the reach of Gödel's proof into law, economics, religion, the sciences, how we view history, and how we should judge schemes for improving our lot, is not explored.

In *A Mind Too Far* (Houghton Mifflin, 1987), writer and mathematician Rudy Rucker points out that "above all" Gödel's theorem shows that human thought is more complex and less mechanical than anyone had ever believed, but after the initial flurry of excitement in the 1930s, the result ossified into a piece of technical mathematics—and became the private property of the mathematical logic establishment, and many of those academics were contemptuous of any suggestion that the theorem could have something to do with the real world. Interest in the philosophical consequences of Gödel's theorem was finally "rekindled" in 1961 when Oxford philosopher J. Anthony Lucas wrote an incorrect but very important paper arguing



**Mathematician Kurt Gödel may have found a proof for the way the universe works. Science-fiction writer George Zebrowski takes a moving look at what belief in that proof entails.**

## LIFE IN GÖDEL'S UNIVERSE: MAPS ALL THE WAY

BY GEORGE ZEBROWSKI • PAINTING BY GIORGIO DE CHIRICO

that Gödel's theorem proves that machines cannot think.

Today, most educated people have heard of relativity and quantum theory. Even more stars tote around copies of Stephen Hawking's book on cosmology. But about Gödel's proof, despite Douglas Hofstadter's *Gödel, Escher, Bach* (Basic, 1979; Random House, 1988), the common comment is, "Didn't he prove that we can't know everything? Well, we all know that!"

This is just not good enough. If it were otherwise, he might have shown that we live in a universe in which we could solve all problems and learn everything. So the proof is far from trivial if it tells us that we can't do that ever, and also implies that we can't know everything because the universe is infinite, we could exhaust a finite universe, but not an infinite one that has always existed in some form and, like our idea of God, requires no creation.

There is a world of difference between saying, "We all know that we can't know everything," and giving a "proof" that ends all doubt. The formal proof demonstrates that any sufficient-

sufficiently rich system can be shown to be open-ended. The human mind is such a system.

In the years since Gödel made his proof, examples of undecidable mathematical statements have been found. A physical indeterminism involving quantum gravity, in keeping with Gödel's incompleteness theorem, was put forward in the 1980s. John von Neumann, a great mathematician himself, wrote that "Gödel's achievement in modern logic is singular and monumental—a landmark which will remain visible far in space and time."

But given the rigorous truth expressed in Gödel's proof, what does it mean for how we should regard the universe, and what does it say for how human affairs should be arranged? Is Gödel's proof about us or the physical universe? Would Gödel's proof be just as binding on an alien civilization as it is on us? Logical and mathematical truths are presumably universal. Laws that apply in one corner of the universe are likely to apply in others. Notational systems might differ from ours, but they would express the same truths.



Kurt Gödel receives the first Albert Einstein Award for achievement in the natural sciences from Einstein himself. [1951]

ly rich deductive system—arithmetic, for example—will generate statements that are meaningful but unprovable, one way or the other, within the system. Mathematics, or any sufficiently developed system, cannot ever be complete. The proof is binding, because to deny the conclusion puts you in the position of trying to have it both ways. The conclusion is true if it's false and false if it's true. You can clearly see that the undecidable conclusion is true because it is properly derived. Rucker has described this fear as akin to finding a way to stand on one's own shoulders. Any

However, it has been claimed that Gödel's proof is a truth about systems of thought, not about the universe. It's about maps, and not about the territory they represent. But this is what Gödel set out to prove—that the actual territory will always transcend the map.

Mathematics has always shown a curious ability to be applicable to nature and this may express a deep link between our minds and nature. We are the universe speaking out, a part of nature, so it is not surprising that our systems of logic and mathematics sing in tune with nature. Gödel himself believed

**"IS GÖDEL'S PROOF ABOUT US OR THE PHYSICAL UNIVERSE?  
WOULD IT BIND AN ALIEN CIVILIZATION AS IT DOES US?"**

that mathematical objects have as much reality as those we perceive with our senses. Rucker points out that it was typical of Gödel to use mathematical procedures to prove truths about the objective world. He recognized no obstacles to being able to do this, provided it was done *so rigorously* that we do a physical experiment. We cannot simply imagine what we please and have it be true.

Some critics have argued that there is an unbridgeable gulf between language and reality. But if this is so, then no amount of language can decide the nature of the relationship, or even decide that there is a gulf at all—but we have many reasons to think that the gulf is bridgeable, because we do it quite often.

If what we do rigorously in our minds with systems of mathematics and logic can't help being connected with the territory outside, then Gödel's proof is also about nature. The same limits that it sets for human reason and potential for knowledge it also expresses about the universe. And the kind of universe that Gödel's proof suggests is the one put forward by current cosmological modeling: an open-ended, infinite, eternal existence, requiring no beginning, in which our knowledge may be-

come significant and extensive but never complete. The relationship between Gödel's theorem and the universe outside our minds may be best suggested by asking the question, In what kind of universe is Gödel's theorem true? And the answer is, not a clockwork universe.

But perhaps outside of our psychology nature is a complete determinist, but we can't see it. We are finite, fallibly deductive beings who experience time, so for us events seem unpredictable but usually explainable after the fact. Finite beings experience a softer determinism by wearing the blinding of time inside a nature that may be complete, deterministic, and timeless.

Unpredictable things happen to finite beings. In the crime film classic *The Asphalt Jungle*, Doc, the supremely rational criminal, expressed wonder at how the sleight of hand that is "chance" ruined his heist plan. He is deeply wedded to deductive reason. He admits misjudging a man who double-crossed him, but does not see how he could not have predicted alarms going off at random or a gun being dropped, firing and wounding one of his partners. If Doc had known that he lived in Gödel's universe, he would not have believed that he could plan everything in advance.

#### Living in Gödel's universe means

Rising kids is a potentially endless job. The same will be true of raising artificial intelligences, but Gödel's theorem will find application in our construction of more richly endowed computers that would be like human minds—continuous rather than step-by-step clockworks.

In law there will always be cases that escape the written code, no matter how often it is revised. Legal practice appears to know that it operates in Gödel's universe, because judges apply laws with the help of examples set by precedent—to fit laws to specific cases and recognize the difference between the letter and spirit of a law. A perfect fit is not expected, which recognizes the logical fallacy of "perfection or nothing". Yet a recent civil rights bill whose language was repeatedly revised by Democrats to make it acceptable by seeking to avoid racial quotas in hiring was learned (in unconscious recognition of Gödel's theorem) to holding an ever-increasing number of marbles in one hand—with some always falling out. There was no way to draft a perfect law that would avoid quotas in hiring, since some employers would



engage in such hiring to avoid the charge of racism. (Some critics charged that this "perfection or nothing" demand was simply a way to have no law at all.) The more precise the drafting, the more it fails to cover cases; too loose, it compels nothing constructive. Law cannot ever be more than "good enough" in Gödel's universe.

In economics we've had positive number accounting, negative (deficit) accounting, and now we have (following the lead of mathematical thought) imaginary number accounting (credit), which is not the same as deficit accounting, because it became necessary to mirror the true value of humankind's varied capacity for work, which is in keeping with the nature of Gödel's universe. We've had inefficiency and dishonesty in positive-negative number accounting, as well as in imaginary, but the gains are too great to forego the open-ended system of growth for the rigidity of the past, which would put too low a ceiling on human aspiration.

Karl Popper's "falsifiability" criterion, in which a positive proof of something is not possible because the number of cases to be tested is infinite, dovetails with Gödel's proof of incompleteness

Popper showed that if something can be false (how it might be untrue must at least be imaginable), then it has a chance of being true—the best candidate possible for truth in Gödel's universe, even though it will never be absolutely proved. An unfalsifiable candidate, however, can be ruled out, because it is consistent with all evidence and can never be disproved, while a falsifiable idea may continue to resist while remaining, in principle, falsifiable. In Gödel's universe, an unfalsifiable idea is complete. Nothing can ever count against it. A trivial example: Little green men live in all refrigerators, but they disappear when the door is opened. Another example is a religious dogma of any kind, held on faith. Both of these are what Popper calls "self-forced dogmas," because they have a built-in resistance to any kind of test: they contain as part of the idea an injunction against questioning them. Popper's "falsifiability" criterion for truth can only work in Gödel's open universe.

Dogmas are the enemies of Gödel's universe because they attempt to end all discussions and tests of truth; they are totalitarian viruses for the mind, preventing the creative growth that Gödel's proof implies is possible. Gödel's universe is not totalitarian, yet

it does not deny our need for order and explanation. Its liberating incompleteness suggests that we can, in time, achieve our dreams, vast if not final knowledge, ongoing civilization, perhaps even endless life and a redemption of the past. It only asks us to reenact all forms of completeness or closure, which is totalitarian (clockwork deductive); all forms of dogma, control, and domination—all impulses to completeness and certainty; and it asks us to appreciate the practical value of imperfection, serendipity, wildness. Completeness is a form of death; wildness is a form of fertility, growth.

Like clockwork, is an ideal that is often admired—but we must fear its realization: for the closer we approach it, the more our thoughts and actions tend toward rigidity. In a clockwork universe, we could have exhaustive recipes for becoming a poet or a scientist, and they would work every time.

James Gleick's book *Chaos: Making a New Science* (Penguin, 1987) is filled with the kinds of descriptions and insights that can be expected of Gödel's universe:

"The vogue for geometrical architecture and painting came and went. Architects no longer dare to build blockish skyscrapers like the Seagram Building in New York, once much hailed and copied. To Mandelbrot and his followers, the reason is clear: Simple shapes are inhuman. They fail to resonate with the way nature organizes itself or with the way human perception sees the world. In the words of Gert Enderberger, a German physicist who took up nonlinear science after specializing in superconductivity: 'Why is it that the silhouette of a storm-bent, leafless tree against an evening sky in winter is perceived as beautiful, but the corresponding silhouette of any multipurpose university building is not in spite of all the efforts of the architect? The answer seems to me, even if somewhat speculative, to follow from the new insights into dynamical systems: Our feeling for beauty is inspired by the harmonious arrangement of order and disorder as it occurs in natural objects—in clouds, trees, mountain ranges, or snow crystals. The shapes of all these are dynamical processes, jelled into physical forms, and particular combinations of order and disorder are typical for them.'"

And Gleick concludes:

"Appreciating the harmonious structure of any architecture is one thing, admiring the wildness of nature is quite another. In terms of aesthetic values, the



## SHIP FULL OF JEWS

Chasidoro  
could hear  
the moaning  
from strange, far

Chasidoro were chant-  
ing again, moaning and  
raving in their strange and  
stuporized tongues; the sounds of  
the Hebrews emerging cloudily  
from the deck of the ship, filling him

with some mixture of dread and regard; regally and hope, the swells and pitching of the  
burnt seas reminding him of the wondrousness of his journey, images of spices, Im-  
perial bouquets from the sultry and mysterious East rose in his nostrils, taunting thoughts of the  
new and lovely Americas opening up before him possessed him with a kind of gaudiness. The  
sounds of the Chasidoro were overwhelming. Sometimes they would pray for hours, unceasing,  
one after beginning when another paused, filling the moist air with imprecations and song, at  
other times they were silent, pitching and rolling in the deck, the queerness of their condi-

tion doubling their orgies of rage and necessary silence. Chasidoro did not understand any of it. Of course the Chasidoro had not to understand, they were to trans-  
port Isabella had pointed that out to him. "They do things of your concern," she

had said. "That are being carried out, will keep to themselves under guard, will  
grow and move in their strange way by have nothing to do with your journey."

The execrable Queen had gazed at him, her red lips and penitent eyes in the  
darkness. There was something very special between her and Chasidoro,  
that had been his intuition from the start but of course under Fadimond's cruel  
of gods and with the disappearance of the suspicion, it was impossible to bring  
the strange and stunned accord to any kind of realization. Chasidoro was a man of  
his time, his mind was seized by the fragrance of spices, dreams of India, dreams of  
faraway Indians clutching round his person, their strange and weird approaches, their  
eyes round with promise. But with all of that, with thoughts of approaching Indians, his  
imagination moved clear and pristine beyond this, somewhere far beyond fantasy. He was an  
admirer, the Chasidoro was only the main manager of the "Santa" on the deck, swaying,  
finding purchase on the thin and decaying boards of the wretched ship which was, his great  
friend Isabella had insisted, the very best available. Chasidoro pondered his fate, considered  
his condition, swung keen and penetrating glances toward India, the New World, the mysteri-

ous apocryphic land tucked beyond  
the clip of the great horizon. San-

ta Maria, Chasidoro murmured  
and did not know if he was  
invoking that mother of  
passage or repelling  
the name of his  
third and most  
eccentric ship.  
filled with

BY BARRY N. MALZBERG  
ILLUSTRATION BY Rafał Olbinski



roundabouts and assassins also deplored a gang so cruel that he had taken Ferdinand's instruction not to deal with that ship at all, even in his capacity as overseer. "You will be much better, my son," Ferdinand had said kindly, "staying with your crew and examining the route to India with compass and divination, allowing the guards to control that hostile ship." Cristoforo had shuddered. Who was he to argue with Ferdinand? A king's reputation stood between him and all desire. Cristoforo looked hopefully for the queen but all proportion was necessary within the arc of condition. Sometimes his thoughts were metaphysical, sometimes they were practical, and at all times the three ships rolled and sculled their way toward India, henceforth to be known in his heart only as that sphinxical New World. Absent all desire, he thought, and the spices of desire would someday be his. All of them, then.

"Excuse me, Master, his yeoman said, approaching with suitable humility. Everyone knew of Cristoforo's special relationship with Isabella, also of his temper and the secret instructions from the queen which rumored the right to scuttle any who displeased. Behind lay the Inquisition, of course, but for Jews so far out who could indeed

feel? Ahead lay the equally imponderable New World, but somewhere in the middle, Cristoforo presided and his word was terrible, his authority absolute.

The rabbi has requested permission to speak to you. He asked me to carry this message—

Rabbi? What rabbi? Cristoforo could feel his consciousness swim as he slowly reoriented himself to the possession of a steerage filled not only with chancing but with hierarchy: there was a leader or several leaders of the Chasidic yeshiva, and they obtained not only the spiritual but the temporal title rabbi, corrupted by the idiomatic language of his day to this less forbidding form. Jesus had been rabbi too, Cristoforo noted. Cristoforo was no longer a religious man, no longer possessed by any vision other than the spicy and delicious East toward which they so pell-mell crusaded, but he recalled from his childhood pictures of the bearded Master who had of course emerged from the Pharisees of his day and had been put to torture and death for daring to rival them in popularity. Or was that the story? He was not sure. The Inquisition of course was a final setting of accounts for this ancient injustice, but Cristoforo, concerned with matters of the sea as well as certain entanglements on

shore which even before Isabella had made his life colorful and difficult, had not paid much attention to that.

"Master, the yeoman said, I have brought the rabbi to the deck. He is over there, demanding to see you—

Cristoforo shrugged. A shrug seemed to possess him head to toe front to back, through all the specious and yet solid aspects of his frame; he had been shrugging, he sometimes thought, all his life. Shrug for the mean-spirited Barcelona of his day which seemed obsessed with questions of retaliation which could not concern a simple Master of the sea. A shrug for Isabella who, after all, was beyond him for all of her flirtatiousness and desirability and would have made much trouble in the possession, a trouble which he suspected she would have found no less titillating than the specter of his master. Shrug for the Santa Maria and its crew full of sailors who would be the first to grapple with the savages of the New Land if the savages were to show any hostile intent. Shrug for the jewels and fragrances which Ferdinand had promised him if he were successful on this difficult mission. Shrug for this and shrug for that, meet the temper of the world with a certain calculated indifference and ignore the

CONTINUED ON PAGE 86



"I'm forty-nine, but with the wind-chill factor, I feel more like eighty-one."

# KARY MULLIS

He's been called "untamed genius," "inventor of the decades," and "sexist pig." His discovery has determined the future of molecular biology. And he has more amazing gene machines in the works.

PHOTOGRAPHS BY FRAN COLLIN

It was a shock for the audience, so soon after breakfast. The keynote speaker at "Nucleic Acids: New Frontiers," a San Diego conference of the American Association for Clinical Chemistry, was giving his slide talk. Then, right after a scientific chart, there flashed on the huge screen a sharply defined image of the speaker's ex-girlfriend clad only in a multicolored Mandelbrot fractal pattern, generated by computer and projected with considerable transparency onto her skin. As a nervous risotto rippled through the auditorium, the speaker Kary Mullis was unbothered. This is my home town, and I can do what I like! he joked. Indeed, no one seemed to mind this and other examples of his "creativity." As a young woman chemist said afterwards, Mullis might be "a sexist pig" but his ideas were "so refreshing. I could have listened to him all day."

Among the more scientific goodie-byes, Mullis saved up less a technique to filter DNA from blood in 15 minutes (the conventional process takes a day), a suggestion that the historic Avogadro number system for counting molecules be replaced by a common-sense Mullis measure of "things per microliter," and a novel explanation for how AIDS depletes the immune system. But beyond the scintillio pyrotechnics, oomph, and provocations, Mullis also had the enduring respect of everyone in the room for the single-handed invention of PCR—polymerase chain reaction—the most powerful lab advance in molecular biology in a decade.

PCR finds and multiplies tiny fragments of DNA millions of times in just hours. Picking out a few base pairs from normal DNA is like hunting for a needle in a haystack. PCR detects the bit of DNA aimed for and keeps doubling it. After 30 exponential steps, you have a haystack



**MOST FAMOUS INVENTION:**  
Polymerase Chain Reaction

the amazing DNA maker

**BONUS RECEIVED FOR INVENTION:**  
\$10,000

**AMOUNT INVENTION SOLD FOR:**  
\$300 000,000

of a billion needles. The technique has replaced clumsy recombinant DNA cloning with a fast and slick way to make as much specimen DNA as desired and has inspired a burst of shortsighted in the still-vast project to decode the human genome.

Applications abound. In forensics, PCR helps solve murders from degraded bloodstains and bizarre mysteries of disease from samples as old as 40 years. It helps diagnose genetic problems in human eggs and embryos, can detect the AIDS virus in blood before antibodies develop, and may yield an early warning system for cancer. Archaeologists and botanists can track evolution in many specimens of dried leaves, skin, hair, feathers, and eggshells. They line up mice or butterflies and plot the history of the species by means of DNA variations that PCR detects. PCR has proven that a 40,000-year-old mammoth is the ancestor of the elephant, and it was used to analyze DNA in an 18-million-year-old magnolia leaf preserved in a peat bog. There are plans to use PCR to trace ships responsible for oil spills and to analyze President Lincoln's bloodstains and bone fragments for genetic weaknesses.

One problem with PCR is that it's so sensitive, the investigator's own hair and skin can contaminate the works. There is also a patent war. Mullis, now an independent consultant on PCR applications, invented the process while at Cetus, which owned the patent. The biotech company was sued by DuPont (DuPont lost) on the basis of a paper written 20 years earlier by Nobel-prize winner Han Gobind Khorana (then of MIT) that raised the possibility of a process such as PCR. Meanwhile other companies are racing to develop rival systems. Mullis helped Cetus defend itself, although he resigned two years after he invented PCR,

which has raised well a meager \$10,000 bonus. His brand of free-wheeling creativity was why he's far out for corporate minds, even after he produced a breakthrough now worth hundreds of millions of dollars. In the meantime, Cetus sold PCR to Hoffman-LaRoche for \$300 million and consequently merged the company with Chiron Corporation of Emeryville, California, in December 1991.

Mullis, whose emancipation from dull conformity has always been evident, was born in 1944. As a high-school student in Columbia, South Carolina, he sent a frog up a mile and a half in a rocket. He started a pyrotechnics and explosives chemicals factory at Georgia Tech and invented a remote-control device to turn lights on and off with brain waves alone (flipping to a men's magazine caused fold triggers it). As a biochemistry major at Berkeley (from 1969 to 1972), he taught neurochemistry classes in hallucinogens, and at age 24 he published his first paper on the structure of the universe in *Nature* magazine. His adviser, Joe Neilands, recalls that Mullis's thesis was written in such a personal manner that it's still the best read in the department. Mullis was "very undisciplined and unruly," Neilands says—"a free spirit."

Interviewer Anthony Liveridge talked to Mullis at his La Jolla home overlooking the Pacific, where sunsets dotted the afternoon rollers. After the interview, Mullis rushed to join them.

**Q:** Are you sexist?

**M:** No, but a lot of people think so. I show pictures of naked women, that's why! I like naked women. I like them with their clothes on, too, but if you gonna take a picture, you might as well take it with them naked. I show them with those Mandelbrots on them. This is my art! If you don't like it, close your eyes. I gave a lecture in Naples to a math department about how fractals were generated, interspersed with pictures of naked women with Mandelbrots. It went over real big. They wanted copies of my slides. They didn't call me sexist, though it's hard to be a sexist in Italy. But almost always someone comes up and says you can't show those kinds of pictures; it's not politically correct. I've cut down on it now because it causes me so much trouble. Women are some of my best friends and the people I confide in most. But sometimes the harder you try to say you sympathize with

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A place where no study can be considered complete until results hold



pending further study, no publications forthcoming, all appointments tentative

## INSTITUTE POSITION:

Provisional director awaiting study of the committee studying the provisional status of the director

## INVENTION IN WORKS:

Celebrity DNA jewelry

their problems, the more some people just sneer and say 'Sure.'

**Q:** What are you working on now?  
**M:** I've made this breakthrough in using PCR to screen the blood supply. That normally takes about a day, exposes people to infection, and is a pain in the ass. My way takes the DNA out of a large volume of blood in 15 minutes + just write a new patent. I tried the simplest thing possible and it worked. Pretty lucky, but lots of times I get real lucky. I took advantage of the fact that DNA is spider-webby. You get it out of cells by breaking them very gently. You pour the blood into a buffer with a detergent. Just don't jiggle the solution, let the DNA come out slowly so as not to break the pieces. Takes about five minutes. Then you pour the solution with the DNA molecules into a little filtration device. The only thing that stays on the filter is the DNA, because it's a long molecule, maybe a millimeter. The DNA catches like spaghetti in a colander. People said I'd never get the DNA off the filter. I tried for three weeks and finally popped it into the microwave. In a minute all the DNA came off the filter into the water! It's almost as if my fairy godmother said, "Pop it in the microwave."

The trick probably works because microwaves turn water molecules into little buzz saws by whirling them around. Where the DNA is pulled down into the holes [of the filter], it's twisted and stretched, and these little water molecules go whoosh! and rupture the bonds. Whatever it does, it works and works real fast.

**Q:** What inspired PCR?

**M:** I wasn't developing a way to amplify DNA at all. It was like I was randomly putting Trivialbys together and finally made a structure and said, "You know what? If I turn this toy wheel over there, that damn thing would wind string." Coming up to Mendocino and thinking about an experiment to look at one particular letter of the genetic code, I designed a system in my mind. As I imagined the things I thought could go wrong with it, suddenly I generalized something that if I did it over and over again would be PCR. It would go 2, 4, 8, 16, 32... in 30 cycles make as many base pairs from one little region as I had in the whole genome! That was the eureka point. I said holy shit! By putting the inophosphates [DNA building blocks] in there myself, I could do the process over and over and amplify the DNA

I slammed on the brakes and stopped by the side of the road to calculate it out. Then I drove on, because my lab assistant was pissed. I said, "I have just come up with something incredible!" She'd been asleep in the car. She was the only person in Mendocino that night who knew anything about biotechnology, but she didn't think it was any good.

A couple of miles down the road I stopped again. I realized I could use these bastards, the oligonucleotides [short pieces of DNA], and get the enzymes to reproduce as big a piece as I wanted to. They didn't have to be aimed at just one base pair. Hell, I could do a whole sequence! I realized you can cut the sequence out from a great big molecule. Pretty cool! Just cut, paste, and amplify. This is going to be a tool that's spread around the world!

I said, "If you get up and listen and help me with this, I'll put you on the invention." But she was just like the others in Cetus. She did not believe I could possibly have invented anything interesting because she knew me. She is not on the invention!

Omn: How does PCR work, starting with one oligonucleotide?

Mullis: I have suggested dropping that clumsy word from the dictionary. An oligonucleotide is a short piece of several nucleotides, of single-stranded DNA. In PCR it acts as a primer, anchoring itself onto a long, single strand of DNA and getting elongated by the polymerase, the enzyme molecule. The polymerase copies the DNA by snatching these little monomers [DNA constituents] out of the solution and stuffing them in at the right place on the oligonucleotide. The polymerase copies down the information from the long strand. With PCR, the first copy you make has one end defined, so it can't get elongated. During the next cycle, the other end is closed off, too, so the polymerase just copies the target section of DNA you want. Then in cycles after that, only the defined DNA piece will be copied. It can be copied forever.

Omn: So you end up with a pure sample of the DNA you're after?

Mullis: PCR detects a very, very small amount of some sequence interspersed in a whole bunch of similar sequences. Then PCR makes as much of the sequence, you end up with something that is almost all what you're interested in. It purifies as it amplifies because it only amplifies one thing. It's like a radio amplifying only one wavelength amid all that are coming in.

Omn: You made history at Cetus. Why aren't you still its superstar?

Mullis: If Cetus had been more attentive to the needs of its inventors, I would have stayed and invented more things. At first it was a good environment. I used the Cetus computer to set up a lab to make oligonucleotides and then had nothing to do. My boss said "Don't tell them you've got it beat. Just play." I started thinking of what we could do with all these oligonucleotides. I'd no real responsibilities for about two years, and just played. By the end, I had PCR.

Omn: What went wrong?

Mullis: When they finally realized that someone among them had discovered something really good, every sonofabitch administrator who wanted to make a name for himself suddenly decided he wanted to be my boss. There were wolves all around me. They all started proposing experiments for me to do, treating me like a grad student. By

inventions almost always cross the lines of disciplines. You don't develop an invention by having one hundred guys working for five years to produce an invention. You have one guy who may even be faky in his head and who jumps around and puts 'em together in unlikely ways and sees something. It's hard to imagine even a good administrator having a sense of how it works if he did, he'd be an inventor himself because it's more fun.

Most administrators work in sneaky ways, conferring in back rooms and coming in and acting as if the decision hasn't been made, and suddenly you think, What happened here? And they're off again to have another big meeting.

There's nothing on the agenda of the board meeting on "What We Have Done This Week for People Who Have No Legal Right to It!"

Omn: You didn't even get a promotion as a result of your discovery?

Mullis: I didn't ever hang out in situations that lead to that. How do you do it—put a sign up in the bathroom? I used to hang out with the younger people in the company. A mistake. But I don't generally like people my age. Most of my good male friends are former boyfriends of my daughters.

Omn: In other words, you're not interested in power?

Mullis: Over my own life, yes, but not over anybody else's. I had power. I ran the oligo lab and went up and said, "Let me out of this. I want to work by myself in the lab."

Omn: But you helped Cetus fight DuPont over the patent for PCR?

Mullis: I wouldn't have if DuPont hadn't sued Cetus. I could've worked for either but reckoned I'd defend my patent. I felt the challenge was unreasonable. Nobody ever heard of what Khorana had done. It was unpublished because they didn't think it'd really work—because Khorana was publishing papers about once a month. It would have been a very interesting advance and would have changed the course of a lot of his work.

Omn: What's their claim based on?

Mullis: In 1971 his lab was assembling synthetic pieces of DNA. They were trying to figure out a way of making more of what they had already made in pure form. They knew there was an enzyme that would copy DNA sequences if a single long strand sequence had another short, single-strand piece, with a primer, on it. The DNA polymerase would start at the end of the short strand and add nucleotides complementary to the long strand. They wondered if it were possible to get a piece of DNA, melt the

Then I realized you can cut the DNA sequence from a great big molecule. This is pretty cool—just cut, paste, and amplify! This is going to be a tool that is spread around the world. ♦

then I was working on what I thought would be the future direction of PCR. Nobody quite understood. They demanded I write down what I did and present it to a committee who'd decide if it was okay. I said, "I don't think that's necessary; I should be able to do it, okay?" They said no.

They put me over the flames—"You haven't done this control, that control," I said, "I've done it before and can probably do it again, but I am not a technician. If I have to do things your way I'll end up doing things just like you and that's all."

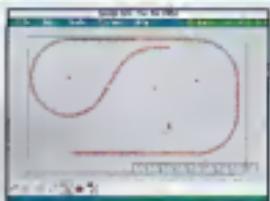
They should've said, "Okay, you just produced something that might make us a hundred million bucks, maybe a billion. What can we do to make life easier?" But they took the golden goose and cut its head off.

I was screaming for a year and a half about how important PCR was and no one was listening. They didn't expect an important breakthrough in genetics to come from an oligonucleotides lab. They didn't understand that important

continued on page 98

# DESIGN SOFTWARE:

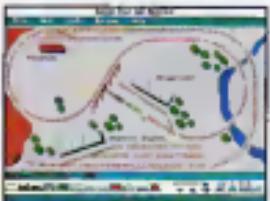
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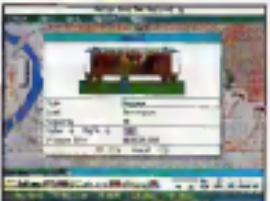
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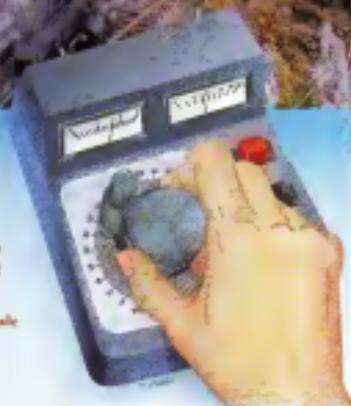


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# ANTIMATTER

## HIGH-RISE UFO ABDUCTIONS:

Alien abductions routinely occur in big cities and high-rise buildings around the world

If you had to guess the perfect time and place for a UFO abduction, you would probably choose a deserted country road late at night. But according to Budd Hopkins, author of two books on UFO abduction, the idea that aliens only snatch people from desolate areas is a myth. In reality, Hopkins claims, abductions routinely occur in big cities around the world.

But there's one catch: Alien craft do not actually land in populated areas, Hopkins explains. Instead, they hover 15, 20, or even 30 floors up and abduct people through windows. "I know it seems impossible that this could happen in a place like New York City," Hopkins contends, "yet it goes on a lot."

"What's more," he adds, "high-rise abductions are extraordinarily similar to their rural counterparts." Indeed, like the rural variety, urban abductions occur in the wee hours of the morning. Urban abductees, like their country cousins, report unpleasant medical exams aboard the alien craft. And virtually all abductees say they've been abducted repeatedly since childhood, regardless of their address. "If they pick you up, they pick you up when you're a child, and you're like a tagged elk," says Hopkins. "You're part of the ongoing thing."

Linda Nap (not her real name) is a typical high-rise abductee. Nap, a secretary, claims that she was first abducted from her family's home on the fifteenth floor of a Manhattan apartment building at the age of six. Nap vividly recalls "a toy top with lights" on the roof of a neighboring building and says that paralysis and fear were all part of the bizarre childhood



events. She is especially keen to describe an abduction which she claims took place in the fall of 1989. "I was in bed in my twelfth-floor apartment on Manhattan's East Side," she says. Suddenly she found herself standing outside her window bathed in a blue-white light.

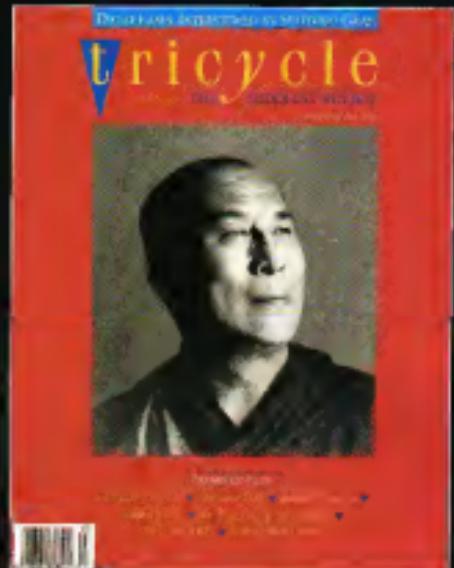
"They'll get you anywhere," adds Gerald Chamberlain, a trombone player who performs on Broadway. "When skies are overcast after dark, there can be 50 UFOs sitting 200 feet off the ground of a big city, and no one will know it." According to Chamberlain, aliens abducted him from his backyard in Refugio, Texas, when he was a child, in 1953. He also says he has been abducted "more times than I can count" from his six-story apartment in Upper Manhattan, since the 1980s.

But if so many UFOs are visiting densely populated areas and abducting victims, how is it that none have ever been documented? According to Chamberlain, the aliens can "erase any episode from the minds of witnesses. They can tell an entire borough to forget what they saw. I recently saw a UFO in Queens. I was yelling and pointing and there must have been 40 people in the street, but nobody looked. People just don't watch the sky. Especially in the city. They just don't look up."

"Crazy as all this sounds," adds Hopkins, "if one can accept the idea of a craft that's circular, can stop on a dime, make right-angle turns, and go almost instantly from zero to God-knows-what speed, then one has to accept that these craft can visit the city, too." —Anita Baskin



# ANTIMATTER



## TRICYCLE: THE BUDDHIST REVIEW

The pilot issue of *Tricycle: The Buddhist Review* features a cover portrait of the Dalai Lama staring into the distance, looking every inch the traditional king. But inside, the magazine is hardly traditional at all. Besides features on the radical environmental group Earth First!, poetry, politics, and hot streaks in professional sports, Spalding Gray, the avant-garde writer and

performer, interviews the Dalai Lama. Among other things, Gray asked the exiled spiritual and temporal leader of Tibet whether he had ever seen any holy man fly (he had not) and whether he didn't sometimes allow visions of bikini-clad women to drift into his four-hour morning meditations.

"As a monk I have to avoid that experience," said the Dalai Lama.

Asking bold, and sometimes purposefully naive, questions is what *Tricycle* is all about. The kiddy title

is cobbled from a heap of Buddhist catchwords—triads, wheels, cycles—and designed to convey the cherished Buddhist concept of "beginner's mind," a state of complete openness.

Openness in the American Buddhist community is critical, according to Helen Tworkov, the magazine's founder. "Buddhists needed a forum where they could discuss issues without the fear of scandal or worries about the rules and regulations of Buddhism," says Tworkov, who wrote *Zen in America*.

Now that *Tricycle* has rolled onto the newsstands, Tworkov is expanding her forum to embrace the culture at large. In spite of everything, "people trust Buddhism," she claims. Especially, it seems, when its Tricycle-riding wisdom issues from the mouths of babes like Philip Glass, Iris Murdoch, and Laurie Anderson. Reaction has been positive, a few ruffled conservative feathers notwithstanding.

"This magazine represents the ongoing evolution of Buddhism in America," says Rick Fields, author of *How the Swans Came to the Lake*, a narrative history of Buddhism in America. "It's a very natural thing."

—Tracy Cochran

## REVELATIONS

If computer scientist Jacques Vallee is correct, bogus UFO abductions are sometimes staged by the CIA. In fact, says Vallee, the author of the controversial book, *Revelations*, so-called abductions are sometimes staged by government agents to "create new belief systems and cover up intelligence activities that are blatantly illegal."

"I have investigated a series of such cases," explains Vallee. "If you can make people believe there are aliens coming here from another planet and cooperating with the government, they'll also believe anything else you tell them. In the meantime, the real UFO phenomenon is not receiving the proper scientific attention."

Aerospace technical journalist Philip Klass disagrees with Vallee's conclusions. Some UFO hoaxers may be practical jokers or celebrity seekers, Klass suggests, and those who claim to have been abducted may be fantasy prone or psychologically disturbed. "Although, on occasion, the CIA and Defense Intelligence Agency people have done some dumb things," Klass notes, they have more important things to do than dabble in UFOs.

—Keith Hessey

## NEAR-PET EXPERIENCE

Children do not often report near-death experiences in which ethereally visions appear to those close to death. That's why William Sersdahely, professor of health science at Montana State University, was surprised to discover one in his local newspaper. Even more surprising was that the child reported the presence of animals in his NDE.

P., a seven-year-old boy, fell from a bridge while fishing, hitting his head on a rock at the bottom of the pond. He was submerged for some five to ten minutes, and when fished out, his heartbeat had ceased. Yet two days later he

came out of a coma with an unusual story to tell.

Although he was unconscious, he remembered seeing himself transported in an ambulance while wearing an oxygen mask. He also reported that while near death, he entered a dark tunnel lined with his family's deceased pets. Abby the cat and Andy the springer spaniel. After Andy licked P.'s face, he woke up.

In previous reports, Sersdahely notes, people have recalled deceased friends or relatives, but "this is the first case of pets." Why pets? "For this little boy," Sersdahely explains, "the dog and cat obviously provided the kind of comfort that he needed."

—Paul McCarthy



## MONSTER CD

Back in 1971 an enthusiastic 19-year-old named Keith Keeler Walsh made a transatlantic call to David James, a Member of Parliament then raising funds for a search of Loch Ness. When the teenager asked if he could join the search for the creature, James agreed. Walsh then spent five and a half weeks helping monitor the six camera locations around the loch. Though he never saw the mythical monster, the experience made a lasting impression.

Now a musician who goes by the name of Keeler, Walsh has released his fifth work, *The Preyent Link*, a compact disc of "sonic constructions" inspired by Nessie and other mystery animals from around the world. Using synthesizers, electronic drums, and other percussion instruments, as well as shortwave radio sounds, Keeler's impressionistic music portrays seven monsters, including the Congo's Mokele-Mbembe, an alleged dinosaur, and New York's Champ, the so-called sea serpent of Lake Champlain. His music also alludes to five bipedal mystery creatures, including California's Sasquatch and China's Mao-Jen.

"I don't know if they are all



real," says Keeler, "but I do think such creatures exist."

So far, Keeler's electronic monster music has garnered favorable re-

## A COLLECTION OF IMPRESSIONISTIC MUSIC PORTRAYS 7 MYSTERY ANIMALS INCLUDING BIGFOOT AND NESSIE.

views. Option, an alternative music magazine, found the disc to be "a majestic 1980s sci-fi soufflé." And Champ researcher Joseph Zarynski, reviewing the CD for Strange Magazine, praised Keeler's "pioneering effort," calling it "the missing link that musically minded cryptozoologists have sought for so long."

You may order the CD from Great Om, 496-A Hudson Street, Suite D-35, New York, NY 10014 for \$15 postpaid.

—Patrick Hayge

# PORTRAIT

CONTINUED FROM PAGE 46

Kautz says, "More importantly, they realized in retrospect that what came to them in a flash could not have been rationally deduced from knowledge they had before."

To illustrate, Kautz tells a story: German-born chemist Friedrich August Kekulé von Stradonitz was napping in front of a fireplace and he dreamt that a snake was biting its own tail. From the dream image, he conceived the benzene ring and the basis of modern organic chemistry. Kautz, very gently, also likes to remind critics that Albert Einstein himself said, "I did not arrive at my understanding of the fundamental laws of the universe through my rational mind."

Eventually Kautz's curiosity lead him to the works of Jane Roberts, the woman who channeled the entity Seth. After reading the book, *Seth Speaks*, Kautz flew to New York to meet Roberts and had a number of sessions with Seth. He was intrigued by the idea that Roberts tapped into knowledge through Seth about subjects that were unfamiliar to her. During his sessions with Seth, Kautz posed personal ques-

tions, scientific questions, and questions about issues most people have no direct knowledge about, such as the origin of language. Kautz was so impressed by the quality of Seth's answers that he attributes his experience with Seth/Roberts as "the log that broke the jam."

When Kautz returned to the Bay Area, he sought out other intuitives: Penny Peirce, a former art director who is a CNI expert intuitive, met Kautz at the now nearly defunct Gaia Institute, an organization in San Francisco dedicated to exploring issues in consciousness. "Bill Kautz was so refreshing," she says. "He was the typical absent-minded professor trying to learn, taking notes on little slips of paper. His whole approach to channeling was so methodical and grounded."

For seven or eight years, Kautz lived a double professional life. At SRI his fellow scientists knew that he was investigating intuition and creativity, but most of them weren't all that interested. So Kautz quietly plodded along giving unto SRI what was for SRI and giving unto intuition whatever he discovered in his travels. But people did begin to talk. "At SRI, trance mediumship is one area of research which has a high gaga factor," says Oliver W. Markey, the

former methodology director of a futures study at SRI. A comparable example, he says, would be NASA scientists who are "closet UFO freaks."

Fortunately for Kautz, he wasn't the only SRI scientist to embrace the seemingly nonrational. During the mid-seventies, SRI became a spawning ground for renegade scientists and engineers who were looking at nontraditional ways of gathering information and solving complex problems. One group was doing futures research, trying to determine what direction America might be taking 33 years into the future. One of their conclusions: Rational/intellectual linear thinking would have to be replaced by more intuitive methods of learning. Another group began a government-sponsored series of remote-viewing experiments in which people in one room would describe what was going on in another location.

Today, many SRI "graduates" and former "straight" scientists work in areas such as consciousness studies and futures research—just like Kautz. As professor of human sciences and studies of the future at the University of Houston in Clear Lake, Markey now runs the nation's only degree-granting program in futures work. Another former SRI scientist, Willis Harman, became a well-known author and president of the Institute for Noetic Sciences, founded by Edgar Mitchell: the Apollo astronaut who, when he saw the earth from space, had a profound spiritual experience. The institute is one of the premier centers for consciousness studies in America. O'Regan, Noetic's VP for research, is also a former SRI staffer. Other SRI personnel from this period include Marshall Piascik, executive director of the Foundation for Mind/Being Research in Los Allos; and Hal Puthoff, a scientist at the Institute for Advanced Studies in Austin, Texas, an organization that pioneered zero-point energy and its applications and quantum fluctuations in empty space.

In 1977, while still a scientist at SRI, Kautz started the Center for Applied Intuition. His mandate: to apply intuitive principles in areas where intuition experts had rarely ventured—personal counseling, business consulting, and scientific inquiry. To assemble a staff of highly intuitive individuals, Kautz, in effect, held auditions. "I needed to find people who were responsible and who had a high degree of integrity. If they were into channeling for stock tips, forget it." During the interviews, Kautz says he discovered an important parapsychological principle. The inquirer must read the information from the channel. "Asking questions simply out of



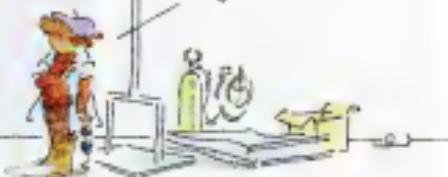
# The Artist

© ART CUMINGS

Nude abstract sculpture

is hard to do

Thanks withouts  
for coming



What  
do you  
think?

How about  
if we  
do it in  
clay?



curiosity does not work," Kautz says. "That's why so much parapsychological research has failed over the past 100 years. Researchers ask questions which have no use to anyone, or they already know the answers to the questions they ask. According to Kautz, the need to know is a critical factor when working with channelled information.

The individuals Kautz ultimately asked to join CAI came from a variety of backgrounds ranging from computer programming and engineering to fine art and holistic healing. Nancy Sheppard, for example, a mother and former statistician with the U.S. Forestry Service, channels a spirit. Hers is called Etherton. Other intuitives like Pearce and Nunn work in altered states (which more closely resemble normal consciousness than trance), offering what Pearce calls "heightened common sense." Kautz says he's never been able to find anything the intuitives have in common with each other except that they share a willingness to develop their intuitive abilities and they have a more spiritual outlook on life. "They've developed their natural intuitive abilities and learned to use their intuition in a deliberate, focused, and conscious way," Kautz says.

In 1985 Kautz left SRI to pursue his intuition-related interests full time. During the late eighties, Kautz's dedicated staff and his own scientific reputation attracted a diversity of clients such as Funai Research and Development based in Osaka. With over 1,200 clients, Funai is one of the largest consulting firms in Japan, and Kautz and Nunn worked with over 25 Funai clients. CAI also sponsored a number of sessions in the United States for a broad spectrum of individuals, from Japanese housewives to dentists and businessmen. The groups typically spend a week and a half in California attending CAI lectures and workshops which cover topics such as dream work, self-awareness, and consciousness.

During this period, Kautz plunged into a number of research projects and pioneered the method of inquiry known as "intuitive consensus," which involved posing independently the same set of carefully prepared questions to three to seven expert intuitives. Their responses are compiled, compared, and integrated into a report. One of Kautz's first studies focused on earthquakes. Choosing this phenomenon was a logical extension of Kautz's belief that natural events can be predicted where human decision-making factors aren't present. He also believed that by performing a consensus study, the intuitives might be able to generate

a range of new hypotheses in the area of geophysics.

The CAI team's consensus: The components which cause most major earthquakes are, among other factors, low-frequency electromagnetic radiation from the interior of the earth, the release of fossil-generated gases to the earth's surface, and extremely dry weather patterns. Contrary to current ground-based theories, what triggers an earthquake, the team discovered, lies in the atmosphere—not in the ground. According to Kautz, two recent government-sponsored studies conducted at SRI and observational data from earthquake monitoring stations around the world have corroborated some of Kautz's findings, giving credibility to the team's revo-

lutionary hypothesis.

No matter how rigorously Kautz approaches his intuition work, his methods—using trance channels to generate consensus or hiring out experts intuitives to access information—inevitably challenge the principles of a rational mechanistic view of reality, particularly in the United States. "The farther you go in intuition studies, the spookier it gets for a lot of people," says Harman of Noetic Sciences. "If you push it to the extreme, you get into things like channeling." Harman thinks we're at a peculiar point in history. A generation ago, we wouldn't have thought about looking into areas such as intuition, levitation, or remote viewing. A generation from now, people will wonder

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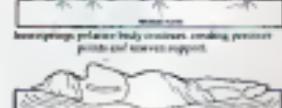
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what all the fuss was about. "Bill Kautz is an explorer, someone who charges out and plants a flag 'out there' in front of even the vanguard and then wonders why various missiles come his way."

Like many new-paradigm thinkers who embrace a more holistic view of the nature of reality, Kautz says that his work with intuition has dramatically changed the way he looks at life. "Science has been the source of authority in our modern world, and it's based on shaky assumptions—causality, opposition of subject and object, rigid distinctions between observer and observed," he says. "Science assumes that there is an objective world out there, obeying mathematical laws; and we can learn all about reality by breaking matter down into its simplest components and then observing and measuring it." Kautz no longer believes the prevailing view can explain the nature of reality. Neither does Harman: "All the old puzzles in science—falling bodies, frictionless planes, spacetime continuum—have been framed so that the observer assumes separability first and then asks the appropriate questions. When you look at things from the assumption that everything is connected, the picture changes," Harman says.

Some of Kautz's harshest critics

come from the evangelical Christian community—and again, it's a question of a worldview or perspective on the nature of reality. Evangelicals acknowledge a spiritual realm where the forces of light and darkness are engaged in warfare. From their Biblical point of view, Kautz is tempting with evil. The phenomenon of channeling can't be denied when people seem to manifest personalities," says Tel Brooke, president of the Berkeley-based Spiritual Counterfeits Project. "The question is, how do we interpret it?" Some say that there is nothing supernatural going on; it's simply psychological projection, says Brooke, who was for many years a top Western disciple of Indian guru Sri Baba before converting to Christianity. As a Biblical atheist, however, he believes channeled entities could be real. "If they are, we know they can't be God because mediatorship is condemned by the Bible."

What about hunches, premonitions, and sudden bursts of knowledge? Where do these non-uncommon happenings fit into the Christian world view? "There are Christians who accept a new kind, latent psychic power in man, but I don't," says Brooke. He believes in intuition, but he doesn't think it's capable of revealing information apart from

the five senses. When someone reveals supernatural knowledge that can be verified but which couldn't possibly have been known, "there has to be a spirit power involved, and it can only be one of two origins—God or the powers of darkness," Brooke says.

Does this mean that the spirits are seducing international business executives who enlist the services of CAI? Why the Japanese gravitate to Kautz has as much to do with economics and politics as it does with spirituality and belief systems. The Japanese place a great deal of trust in all forms of intuitive communication. Even seemingly conservative businessmen accept the idea that certain people have special knowledge, unusual insight.

Japanese businessmen rely a great deal on *honne*, which means belly-talk," says Margaret Haas, the president of Haas International, a New York- and Tokyo-based executive recruiting firm. "It's belly-to-belly gut to gut information. They honor intuition." And Haas says, Buddhist influences still permeate Japanese culture. It's not uncommon for a Japanese executive to refer to karma or fate when talking about a business deal or meeting.

Whether or not American businessmen and corporate executives come to embrace the work of CAI is yet to be seen. Although most of CAI's on-site corporate work has been in Japan, Nunn reports that he does consult for American companies—a behind-the-scenes kind of assignment. Typically, Nunn is hired by one individual, usually the CEO, to spend time at the company observing the day-to-day happenings. So as not to attract attention, Nunn's business card simply says "consultant."

The inclination to openly invite expert intuitives into the American boardroom and workplace may be shifting. Scores of books about enlightened leadership and management trends are on the new Americans—across the spectrum—are expressing a longing and interest in understanding more about the spiritual realm. "More and more people are crossing over a threshold from one way of looking at the world to another," Kautz says. "If they are reaching and want to break through, then maybe our work at CAI can help them through the doorway. If they're not there, I can't do anything." For a long time, Kautz thought there was only one way to acquire knowledge—the scientific, rational way. "Today, I know that there is another way to learn—through direct knowing, through intuition. My career has involved going from one camp to the other. The only thing I can do is to try to bring the two together." **DO**



# GÖDEL

CONTINUED FROM PAGE 10

new mathematics of fractal geometry brought hard science in tune with the peculiarly modern feeling for untamed, univilized, undomesticated nature. At one time sun forests, deserts, bush and badlands represented all that society was trying to subdue. If people wanted aesthetic satisfaction from vegetation, they looked at gardens.... By the end of the twentieth century, the culture had changed, and now science was changing with it.

In this we can see a coming together of many intellectual and scientific tools, empirical and mathematical, to reveal that we do, in fact, live in Gödel's universe, by giving us back an intuitive understanding of what we can expect from such an existence, and what is possible within it. Political systems, for example, should accept dynamism rather than clockwork, bureaucratic procedures for governing human affairs that cannot deal with open-ended developments. Totalitarianisms have tried this and failed, impoverishing the economic and cultural lives of their people along the way. It makes one appreci-

ate the feedback that is encouraged by parliamentary democracies, which permit dissent in their design, and fear the efforts at closure that have been directed at open-ended political systems from within through the silting of free speech and the right to be wrong.

Einstein was once asked what he would have done if a physical experiment had contradicted his mathematical prediction, and he answered by saying that he would have felt sorry for the Lord. Throughout his scientific life, he always stood up for intuitive imagination as being superior to physical experiment, although not independent of it. This was his way of accepting that we live in Gödel's universe, and that what we can build in logic and mathematics also leads to discovery—that we are, in fact, connected by what we can do in our minds to aspects of reality. We can work backward from imaginative insights to physical proofs, and forward from physical facts and observations to larger systems of explanation. Gödel himself believed that mathematical intuition and ordinary sense perception are both ways of knowing, that the presence of mathematical intuition within us is not purely subjective but also expresses an aspect of reality and "may be due to another kind of relationship between

ourselves and reality." Gödel's proof is as much about the limits of human minds as it is about nature, because mind and nature are continuous.

To live in Gödel's universe is to be able to grow, to move from lesser to greater states of knowledge, to develop. It may be that outside human psychology the universe is a complete, deterministic, totalitarian clockwork, and that it is the blinders we wear that makes it otherwise for us, which makes us a modifier of the nature outside our experience. It is how information from that nature reaches us that makes our kind of experience possible.

Carl Bagan and others have told the apocryphal story about the Oriental philosopher's explanation of the world. I prefer the modern version about the little old lady who comes to a meeting of cosmologists and insists that the world rests on the back of a giant turtle. The contemptuous chairman asks her what this turtle stands on, and she snaps back that it stands on the back of yet another turtle. "And what does that turtle stand on?" the chairman demands. The little old lady shakes her finger at him and replies, "You can't fool me, sonny, it's turtles all the way down!"

Well, for human knowledge, it's maps all the way, and they will always fail to capture completely the infinity outside, and I wouldn't have it any other way. Gödel's proof may be the best expression we've achieved of our relationship to maps and nature. At his death, Gödel was compared to Einstein and to Kafka, having proved that the castle was an infinite labyrinth that would never reveal any ultimate secret.

I suspect that this is the secret. ☐



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# SHIP FULL

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screams and concerns of the Inquisition which after all had absolutely nothing to do with him and which would go on its tortuous way whether or not he was present. So bring him here, Cristoforo said. Let me discuss with you later the proper way to deal below deck, do you hear me?

Whatever you say, Master, the yeoman said and gestured. This night, a huge bearded man wrapped in the vestments of his calling—but they all seemed to wear this strange and elaborate garb—shuffled toward him downcast; his eyes seeking the deck, then his head tilting upward, the strange, luminous Israeli eyes looking with Cristoforo's in a way which induced strange sensations, perhaps due to the odors of strange waiting from the rabbi and vague screams across the water which might have been emanating from the New Land just barely visible, or the more distant Santa Maria where Jesus Christ he could not and would not want to see in these conditions.

Well, well, he said. In the dark, the yeoman backed away, submission in all of his posture—if nothing else he had established deference in the crew; he had the weight of royalty behind him and there were rumored special and terrible arrangements which the king could visit even at a distance upon mutineers, spies among the crew—tell me what brings you above deck? Yes, what do you want?

The Jew still staring at him in that curious and affecting way said, My name is Solomon Schelomo, I come to ask, you a favor—

I am not interested in your name, Cristoforo said. Your names, frankly, mean nothing to me.

Yes, but—

If I wanted to establish special relations with Jews, Cristoforo said, it would not be through the medium of names. I would request your presence in other ways. You are here, below the decks, on suffering, through the misery of Isabella and Ferdinand, our king and queen. I have nothing whatsoever to do with any of this. I am simply under orders.

That is understood, the Jew said. The conditions below are impossible. There are five hundred and fifty-two of us and we are fainting, we are placed one upon another in tight rocks and without fresh air, without even the possibility of air. There is much fainting and illness.

This is not my account, Cristoforo

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said. Conditions are difficult for all of us. This is a voyage of privation.

I beg of you, Solomon said. Permit us to come above decks. Not all together—but ten or twenty at a time, just to relieve ourselves of this torment, to take the air, to move—

Conditions are worse on the Santa Maria. Cristoforo said. It is a slave ship, filled with the darkest felons of our time. But they do not complain. They drift upon the waters to the New World uncomplainingly and they hold against the day

I know nothing of that, Solomon said. I know only the conditions below deck. We are perishing, soon the disease will begin then the slow and terrible wasting of flesh—even our most fervent prayers will go unanswered—

Cristoforo shrugged. Another shrug. Shrugging at this turn away from that, consider the Marine who it was rumored had renounced their Judaism to live in secret and had thus evaded the eye of the Inquisition while seeking remission in other ways. Cristoforo knew plenty about that. Shrugs at the sea, shrug at the New World itself. If it had been left to him he would have been a merchant at the Port of Barcelona, and would have left conditions such as these to the more intrepid. How did this happen to

him? How had he become the Master of such a ruck voyage? It was all that Cristoforo could do not to rush out and shake the rabbi, explain that there were many in agony here and that agony was not now only a matter of steerage. But he said nothing, of course. The loneliness and fervency of command.

I am sorry, he said. I cannot help you. You will have to do what you can down there. It is so decided. The conditions were made quite explicit to me, surely the same was done for you.

But how long? Solomon said. How long will this voyage be?

Another shrug. Shrugs at distance, at last, at all the complications of empire and design. I can't answer that, Cristoforo said. It could be weeks, it could be a matter of days. We have been at sea for almost a month and we are in uncharted waters. When the New World looms over the horizon and not before, then the journey will end. The rest is in hands we cannot understand. Surely you know of imponderables, of fate.

I know of nothing, Solomon said. You misjudge us, all of us, clearly. We are not cattle, we are as you and we are suffering. Men, women, and little children come with pets smuggled aboard, all in pain, all of them with special and necessary grace. Do you understand

any of this?

You are to return below deck at once, Cristoforo said, the dark lash of anger trailing through his bowels. Now, before this continues. You are insolent and you are exceeding my patience. You were taken aboard by measure of the queen's generosity and because she took a sudden and unaccustomed pity upon you. I know of nothing else.

They cry, Solomon said. They pray and in their prayers in their spirit and their torment. He gestured. Can't you hear? Indeed the keening of the Jews to which Cristoforo had accommodated himself as he had to the stunting cutvature of the water struck him suddenly, rose up within him now with the urgency if not the fragrance of those spiccas he sought. Words seemed to emerge dimly from the groans of insistence, then subsided. Adonai, the Jews cried. Echim, Echim hu amen.

O countrymen, Solomon said, my countrymen, my brother—

Enough, Cristoforo said. I am the captain. He turned his back to signal that the interview was over, that the petition had been reviewed and denied, that no less than Torquemada he had been forced to obduracy as a means of containing these people. Behind him he could hear grunts, then whimpers as if



"Let's try again, say in Spring, about 100,000 years from now."

Solomon were planning some desperate final assault. Cristoforo shook his head, folded his arms, stared grimly at the sea which heaved from its greenish depths the small mysteries of flotsam, small pieces of debris which assumed vaguely organic shape, then were swallowed by the water. Yigael Shmeh raged. The small and diminished sound of Solomon patterning away from him and then the chant rising from the spaces of Neptune, mingling with the sounds of the sea itself, swaddling Cristoforo in the dangerous and terrible sounds which signaled the slow tuning of the Earth, the emergence of the New World to the starboard.

In the distance Cristoforo imagined that he could see mountains, could glimpse the tread of elephant, could see the bangles of princes as they contended with one another for the splendors of their new estate, but he knew the signs of calamity when from a great distance he let it signal him. He was a man of the sea. Cristoforo shuddered again, shivering for the Jews, for Torquemada's insistence, for Torquemada's descent. Shrug for the New World, shrug for the troubles and purchase of his hundred Jews below deck whom he would never see, could never grasp. More was to be done and later. He felt his body tighten as a sense of decision came upon him. This would only last to a certain point, then there would be another circumstance. He was sure of it. Shrug and step, step and shrug, a sudden disturbing intimation of Isabella's swollen and needful breast prodding at him as he signalled the yeoman to take over, however momentarily, the helm.

On the Santa Maria, Torquemada, enthused, gathered the desperados around him. Garbed as they indistinguishable from them, far departed from the priestly robes of his magnificence, he had become their equal and therefore their superior. The plan was working. The cunning and ingenious plan, worked out in the most sacred places of the Church and then with the king and queen was working.

"Oh listen to me, Torquemada said. Oh listen friends and companions. They gathered around him, the most desperate men of Spain, men so desperate that on this voyage of desperation they had been segregated. Only Torquemada could control them, could understand and apprehend their spirit and it was for this reason, so test himself that he had embarked upon this exile. Behind him the Jews who soon enough would be encountered. The New World beckons, Torquemada said, a place of justice, light, and peace. At-

hand to it! Can you not see it? Unshaven and desperate heads turned gleaning the new land through the spume of the sea. Here we will begin afresh, Torquemada said. That will be the plan, the plan for all of us. They murmured in response. Here, Torquemada said, we will take the Jews and plant them, rid the world of Israel, depart then for new and better shores. But you must keep your courage up. Must not fail.

"Kill them, one of the men said. We should go back to the Master's ship and kill them now."

Torquemada stalled, thinking of how far he had taken them now for all of them had come in this one ship, difficult month of voyage. Not just yet, he said. It must be at the right time for the right purpose. Now it would be just slaughter. There was enough slaughter in Spain here, it will be of a different kind. We will bleed the ground, Torquemada said. We will expend their blood in the purposes of consecration and it will be better.

You talk like a priest, one of them said. Are you a priest then? Or are you one of us?

I am one of this and one of the other, Torquemada said. I make faith with you in these species as you make faith with me. Soon the mountains, the tablelands of the New World will be upon us and we will turn them holy under the gush of sacrificial blood. But for now, he said, for now we must once again pray. We must place our knives and ordnance in protected places and pray for a good conclusion to this voyage. Do you hear me? Ave Maria, Torquemada said, and continued with the familiar litany. They recited it with him, silent as scholars to the rhythm of his words. I had no choice, Torquemada thought, looking at the high plumes of the water, the sun glinting against the turbulence. It was difficult but the only means to carry forth the Inquisition. One must constantly move outward in order to move inward. We had accomplished our sacred purposes in Madrid. Barcelona had become ours as well, soon it will have turned within and by losing everything we would have gone beyond risk. But here, here, by kidnapping the Jews, by moving forth even as we move back, we have encountered and made ripe the oldest possibility of all.

"Or am I not sanctified?" he thought, a man of doubt as well as of faith, just as the honored Saviour himself had been. Is it this or that? Is it one thing or the other? Is that handful of Jews headed for the Jerusalem of the spirit which we will erect or, aligned in the sign of the cross, will they perish at the bottom of the seas? In Cristoforo's hands, he

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thought, but fortunately I can attend to the matters of transcendence. Leave the temporal in the hands of Cristoforo. Thy will be done, Torquemada said. They looked at him intently. He raised his hands in the gesture of submission, feeling the terrible power of the waters underneath.

In the racks, Solomon said, I did the best I can. I pleaded with him. I asked for air and light.

But he said no, the three Davids said. He said no, the Israhels said. He would not have us, Judith and Rachael said, wiping the foreheads of the children who clustered. He refused.

That is right, Solomon said. He refused. He said that we were steerage garbage, at the behest of the queen but of no concern to him. I told him that we would die and he turned away. There is nothing to be done.

Cristoforo is not a man of mercy, Judith said. He cares nothing for any of us.

That is not so, Solomon said. He is doing what he must, just as we are. He is in the control of larger forces. At least we are on the seas. We have been spared the Inquisition. Maybe it will be different for those of us who live. If they live if we live. This miserable voyage—

Spared the Inquisition Ruth said, taking Solomon's hand, but not the Inquisitor. The Inquisitor is always with us. He comes in the night, he follows on the seas, he screams from the bowels of Neptune. I understand that now.

Nothing to be done, Solomon said. We are creatures of their mercy.

I tell you, Rachael said, that there is a judgment coming which is beyond all of us. They seek a New World but it is eternally the old.

The steerage, silent when Solomon had returned, cast down to silence by hope or at least curiosity, resumed, broken fragments of prayers ascending only to the thin bulkheads which made them撞 against the racks, then dispersed. It will not be long, Solomon said. We cannot survive this. We are a shipful of Jews, not of mystics or explorers, and in our flight is our guilt and our culpability. Nevertheless—

Nevertheless, Judith said, as if she had taken his thought, pressing his hand nevertheless we have at least carried ourselves, carried a bit of testimony, moved to some different place through the designs of our own spirit. We are not Nazis. We are not apostates. Our apostasy is of a different kind—

All displacement is apostasy, Solomon said, the chanting murmuring about him, the disputation with Judith—the women, to engage not only in prayers but Talmudic disputation with

women was their peculiar but necessary fate in these conditions—continuing all of their strange and strangely confluent anguish melting as the Pinta inexorably carried them toward a fate which they could not determine in all faith, in the faith of God, the one God of Israel whose Name was One and whose Oneness was invisible in the heart of their exile.

Torquemada, seized by a sudden spasm of ecstasy and affirmation, struck as if by a bolt from the brow of the Holy Ghost, began to dance and weave upon the deck of the Santa Maria, incognizant of the stares of the felons, indifferent to the risks which this display of ecstasy might bring upon him, the steps of his dance, carrying him from one side of the ship to the other while on the bosom of the ocean the craft lurched and spilled not only its provisions but its prayers in theullen light of the journey.

And so, and so they came upon mysterious India, then, their New World, the slave ship and the Master's ship and the ship between, the shipful of Jews and the ship of the Inquisitor, caught then first glimpse then of the New World through the mist and fog of their combined prayers and in that moment, as Torquemada kept, as the Jews changed, as a grim and complicit Cristoforo adjusted sextant and compass, shrugged toward this newest part of his destiny. In that moment it was as if all the contours had expired and the strange and mismatched concatenation of spirit and flesh, voyagers and prisoners, repelled and necessitous were gathered by the bolt which had struck Torquemada and which swept them from the heart of the ocean to the bowels of the ship, then expelled them to the crowsfeet of the millennium itself, myths of purgation and collision hastening their way toward coming apostasies. The shipful of Jews, their captain, their keeper and their Inquisitor joined at last in that voyage of transcendence. Cristoforo dreamed it, charmed it all, dreamed that he was in the gravity of Isabella herself, her capacious sex absorbing and expelling him as would all the centunes and scholars to come and the spray of his seed upon the ocean of the queen's plume to crack hemp myth and toward the first awareness of his destiny. Cristoforo the Jew, Cristoforo the keeper of souls.

Reciting Kaddish then: V'yish

kavash. Steven rabba

All hallowed be the name of our God

Bach hu

Hallowed and sanctified

G-men. **□**

# INTERVIEW

CONTINUED FROM PAGE 79

two strands apart; put the short DNA primer on them, and get the enzyme to make two copies. The trouble was there was a competing reaction. If you melt a DNA molecule apart into two strands, as soon as you cool it they'll find each other and wrap up into one strand again.

Somebody of high authority, maybe Khorana himself, said that it wouldn't work for this reason. As far as I can tell they abandoned those experiments and stuck to doing the strands separately in two tubes. Then at a meeting in Hawaii, Stan Cohen [Vanderbilt] and Herb Boyer [UCSF] invented recombinant DNA cloning in an all-night deli drinking beer. When word got back to MIT they dropped all those experiments and pushed all the tubes to the back of the freezer. They solved their problems by cloning. So they never went back and tried to solve the separation problem.

Omn: Cloning will make huge amounts of DNA, but unselectively right?

Mullis: In molecular cloning, every 30 minutes or so the cell divides, making 2, 4, 8, 16 copies of an inserted DNA sequence. But every time it doubles, it copies everything, the whole DNA piece. There might be 5 million pairs of it there.

Cloning was a gizzy thing when it was discovered. It just blew people away. Everyone who could find a use for it dropped everything and did it. Now PCR has replaced it in many ways because it makes a small piece of DNA faster and easier. You don't get all the other stuff, you make a purified product. PCR is the first step that makes it easier to clone. It allows you to go in and clone a human gene by first isolating it, like a pair of tweezers going in and pulling it out. Once am plied up a millionfold, you can separate it and clone it up. All cloning of human genes today uses PCR in one way or another.

Omn: What is the direction PCR's going in right now?

Mullis: It's so widely used by molecular biologists that its future direction is the future of molecular biology itself. It's like asking what is the future direction of the screwdriver—if whatever people use screws for PCR is to DNA what the screwdriver is to screws. For now PCR's future is whatever anything is being done with DNA. There is a PCR machine in every DNA lab already.

Omn: What neat things are PCR machines making possible? ..

Mullis: A rather complex one is a way of re-creating evolution. This will have major significance in designing pharmaceuticals. PCR enables you to re-create molecular evolution fast in the lab. You start with a mess of molecules and select the property you want. Then PCR pulls the molecules with that property away from the rest—one part in a billion—and amplifies that. In the process, you introduce new mutations and select for those with the properties you want. Craig Tark at the University of Colorado has already used it to select for RNA molecules and is now using it to select for protein molecules.

Omn: Why did you decide to call your cabin up in Mendocino the Institute for Further Study?

Mullis: A lot of papers end with the phrase "This result deserves further study," trying to get a grant. The IFS is a place where this can be done, where no study can be considered complete, where all results will be held pending further study, where no publications will be forthcoming, and all appointments are tentative. I am the provostial director awaiting study of the committee studying the provisional status of the director!

Omn: Where are you going next?

Mullis: I have a great new job with General Atomics in San Diego. They make nuclear reactors for satellites and one of the two controlled fusion reactions in the world that work. Most of their stuff is classified. They are physicists, basically who've decided to apply their sophisticated devices to create new biology technology. Molecular biology is, after all, a result of physicists going into biology. I'm supposed to look over their scientific proposals for research into problems they've identified and see if the proposed solution makes any sense. This is what I like most to do—look at basic ideas and have others work on ideas I suggest. I will come up with and review ideas.

Omn: What are the potentials here?

Mullis: Frontiers of medicine are converging with the frontiers of chemistry. Aside from surgical procedures, developments have been coming mainly from chemistry for the last 15 years. Biology down underneath is just chemistry in a very, very sophisticated manifestation. How we can approach biological problems with sophisticated instruments. We can study the structure of the microbe that causes measles, or whatever.

Omn: Do you think that you will be able to come up with a second PCR-type breakthrough?

Mullis: My blood sampler may benefit some of their physics expertise and

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might be more valuable to the world than PCR. To identify the hundreds of compounds in a blood sample, I'll use a scanning probe microscope that can see atoms one at a time. The aspect I'm working on now is cluster coding molecules—like putting bar codes in a grocery store. The checker never has to look at the article you're buying but just has to pull it over the bar-code reader. I'm trying to do that for clinical chemistry to find a way to recognize the molecules in a blood sample without having to observe them directly. If you can put a bar code on each kind of molecule and find some way to read it, the problem is over.

Cetus: You'll put a blood sample in your machine and out will come a list of its constituents?

Mullis: All the things in it, and much more efficiently than before. A machine in hospitals gives the levels of some 12 chemicals in blood—sodium, calcium, potassium, and so on. But there's no such thing that will work for hundreds of proteins, really complex molecules. I'm going to try for 32 compounds at first. Then it should be no problem to do it for 64, or 128. That's as many things as anybody gives a damn about in blood. If it works, there's no reason it can't be done in a doctor's office. Commercially it would be enormous; you could take over all of clinical diagnostics, a 5-billion-dollar-a-year market. I have to figure out how to make it work or get someone else to. The concept is biologically valid, though technical problems need to be solved, just like with PCR.

This time I'm not going to hand it over to some company like Cetus without something saying it's mine. If anyone makes \$300 million off it, I'm going to be part of that. Cetus has sold the rest of PCR they had not already sold for \$300 million. This is the most money ever paid in history for a patent. You couldn't tell that from looking at my carpet in here that's not even clean. And it's not earning either!

Cetus: Couldn't they have given you a million dollars?

Mullis: I said, "Hey, why don't you make it \$301 million? Send it in the mail, it will be good publicity for you." But I'm going to do all right. You don't expect the world to take care of you. Absolutely no reason to think businessmen are going to behave like photographers. Fair is not business, and business will grow despite nasties and crumplings in your tummy, as Dr. Seuss said. I don't have any resentment. You'd have to be neurotic to expect that business will be fair.

Cetus: Why didn't you charge Cetus to

help defend the patent?

Mullis: I could have, but didn't realize it. When DuPont started their suit, I could have demanded one million straight up front or go work for DuPont. The lawyer told me this as we drove home from the courthouse after the verdict: "You don't realize sometimes how important you are. I didn't take the case seriously. I didn't realize how fragile is the interaction between science and the law. A scientist has certain ways of thinking about how to establish proof that are not exactly the same as lawyers, and the response of the jury is a delicate kind of thing."

Cetus: How could you imagine believing PCR had been invented before you did invent it?

Mullis: When I told them in 1988 about PCR at the Symposium on Quantitative Biology held every June in Cold Spring Harbor—a big meeting of the elite in molecular biology—I got a standing ovation. It was an excited knot of people walking out of that room. Clearly something had been invented for the people who needed it. And nobody stood up to say, "That's cool, but we've known about it for years." It was, "Wow! You have just changed our lives!" Even Khorana never said he'd invented it and hadn't told anybody about it. He'd have been an absolute fool in front of his colleagues if he'd said, "Sure we invented it in 1970, we just regrettably didn't publish it, and I'm sorry you guys had to wait 15 years for this little wimp from Cetus to come up with it."

The patent had my name on it. I would've felt real lousy working for the other side, saying I really didn't invent it. I'd have had to say I didn't know it was invented before, or that all the elements were there, but I don't know why it wasn't invented before. Could have made a convincing case for the jury but I knew I really had invented it for the first time. It is hard to invent it and forget it.

Cetus: When you become rich, will you work less hard?

Mullis: I will write. That's all. I am looking forward to setting up in my place in Mendocino and spewing out all kinds of nonsense in my little computer. I've got a really nice science fiction movie or two in my mind.

I've done a lot of fiction. The best fiction teaches people something of interest in a totally painless way. That's what I'd like to do more than anything else. But I don't want to be poor.

Cetus: What about your idea to sell celebrity DNA?

Mullis: A weird little thing, yes. We are going to try to use PCR to make certain pieces of DNA of celebrities. The

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idea is that Heinrichs might pay a little money to get a piece of jewelry, a bracelet, or whatever, containing the actual piece of amplified DNA of somebody like a rock star. We just have to get a little piece of skin, clip a nail or something from the person, prepare the DNA, copy it through PCR, and put it in a locker. You could say, "Here's a sequence from Mick Jagger." Something to do with his lips, say. The jewelry will look like something your Gypsy grandmother gave you, and in there will be a little speck of DNA.

Orrell: Who's to know that what you put in there isn't chicken DNA?

Mullis: The problem of authenticity is solved by the fact that I am Kary Mullis. Anyone from Taiwan who tried to pull it off might not get away with it. We will certify authenticity.

We'll also have a little collection of DNA of all primates showing evolution over the millennia, for the Nature Company say. There are a lot of angles.

We've got a jeweler working on it now. You could stamp the DNA sequence on the jewelry, like stamping coins, so it looks really official. If we could get permission to use someone like Elvis Presley we could do a guitar of the month, and you could have a collection like stamps. We're doing this as

fun. If we succeed, fine, if not, no one is going to go broke.

Orrell: How feasible is cloning a whole human today?

Mullis: If there wasn't a law against it we could do it in an apartment. We'd have to get a woman who'd let us get some eggs. The mechanisms are fairly sophisticated on paper, but the actual manipulations you do are not hard at all. You just put a drop of this on that, do such-and-such, check for X, stick it back into some kind of thing, and grow it up. They make transgenic mice now routinely. Anything you can do with a mouse, you can do with a person if the person, the Catholic church, and the law allow it.

Orrell: Where do you see biology changing life most in the future?

Mullis: The biological weirdness will come in virtual reality. In the twenty-second century, people will experience realities so bizarre, we can hardly comprehend them. Once we crack the right code, we will take a little piece of something and lay it over your spinal cord, or maybe go in electronically through your finger to allow signals to be sent into your brain directly from a computer.

The machine will totally shut out all peripheral senses and take over... talking

directly to your brain. You will sit at some console to control it. What you will experience will not be you anymore but a character in a videogame, and you'll really feel like it. Everything you ever hoped for you will now feel. In fact you will be able to change into things you never imagined, because the setup will generate new kinds of sensations.

Many people will never go outside unless they have to. For entertainment, they will always get out their virtual reality equipment and dial up and visit a bar in Bangkok, say or fly over Bangkok at 3,000 feet on their back. The images will include other individuals who can plug in and meet you in the bar, and you can have anything you want as your persona. You can come in as a perfectly functional male or female, or as an elephant. Some people such as the bartender will be paid to do this every day. He gets up, attaches himself to the system, and projects a bartender persona there. He may be a robot. Most customers won't be able to tell the difference. The reproduction will be so complete, you can see, touch, smell, and feel it. You can go home with somebody in the bar to some apartment in Bangkok and it will all be charged to your VISA card.

Orrell: How did you come to write your 1988 paper for *Nature* on the cosmological reversal of time?

Mullis: Courses in astrophysics gave me two compelling descriptions of the universe: big-bang and steady-state theory. I thought both were sophomoric approaches because each is based on the premise that you could actually step outside the universe and look at it. That's stupid. Relativity makes it clear you can't talk about the universe from outside. If you look at it from inside and assume relativity is part of what's going on—which neither theory did then—it makes sense.

I was at Berkeley and taking acid every week. That's what people did for entertainment: drink beer or go out into Tilden Park and take 500 micrograms of LSD and sit all day thinking about the universe, time going back, winds and forward. Some mornings I'd wake up and think I ought to write that out. So I did.

Moving between fields is the way to be creative. Keep your fingers in a lot of pies. I do it because I'm curious. I'm the only person I know who goes into a poster session [at a scientific meeting] and sits at the last poster I have no idea what it's about. Find the poster you don't know anything about, and look at it for a long time, and you might learn something totally different. ☐

# GAMES

## BELIEVE YOUR EYES

New illusions to test your senses

By Scot Morris

Illusions are merely games of perception. Here are some of my favorite new ways to play tricks on your visual senses.

The Living Image (Fantasyland, 18954 Del Marines Way South, Seattle, Washington 98148, \$38). From the time we're born, our minds are predisposed to seeing the world illuminated from above because of the sun. So what happens to our perception when normally convex objects are illuminated from below?



The Living Image uses underlighting to make a white, concave face appear convex. A light in its base brightens the upper portion of the face—the forehead and top of the nose—the way sunlight would a regular, convex face. What you see is a 3-D face that appears to rotate and follow you as you move around the room. The illusion is so strong it's hard not to see.

Day Dreamer (Alpha, Odyssey, P.O. Box 17987, Boulder, Colorado 80308, \$14.95 plus \$3.00 shipping and handling). You can spend hundreds of dollars on meditation machines that use a strobe light, visible



through special plugged-in goggles, or you can get the same effect with the lung-powered Day Dreamer.

Don the face mask and look toward the midday sun, with your eyes closed. As you blow gently into the mouthpiece, a spinning shutter blocks the eye holes and produces a flickering effect. As you blow harder, the shutter spins faster, and your mind's eye sees a pulsating display of swirling, multicolored patterns and geometric, 3-D designs. This is the only strobe-light experience that uses the true source of full spectrum light—the sun. Timothy Leary has called it "a wonderful window into the neuroverse."

It's Alivel (Kevin James, 9882 Katella, Anaheim, California 92804, \$25). This is the best shock illusion since the classic "severed thumb." In your white-gloved right hand you hold a grisly human forearm. At one end is a bloody stump; at the other end is what appears to be a severed

hand—that moved! Los Angeles magician Kevin James, who invented it's Alivel and uses it in his stage act, now offers a packaged version available to the public that looks remarkably real—even close up. The fake severed arm comes with an extra white glove for your left hand to complete the startling effect.

Wordplay Ambigrams and Reflections on the Art of Ambigraphy by John Langdon (Harcourt Brace, Joyovovich, Spring 1989). John Langdon has been creating elegant word designs for about 15 years, and we've printed several of them in this column: VICTORIA and TOUCH in November 1980 in connection with the publication of Scott Kim's *Inversions*, and two more AMBIGUITY and PHILOSOPHY, which we announced Competition #48 for Ambigrams in June 1988.

Now Langdon is publish-

## Wordplay minimum

ing more than 40 of his word-art works in his new Wordplay book. My favorite is MINIMUM—simply conveyed with a zigzag line and four dots. Langdon writes well, too, offering clever and thoughtful essays about each word subject—from SCIENCE to RELATIVITY to BALANCE.

Hologram Time Traveler (Sega, at arcades for \$6.50 to

\$7.50 per play). This new interactive 3-D game is the best reason to visit a game arcade now. Time Traveler's characters are actually four-inch-tall holograms.

Twenty-five actors were filmed for the parts in various stages of action—jumping, ducking, attacking, dying. The scenes were then transferred to a Sony 12-inch videotape. A Trinitron TV monitor inside the console plays back the scenes, which are reflected by a parabolic mirror into the space above the glass playing surface.

Gameplay is complex as you travel through time, and the scenes are sometimes violent. Pull the joystick back in time and the character Marshal Gram jumps clear of a warrior's flaming arrow, move too slowly and the cowboy gets it. But the technology used to create the arcade-hall illusion is a real breakthrough. **DC**

MINIMUM, AMBIGUITY, PHILOSOPHY, TOUCH, and REFLECTIONS ON THE ART OF AMBIGRAPHY BY JOHN LANGDON. HARPERCOLLINS, 1989. \$14.95.

## science

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# ELECTRONIC UNIVERSE

## FORCE FIELDS:

Computer sports games offer vivid visions of future competition

By Gregg Keizer

**Y**ou can't see far enough into the future to tell if the point spread is going to work for you this weekend, but you can see the future of sports—if you suspend disbelief.

Sports may not hold science fiction in a headlock, but there have been some interesting extrapolations, mostly in the movies. *Robo-Ball* and *Death Race 2050* are two violent extrapolations of the future of sports, where mayhem is the norm and players come off the field on their shields instead of coming off the bench.

Video and computer SF sports games follow that trend for the most part, upping the action and also speculating about the nature of violence in competition.

*Speedball 2: Brutal Deluxe* (Sega Genesis) from Aeria Entertainment is a perfect example, if not a perfect game. The year is 2100. Streetball—a rough-and-tumble

game once played in alleys between gangs—has gone legit! You take over the ceiling-dwelling Brutal Deluxe, one of 16 teams in the new league, and as its manager, march it from loser to league champion.

It's a lot like soccer in England, only rougher: this *Speedball 2: Nano* player per side streak up and down the court as they try to throw a steel ball into a goal. You control the player closest to the ball as he passes, runs, and trades punches with the enemy. In fact, you've got motivation to pummel the other players—you score points when you disable an opponent. But though the tactical play of *Speedball 2* excites arcade fans, there's more here than just a brute-force biffle. You run the front office, too.

*Speedball* plays fast and furious—the three-minute games are frenetic. Like many video games, it demands patience, lots of practice, and twitchy reactions. Even against the lowly Revolvers, the league's most sluggish team, you'll have a tough time early on. Keep at it, and you'll master up-court rushes, time your players' punches, and move up in the standings. Nothing special here, neither in gameplay nor in the science-fiction trappings, but a good Sunday diversion nonetheless.

Step Nintendo's *F-Zero* cartridge into the new Super NES game deck and find yourself racing across nine planets in a magnetically levitated machine. With down-to-earth arcade parents like Alexi's Pole Position race game, *F-Zero* doesn't demand rocket scientist brains, just quick reflexes. You sprint past other cars along 15 twisty tracks, make pit stops, and race to finish in the top three each time.

*F-Zero* is as much a form of intergalactic bumper cars as a true Grand Prix. Your machine—

you pick from four, each with a different performance curve—loses power each time it collides off the antimatter guard rails and other cars. Let that power drain completely and you explode in a nice ball of flame. Of course, you can shove opponents out of the way with greater impunity than any NASCAR hot rod. To refuel, you drive through the pit stop. No tire changes in *F-Zero*—the slower you roll through the pits, the more energy you get back.

If you've put the pedal to the floor in almost any video race game, you'll find *F-Zero* familiar. There's no ground-breaking gameplay in *F-Zero*, but the action's still addictive, thanks to the bump and grind between cars. Once you work your way through the game's three levels and 15 tracks, though, the charm wears off fast. You can get some of the magic back by switching cars. Handling the Golden Fox is tough, for instance, since it corners horribly.

The SNES deck may not be the Sega-killer that Nintendo hoped, but it pumps out surprisingly good graphics and is a big step up from the blocky original NES *F-Zero*. It's a snappy example of what this system can do.

You can't walk away from SF sports without at least a look at one more game—*Maxis Robo-Sport* (IBM PC compatibles with Windows, Macintosh, Amiga).

Your team of robots battles it out against the computer's or against as many as three other players (you can play over a network of computers) in battles of capture-the-flag, treasure hunt, or hostage rescue. Program each robot's movements and then watch a VCR-style replay as they scuttle across two dozen different arenas, guns blazing.

It beats American Gladiators hands down. **OO**

No bumper street  
gamer,  
*Speedball 2: Lens*  
you batter  
bad guys. But  
you have  
to use your head  
to play, too.



# LAST WORD

## SPRINGTIME FOR NUCLEAR WINTER

No need to duck and cover; just let a smile be your bomb shelter

By Stan Sinberg

**H**ey bad news. Just when the threat of nuclear war with the former Soviet Union is diminishing—or seems to be—a bunch of scientists announced that World War III probably wouldn't destroy the planet after all. That's right. We could've had "the big one" and only about half of us would've been incinerated.

Remember that nuclear winter scenario that scientists warned us about a few years back? The one predicting that a nuclear war would result in frigid temperatures, no sunlight, raging winds and the end of the human race? Well, while we were building homes and raising families, assuming that was that, many scientists have been furiously arguing that nuclear war was getting a bum rap. And scientists now agree they overestimated the devastation. Even Richard P. Turco, the physicist at UCLA who coined the phrase "nuclear winter" now admits, "The human race wouldn't become extinct, but civilization as we know it certainly would."

What a relief! Here we spent years trying to avert the thing, rallying for nuclear freeze, constructing bomb shelters, ducking under our desks in grade school during mock air raid drills and enduring terrifying movies like *The Day After*, only to find out that an all-out war would have merely destroyed civilization.

Stephen Schneider of the National Center for Atmospheric Research even dispelled the very term nuclear winter. "I would call it nuclear fall, not winter," he said, immediately prompting a noted clothing manufacturer to switch from producing radiation-proof down jackets to trendy combat-resistant cardigan sweaters.

For years physicists have been heatedly debating these issues in top-secret Physicist Meet-

ings because only they could understand the world-shaking ramifications of nuclear war. How wise this decision was made clear by this typical exchange at a recent Physicist Meeting:

**Pro-Winter Physicist:** In conclusion, a nuclear war would mean the destruction of everything we hold dear and cherish on the face of the earth.

**Anti-Winter Physicist:** Up your nose with a fire hose!

**PWP:** Oh, yeah?

**AWP:** Yeah.

**PWP:** You want to step outside?

**AWP:** Aren't you afraid you'll freeze in the nuclear winter?

As you can see, it was a bitter dispute with plenty of good points made by both sides.

Now that a consensus has been reached, rumor has it a lot of physicists are pretty p.o.'d at Carl Sagan. He was one of the chief popularizers of this nuclear winter business, and partly because of the way he says "billions and billions," many intellects believed everything he said. Opposing physicists had to waste valuable time trying to disprove Sagan's doomsaying, which they could've moved on to their next project: nuking the moon.

In case you're wondering why physicists were intent on proving the world could take a nuclear holocaust, a little history should clear it right up. These actually was a time when official U.S. policy stated that nuclear war was unthinkable. The point of building a nuclear arsenal was to make sure we wouldn't have a war. But then computers became sophisticated enough to simulate war, and Pentagon heads demanded one when they learned that NASA officials got to spend all day preparing for alien interplanetary attacks by playing Space

Invasions. Physicists, a professional group whose contract explicitly states that working on anything practical is punishable by death, jumped aboard. Since then we've had military commandos sitting around simulating what-if scenarios and loads of scientists debating whether nuclear Armageddon would mean the end of life, or merely life as we knew it.

There had been speculation that with the recent meeting of minds, physicists might turn to other vital issues, like getting the word "indivisible" struck from the Pledge of Allegiance, since the nation is divisible—into trillions of atoms. Instead, though, they have taken to debating new postcolonialization questions such as:

In a nuclear fall, will the leaves on the trees still turn color, and, if so, will they contrast sufficiently with the color humans will turn?

Does "the end of civilization" mean a return to the Stone Age or only to a time when My Favorite Martian ruled the airwaves?

If the sun from the war creates a condition of daytime darkness, can we offset it by turning the clock ahead 12 hours?

If a nuclear winter does occur, will *Life with Regis and Kathie Lee* still seem as urgent?

Of course, if the Eastern Bloc and former Soviet republics keep turning from communism, the answer to all of these questions may never be more than hypothetical musings. That's why we should take whatever steps are necessary to promote a respectable nuclear exchange. Otherwise, we will have wasted the untold efforts of some of our most brilliant minds who devoted prodigious amounts of time and energy bravely struggling to prove that a little nuclear war isn't such a bad thing, after all. **DO**

**Stan Sinberg**  
is looking  
for investors for  
his personal  
chain of bomb  
shelters.

