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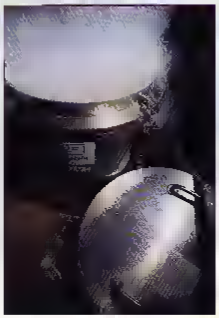
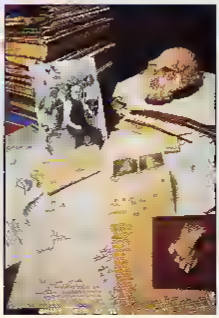
DEPARTMENTS





An exotic spacecraft flies over a rugged landscape in Tsuneo Sanda's cover illustration. Is this a scene from the earth's future? The architects of tomorrow—those who predict and shape the future—might be able to tell. (Additional art and photo credits, page 43)

FEATURES

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SONY
SONY
LISTEN TO YOUR HEAD.

FIRST WORD

DEUS EX MACHINA
The environmental hope

By Philip C Cruver

We have mortgaged our environmental future! Tragically we are not keeping current on the interest payments, and the principal is becoming a burden beyond comprehension. The story of modern civilization has reflected humankind's victory over nature with technology as the principal weapon. Only in the last two decades, however, has there been an emerging consciousness that technology has extracted an extraordinary price in terms of pollution. Advanced technologies, yet to be invented, may now be the only means to pay the past-due trillion-dollar remediation bill after more than a century of destruction.

"The myth that man and machine are antithetical entities must be proven apocryphal and dispelled," says Cruver, president of Unisil, an environmental products and services company based in McLean, Virginia.

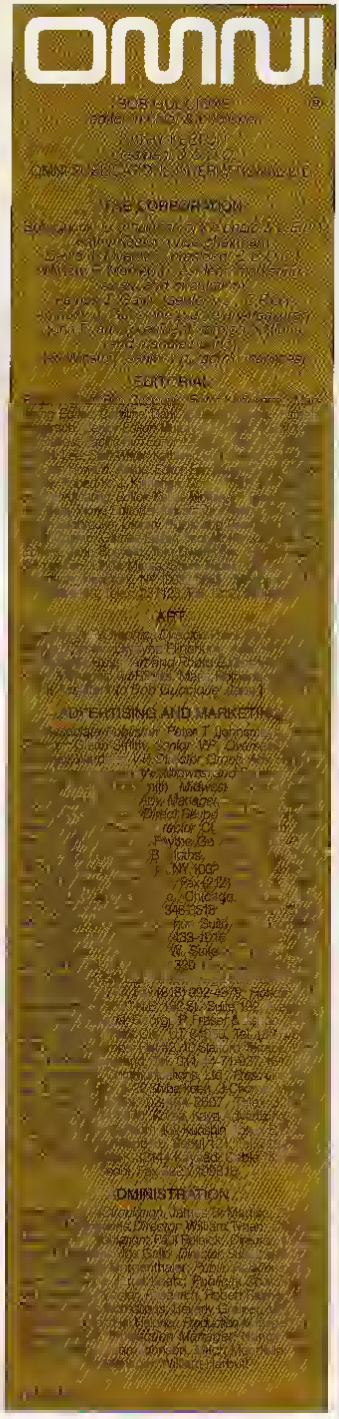
If we are to hope for a reversal of our planet's march toward Armageddon, philosophical attitudes must change. The myths that economic development and environmental protection, and that man and machine are antithetical entities must be proven apocryphal and dispelled. We must replace these misconceptions with a new world-view—a view which advocates the true meaning, benefits, necessity, and perhaps superiority of advanced technologies. We have progressed too far to now breech humankind's Faustian bargain with technology.

Advocacy of technology as the panacea for our environmental woes is not without its detractors. Not only is it criticized as not being capable of responding to today's problems of unprecedented growth in human population and economic development, anti-growth pundits contend that technological progress is actually creating new hazards such as the problem of rampant pollution. Moreover, these critics contend, technological optimism is the opiate of the masses. It sustains our addiction for more, which, of course, only exacerbates the underlying affliction.

Contemporary philosopher Thomas Kuhn provides some insight and hope for this impending dilemma when he argues that the transfer of allegiance from paradigm to paradigm is a conversion experience that cannot be forced, but after an extended period of turmoil, the old paradigm is abandoned and replaced with a new one. This occurs only after persistent failure to solve the problem gives rise to a crisis. Adopting Kuhn's theory, could we not ask if our being on the precipice of ecological bankruptcy might ultimately create a new scientific-technological paradigm, redefining and overcoming the misconceptions of technology that would extricate us from this malaise? In other words, might we consider that by as soon as the end of the twenty-first century, the present anthropogenic world-view which promulgates human dominance on Earth, may eventually be replaced by a new paradigm that recognizes technology's superior ability to rapidly evolve and adapt to an ever-changing and increasingly hostile environment?

In his book *Disappearing Through the Skylight* O. B. Hardison, cultural critic and scholar, projects a vision of a society in which such a "conversion" has occurred through the use of silicon devices. "Today's silicon devices operate in deep oceans and deserts, arctic ice flows, the high temperatures and pressures of Venus, and the airlessness of the moon," Hardison writes. "Whereas the habitat of carbon man is Earth, the natural home of silicon devices is space." He theorizes that all scenarios which depict a conflict between humans and machines will become meaningless—the deification of intelligent machines will coincide with their ascension into space. They will become invisible and therefore nonconfrontational.

Technology may be the only means whereby humankind can increase its standard of living while preserving its quality of life. And while this philosophical resolution of our environmental woes may not deal immediately with many of the more pressing problems, it certainly can supply us with a source of future hope for amortizing the huge environmental mortgage and avoiding ecological bankruptcy.



COMMUNICATIONS

READERS' WRITES

Support your local alien, baby boomers budget bumped, and confection perfection

I Want My SFTV

Thank you so much for the exciting article on the Science Fiction Channel [October 1992]. I immediately sent a letter off to my local cable-TV carrier urging them to pick up the new channel. I also wanted to send a letter to USA Network encouraging them to get their programming into my area. Could you provide your readers with an address where they can write so science-fiction fans such as myself know where to send our letters of support and encouragement?

A.D. Ray
Round Rock, TX

Editor's note: You can write to USA Network in care of Sci-fi Fan Alliance, P.O. Box 331, New York, New York 10185.

Texas Revisited

While no doubt correct in other regards, Keith Ferrell's Forum article on Stephen Hawking's singular popularity ["A Brief History of Time Revisited," September 1992] contains one glaring error, once repeated. The *Thin Blue Line*, Errol Morris's previous award-winning film, was not "a documentary about the Houston police department" as stated. In fact, it was about one Randall Adams, who was accused of shooting a *Dallas* police officer to death.

Dennis Stacy
Occasional *Omni* contributor
San Antonio, TX

You were mistaken that the film *Thin Blue Line* is about the Houston Police Department. Rather, it is about the murder of Robert Wood, a Dallas police officer.

W. Frederick Dews II
Arlington, VA

Born in the USA?

As anyone who has perused popular science magazines from the 1950s can attest, predicting the future is a risky proposition. The least a speculator can do is take into account existing trends. The authorities quoted in Linda Marsa's thoughtful "Funds" column [October 1992] failed to do this. For instance, Karen Meredith of the American Association of Boomers says there will be an "evaporation" of age discrimination and that elderly baby boomers will be courted by employers because of a lack of enough skilled young workers. She forgets to take into consideration two crucial interconnected factors: the globalization of the world economy and the lessening of American global dominance. Throughout Asia and Latin America and perhaps Russia, there will be ample numbers of skilled workers. These factors will have a greater impact on the future well-being of the baby-boom generation than any lag in the number of skilled workers in the United States.

Timothy Lange
Los Angeles, CA

Sweet Memories Never Melt

Your article, "Hot Chocolate" [Continuum, October 1992], which described a new production technique to raise the melting point of chocolate so it wouldn't melt in your hands made me remember one of my father's favorite stories about his days as an Army doctor stationed in Brazil. Since there wasn't a lot of action, my father was assigned the task of creating table butter that would keep its square "stick" form even in the oppressive heat of South America. Although I can't recall the exact ingredient, my father managed to add something to the butter that raised its melting point to above 100 degrees. That evening, my father proudly brought the new butter to dinner, and his companions congratulated him as it spread perfectly onto the slices of bread. But as soon as they tasted it, they realized an important property of the new, improved butter. It simply refused to melt in their mouths. Just like that butter, a chocolate with a melting point of 158 degrees just isn't going to produce the same sensory appeal as good ol' melt-in-your-hands-style chocolate. Besides, we can always wash our hands.

Powell Scott
Brooklyn, NY

POLITICAL SCIENCE

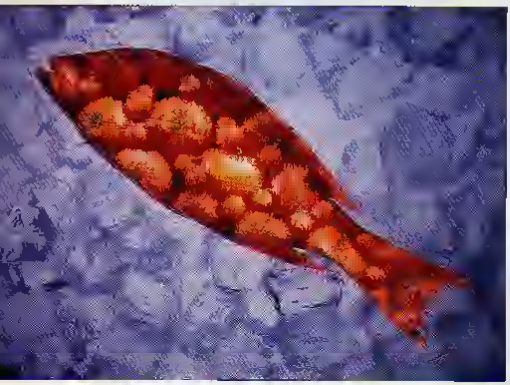
HI-TECH PHARMING

How're you gonna keep 'em down on the farm once they've had *E. coli*?

By Tom Dworetzky

Farming is traditionally considered pretty low tech, low profit. Export raw resources and products—so called non-value-added goods—and you risk turning into an economic colony of some country buying your goods, making something out of them, and selling them back to you for more. The United States did this during the height of our imperial days. It's what all empires have done. If you're an economic colony, you never get out of debt to the company/imperial store.

Farming of the future, however



Crossing the veggie-animal line: transgenic mutations such as tomatoes bred with fish DNA in their genome will be in our salads and sauces within three years.

is poised to break new ground, so to speak. According to a recent study from the Congressional Office of Technology Assessment (OTA), expert systems now under development will, by the mid-Nineties, let farmers better manage weather, water, disease, and other concerns. By 2000, robotics will increase planting and harvesting efficiency. But the biggest change is the revolution in genetic engineering. Already in hundreds of trials, gene manipulation in plants has created variations able to withstand lethal environmental conditions and pestilence. Creating new animal "replicants" is so near on the horizon you can't get a clear missile shot at it. Moreover, although the United States pioneered biotech, other countries are hot on our heels. The implication of this race is simply put by OTA's Michael Phillips. "We've been leaders in basic research, but adapting and getting it to industry and marketplace has proved a stumbling block. And whoever gets to market first, wins."

A thriving industry means money, revenue and jobs for us, more food for the world. But biotech has some spooky implications—although all biotech is not the same. Taking a gene from a plant's DNA and fooling with it a little—reversing it and reinserting it back into the chromosome, for example—is not really scary. That is what gives the new Madonna of modern genetic legerdemain, the FlavrSavr tomato, its slow-ripening edge.

Much more bizarre is what will soon hit the market. Still a bud on the tomato vine, but ripening fast, is a new breed due to arrive by early 1995. As yet unnamed, this product of research efforts at DNA plant technology crosses the veggie-animal boundary. Embedded in its DNA is a gene from fish that lets said animal withstand icy waters. Placed into the plant's genetic strands, it allows the tomato to survive frost.

Such transgenic mutations raise certain Frankensteinian possibilities. These are remote. In reality, there's a trade-off of risks. Conventional farming laces the earth and ground water with toxic chemicals. Worse, there are hundreds of resistant pest strains thanks to these pesticides. Farmers lose the same 30 percent of crops they lost before the chemicals' introduction 50 years ago.

Still, biotech is not risk free. Gene engineering, like all technological innovations, can be misused in practices from poorly monitored experimentation in less developed countries, to teenage ninja mutators—"biohackers." The technology is not all that complicated, nor are the basic ingredients harder to obtain than those in a Gilbert chemistry set. Any bright kid can get the stuff to slice and dice genetic material and presto!—Blade Runner.

While government and industry are aware of the potential downside, once the biotech genie is out of the bottle, it's out for good. There are plenty of safeguards to prevent hackers from crashing computer systems, to prevent fissionable material from falling into the "wrong" hands. There are safeguards on just about everything that can hurt you. But genetically speaking, it's still a jungle out there; nothing will absolutely prevent unthoughtful—if not malicious—biohacking in the near future.

Then we'll face the eternal dilemma dogging the footsteps of all science. Every solution to any problem creates an even bigger problem. The basic problem is that we always find the need too pressing to resist the problem-provoking solution. Biotech farming is no exception. By 2000, the world population will top 6 billion, and we'll face a crisis in food supply far worse than today's horror of starving millions. Even if all rain forests and marginal lands now untilled were put under the plow, today's agricultural methods might yield too little to feed the species.

So we face the Hobbesian choice once again: solutions that turn into more daunting challenges. Future generations of researchers will face the unknown harvest of the biotech genie loosened on the world. ∞

FORUM

THE SOCIETY FOR LITERATURE AND SCIENCE:
A conference dedicated to connecting the two cultures

By Keith Ferrell

I spent a fascinating weekend recently, in the company of hundreds of scholars, both professional and amateur, whose area of interest lies in the interface between science and the humanities. The occasion was the annual conference of the Society for Literature and Science, a rapidly growing, exciting organization dedicated to examining the relationship of what C. P. Snow called "the two cultures."

Dozens of scholarly papers were presented on topics ranging from the visionary imagery of Ralph Waldo Emerson to the somatic impact of virtual reality. Virtual reality—indeed, cyberspace and all of its implications—served as one of the major foci of the conference. It seemed sometimes that every other paper dealt with either the literature of cyberspace (much of which is by *Omni* contributors, and a good bit of which originally appeared in *Omni*) or the sociopolitical implications of the cybernetic revolution. A number of presentations were pure academic hooey, but even more were the product of honest scholarship and hard, serious contemplation.

The hooey was easy to spot. Too often our academic community, particularly academic literary critics, couch their insights in a rhetoric that's also a code, accessible only to accredited members of the critical club. Your membership—and thus your ability to enjoy (or even follow) an argument—depends on the school of critical thought to which you subscribe. Over the course of the conference weekend, one could hear a number of academic doublespeak harangues, as one or another literary or scientific dead horse was flayed.

But there was even more—much more—genuine scholarship and enthusiasm. Better than perhaps any literary conference I've attended, the SLS meeting attracted scholars with real passion not only for their work, but also for connecting their work with other disciplines. The commitment to a broad spectrum approach—science and literature are but two sides of our many-sided human culture—was on the whole well-served, and often brilliantly served by the conference. Should you have a chance to attend a meeting of the Society for Literature and Science, I recommend highly that you take advantage of it.

At the same time, there's something ultimately enervating as well as energizing about a large conference. Presentation of papers starts on multiple tracks early in the morning and continues until after dark. One careers from presentation to presentation, seeking to absorb as much as possible. This can result in some wild juxtapositions—a session on the prose of Loren Eisely followed in short order by a look at the political subtext of David Cronenberg's film *Videodrome*, the neurophysiological mechanics of reading crammed in before a deconstructionist analysis of science fiction, and on and on.

One can only absorb so much before seeking a break.

Fortunately, there was serendipity at work as well as scholarship. A couple of blocks away from the convention hotel stood Atlanta's High Museum of Art. Centerpiece of the museum at the moment is a traveling exhibition, The Age of the Marvelous. The exhibition mingled paintings and books, objects and tools, instruments of science and instruments of war. All of the items in the exhibit hold marvelous aspects, reminding us of a time when science and art were less separated, when the marvels human beings are capable of fell into a single category, human accomplishment, unfettered by academic taxonomies. The Age of the Marvelous is a breathtaking exhibit.

Refreshed by the exhibition, one could return to the conference for more close-up perspectives on newer marvels. By the end of the weekend, one could almost believe that the various academic cultures had achieved some common ground. And perhaps they had.

That common ground should be familiar turf to you, and to all *Omni* readers. *Omni* came into being a decade and a half ago precisely in opposition to the separation of the two cultures of science and the arts. The magazine has held from the first issue the conceit that there is but a single culture—human culture—and that our job is to illuminate as many of its aspects as possible.

Science and the arts have drifted too far apart on our campuses. The SLS is attempting to bring the two closer.

Our attendance at and enjoyment of the SLS conference has opened for us a new initiative as well as a renewal of our original promise. In the months ahead, we'll be looking more closely at areas in which the two cultures merge and diverge. We hope you'll join us.

WHEELS

MERRILY WE ROLL ALONG:
A tale of talkin' tires, run flats, and super synthetics

By Paul Shepherd

Motorcycles rarely do. Tractor-trailer trucks usually don't. But the queasy feeling is unmistakable in cars, where the combination of weight and tire size make hydroplaning common. In an instant, braking and steering become useless as a vapor-thin layer of rainwater sends several thousand pounds of machinery hurling into flight and even seasoned drivers into frozen fear. Hydroplaning, the loss of the tire's contact with the road, will soon be as much a worry of the past as blowouts and locked brakes.

In early 1992, Goodyear began marketing the Aquatred, which features a deep center channel that together with lateral grooves evacuates excess road water. The use of channels like the Aquatred's means not only a dramatic decrease in hydroplaning, but also remarkable advantages in all wet-weather handling, including reducing the stopping distance with antilock brakes by several car lengths.

Competition in the tire industry has always been fierce, but promises to become spectacular over the next few years as manufacturers race to market the most advanced and sometimes downright startling technologies imaginable. Thanks to superior synthetic-rubber compounds, Michelin now offers an 80,000-mile treadwear warranty and has also decreased rolling resistance, which reduces fuel mileage, by as much as 20 percent over the next best product without compromising other performance factors.

But these advances are only the beginning. Asymmetrical tread patterns, in which tread cuts and even compounds differ completely from one side of the tire to the other, will soon be commonplace. More tires, like the Aquatred, will be mountable only in one direction for better wear and water evacuation. We may even see wider production of rubberized asphalt, color-coordinated sidewalls, and super low-profile performance tires.

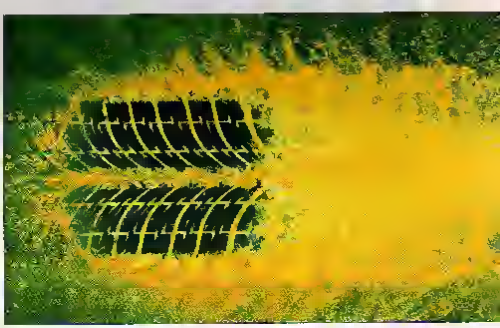
Goodyear first introduced the Aquatred on a concept car at the Epcot Center in 1981. Only recently, however, with the help of the *Alias* software that created the *Terminator II* special effects, have Goodyear's industrial designers and engineers been able to optimize Aquatred's unusual tread patterns for mass-market production. The number of variables that engineers must account for when designing a tire—from bypass noise and rolling resistance to how it will perform on any given vehicle under any given conditions—has always limited the amount of in-depth testing possible for experimental designs such as the Aquatred. Even when fully tested, the demands of manufacturing molds for dozens of sizes were overwhelming until CAD/CAM-type (Computer-Assisted Design/Computer-Assisted Manufacturing) systems could be modified for the tire industry.

Today, tire makers including Michelin and Goodyear are making tires that can be driven up to 200 miles with a complete loss of air pressure. Methods include the application of a puncture sealant to the inside of a tire, extra-rigid sidewalls, and an interesting experiment at Michelin with a foam core that's compressed during normal inflation. In the event of pressure loss, the foam core expands to fill the deflated tire.

"Run flats," one Goodyear engineer notes, handle so well with zero PSI (pounds per square inch) that a warning device must be installed to alert drivers to the condition. Consumers can expect to see the "run flat" or self-supporting capability a common feature of passenger-car tires.

Even the integrated-circuit chip that is already driving our braking and suspension systems has found its way into the tire. This past summer, Goodyear announced a truck tire outfitted with a chip and transponder capable of monitoring tire pressure, load conditions, and temperature stresses throughout the life of the tire, helping trucking companies save replacement costs of expensive tires. "Adapting this recent technology to standard passenger-car tires could mean dramatic improvements in antilock braking systems, since we can monitor a skid at the tire's point of contact with the road rather than through the wheel," says Bill Egan, chief engineer of product design at Goodyear.

One of the most maddening properties of a tire is its tendency to flatten. Today, tire makers at Michelin and Goodyear are working to end this nightmare. Consumers can expect to see the run flat or self-supporting capability a common feature of passenger-car tires.



What's next? Well, despite their recent radicalism, the taciturn response among tire scientists is that "they'll be round and black for a long time."

Off the record, however, one visionary engineer did dare to dream beyond where the rubber hits the road. "Way out there," he says, "I guess there would be no tires. You know," he says, his hand gliding away, "just air." But would they still charge extra for whitewalls? DO

ELECTRONIC UNIVERSE

SIMLIFE:
Life goes on and on and on

By Gregg Keizer

It took long enough. Last century, Mendel figured out genetics. Early in this one, Morgan discovered the chromosome. Thirty years ago, Watson, Crick, and Wilkins won a Nobel Prize for devising DNA's double-helix model. Five years ago, the U.S. Patent and Trademark Office issued the first patent for a genetically engineered animal, a mouse. But not until now, a few measly years from the millennium, can we work it out for ourselves.

You may have skipped college biochemistry, but you won't want to skip one of this year's most intriguing simulations, titled, appropriately enough, *SimLife*. Call it a genetic lab in a floppy, call it a toy for the recombinant DNA engineer in all of us; call it anything you want. Just call it up on your computer. *SimLife* is a must-have on your hard disk drive.

Maxis, the publisher of *SimLife*, knows electronic life. Its *SimCity*, *SimEarth*, and *SimAnt* trilogy let you play with cities, planets, and backyard ant colonies; gave thousands hands-on experience with urban decay, continental drift, and scorpions, and along the way, breathed some originality into personal computer software. *SimLife* is its best yet.

All creatures great and small; out of the primordial soup and onto your computer screen.

It's also the toughest to grab hold of. Blame the nearly bewildering set of controls, for this simulation puts up more windows, menus, buttons, and graphs than most mainline business programs. You'll get lost, literally, in this program at least once. But the payoff—a successful ecosystem with custom-designed creatures—is so big you won't mind.

You can start from scratch by building a world from the ground up or play around with one of the half-dozen scenarios bundled with *SimLife*. Though it's ultimately more fun to do it your way, it's best to start with one of the existing worlds. The dinosaur scenario may not be the easiest, but it's an attention grabber.

Like *SimEarth*, a distant cousin to this simulation, *SimLife* lets you populate the world with creatures great and small, plant plants, and generally play God in only one day. And just as in *SimEarth*, *SimLife* includes disasters you can rain upon the heads of your ungrateful progeny, although the names have changed and include an oh-so-modern sexually transmitted disease and an invasion of real-estate developers (no kidding). You can also modify such things as rainfall and temperature or play with some physics, like the length of day or caloric content of food. So far, standard stuff.

But the best is buried a bit under the surface. With *SimLife*, you can mess around with any of the plant or animal species, changing any of their genetic characteristics, even their sex life.

To fashion a new species, for instance, you head to the Biology Lab, a set of screens where you build a composite of its major characteristics, and then let the computer do the rest. Or you can delve deeper into genetics and actually select a species' genomes. When you're making plants, you get to pick everything from its gender and seeding technique to its evaporation rate and moisture retention. With animals, it's more complicated, naturally. Just a few of the possibilities include methods of movement, gestation period, life span, and food sources. If you've got an artistic bent, you can even draw the pictures that will represent the species on the screen.

Of course, you can modify existing creatures to make them better suited to their environment or compete successfully against predators. In fact, you'd better. Leave a *SimLife* world to its own devices and you'll probably end up with a dead planet.

When you do leave the computer and *SimLife* to their own devices, they quietly conspire against you. That's called evolution. Plants and animals mutate behind your back, slowly changing and adapting until they metamorphose into a new species. If you're lucky, they'll live longer, but don't count on it. There are as many evolutionary dead ends here as in reality. If that bothers you, you can force a deviant species back into genetic line. Darwin would have *loved* that.

SimLife isn't the first program to synthesize life—*Life* and Autodesk's *CA Lab* came first—but it is the world's best scientific software toy.

Go forth and multiply. And mutate while you're at it. DC

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(Photographic reproduction of DCG hologram by Michael Medora)

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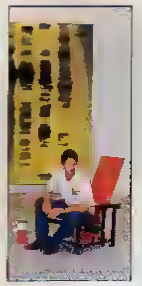
BOOKS

THE SHAPE OF BOOKS TO COME:
A collaborative book (?) challenges ideas about the immortality of art

By Robert K. J. Killheffer



The experimental *Agrippa* (below) blends the book of yesterday with the book of tomorrow. Above, artist Ashbaugh in his studio.

When we think about art and literature, we often think of huge granite and marble libraries and vast museums like the Metropolitan or the Louvre. We tend to place high emphasis on the permanence of these twin pillars of our culture. Libraries spend millions maintaining their collections, and museums likewise on restoration and cleaning.

But one of the functions of art and literature is to challenge our assumptions. Now cyberpunk guru William Gibson and artist Dennis Ashbaugh have collaborated on *Agrippa: A Book of the Dead*, an elaborately conceived marriage of antique bookcraft and modern computer technology that may alter our conceptions of the immortality of artworks.

Agrippa was published last September by art-book publisher Kevin Begos, Jr. A 95-copy edition costs $1,500. (The ten deluxe copies go for $7,500 each, while a simpler 350-copy edition is priced at $450 each.) At its heart is a diskette containing the text of Gibson's story. Ashbaugh created a weighty, worn-looking book to house the disk, illustrated with his copperplate engravings. The oversized book's pages feature an alphabetic representation of a strand of DNA—a continuous series of the letters A, C, G, and T, standing for the four basic building blocks of DNA: adenine, cytosine, guanine, and thymine.

Sounds interesting, you say, but what's so special? There's a catch: An encryption program on the disk devours the text as you read it, so you can only read it once. And Ashbaugh's etchings mutate when exposed to light—some of the ink vanishes while other images appear. So for all the care that went into its production, *Agrippa* will not "survive" a single reading intact.

Reactions to this audacious project have ranged from excitement to outrage. Begos says at least one person insisted, "It's not a book," but most have reacted with "a combination of admiration and discomfort." Begos likes the idea of challenging people's perceptions. "Our assumptions about books and bookmaking are in some ways like all our romantic ideas about life," and therefore "worth questioning."

Ashbaugh, somewhat facetiously, calls *Agrippa* "the most important book since the Gutenberg Bible." That he admits may be overstatement, but it *has* been a long time since any project challenged bookmaking concepts so strongly. Electronic books have been threatening to force this sort of reevaluation for years, and perhaps now, with *Agrippa* and the recent release of the Sony "Bookman," they will finally do so. But *Agrippa* challenges perceptions on a number of levels. The book feels like an ancient volume. It's oversized, to be read at a lectern not on the subway, its pages are heavy rag, its binding handsewn, and its page design reminiscent of the earliest printed books. Yet the text is not words but DNA code, and Ashbaugh's "book" is actually a container for the book of the future, a floppy diskette. In fact, *Agrippa* is more art object than book—the arbitrary division between art and literature is wholly erased.

One further twist was added to the *Agrippa* project on December 9 when the text of Gibson's story was broadcast via modem to viewing sites across the country and in Japan and Germany. Venues varied from the turn-of-the-century charm of the Americas Society in New York to a room in the University of Tallahassee's art department. Such an event is an open invitation to computer hackers to tap in and acquire Gibson's story free, but *Agrippa*'s makers don't see that as a drawback. As Ashbaugh puts it, "They only get the text." They miss all the context, which is a vital part of the impact of *Agrippa*. And that hijacked text will still contain the encryption program, which few computer pirates will be able to defeat. Says Begos: "You'd have to hit it with a lot of brute mathematical force. Anyone with access to a supercomputer would have a chance, but you couldn't do it with a PC."

Where will it all lead? No one can say least of all Begos, Ashbaugh, and Gibson. But *Agrippa* raises issues about the shape of books to come, issues we'll all be confronting, like it or not, in the very near future.

SPACE

A CONVERSATION WITH BUZZ ALDRIN:
The Apollo astronaut outlines his plan to save the space station

By Brenda Forman

Maybe we should call it the Once and Future Space Station When President Reagan first announced plans for space station *Freedom* in 1984, it was to be flying in 1992 Instead political battles over its funding, purposes and design have raged almost continuously Congress has mandated some half-dozen redesigns thus far Even so the House of Representatives almost killed its funding in 1991, and further funding cuts appear quite possible

The second man on the moon, Bezz Aldrin, wents the United Stetes to cooperate wilh Russia on the spece station.

In space parlance this is a decaying orbit

Apollo astronaut Buzz Aldrin views this deteriorating situation with increasing alarm Recognizing that the station's cost is the central issue, he has been trying to enlist support for options that would preserve as much as possible of what the United States and its international partners in the space station—the European Space Agency, Japan, and Canada—have already developed while adding up to a taster, less-expensive and therefore more politically viable program

Coming from the second American to leave his footprints on the moon Aldrin's views carry weight "Congress is only being given all-or-nothing choices for the space station," he told *Omni* "I'm trying for something in between putting the pieces together in more cost-effective ways"

The end of the Cold War has helped by opening up some options that were once unthinkable The Russians have formidable assets that could complement our own in important ways

Aldrin suggests that we start by teaming our launch capabilities The Russians' huge *Energia* rocket can lug a whopping 220,000 pounds to low Earth orbit (LEO) That's more than four times the capacity of either the shuttle or the *Titan 4*, our largest rocket But the Russians have no working equivalent of the shuttle "*Energia* and the shuttle could take payloads up in tandem," Aldrin explains "*Energia* would do the heavy lifting, and the shuttle would then rendezvous with those payloads bringing astronauts up to assemble them"

Aldrin sketches out possible launch and assembly sequences for the station "Right now, we're going to need about thirty shuttle launches to get the baseline station into orbit, because you have to break up station components to fit inside the shuttle bay But with the *Energia*, we could launch those pieces in bigger chunks and get them up a lot faster—and at the prices the Russians are quoting these days, a lot cheaper, too—while the shuttle could do what it does best bring humans up to put it all together and deal with the unexpected"

Aldrin envisions a series of four *Energia*-followed-by-shuttle launches to loft the station's main elements "We could take the station truss [the crosspiece on which the station's pressurized modules, solar panels, radiators, and external experiments are hung] up first Next would be the U S lab and habitation modules After that we'd take the JEM [Japanese Experimental Module] and the [European Space Agency's] Columbus module"

Eventually, Aldrin would also like to see a new large-volume, single-launch version of *Skylab*, staffed continuously, added to the station

"In theory," Aldrin continues, "we could do all that by ourselves in a low-inclination orbit"—the station's planned inclination of 28 5 degrees The optimal inclination for the *Energia* is 51 6 degrees, where the Russian space station *Mir* orbits "But whatever you decide to do you need everything to be in the same orbit," Aldrin says "And the trouble is that the booster capable of putting all that up faster, cheaper—and maybe safer—doesn't belong to us Furthermore, it would take at least five years and billions of dollars to develop it

"If we went for the higher-inclination orbit and used Russian assets together with our own, we could all benefit," he says "We could either construct a facility to co-orbit with the *Mir* or join forces with the Russians to upgrade the *Mir*'s capabilities and attach *Freedom*'s habitation module to it and triple its capacity"

Aldrin's proposals may meet with skepticism from U S firms worried about losing business to the Russians However, unless we do something along the lines that Aldrin proposes, the space station's steady downward spiral will continue, and eventually, Congress will simply kill off the station, wasting years of effort and billions of dollars without ever having actually flown anything in space ∞

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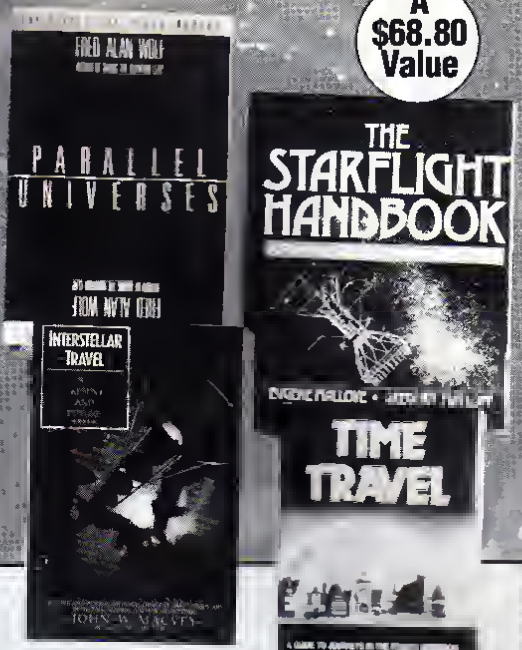

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SOUNDS

ROLL TAPE

Digital technology meets the audio cassette

By Robert Angus

It looks like a tape cassette, and it sounds like a compact disc. It's the digital compact cassette (DCC), the logical successor to the ubiquitous audio compact cassette that's been with us for the past 30 years.

Digital audio tape (DAT), introduced a couple of years back, actually brought digital technology to tape, but its high price, a political squabble with the recording industry over copying, and some technical bugs kept it from broad acceptance. DCC claims to be successful in addressing these concerns.

Not vice versa: Digital compact cassette players can play conventional cassettes, but conventional tape decks can't play DCC tapes.

DCC is more rugged and durable than the compact cassette, it's smaller than a compact disc, more portable, and less susceptible to damage, and, of course, you can record on it. All of these make it ideal for portable or automotive use. However, like all tape, DCC eventually wears out.

When the compact cassette first appeared in the early 1960s, its developers protested that it wasn't intended for music reproduction; it was created instead as a dictation medium. Music lovers and audiophiles refused to pay any attention, however, and, thanks to heavy doses of innovation like Dolby noise reduction, those gray plastic wafers evolved into the primary medium for recorded music in the early 1990s. At their best, today's audio cassettes represent state-of-the-art analog recording.

Nevertheless, the cassette's inventors think it's time to upgrade it to the Age of Digital Sound. Compared to compact discs, cassettes just don't sound very good. They suffer from, among other things, mechanical problems caused by inferior or well-worn players and manufacturing shortcuts that cause the tape to jam inside the shell and the pressure pads to come apart.

When engineers set out to create a cassette for the 1990s, they kept in mind the need to provide some compatibility with the older variety while upgrading sound quality and improving structural design. Thus, the new digital compact cassette has roughly the same outside dimensions as the original compact cassette, so DCC players can play back conventional cassettes as well as the new digital variety. The new decks won't record on conventional cassettes, although they will make digital recordings on DCC blanks also. Older cassette equipment can't accommodate the new tapes.

DCC players and recorders soon will be available from several manufacturers at prices in the $700–$1,000 range. Prerecorded digital cassettes cost about the same as a full-priced CD, while blank 90-minute digital tapes cost about $10 each. The first DCC units are full-sized components meant for a home stereo system. It's likely, however, that automotive playback units and boom-box portables will be available within a year at prices $100 to $200 above conventional cassette models.

DCC decks also include a circuit designed to prevent using the decks to make copies of recordings for resale. While you can use your DCC recorder to make as many copies as you like—one at a time—of any CD or nondigital material, you can't make digital copies of your DCC tapes.

As its name implies, DCC uses digital recording techniques to attain sound quality approaching that of the compact disc. It differs from the CD sonically in that it uses a signal-compression technique called Precision Adaptive Subband Coding (PASC) to squeeze the necessary digital information onto the tape. Experts claim that even the platinum-eared can't reliably tell the difference between PASC and conventional CD versions of the same music, although the latter enjoys slightly better dynamic range.

No matter how sweet DCC sounds, however, it may very well have trouble attracting buyers in today's tight economy. DC

Robert Angus has been writing about consumer electronics for 35 years for numerous publications, including Penthouse *and the* Chicago Sun-Times.

THE WORLDVIEW DOCTOR

The world's first private practice in personal anthropology

By Judith Hooper

It took a community of Rastafarians to put Charles Case's worldview on the line. This was nearly two decades ago when Case, a cultural anthropologist, was field-testing an interrogation method designed to elicit the philosophy, or worldview, of Rastas living in Brooklyn, New York. At least that was the *idea*. What happened was that his subject turned the tables on him by fending off each of his questions with a question about himself, thus pushing Case—somewhat reluctantly at first—into the deepest strata of his own belief system. Out of this experience came a novel form of self-analysis, or "personal anthropology."

"You don't have to go to New Guinea," says cultural anthropologist Case. "Manhattan is full of cultures as fascinating as the primitives."

"The closest thing Rastas have to a ritual is discussion. They smoke ganja and then dialogue. They'll take the *New York Times*, say, and discuss it philosophically, theologically, psychologically," explains Case, who is a faculty member of The New School in New York City. "They've developed a sensitive means of probing people's belief systems, and they also use it to defend themselves. They did to me what I'd tried to do with them."

Instead of doing his fieldwork among a less inquisitorial culture, Case continued to map in detail the topography of his own "personal culture." Some revelations were surprising, some painful. A religious agnostic, he was startled to unearth a deep vein of spirituality—a belief in a "conscious energy" in the universe.

When Case proceeded to apply his methodology to other worldviews, "the world's first private practice in anthropology" was born. Yuppies, artists, corporate managers, doctors, lawyers, the terminally ill, even convicted murderers in a maximum-security prison have come to Case over the past 17 years to have their personal cultures clarified. "You don't have to go to Arizona or New Guinea," says cultural anthropologist Case. "Manhattan is full of cultures as fascinating as the primitives."

At the heart of his system are the "Whys." This barrage of "why" questions—some 40 to 50 in a row—compel the client to "burrow deeper into his or her belief system." Being on the receiving end of the Whys (as I can attest after undergoing a short session) is a powerful, often dislocating experience not unlike conversing with a relentless toddler. Say you mention in passing that you live on New York's Riverside Drive. "Why?" you're asked. You flounder in a sea of unexamined postulates: you feel like Alice talking to the caterpillar, asking yourself weirdly, "Why *do* I live on Riverside Drive?" The process leads inexorably to its end point: an unanswerable question. You have uncovered a core belief.

After reversing the order of six interview sessions, going from the last unanswerable question back to the initial statement, Case transforms this record of your inner world into something that reads like a coherent philosophical treatise: "a description of your reality in your words—your own Worldview Book." Case claims he's never met a person who lacked a personal philosophy. "You couldn't get out of bed in the morning if you didn't have a set of beliefs about the world. But the vast majority of people have belief systems that are internally inconsistent, figured out on an ad hoc basis. Some have refined their philosophies to a high degree. What they get from the technique is a creative boost."

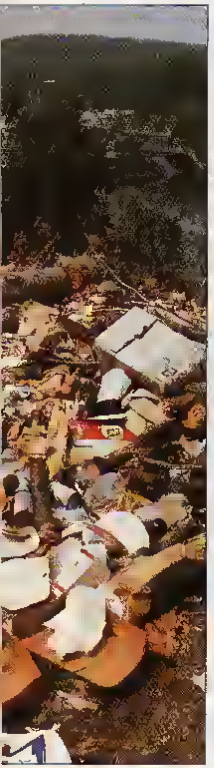
What sorts of revelations emerge during personal anthropology? A well-known sculptor in her seventies discovers in the course of the Whys that she has a deep-seated confusion about who owns her art—she or the collectors. She resolves it by talking to other artists. A photographer whose core issue was a conflict between the "internal" and "external" finds to her surprise that this very conflict is the source of her creativity. A murderer unearths the real reasons for his crime. A divorced mother traces her reluctance to remarry to the fact that she'd been molested by her stepfather and fears a similar fate for her teenage daughter.

Yet personal anthropology is emphatically not a form of psychotherapy, according to Case. Unlike therapy, it does not start with the premise that the client has a problem. Psychology emphasizes the unconscious, he says, while personal anthropology "comes out of cognitive anthropology which emphasizes consciousness. You do an inventory of your beliefs. You know the principle of cognitive dissonance?—basically, that if your beliefs are inconsistent, you feel bad? I like to talk about cognitive *consonance*. If your beliefs are consistent, you feel good. Thought energy can travel through a person most efficiently if that energy is not lost in internal conflicts."

EARTH

ENVIRONMENTAL CRIME
Polluters in one community are learning that slime doesn't pay

By Jessica Cohen



Small-town tactics: From California to Connecticut, communities across the country are taking the lead in fighting assaults against the earth. Their aggressive methods: Radically raising penalties and sending polluters to jail.

It was 4:30 on a May afternoon when police blocked off traffic in a small industrial park. They evacuated two buildings and questioned witnesses on the scene. Bomb scare? No. A woman walking down the street had reported a noxious, dizzying odor. And in Santa Rosa, a Northern California city of 125,000, environmental violations are treated as potential criminal offenses—so this was a crime scene. A chemical company had been "off-gassing" a waste product, allowing it to evaporate into the atmosphere.

Police and fire officials were accompanied by an assemblage of gas, electric, public health and Air Quality Control officials to balance investigative expertise with technical knowledge. And the police investigator would later consult with Sonoma County's environmental case prosecutor on gathering evidence to prosecute.

But don't count on this precisely coordinated response to toxic fumes, polluted water, or improperly stored hazardous materials in your neighborhood—at least not yet. Santa Rosa, along with a handful of municipalities scattered across the nation, is in the forefront of a new aggressive approach to environmental violations. And increasingly they are taking offenders to court instead of simply slapping them with annoying fines. Some experts believe that such grass-roots efforts to halt crimes against the planet represent its best hope.

About 90 percent of chemical wastes were illegally disposed of in the early Eighties, according to an Environmental Protection Agency (EPA) estimate. Violations often occurred at the local level. "Most offenders are mom-and-pop type organizations," says Don Rebovich, author of *Dangerous Ground*, a new book about hazardous wastes. "They tend to look like typical businessmen gone bad." And in a study of several Northeastern states, Rebovich found that most violations are reported not by regulators, but by citizens and local police.

Federal law mandates that all police officers have at least four hours of hazardous-materials-response training, and traffic officers 20 hours. But now, only the most progressive police departments go after eco-criminals.

Santa Rosa's environmental evolution could be a blueprint for communities across America. The impetus for change: the police's inept response to an incident involving fumes in a movie theater. Although the fumes turned out to be a harmless "stink bomb," the case pointed up how unprepared the city was for an environmental disaster. Lt. Scott Swanson, then traffic sergeant, investigated the incident and in the process was galvanized to make environmental hazards a priority issue.

In a 1988 advanced officers' training program, Swanson developed a plan to incorporate police in enforcing environmental protection laws. Police are now alert to crime evidence from plumes in the creek to suspicious-looking substances in dumps. The department also sent an officer to an EPA training program in Georgia and hopes to assign a full-time environmental crime detective.

Key to the department's effectiveness is prosecutorial support. Swanson says Sonoma County's environmental and consumer law unit shows what a savvy prosecutor can do in a small community. In his first year, with a budget of $266,500, Deputy District Attorney Jeffrey W. Holtzman wrested more than $400,000 from prosecutions of environmental and consumer crimes. When actions are filed, the D.A.'s office alleges unfair competition and business practices. The warning to polluters: They can no longer dismiss penalties as a cost of doing business.

While rare, such environmentally minded prosecution should increase. The National District Attorneys' Association will soon form a centralized information bank to share data on environmental cases, similar to the databanks created for drug and child abuse cases. Santa Rosa's efforts to fight environmental crime could be the wave of the future. ∞

CONTINUUM

LET'S PUT ON A SHOW:

Theatre thrives *everywhere* in Chicago. Plus, why vultures prey on a Miami building, and fighting the war on caffeine

The Windy City's theatre scene

Scene. Chicago's North Side. Time. Early 1990s and beyond. A group of young actors known as the Shattered Globe Theatre has just presented its production of Ronald Harwood's *The Dresser*. This is guerrilla theatre. Don't look back. The play's the thing. The actors have already produced a diverse menu of plays from Swiss playwright Max Frisch to Britain's Barrie Keeffe, secured their own performance space—the golden wish of every new group in the city—and established a solid administration to keep their company going. And they have only been together for two years. "This first year was about letting everyone go as far as they can go," says Joe Forbrich, one of the founding members. "We were operating by the seat of our pants, learning the business. Now things are getting organized."

The survival rate of a new theatre company is slim, and the actors know it. Indeed, a Chicago theatregoer might view these latest aspirants with skepticism—"Not another new theatre company!" See, they're used to this. The City of Big Shoulders is also the City of Big Theatre, with each week ushering in a wealth of plays, improvisation, performance art, and poetry reading. A large number of these performers are just out of college—the twenty-something crowd with a passion for live stage work.

The story on Chicago theatre has been told once before. In the early Eighties, local companies such as Steppenwolf gained national recognition for their landmark productions (Sam Shepard's *True West* and Lyle Kessler's *Orphans*) and their now-famous resident actors (John Malkovich, Laurie Metcalf). Now there's a new story.

The League of Chicago Theatres, a service organization for area companies, boasted nearly 120 member theatres at the end of 1992. But nearly a hundred other "renegade" groups exist outside the League, performing wherever and whenever they can. On any given night, you might find Chekhov being done in a church basement. Pub owners now thrive by inviting new plays, comedy troupes, and open-mike nights into their back rooms. An espresso bar isn't just an espresso bar here, it's an espresso bar/bookstore/poetry-reading-workshop space.

Although other American cities such as Seattle and Louisville have strong professional companies and underground movements emerging, the mere density of Chicago's scene is shaping the art form for the century to come. Companies have managed to find audiences as diverse as the kind of work being presented. The Goodman Theatre, the city's oldest and most prestigious company, continues to produce plays that explore different cultures and classes for its 22,000 subscribers. Its 1992–1993 season will include two plays about the African-American experience. *Two Trains Running*, by award-winning playwright August Wilson, and the world premiere of Chicagoan Cheryl L. West's *Puddin' N Pete*.

The young masterminds behind Shattered Globe have big plans for their second year, and with endless hours and persistence, they could find themselves in the same position as their neighbor across the street, Touchstone Theatre. Founded by producing artistic director Ina Marlowe in 1985, Touchstone has evolved into what looks like the rising star of regional theatres in the city. Her company's current season embraces the spectrum of contemporary repertoire: Henrik Ibsen's *The Wild Duck*, Bertolt Brecht's *Mother Courage*, and Thomas Babe's *Taken in Marriage*.

Marlowe's commitment to her company and its work embodies the essential spirit of the modern theatre artist. For her, it is "a lifetime of work." She produces "language-driven" plays that "stir the soul." Even with many artistic and financial hurdles in front of her, she plans on her company's future. "We believe the audience exists for serious theatre and that our vision, determination, and passion will bring them to Touchstone."

The potential for a new American theatre lies in the communal bonds between theatre artists and the public who supports them. If can happen anywhere. The 1992 Pulitzer Prize for drama was awarded to *The Kentucky Cycle* by Robert Schenkhan, a six-hour, nine-play epic, which has only been produced in Seattle and Los Angeles. It was the first Pulitzer awarded to a play that was not produced in New York City. This acknowledgment of a nontraditional work by an often geocentric award can be seen as a wake-up call to those who make theatre and those who enjoy it. The future of playmaking is wide open. The stage is set. It is up to us to collectively raise the curtain. —*STEPHEN SERPAS*

CONTINUUM

Turkey vultures really like a building in Miami s skyline

A ROOF WITH A VIEW

Every year, about two weeks before Halloween, hundreds of turkey vultures descend on Miami like snowbirds from hell, roosting in the daytime on the pyramid-shaped roof of the Dade County Courthouse. They remain in town all winter, soaring up to 25 000 feet over the busy downtown area and commuting for offal to the city's garbage dumps or the Everglades.

Since the courthouse was built in 1925, the huge birds have migrated from New York, Ontario, and other northeastern nesting grounds to the stepped roof that still towers above most nearby buildings. They like the roof because they can simply step off and catch a rising thermal like an elevator, effortlessly riding it to search for food.

The turkey vultures (*Cathartes aura*) began migrating to Florida "long before the courthouse existed," says biologist Sheila Parness Gaby. The arrival of the big birds—' the only major wintering population of urban turkey vultures in North America,' Gaby says—signals the end of the sweltering summer in South Florida and the onrush of the more lucrative snowbirds who fill the hotels and condos all winter. By the first week in May, the snowbirds and the vultures have departed.

The birds cast a bizarre and ominous shadow over the courthouse, symbolic of the business conducted below them. Jokes abound about how the vultures on the roof are attracted by a professional kinship to the lawyers in the courts below, according to Gaby.

About 300 turkey vultures may occupy the roof at one time. They spend the nights roosting in trees on nearby islands but return to the roof each day. Gaby, who wrote her doctoral thesis on the vultures, says the same vultures probably visit the roof each year.—Ben Barber

"Fear not that thy life shall come to an end but rather fear it shall never have a beginning.'
—Cardinal Newman

FEED ME, MICROBE

Plants in the legume family, including beans and alfalfa, sing a siren's song of symbiosis for a soil bacterium called rhizobium. The legumes emit chemical signals to which rhizobia respond by setting up colonies in the plants' root systems. There, they lead a sheltered life for which they pay by helping the plants capture nitrogen, a valuable nutrient, from the surrounding air.

Armed with those insights and more about the cozy relationship between plants and bacteria, Stanford University biologists have identified a molecular and genetic switch that may eventually allow agricultural scientists to deliver customized, genetically engineered pesticides and nutrients with unerring accuracy to root systems in need of them.

This provides a level of finesse that we haven t had before,' explains Sharon Long, who directed the research. "We have discovered the gene response mechanism that the microbes use to pick up signals, and we have identified the exact piece of DNA that picks it up."

In effect, the scientists have located a key segment of the rhizobium microbe's genetic code that functions as an activator, responding to chemical messages from the individual legume. The discovery means that biologists can now use existing gene-splicing techniques to attach similar switches to the genes of new, custom-designed microbes capable of producing either pesticides or nutrients. When a plant's chemical signals turn the switch on, the special microbes will release a pesticide or nutrient, depending on which is needed, according to Long.

Such precision delivery will make it harder for most insects to build immunities to pesticides because they won't come in direct contact with them. Also, pinpoint targeting of nutrients will minimize the possibility of fertilizing weeds along with crops.

"It gives you regulatory control over what your microbes are doing,' says Long, who has no ready explanation for the botanical phenomenon. "Doubtless it's a product of long coevolution, but no one has a good explanation."

—George Nobbe

Rhizobium helps alfalfa grow

Oil from industrial users like railroads is being recycled

GREASING THE WHEELS OF PROGRESS—WITH RECYCLED OIL

U S motorists generate about 1 3 billion gallons of used motor oil a year, which they have a tendency to dump into landfills where it pollutes ground water sources according to the Environmental Protection Agency Now a Houston company has come up with an inexpensive way to recycle used lubricants into high-quality gasoline and home heating fuel

Since March, Lyondell Petrochemical has been processing 500 barrels a day of used motor oil obtained from various large industrial users quick-oil-change businesses, and municipal oil-collection programs

"It's a fairly straightforward technology,' says Lyondell's president and chief executive officer Bob G Gower, noting that his company screens the used oil three times for unwanted chlorides and oxygenates before blending it with crude oil and some refined hydrocarbons The mixture is then separated under extreme temperatures, resulting in grades of gasoline and heating oil that Gower claims are "of the same high quality we normally get from crude oil

Currently, Lyondell plans to continue collecting used lubricants from only the sources already involved in the recycling project Gower points out that some gasoline retailers already accept used oil from individual motorists "We're not set up to handle that right now,' he adds, ' but we think systems like that will develop '

Lyondell intends to recycle some 30 million gallons of lubricants yearly and substitute them for raw crude in its own refining operation, Gower says That volume equals the dirty oil produced by 25 million passenger cars If other refiners follow suit, he says "it will have a significant impact on the environment and reduced oil imports We're perfectly willing to provide our technology and information to others.'

—George Nobbe

"If you are to persuade, you must appeal to interests rather than intellect "

—Benjamin Franklin

IT'S A BOY—AGAIN

Genetic engineering still has a way to go before it can match the ability of the howling monkeys of Costa Rica The creatures whose impressive leonine roars belie their diminutive size, can apparently select the sex of their offspring It s a good thing they can because 87 percent of the infants born to females on the bottom rung of the howler social ladder die before their time

'With more male offspring, the females have a better chance for their genes to be maintained in the general population because of this greater genetic return ' says Kenneth E Glander, a primatologist who directs the Duke University Primate Center in Durham, North Carolina He has spent 22 years studying howlers in the tropical dry forests of Guanacaste Costa Rica, near the Nicaraguan border There, he noticed that groups of the black animals seemed to be evenly divided between males and females, even though some mothers had produced as many as nine babies, all male The two that survived in one such family later controlled many females, an oddity that intrigued him

The key seems to lie in the ion concentration, or electrical potential, in the female howler's reproductive organs Examining sedated monkeys, Glander found a significant ion variation between the vagina and the opening of the uterus He theorizes that positive charges restrict sperm with positive X chromosomes, which often produce females, but support negatively charged Y chromosomes, which result in males

"This is not a reasoned, conscious decision by the female," he says "It is somehow selected for her by nature When she goes into estrus, she is responding to hourly bodily changes that could be the result of what she eats '

LIGHTNING FLASHES DOWNWARD AS FAST AS 1,000 MILES PER SECOND, OR 3.6 MILLION MILES PER HOUR

A 100–TON BLUE WHALE EATS ABOUT FOUR TONS OF KRILL EACH DAY

Glander plans to work with more howlers to confirm his belief that mating females alter the ion concentration of their reproductive organs by eating foods rich in potassium and sodium, which produces males, and shunning plants containing calcium and magnesium, which would lead to more females

—George Nobbe

CONTINUUM

Canning cancer: New research uses pectin, which binds jellies

BEATING THE SPREAD

One of the key problems in combating cancer is stopping metastasis, the spread of malignant cancer cells throughout the body. David Platt and Avraham Raz, researchers at the Michigan Cancer Center in Detroit, may have found a way to arrest that deadly spread by means of an unlikely agent—modified citrus pectin (MCP). Pectins are complex carbohydrates found in the cell walls of all fruits and vegetables, and they are commonly used to bind jams and jellies.

A crucial step in cancer's spread occurs when tumor cells clump together in the bloodstream, eventually lodging in a capillary. From there, the malignant cells can bore through the blood-vessel wall, invading surrounding tissues and organs. The trick, Raz says, is to keep these cells from clinging together and that's where the modified citrus pectin comes in. Once injected into the blood stream, the MCP attaches to just one or two stray tumor cells in the blood, which is enough to prevent larger aggregates from forming.

In experiments with mice, intravenous injections of MCP completely blocked the advance of melanoma cells to the lungs. Raz is currently conducting experiments to determine reasonable doses. He will then apply to the National Institutes of Health for permission to test MCP on humans.

The researchers anticipate no side effects because pectin is completely nontoxic. MCP won't replace conventional radiation and chemical therapy, Raz says. "But by limiting the total number of tumor cells in the body, it can make that therapy more effective."

—Steve Nadis

"Don't be afraid to take a big step. You can't cross a chasm in two short jumps."

—David Lloyd George

THE OLDEST IRON DAGGER IN THE WORLD WAS UNEARTHED AT UR IN PRESENT-DAY IRAQ. THE WEAPON WAS FORGED 5,000 YEARS AGO FROM A METEORITE.

SLIPPING INTO TWO-WHEEL DRIVE

Ever wipe out on your bike when hitting a patch of sand or gravel or when riding on wet, icy roads? The two-wheel drive bike may solve your problems.

Invented by entrepreneur Bill Becoat, the new contraption operates like a conventional bike, save for a strong cable linking the two wheels. As a rider pedals, extra gearing transmits torque from the back axle through a flexible, spinning, steel cable to gears that drive the front axle. Like a four-wheel-drive car, power is sent to all wheels. Therefore, if one wheel slides or spins on a slick surface, the other retains its grip. Every one of the hundreds of riders who have tested his bikes, Becoat says, have testified to experiencing greater traction, more stability, and better handling as they cruised over varied terrain.

Pedaling also comes easier. Because the torque is split between the wheels, the bike has 10 to 30 percent less rolling resistance than regular bicycles, depending on the surface, according to Richard Klein, a professor at the University of Illinois and a leading theorist on the mechanics of bicycles, who consulted with Becoat during the bike's development.

Becoat's quickly growing St. Louis, Missouri, company, called 2 Bi-2, has sold more than 5,000 bikes. On average, the bicycles weigh several pounds more and cost $40 to $100 more than their single wheel-drive counterparts.

Why hasn't the world clamored all along for two wheel drive bikes? "Just because no one ever envisioned it," says Becoat, a former building contractor who admits to stumbling on the idea after growing tired of fixing the loose chain on his son's bike.

—Mark Fischetti

Building a better bicycle

CONTINUUM

THE COFFEE HABIT?

There's no Coffee Drinkers Anonymous yet, but some psychiatrists feel that caffeine consumption may pose more of a problem than we think. They would like to see caffeine withdrawal classified as a legitimate psychiatric condition in the next revision of the American Psychiatric Association's *Diagnostic and Statistical Manual*.

According to psychiatrist John Hughes of the University of Vermont, evidence exists for caffeine withdrawal. Studies have shown that some people suffer from headaches, fatigue, and drowsiness—signs of withdrawal—when given decaffeinated java rather than the real thing.

So far, there's no evidence of caffeine abuse or dependence, but because these haven't actually been studied, Hughes says, the jury is still out. He traces this scientific neglect to the lack of medical problems stemming from caffeine use. "Our society," he says, "is not worried about drugs of dependence unless they have medical consequences." Even so, he suspects future studies may show that caffeine does have negative effects on the health of some people.

In his practice, Hughes has seen patients with behavioral problems such as restlessness, insomnia, and difficulty concentrating that he attributes to caffeine intoxication. Many patients also report that caffeine worsens their anxiety disorders, he says, and some evidence indicates that it causes panic attacks in certain people.

But don't get anxious about your coffee habit just yet. Hughes is not optimistic that caffeine withdrawal will achieve the status of a psychiatric condition in the revised edition of the *Manual*. "I wouldn't bet on it," he says.—Paul McCarthy

I CAN'T GET NO SATISFACTION HORMONE

Scientists recently found that oxytocin, a chemical discovered 90 years ago that has become one of the most-employed obstetrical drugs in the United States, can give rise to a number of "satisfaction states." While researchers have only begun to explore its possible applications, they speculate that it could prime females for sex, strengthen monogamous relationships, relieve penile dysfunction, generate blissful satisfaction and bonding between mothers and their nursing infants, make females act maternal with children, relieve depression, and even make friends stay friendly.

In humans and other mammals, oxytocin is released by the body's pituitary gland, thus entering the bloodstream. Researchers have found that the chemical is also present in the brain, linking it to a host of satisfaction states.

This so-called satisfaction hormone "may mediate the good feelings animals have in all sorts of interactions," says Jack Caldwell, research assistant professor of psychiatry at the University of North Carolina at Chapel Hill. He cautions that much more study is needed on how oxytocin works and how its actions are modified by other hormones and chemicals, but he says oxytocin research may lead to drugs that alleviate birth blues, depression, and premenstrual syndrome. Scientists have also found oxytocin receptors in the thymus, implying that it may have an effect on the immune system as well.

Exactly how it works "is the sixty-four-thousand-dollar question," he says.

So when can you run down to the store for some oxytocin diet or sex or antidepression pills? Not soon. So far, Caldwell says, the hormone can be administered only by injection, nasal spray, or as an agonist, a chemical that fits an oxytocin receptor though it differs slightly from the original. And while there are patents out on such agonists, they're far from being ready for mass use.—Peggy Noonan

IN ONE YEAR, LIGHT TRAVELS 6,000 BILLION MILES

WHILE LIVING IN MEMPHIS FROM 1866 TO 1867, THOMAS EDISON INVENTED A DEVICE TO ELECTROCUTE COCKROACHES

"If you stay in Beverly Hills too long, you become a Mercedes."
—*Robert Redford*

"If you want to have clean ideas, change them as often as your shirts."
—*Gilbert Adair*

THE WALKING WAY

ARTICLE BY MARCELO GAMES

Bipedal walking has been with us, has characterized our kind since the proposed evolutionary beginning

PHOTOGRAPH BY EADWEARD MUYBRIDGE

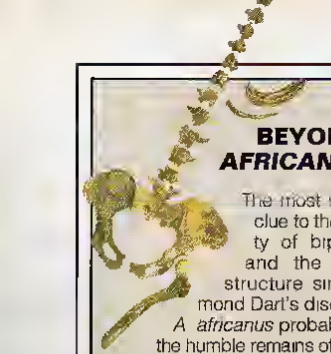
MOST PEOPLE WALK EVERY DAY, SEVERAL TIMES A DAY, AND IN SEVERAL DIFFERENT CONTEXTS. WE WALK IN AND OUT, TO AND FROM, OVER AND UNDER, AROUND, ABOUT, AND BETWEEN. IT'S SORT OF LIKE BREATHING—WE DO IT SO OFTEN AND IT

comes so naturally that we don't even think about it. But if we did think about it, we would soon realize that simple, everyday, run-of-the-mill, bipedal walking is among the most crucial and defining elements of human nature. Humans, in fact, are the only mammals on Earth *designed* to walk in a habitually upright position, using only the hind limbs for locomotion while releasing the forelimbs to a myriad of "extralocomotor" activities. Not even the Great Apes, our closest living relatives, [illegible] with such proficiency. So unique is the notion and the architecture of bipedal walking that it may very well be the hallmark of our species. We are, in essence, the way we walk.

In the early days of anthropology, back at the turn of the century when Darwinism was shedding its baby teeth and naturalists-cum-anthropologists had begun in earnest the process of full-blown public deliberation over the origins of humanity, the major consensus was that the development of a large brain had been the principal factor in the [illegible] of the human species. For years, scholars considered intelligence—abstraction, language, consciousness—to be *the* evolutionary guide to human uniqueness.

The argument began roughly as follows: if human beings evolved from a common apelike ancestor, and human beings are most visibly distinguished from apes by their high level of physical, technological, and intellectual sophistication, it follows that some major adaptive element, such as brain growth, must have been selected to initiate this distinction.

The [illegible] for an early human ancestry, which at the turn of



BEYOND *AFRICANUS*

The most important clue to the antiquity of bipedalism and the hominid structure since Raymond Dart's discovery of *A. africanus* probably lies in the humble remains of the now-famous "Lucy," the oldest (approximately 3.8 million years) and most transitional of the early human prototypes.

Everything about Lucy (genus *Australopithecus afarensis*) suggests transition. She had a small brain, similar in size to that of a common chimpanzee. Her arms and fingers were long and powerful, much like those of a chimpanzee. Her legs however were also long and powerful—more like a human's. Her teeth were arranged in a rectangular fashion within the mandible and maxilla, and they were characterized by large canines and incisors (not quite as large as a chimp's but much larger than a human's).

Lucy's most significant link with humanity may be revealed in the pelvis and lower-limb structures, which clearly were designed to function in an almost completely bipedal manner. The only major difference, according to various scholars, between Lucy and ourselves as far as locomotion is concerned, is that she was designed to be a little more versatile. Lucy appears to have been just as comfortable climbing a tree as she was strolling across the grasslands. *Australopithecus afarensis*, it is argued, may have lived both on and off the trees, emphasizing over time the more adaptive terrestrial mode.

"THE QUESTION OF WHAT GAME FIRST IN HUMAN ORIGINS REMAINS A SIZZLING TOPIC OF CONTROVERSY IN THE FOREFRONT OF ANTHROPOLOGICAL RESEARCH."

the century indicated a prehistory of perhaps 800,000 years consisted primarily of skulls, skull fragments, teeth, upper-leg bones, stone tools, and living sites, all of which suggested a big-brained, tool-manufacturing, upright-walking, relatively intelligent humanlike ancestor. Somehow, for whatever reasons, our earliest representatives developed uncommonly large brains, which sparked creativity and invention, and which, in turn, ignited technology.

Technology required manipulation and precision, and what better than the ever-versatile primate fingers to manipulate precisely? The fingers, hands, and arms, now busy with the manipulating of technology, could no longer be used for walking—hence, the development of bipedal locomotion and all the rest of what would come to characterize the human form. Intelligence, the scholars concluded, was the crucial motivating factor in the divergence of human from the rest of the animal kingdom.

Raymond Dart discovered *A. africanus* in a lima quarry in South Africa.

Ironically, intelligence has all but proven itself a byproduct, the result of a far deeper *structural* variation of an otherwise common primate mold. In 1925, the notion of brain growth as the seed of human fruition received the first official challenge to its credibility. An anatomist named Raymond Dart announced the discovery of an apelike-humanlike skull far more primitive than anything yet recorded and endowed with an embarrassingly tiny noggin. Key to Dart's assessment of the skull's "humanness" (as opposed to "apeness") was the location of a very special hole at its base.

This hole, a common feature at the bottom of every skull, the entryway of the spinal cord to the brain, is the pinnacle upon which the head is balanced in relation to the body. It is called the *foramen magnum*, and it may well be the most telltale clue as to the humanness of an otherwise

MORE CLUES TO "HUMANNESS"

Dart's assignment of the original *A. africanus* skull to hominid status, while initially perhaps determined by the placement of the foramen magnum, also relied on several very suggestive and consistent dental features.

1. *Arrangement*: The human mandible and maxilla—the lower and upper jawbones—are characterized by a curved or arched arrangement of the teeth within them. This is because our faces are flat. Little aside from the tips of our noses tends to be more prominent in profile than our foreheads. In apes, the arrangement is more like a rectangle. The entire mouth of an ape projects outward like a snout, far beyond what amounts to an almost nonexistent forehead.

2. *Size*: Human faces are flat because the front teeth—incisors and canines—are small. They are small because, among other reasons, we no longer use them for any major physical or tactical maneuvering, such as tearing bark from a tree trunk or warding off a potential enemy. (We have guns and knives and hatchets for things like that.) Ape faces are prognathic—they stick out—precisely because apes *do* use their front teeth for major physical and tactical maneuvering. Ape canines are huge and rather intimidating next to our mere ancillary protuberances.

3. *Shape*: Human molars, which are large in relation to the front teeth, primarily because they do the bulk of food processing before swallowing, tend to wear flatly and evenly and are housed in a thick enamel coating. Ape molars, which are relatively consistent in size with the front teeth, tend to wear sharply and in uneven ridges and peaks while being characterized by a thin enamel coating.

In these categories, *A. africanus* consistently appeared more humanlike than apelike, a pattern which would carry over to the many and varied discoveries that followed.

questionable cranium Only in humans apart from all the other primates with whom we share the same basic anatomical machinery is the foramen magnum centered in the skull so that the head rests upon a *vertical midline* This placement is the function the result the calling card of bipedal locomotion

Most mammals are quadrupedal (four-legged) or, in some cases quadrumanal as in arboreal monkeys who use all fours to climb and swing and leap The "locomotor apparatus"—the spinal column in association with the skull pelvis and limbs—is typically designed like a bridge with four legs Basically the spinal column spans from the neck to the pelvis in a slight arch so that weight and gravity are absorbed and displaced along a *horizontal* train of more or less equally sized vertebrae The foramen magnum in these animals is located near the back of the skull so that the head "hangs" from the neck like the scoop of a backhoe The pelvis is long and narrow and lies at an angle to the femur (thigh bone) so that the hip joint lies behind and below the horizontal midline directly across from and parallel to the forelimbs

In humans the locomotor apparatus is designed like a column At the top the spine begins with a single outward arch but gradually curves inward toward the lumbar region (lower back) to form a second arch, thus moving the midline of the trunk forward so that it is centered, along with the skull and forelimbs directly above the hip joint Weight and gravity, therefore, are absorbed and displaced along a *vertical* continuum of gradually enlarging vertebrae The skull balances rather than projects The pelvis shortened and flared like the wings of a butterfly is aligned with the femur and lies beneath and around the midline The human walks upright, stacked like a tower rather than extended like a clothesline

Dart was able to identify the humanoid, or *hominid* positioning of the foramen magnum as well as several hominid dental characteristics on the ancient skull he recovered from Africa's distant past Citing this evidence and the fact that the brain was no larger than a chimpanzee's he proposed that the human walking mode—the blueprint for bipedality—not the growth of gray matter had been the first true 'gait' to the grand fluorescence of humankind The skull was that of a mere child, however and perhaps because adults seem always to know best critics dismissed its importance reminding Dart that even in the modern world the distinguishing features observed between adult humans and chimpanzees are fuzzy until they develop into adolescents

In addition Dart could offer only one example of this supposed "humanape", far more evidence would be needed to substantiate his claim The little skull was deemed indeterminate and the budding world of anthropology happily turned its large brain away from Dart and the audacious suggestion that intelligence might *not* be the root of human uniqueness It was only a matter of time of course before curiosity turned up more of Dart's humanapes—adults, no less, and still lacking in brain development what they more than made up for in bipedal architecture Included among the supporting evidence were teeth, skulls, vertebrae leg and arm bone fragments, pelvic fragments and the very crucial pieces—parts of feet

The foot to divert for a moment, like the foramen magnum, spinal column, and pelvis, is a major signifier of bipedalism Like the pelvis it has been reshaped or molded to accommodate the otherwise awkward two-legged gait In all primates, minus humans, the foot is designed much like the hand—and quite rightly, seeing that both are utilized for the same basic purposes walking climbing grasping In the common primate foot, therefore, the big toe, like the thumb of the hand, is separated from the other toes and is highly flexible or 'opposable'

In humans because weight has been transferred to the vertical midline and centered through the pelvis along the legs and down to the feet, the big toe has become an important stabilizer to the successful execution of the bipedal stride The stride, or gait is composed of a series of skeletomuscular actions (heel-strike, flat-foot, toe-off) which combine to produce two major phases of motion—stance and swing—each occurring simultaneously between the two legs The stance phase occurs in the leg supporting the body as the other in swing phase moves forward to take over Stance begins with the heel-strike body weight moves across the heel, along the outer edge of the foot (flat-foot) and then inward to the ball of the foot and the big toe where toe-off occurs and the body is propelled in a forward direction Swing phase begins with toe-off and proceeds through a series of muscular contractions that swing the leg forward, pulling up the knee and pivoting the body around the stance leg toward the end of the swing and the beginning of a new step (heel-strike flat-foot toe-off)

The human walks or "strides" with a relatively smooth straight, and balanced flow while an ape in the upright

CONTINUED ON PAGE 87

ARTICLE

THE OMNI/ALCOR IMMORTALITY CONTEST

QUESTIONS AND ANSWERS ABOUT CRYONICS

AND HOW TO ENTER OUR REVOLUTIONARY CONTEST • BY CHARLES PLATT

PHOTOGRAPHS BY DAVID MICHAEL KENNEDY

Cryonics is gaining ground. Membership in cryonics organizations grew during the 1980s and has more than doubled in the last five years alone. In 1992, one cryonics group froze three patients in one month. More and more people are weighing the odds and deciding that it makes sense to be frozen when they die in the hope that future medicine will be able to bring them back to life. Are these "cryonauts" fooling themselves? Or will they have the last laugh if they wake up in the far future when all the skeptics have long since been laid to rest? What do you think?

No one can be certain that cryonics will work. Baboons and dogs have been taken down close to freezing and successfully revived, but no animal has been brought back after being frozen to the temperature of liquid nitrogen.

On the other hand, we now have some insight into how it might be possible. Nanotechnology will one day create microscopic molecular machines that can be programmed to repair the cells in our bodies one by one. At that time, we should be able to repair freezing damage and a lot more.

But, even if cryonics does turn out to be

feasible, it will raise substantial social issues. Do we want to spend money and resources maintaining millions of people who are being kept in cold storage? And why should anyone in the future take the trouble to revive these human "corpsicles"?

In consultation with the Alcor Life Extension Foundation (which has more members than any other cryonics group), I've compiled a list of questions that are frequently asked about cryonics—and I've given some possible answers.

What exactly is cryonics?
Cryonics is the process of freezing human beings after death in the hope that medical science may be able to revive them in the future.

How is it done?
Immediately after death—ideally, within a matter of minutes—the patient is put on a heart-lung machine to keep oxygenated blood circulating through the body. Glucose and medications are injected to sustain cells that would otherwise be damaged. At the same time, the patient's temperature is reduced as quickly as possible.

If the patient is located a long way from the cryonics organization, all of his or her blood is replaced with a chemical that's normally used to preserve organs for transplant. The patient is then flown to the cryonics facility and is perfused with a special solution of glycerol, which works as an antifreeze to minimize cell damage during freezing. The patient is cooled to the temperature of dry ice and then transferred into liquid nitrogen at –320 degrees Fahrenheit. At this temperature, no biological change occurs, and the patient will remain unchanged for hundreds of years.

CRYONICISTS BELIEVE THEY'RE SPENDING THEIR MONEY ON A CURE FOR THE MOST SERIOUS ILLNESS OF ALL: MORTALITY!

Is there any real evidence that death can be reversed?
Fifty years ago, any patient whose heart stopped beating was declared legally dead. Today, such cases may be routinely revived using CPR and other methods. The medical definition of "death" has changed over the years, and we can expect future science to revive people who are even more "dead" than those being saved today. Consequently, cryonicists refuse to give up hope so long as the information in the brain is still intact—the memories and cell structure that make us who we are. Elaborate precautions are taken to preserve brain chemistry and structure before a person is frozen.

Have there been any experiments freezing animals?
Yes, although research has been sporadic and underfunded. In the 1950s, hamsters whose brains and bodies had been partially frozen were revived by a British researcher, Audrey Smith, in a series of experiments in Great Britain. In the 1960s, isolated cat brains were frozen to very low temperatures, stored for several months, and then rewarmed, at which point electrical activity—brain waves—spontaneously resumed. This research was conducted by Isamu Suda of the Department of Physiology, Kobe University, in Japan.

How does freezing damage occur?
When water between cells turns to ice, it squashes the cells and tends to puncture them. This damage can be minimized, but it can't be completely prevented—yet. Some research is being done to develop better "cryoprotectants" so that organs can be frozen without damage. Unfortunately, there has been hardly any funding in the past 30 years for this research. Billions have been spent on a cure for cancer, but no one pays much attention to the possibility that cryonics could eliminate the specter of mortality altogether.

Can the damage caused by freezing really be reversed?
Not yet. Cryonicists are pinning their hopes on nanotechnology, the concept of molecular-sized machines popularized by Eric Drexler in his book *Engines of Creation*. According to Drexler, it should be possible within a few decades to build a "nano robot" equipped with an onboard computer and manipuletor arms, tiny enough to be injected into the bloodstream. It would manufacture millions of copies of itself, which would go around repairing damaged cells one by one. If this comes about, there will be some real hope for people in cold storage.

What about memories? Will they be properly preserved?
Scientists are fairly certain that memories are stored in two ways: as links between brain cells and as chemicals in the brain. It seems virtually certain that these links and chemicals are preserved when a person is frozen. Currently, a small research project is trying to verify this.

What happens if there is a power failure?
Nothing! The capsules that contain cryonics patients do not consume any power. Each of them is like a giant thermos bottle containing liquid nitrogen, which boils at –320 degrees

ANNOUNCING THE OMNI/ALCOR
$100,000 IMMORTALITY CONTEST

At *Omni*, we work every month to provide millions of readers with a glimpse of possible futures.

Now, in cooperation with the Alcor Foundation, a world leader in cryonics research, we're offering one of you the chance to see the future firsthand, to be placed in cryonic suspension after death — with the possibility of being revived in the future. That's a prize worth more than $100,000.

As Charles Platt's article shows, the science of cryonics has come of age. Likewise, medical science continues to advance at a phenomenal rate. And that's the hope that cryonics rests upon. In the future, medical science and technology may reach the point at which the cause of your death can be overcome or reversed so that you might be revived to see for yourself the world of tomorrow.

There's never been a prize like this, nor a contest so simple to enter. All you have to do is give the subject a little thought and put your thoughts on paper.

Why should you be placed in cryonic suspension after death? What would you bring to the future? Why should you be selected as the winner of the *Omni*/Alcor Immortality Contest?

Tell us your reason in 250 words or less. Write an essay telling us why you should be selected for possible revival in the future. Entries must be typed or printed. That's all there is to it.

The essays will be reviewed by a panel composed of *Omni* editors, representatives of the Alcor Foundation, and science fiction writer Charles Platt. The winner will be selected based on originality and insight into the opportunities that cryonics offers.

Essays become the property of *Omni* and Alcor. Essays cannot be returned, so keep a copy for yourself. The winning essay will appear in *Omni* and in *Cryonics*, the official publication of the Alcor Foundation, and may be used for other promotional purposes. Your signature on the entry form constitutes your grant to us of these rights. Entrants must be age 21 or over, and the winning entrant will agree to a medical examination at Alcor expense—for insurance purposes, although eligibility for insurance is not a prerequisite for winning the contest—and to the execution of Alcor's standard documents. Only U.S. residents may enter the contest. The prize is not transferable or redeemable for cash. The prizewinner will be required to execute and return an affidavit of eligibility and release within 21 days of the date on the notification letter. Employees of General Media International and the Alcor Foundation or their relatives are not eligible to enter. For the name of the prizewinner, send a self-addressed stamped envelope to Omni, Immortality Contest Winner, 324 W. Wendover Avenue, Greensboro, North Carolina, 27408.

So warm up your word processors and tell us why *you* want a chance at being revived sometime in the future.

Send your entries to Omni Immortality Contest, 324 W. Wendover Avenue, Greensboro, North Carolina 27408. Entries must be postmarked by June 1, 1993, and must be accompanied by your signature on this form or a photocopy.

WIN THE OPPORTUNITY TO BE PLACED IN CRYONIC SUSPENSION AFTER DEATH . . . FOR POSSIBLE REVIVAL IN THE FUTURE.

Enclosed is my entry in the *Omni*/Alcor Immortality Contest. I certify by my signature that I am over 21 years of age and reside in the United States of America. My signature also assigns all rights to my essay, as explained in the contest rules.

Name (please print)_____

Signature _____

Address _____

_____

_____

Fahrenheit. This means that some of it gradually evaporates and has to be replaced. Fortunately, liquid nitrogen is a nontoxic, natural substance cheaply available from many industrial sources. It is delivered in steel cylinders like propane gas tanks.

What if a cryonics organization goes out of business?
In the early days of cryonics, organizations were not properly funded. As a result, there was a substantial risk of insolvency. However, over the years, cryonics has become better established. As a result, the risks have steadily diminished. The Alcor Foundation, for example, has set aside more than a million dollars to pay for the upkeep and the eventual resuscitation of 25 frozen patients.

Why should people of the future bother to revive people who are frozen today?
Cryonics organizations have a moral and contractual obligation to attempt to revive their patients who are in their care. Also, a future society would be just as interested in "people from the past" as we would be today if we had a chance to revive someone from a previous century.

Won't it be expensive to revive people?
Not necessarily. Nanotechnology should follow a spiral of diminishing costs in the same way as microchips and for similar reasons.

Who would want to live in a world of the future?
Anyone who has a real sense of adventure! Bear in mind that people from Third World countries have successfully relocated in the United States. For them, it must have been like a trip into the future. Also, when you wake up in the twenty-second century, you should find that other people who were frozen in your time are being revived with you. Some of them might even be your friends.

Can I invest money now and recover it when I'm revived?
A perpetual trust has been set up in Liechtenstein by the Reanimation Foundation to enable cryonics patients to "take it with them." The trust has been instructed to use the money primarily for reviving patients when the technology is available.

What if my body is old and sick when I die?
When medicine has advanced enough to revive cryonics patients, it should also be able to rejuvenate them.

Isn't it selfish to put my money into cryonics?
No one would disapprove if a hospital patient spent a lot of money to cure himor herself of a serious illness. Cryonicists believe they are spending their money on a cure for the most serious illness of all: mortality!

Isn't death a natural part of being human?
In primitive societies, it was natural for people to die when they were in their twenties or thirties. Currently, it seems natural for people to live into their seventies. In the future, it may seem natural for people to live even longer. No one in industrialized societies lives a "natural" lifespan anymore. We should face the fact that we have already tampered with life expectancy and there's nothing wrong with this if you believe that life is good.

If people manage to avoid death, won't there be overpopulation?
Some time in the next hundred years, scientists may learn how to stop the aging process. Obviously, this is going to create social upheaval. Governments

may try to limit the size of families, or couples may voluntarily decide not to have children in order to preserve their quality of life. Other possibilities include expansion of humanity into space or replicating human intelligence in computers. The number of patients coming out of cryonic suspension will be trivial compared with factors like these.

If cryonics is so wonderful, why isn't it more popular?
To sign up for cryonic suspension, you have to be willing to face the fact that you will die one day. Very few people want to dwell on that. Also, prior to the concept of nanotechnology, no one could imagine how freezing damage could be repaired.

What if there is an afterlife?
When you are frozen, you are no longer alive. Therefore, if there is an afterlife, you should experience it. You can think of cryonics as hedging your bets just in case an afterlife turns out not to exist.

Are any famous scientists in favor of cryonics?
Cryonics is not widely accepted by the scientific establishment. Some doctors in particular have criticized cryonics as being science fiction. Remember though, that some people said exactly the same thing about space travel before men walked on the moon.

No one can prove that cryonics will work. At the same time, no one has enough information to prove that it *won't* work. Some scientists have signed up to be frozen but are reluctant to admit it for fear that it may harm their careers. One man who has openly committed himself is Ralph Merkle, a research scientist at Xerox PARC in Palo Alto, California. Merkle is one of the world's experts on nanotechnology and has written papers examining the feasibility of cryonics. He believes that if a cryonic suspension is properly carried out, nanotechnology will offer an excellent chance of resuscitation.

What kinds of people sign up for cryonics?
All kinds. Most are in the middle-income bracket, and they pay for it by taking out life-insurance policies that pay the cryonics organization when they die. In addition, some of the richest people in America have signed up. Don Laughlin, who founded the city of Laughlin, Nevada, and has a net worth of around $300 million, has talked publicly about his involvement in cryonics. Others prefer to remain anonymous.

Is cryonics legal?
The State of California brought a lawsuit attempting to outlaw cryonics. This was recently defeated. Cryonics is currently outlawed in British Columbia, Canada, but is legal everywhere in the United States.

How do you sign up?
Write or call any of the cryonics organizations and ask them for information. Here are the details for Alcor, co-sponsor of our contest.

Alcor Foundation, 12327 Doherty Street, Riverside, California 92503, (800) 367-2228. This is the largest cryonics organization. It pioneered some of the technical advances in the way cryonic suspensions are performed.

But if you'd like a *free* ticket into tomorrow, maybe you should enter *Omni*'s cryonics contest. The author of the winning entry will receive a free reservation at the Alcor Foundation, worth over $100,000. For details, see page 43. ∞

Science-fiction writer Charles Platt, author of *The Silicon Man*, has made arrangements to be placed in cryonic suspension after death.

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ARCHITECTS OF TOMORROW

Predicting the future is tough. Even tougher is predicting the future—and then changing it to fit your plans and desires.

On a scorching weekend last summer, the World Future Society held one of its meetings in Anaheim, California. The futurists could hardly have chosen a more appropriate place. On one side of their convention hotel was Disneyland, the very home of innocent, timeless joy, and on the other lay the rapidly changing real world with all of its unexpected problems and disquieting fears.

If the whole world is moving toward tomorrow faster than ever before, it's Southern California that leads the way. The area built its boom years on such high-tech industries as oil, aerospace, and the movies. Now it's caught in a morass of problems: health-threatening air pollution, year after year of drought, earthquakes ominously creeping closer to major urban areas, the 1992 South Central Los Angeles riots that destroyed a billion dollars worth of property, cutbacks in federal contracts that sent a lot of highly paid technical people to the unemployment office, and a state government that has had to start paying its creditors with IOUs. After spearheading the advance into the expansionist twentieth century, Southern California stands first in line for the twenty-first, when all the bills come due. If the science of "futurology" hadn't existed, the Californians would have to invent it now.

ARTICLE BY FREDERIK POHL

ILLUSTRATION BY FRED OTNES

The World Future Society's conference on "Creating the 21st Century: Institutions and Social Change" was there to help them puzzle out their prospects and then take action to remold them nearer to the heart's desire.

That's how the World Future Society works. Most people look at the future in two ways. Sometimes they think of it as a remorseless, monolithic juggernaut rumbling 24 hours closer every day. Sometimes it looks like a giant roulette wheel on which the little ball may land capriciously in this set of circumstances or that—each one filled with differing promises or problems—or maybe even drop disastrously into the double-zero slot where everybody loses and we're wiped out by environmental catastrophe or nuclear war.

The 30,000 members of the World Future Society don't buy either scenario. They take a more energetic view of tomorrow. They want to probe the whole spectrum of possibilities that the future holds and alter them to fit the needs of the time. "Everybody talks about the future," they say, "but nobody does anything about it . . . except us."

Naming the future. Yes. Virginia, there is a science—or something—with the name of "futurology" or "futuristics," or sometimes just "futures research" or "future studies." None of its practitioners are thrilled about the names by which it goes. They don't all agree on just what it is, either. If it's not as yet a real science, Howard Didsbury of Kean College of New Jersey considers it at least an academic discipline and has prepared a core curriculum for prospective teachers of the subject. Wendell Bell calls it a "transdisciplinary matrix" and Robert Jungk (who is not only a futurist by vocation but ran for president of Austria on a futurist platform and actually got more than 5 percent of the vote) a "horizontal field"—meaning that futurists specialize in generalities. Futurology has fuzzy boundaries. Since it deals with the *whole* future, it pretty much has to take in every aspect of human affairs, which is why Michael Marien, the editor of *Future Survey*, calls it a "multifield." Whatever name gets tacked onto it, the World Future Society is the place to find it.

In the mid 1960s, futurology boomed. In that same state of California, Olaf Helmer and other scientists at the RAND (Research ANd Development) Corporation unveiled their DELPHI procedure for assessing the shape of things to come. In Croton-on-Hudson, New York, Herman Kahn's Hudson Institute devised future-history scenarios, while Ted Gordon—himself one of the DELPHI pioneers—launched his Institute for the Future in Connecticut. With all those new future-oriented think tanks springing up all over, a man named Edward S. Cornish, recently with the National Geographic Society, perceived a need to organize some sort of holding company that could bring all the future-oriented researchers together under one roof.

That happened in 1966, and Cornish called his new creation the World Future Society. It started small, publishing a single little mimeographed newsletter, *The Futurist*. Then, it began reaching out. Today, the World Future Society operates out of busy offices just outside of Washington, DC (7910 Woodmont Avenue, Bethesda, Maryland 20814). With a hundred local chapters in the United States and assorted foreign countries from Argentina to Zimbabwe, it sponsors large-scale conferences several times each year, of which the symposium in Anaheim was one.

> "There has probably never been a time since the invention of language when someone didn't make his or her living by trying to guess at what lay ahead."

The Anaheim gathering was smallish by World Future Society standards. It brought together less than a thousand people, but they came from places as far apart as Boston and Bombay. They were teachers, businesspeople, scientists, technologists, and ordinary human beings concerned about the way the world is going, and they came together to do something about it.

Technology has turned into the favorite over-the-counter answer to whatever goes wrong—and the Anaheim session had plenty of technological fixes for various problems. Participants could attend sessions on microelectronics—smart machines, telecommunications, networks—and biotechnology—everything from the Human Genome Project to biotechnology's prospects for dealing with cancer, food supplies, and the aging process. And particularly heavy attendance marked sessions on the future of the passenger car.

Once again, Southern California was the right place for this last discussion, because it's the area suffering most from automobile exhaust. Such 1970s innovations as catalytic converters and electronic fuel injection have helped cut down on pollutants, but the improvements in individual performance have been swamped by growth in the number of cars. For about half of each year, the air quality in Los Angeles fails to meet standards, and almost the entire state wrestles with some degree of air pollution caused by auto exhaust. California adopted regulations in 1990 that mandated low- and ultralow-emission vehicles by 1997, with zero-emission cars ordered to be on the market in the following year, 1998.

As the best bets to achieve these aims, the speakers proposed electric cars in one form or another. Electric motors don't pollute the air, and they make less noise than conventional cars. Best of all, they have great starting torque. A 100-horsepower electric motor can outperform a 300-horsepower gasoline engine. But exactly what kind of electric cars future Californians will turn to remains unanswered. At the meeting, John Reuyl of the Hybrid Electric Vehicle Project in Palo Alto, California, and Frank Chilton, head of his own technological consultancy firm, put their bets on the "series hybrid" car. This type of car has both a gasoline motor and an electric one, but the gasoline engine runs only to recharge the car's batteries. The electric motor actually runs the car. Another plus: Since the gasoline engine runs at a constant speed, manufacturers can fine-tune the catalytic converter so that it filters out almost all of the pollutants.

Electric cars are fascinating stuff, but this was a multitrack meeting. If you sat in on the session with Chilton and Reuyl, you missed seven other sessions on such topics as the futures of governance, family values, the transformation of the workplace, and twenty-first-century communications. A lot of future lies ahead of us, and even the World Future Society was hard pressed to cover it all in a weekend.

Science and the future. The World Future Society and the think tanks didn't invent the habit of trying to peer into the future; they just tried to put it on a scientific basis. There has always been plenty of the other kind. There has probably never been a time since the invention of language when some old shaman or wise woman of the tribe didn't make his or her living by trying to guess at what lay ahead.

Those ancient forecasting methods had two drawbacks. First, they simply weren't very good at what they did. The Greek oracles concealed their inad-

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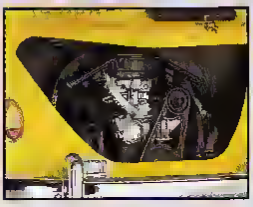

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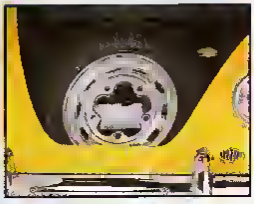

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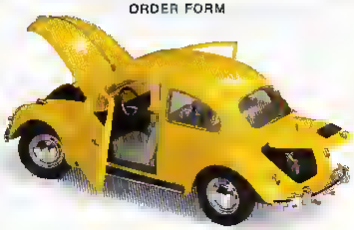

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equacies by sounding oracular—the one at Delphi gained notoriety for clouding her prophecies in allegory and hint so that whatever happened she could claim a hit. But now and then the employers of those old soothsayers ordered them to say something precise and checkable, and then they were in trouble. A Roman emperor like Tiberius was as likely as not to throw his personal astrologer Thrasyllus off a cliff if his predictions went sour, while in China, an oracle who guessed wrong ran the job-related risk of beheading.

Second, ancient futurology was generally custom work. Except for such doomsaying ancient prophets as those of the Bible, the classical forecasters seldom took the holistic point of view. They tried to predict the outcome of a specific battle or the survival chances of a particular individual, but they rarely attempted any large-scale anticipations of the future state of the whole world. And when they did (as in the case of Nostradamus) they protected their batting averages by falling back on Delphic doubletalk. There wasn't much market for such generalized services because, until quite recently, the generalized concept of "the future" hardly existed, and besides, most things just didn't change very much.

Oh, some specific changes certainly occurred. One king died and another replaced him; conquerors took over one empire and then were taken over by another. But there was always *a* king or emperor, and the daily life of most people changed hardly at all. In many ways, the lives of Americans in 1776 bore a closer resemblance to those of Europeans under the Roman Empire than to our own.

Then along came the nineteenth century and the Industrial Revolution.

Without warning, change became a fact of life for ordinary men and women. By the time they reached their three score and ten, the world of their childhood had vanished. Railroads replaced canals; railroads were, in their turn, superseded by cars and airplanes. The steam engine, the Jacquard loom, the cotton gin, and the mass-production assembly line replaced millions of manual jobs. The telegraph, telephone, television, and fax machine revolutionized communications. Now the computer has started a whole new revolution of its own. We see massive changes occurring every decade, almost every year, and so our attitudes toward the future have changed. We may not know exactly what the future will hold, but for the first time in the history of the race, we are now quite sure that it will definitely be *different*.

The differences won't all be technological, either, and the Anaheim meeting took full account of that. The conference chair, Kenneth Hunter, warned against 'naive beliefs in simple solutions' in his keynote address. Other opening speakers dealt with specifics. L. Sunny Hansen discussed the role of women and minorities in defining and creating the future. Maureen O'Hara, psychological problems and solutions; India's Rashmi Mayur, the perils of environmental destruction.

Mayur pulled no punches. "I was at the Earth Summit in Rio de Janeiro," he said, "and it was a dismal failure. Nine-hundred-and-fifty million dollars spent on the conference, two and a half years of preparation, thirty-five thousand people attending from a hundred and seventy-two nations all around the world, and it wound up with nothing: no population control convention, an agreement on global warming so watered down it meant nothing, a biodiversity agreement that the United States refused to sign, a convention on preserving tropical forests that was refused by the very countries that possess them—India, Brazil, Malaysia. The result is that every day we are adding human life which is totally unsustainable, and the whole world is rushing to become like the American dream; in all the Third World villages, they know what the TV shows, and that is exactly what they want for themselves."

> "If we don't survive together," India's Rashmi Mayur says, "I don't think we will be able to have any future."

Other speakers were more hopeful, but all agreed that unless we deal with the overwhelming problems of the environment, in spite of all the resistance from industry and land developers and governments, all other hopes and plans will inevitably fail. "We are all in the same boat," Mayur said. "If we don't survive together, I don't think we will be able to have any future."

In the beginning. Scientific futurology, as distinct from the other kind, goes back only until the early days of this century, and its prophet was the English novelist H. G. Wells.

In 1901, Wells' first series of articles, "Anticipations," began to appear in the magazine *The Fortnightly Review*. Issue by issue, Wells described his blueprint for the future, including its technological, social, and cultural aspects. Some of his predictions were dead on—he predicted Bosnywash, the 500-mile-long superstrip city that is now a reality along the U.S. Eastern seaboard—and some less so, as when he anticipated the demise of capitalism by the end of the twentieth century. The articles met with great success, so did the books and lectures that followed from them. Wells told his audiences that the "systematic exploration of the future" could give the world a "working knowledge" of what lay ahead, and he suggested how the exploration could be carried out by people he later called "Professors of Foresight," charged with identifying trends and exploring their interaction.

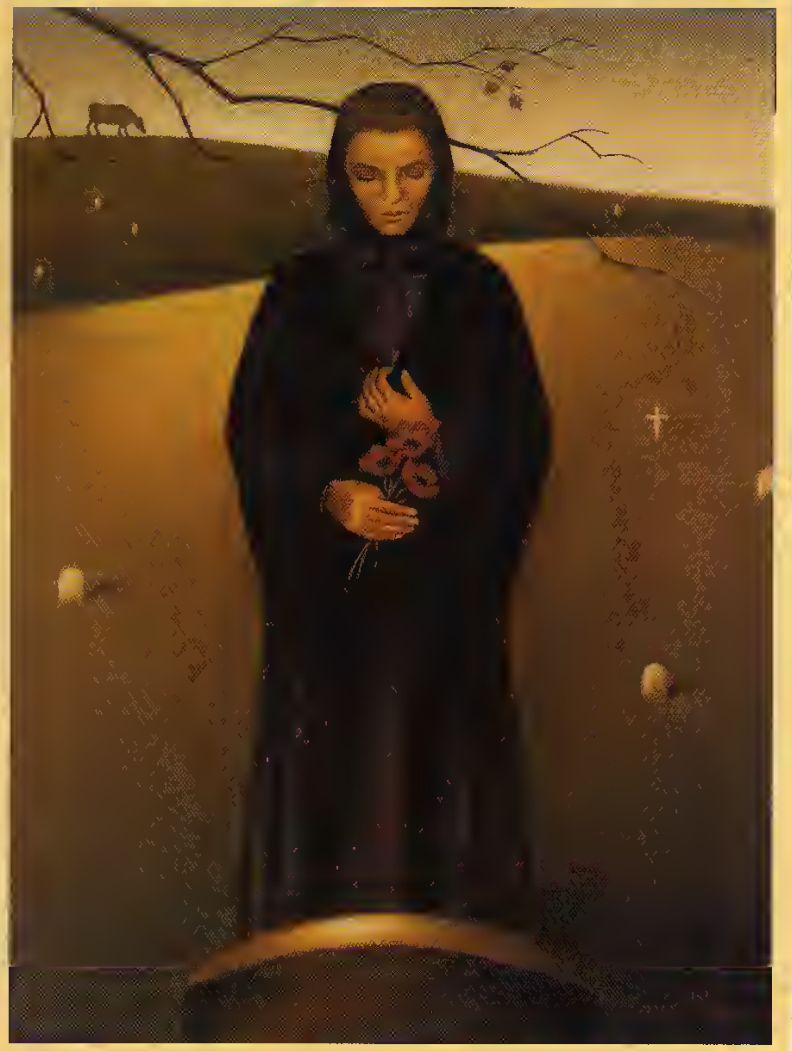
By, in short, the modern science of futurology.

No Professors of Foresight appeared on the world's university campuses in 1901, but they were coming. Right after World War II, the U.S. Department of Defense called on RAND to try to predict what technologies might emerge to affect future wars. In the process, RAND scientists began to develop explicit methodologies for estimating future events, and other researchers quickly followed.

In one day-long session at Anaheim, Didsbury gave a tutorial on these major forecasting techniques. Some, like the RAND Corporation's DELPHI and Kahn's scenario writing, simply try to assess probabilities, others, called normative, don't try to *predict* the future. Instead, they concentrate on *inventing* it, on identifying some future situation or event deemed desirable and trying to define the ways to get there.

The difference between predictive and normative futurology is the difference between wondering what will happen and *making* something happen. In Anaheim, the normative activists far outnumbered the others, and they had a hundred different agendas for making a better world.

Yet a feeling prevailed that all the improvements had to come together or none would succeed. Roberto Vargas, a Chicano Indian, summed it up when he told one session about the efforts of his leaders to get health services for their people. "The reason I'm here," he said, "is that our elders have come to realize that there's not going to be any health for our communities until there's health for the world."



ILLUSTRATIONS BY VERN DUFFORD

SACRED COW

He woke in darkness to the steady racket of the rails. Vast unknowable landscapes, huge as the dreams of childhood, rumbled behind his shocked reflection in the carriage pane.

Jackie smoothed his rumpled hair stretched stiffly, wiped at his moustache, tucked the railway blanket around his silk-pajama'd legs Across the aisle, two of his crew slept uneasily, sprawled across their seats Kumar the soundman, Jimmie Suraj his cinematographer Suraj had an unlit cigarette tucked behind one ear the thin gold chains at his neck bunched in an awkward tangle

The crew's leading lady Lakshmi "Bubbles" Malini, came pale and swaying down the aisle, wrapped sari-like in a souvenir Scottish blanket. "Awake, Jackie?"

"Yaar, girl," he said, "I suppose so "

"So that woke you, okay?" she announced, gripping the seat "That big bump just now That bloody lurch, for Pete's sake It almost threw us from the track "

"Sit down, Bubbles," he apologized

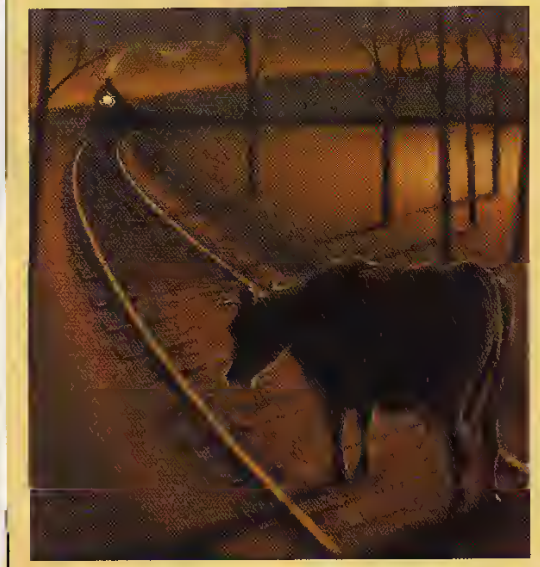
"'Dozens die,' okay?" she said, sitting " Stars director crew perish in bloody English tragic rail accident ' I can see it all in print in bloody *Stardust* already "

Jackie patted her plump hand, found his kit bag, extracted a cigarette case, lit one Bubbles stole a puff, handed it back Bubbles was not a smoker Bad for the voice, bad for a dancer's wind But after two months in Britain she was kipping smokes from everybody

"We're not dying in any bloody train," Jackie told her, smiling "We're filmwallas, darling We were born to be killed by taxmen "

Jackie watched a battered railway terminal rattle past in a spectral glare of fog A pair of tall English, wrapped to the eyes sat on their luggage with looks of sphinxlike inscrutability Jackie liked the look of them Native extras Good atmosphere

Bubbles was restless ' Was this all a good idea, Jackie, you think?"



FICTION BY BRUCE STERLING

He shrugged "Horrid old rail lines here, darling, but they take life damn slow now, the English."

She shook her head. "This country, Jackie!"

"Well," he said, smoothing his hair. "It's bloody cheap here. Four films in the can for the price of one feature in Bombay."

"I liked London." Bubbles offered bravely. "Glasgow too. Bloody cold, but not so bad. But Bolton? Nobody films in bloody Bolton."

"Business, darling," he said. "Need to lower those production costs. The ratio of rupees to meter of filmstock exposed..."

"Jackie?"

He grunted.

"You're bullshitting me, darling."

He shook his head. "Yaar, girl. Jackie Amar never bounce a crew cheque yet. Get some sleep, darling. Got to look beautiful."

Jackie did not title his own movies. He had given that up after his first fifty films. The studio in Bombay kept a whole office of hack writers to do titles, with Hindi rhyming dictionaries at their elbows. Now Jackie kept track of his cinematic oeuvre by number and plot summary in a gold-edged fake-leather notebook with detachable pages.

Jackie Amar Production #127 had been his first in merrie old England. They'd shot #127 in a warehouse in Tooting Bec with a few rented hours at the Tower of London. No. 127 was an adventure/crime/comedy about a pair of hapless expatriate twins (Raj Khanna, Ram Khanna) who cook up a scheme to steal back the Koh-i-noor Diamond from the Crown Jewels of England. The Khanna brothers had been drunk much of the time. Bubbles had done two dance numbers and complained bitterly about the brothers' Scotch-tainted breath in the clinch scenes. Jackie had sent the twins packing back to Bombay.

No. 128 had been the first to star Jackie's English ingenue discovery, Betty Chalmers. Betty had answered a classified ad asking for English girls 18–20 of mixed Indian descent, boasting certain specific bodily measurements. Betty played the exotic Brit-Asian mistress of a gallant Indian military-intelligence attaché (Bobby Denzongpa) who foils a plot by Japanese yakuza gangsters to blow up the Tower of London. (There had been a fair amount of leftover Tower footage from film #127.) Local actors, their English subtitled in Hindi, played the bumbling comics from Scotland Yard. Betty died beautifully in the last reel, struck by a poisoned ninja blowdart, just after the final dance number. Betty's lines in halting phonetic Hindi had been overdubbed in the Bombay studio.

Events then necessitated leaving London, events taking the shape of a dapper and humorless Indian embassy official who had alarmingly specific questions for a certain Javed "Jackie" Amar concerning income-tax arrears for Rupees 6,435,000.

A change of venue to Scotland had considerably complicated the legal case against Jackie, but #129 had been born in the midst of chaos. Veteran soundman Wasant "Winnie" Kumar had been misplaced as the crew scrambled from London, and the musical score of #129 had been done at hours notice by a friend of Betty's from Manchester, a shabby scarecrow-tall youngster named Smith. Smith who owned a jerry-rigged portable mixing station clamped together with duct tape had produced a deathly pounding racket of synthesized tablas and digitally warped sitars.

Jackie, despairing, had left the score as Smith had recorded it for the weird noise seemed to fit the story, and young Smith had worked on percentage—which would likely come to no real pay at all. Western historicals were hot in Bombay this year—or at least they had been back in '48—and Jackie had scripted one in an all-night frenzy of coffee and pills. A penniless Irish actor had starred as John Fitzgerald Kennedy, with Betty Chalmers as a White House chambermaid who falls for the virile young president and becomes the first woman to orbit the Moon. An old film contact in Kazakhstan had provided some stock Soviet space footage with enthusiastic twentieth-century crowd scenes. Bubbles had done a spacesuit dance.

Somewhat ashamed of this excess—he had shot the entire film with only five hours sleep in four days—Jackie gave his best to #130, a foreign dramatic romance. Bobby Denzongpa starred as an Indian engineer disappointed in love, who flees overseas to escape his past and becomes the owner of a seedy Glasgow hotel. No. 130 had been shot by necessity, in the crew's own hotel in Glasgow with the puzzled but enthusiastic Scottish staff as extras. Bubbles starred as an expatriate cabaret dancer and Bobby's love interest. Bubbles died in the last reel, having successfully thawed Bobby's cynical heart and sent him back to India. No. 130 was a classic weepie, and Jackie thought, the only one of the four to have any chance in hell of making money.

Jackie was still not sure about the

plot of No 131, his fifth British film. When the tax troubles had caught up to him in Scotland he had picked the name of Bolton at random from a railway schedule.

Bolton turned out to be a chilly and silent hamlet of perhaps sixty thousand English, all of them busy dismantling the abandoned suburban sprawl around the city and putting fresh paint and flowers on Bolton's nineteenth century core. Such was the tourist economy in modern England. All the real modern-day businesses in Bolton were in the hands of Japanese, Arabs, and Sikhs.

A word with the station master got their rail cars safely parked on an obscure siding and their equipment loaded into a small fleet of English pedal-cabs. A generous offer to pay in rupees found them a fairly reasonable hotel. It began to rain.

Jackie sat stolidly in the lobby that afternoon, leafing through tourist brochures in search of possible shooting sites. The crew drank cheap English beer and bitched. Jimmie Suraj, the cameraman, complained of the few miserable hours of pale, wintry European light. The lighting boys feared suffocation under the mountainous wool blankets in their rooms. Kumar, the sound man, speculated loudly and uneasily over the contents of the hotel's "shepherd's pie" and, worse yet, "toad-in-the-hole." Bobby Denzongpa and Betty Chalmers vanished without permission in search of a disco.

Jackie nodded, sympathized, tut-tutted, patted heads, made empty promises. At ten o'clock, he called the studio in Bombay. No. 127 had been judged a commercial no-hope and had been slotted direct to video. No. 128 had been redubbed in Tamil and was dying a slow kiss-off death on the southern village circuit. "Goldie" Vachchani, head of the studio, had been asking about him. In Jackie's circles it was not considered auspicious to have Goldie ask about a fellow.

Jackie left the hotel's phone number with the studio. At midnight, as he sat sipping bad champagne and studying plot synopses from ten years back in search of inspiration, there was a call for him. It was his son Salim, the eldest of his five children and his only child by his first wife.

"Where did you get this number?" Jackie said.

"A friend," Salim said. "Dad, listen. I need a favor."

Jackie listened to the ugly hiss and warble of long-distance submarine cables. "What is it this time?"

"You know Goldie Vachchani, don't you? The big Bombay filmwalla?"

"I know Goldie." Jackie admitted.

"His brother's just been named head of the state aeronautics bureau."

"I don't know Goldie very well, mind you."

"This is a major to-do, Dad. I have the news on best private background authority. The budget for aeronautics will triple next Congress. The nation is responding to the Japanese challenge in space."

"What challenge is that? A few weather satellites."

Salim sighed patiently. "This is the Fifties now, Dad. History is marching. The nation is on the wing."

"Why?" Jackie asked.

"The Americans went to the Moon eighty years ago."

"I know they did. So?"

"They polluted it." Salim announced. "The Americans left a junkyard of crashed machines up on our Moon. Even a junked motor car is there. And a golf ball." Salim lowered his voice. "And urine and feces, Dad. There is American fecal matter on the Moon that will last there in cold and vacuum for ten million years. Unless, that is, the Moon is ritually purified."

How did things go at the lab today, dear?

"God almighty, you've been talking to those crazy fundamentalists again," Jackie said. "I warned you not to go into politics. It's nothing but crooks and fakirs." The hissing phone line emitted an indulgent chuckle. "You're being culturally inauthentic, daddyji! You're Westoxicated! This is the modern age now! If the Japanese get to the Moon first they'll cover it with bloody shopping malls."

"Best of luck to the damn fool Japanese, then."

"They already own most of China," Salim said, with sinister emphasis. "Expanding all the time. Tireless, soulless, and efficient."

"Bosh," Jackie said. "What about us? The Indian Army's in Laos, Tibet, and Sri Lanka."

"If we want the world to respect our sacred cultural values then we must visibly transcend the earthly realm...."

Jackie shuddered, adjusted his silk dressing gown. "Son, listen to me. This is not real politics. This is a silly movie fantasy you are talking about. A bad dream. Look at the Russians and Americans if you want to know what aiming at the Moon will get you. They're eating chaff today and sleeping on straw."

"You don't know Goldie Vachchani, Dad?"

"I don't like him."

"I thought I'd ask," Salim said sulkily. He paused. "Dad?"

"What?"

"Is there any reason why the Civil Investigation Division would want to inventory your house?"

Jackie went cold. "Some mistake, son. A mixup."

"Are you in trouble, daddyji? I could try to pull some strings, up top...."

"No, no!" Jackie said swiftly. "There's bloody horrid noise on this phone, Salim—I'll be in touch." He hung up.

Half an anxious hour with the script and cigarettes got him nowhere. At last he belted his robe, put on warm slippers and a nightcap, and tapped at Bubbles' door.

"Jackie," she said, opening it, her wet hair turbanned in a towel. Furnace-heated air gushed into the chilly hall. "I'm on the phone, darling. Long distance."

"Who?" he said.

"My husband."

Jackie nodded. "How is Vijay?"

She made a face. "Divorced for Pete's sake! Dalip is my husband now, Dalip Sabnis, remember? Honestly, Jackie, you're so absent-minded sometimes."

"Sorry," Jackie said. "Give Dalip my best." He sat in a chair and leafed through one of Bubbles' Bombay fan mags while she cooed into the phone.

Bubbles hung up, sighed. "I miss him so bad," she said. "What is it, okay?"

"My oldest boy just told me that I am culturally inauthentic."

She tossed the towel from her head, put her fists on her hips. "These young people today! What do they want from us?"

"They want the real India," Jackie said. "But we all watched Hollywood films for a hundred bloody years.... We have no native soul left, don't you know." He sighed heavily. "We're all bits and pieces inside. We're a jigsaw people, we Indians. Quotes and remakes. Rags and tatters."

Bubbles tapped her chin with one lacquered forefinger. "You're having trouble with the script."

Mournfully, he ignored her. "Liberation came a hundred bloody years ago. But still we obsess with the damn British. Look at this country of theirs. It's a museum. But us—we're worse. We're a wounded civilization. Naipaul was right. Rushdie was right!"

"You work too hard," Bubbles said. "That historical we just did, about the

Moon, yaar? That one was stupid crazy, darling. That music boy Smith, from Manchester? He don't even speak English, okay. I can't understand a word he bloody says."

"My dear, that's English. This is England. That is how they speak their native language."

"My foot," Bubbles said. "We have five hundred million to speak English. How many left have they?"

Jackie laughed. "They're getting better, yes. Learning to talk more properly, like us." He yawned hugely. "It's bloody hot in here. Bubbles. Feels good. Just like home."

"That young girl, Betty Chalmers, okay? When she tries to speak Hindi I bust from laughs. Bubbles paused. "She's a smart little cookie, though. She could go places in business. Did you sleep with her?"

"Just once," Jackie said. "She was nice. But very English."

"She's American," Bubbles said triumphantly. "A Cherokee Indian from Tulsa, Oklahoma, USA. When your advert said Indian blood, she thought you meant American Indians."

"Damn!" Jackie said. "Really?"

"Cross my heart, it's true, Jackie."

"Damn.... And the camera loves her, too. Don't tell anybody."

Bubbles shrugged, a little too casually. "It's funny how much they want to be just like us."

"Sad for them," Jackie said. "An existential tragedy."

"No, darling, I mean it's really funny, for an audience at home. Laugh out loud, roll in the aisles, big knee-slapper! It could be a good movie, Jackie. About how funny the English are. Being so inauthentic like us."

"Bloody hell," Jackie marvelled.

"A remake of *Param Dharam* or *Gammat Jammat*, but funny because of all English players, okay."

"*Gammat Jammat* has some great dance scenes."

She smiled.

His head felt inflamed with sudden inspiration. "We can do that. Yes. We will! And it'll make a bloody fortune!" He clapped his hands together, bowed his head to her. "Miss Malini, you are a trouper." She made a pleased salaam. "Satisfaction guaranteed, sahib."

He rose from the chair. "I'll get on it straightaway."

She slipped across the room to block his way. "No, no! Not tonight."

"Why not?"

"None of those little red pills of yours."

He frowned.

"You'll pop from those someday, Jackieji. You jump like a jack-in-box every time they snap the clapperboard. You think I don't know?"

He flinched. "You don't know the troubles of this crew. We need a hit, like hell, darling. Not today, yesterday."

"Money troubles. So what? Not tonight, boss, not to worry. You're the only director that knows my best angles. You think I want to be stuck with no director in this bloody dump?" Gently, she took his hand. "Calming down, okay? Changing your mind, having some fun. This is your old pal Bubbles here, yaar? Look, Jackieji. Bubbles." She struck a hand-on-hip pose and shot him her best sidelong come-on look.

Jackie was touched. He got into bed. She pinned him down, kissed him firmly, put both his hands on her breasts and pulled the cover over her shoulders. "Nice and easy, okay? A little pampering. Let me do it."

She straddled his groin, settled down, undulated a bit in muscular dancer's fashion, then stopped and began to pinch and scratch his chest with absent-minded Vedic skill. "You're so funny sometimes, darling. Inauthentic. I can tap dance, I can bump and grind, and you think I can't wiggle my neck like a natyam dancer? Watch me do it, for Pete's sake."

"Stop it," he begged. "Be funny before, be funny afterward, but don't be funny in the middle."

"Okay, nothing funny, darling, short and sweet." She set to work on him and in two divine minutes she had wrung him out like a sponge.

"There," she said. "All done. Feel better?"

"God, yes."

"Inauthentic as hell and it feels just as good, yaar?"

"It's why the human race goes on."

"Well then," she said. "That, and a good night's sleep, baby."

> "Every half meter or so they came across a marker for the dead. Jackie thought the graveyard must stretch for almost a kilometer."

Jackie was enjoying a solid if somewhat flavorless breakfast of kippers and eggs when Jimmie Suraj came in. "It's Smith, boss," Jimmie said. "We can't get him to shut up that bloody box of his."

Jackie sighed, finished his breakfast, dabbed bits of kipper from his lips and walked into the lobby. Smith, Betty Chalmers, and Bobby Denzongpa sat around a low table in overstuffed chairs. There was a stranger with them. A young Japanese.

"Turn it off, Smithie, there's a good fellow," Jackie said. "It sounds like bloody cats being skinned."

"Just running a demo for Mr. Big Yen here," Smith muttered. With bad grace, he turned off his machine. This was an elaborate procedure, involving much flicking of switches, twisting of knobs, and whirring of disk drives.

The Japanese—a long-haired, elegant youngster in a sheepskin coat, corduroy beret and jeans—rose from his chair, bowed crisply and offered Jackie a business card. Jackie read it. The man was from a movie company—Kinema Junpo. His name was Baisho.

Jackie did a namaste. "A pleasure to meet you, Mr. Baisho." Baisho looked a bit wary.

"Our boss says he's glad to meet you," Smith repeated.

"*Hai*," Baisho said alertly.

"We met Baisho-san at the disco last night," Betty Chalmers said. Baisho, sitting up straighter, emitted an enthusiastic string of alien syllables.

"Baisho says he's a big fan of English dance-hall music," Smith mumbled. "He was looking for a proper dance hall here. What he thinks is one. Vesta Tilly, ta-ra-ra-boom-de-ay, that sort of bloody thing."

"Ah," Jackie said. "You speak any English, Mr. Baisho?"

Baisho smiled politely and replied at length, with much waving of arms. "He's also hunting for first editions of Noel Coward and J. B. Priestley," Betty said. "They're his favorite English authors. And boss—Jackie—Mr. Baisho *is* speaking English. I mean, if you listen, all the vowels and consonants are in there. Really."

"Rather better than *your* English, actually," Smith muttered.

"I have heard of Noel Coward," Jackie said. "Very witty playwright, that Coward fellow." Baisho waited politely until Jackie's lips had stopped moving and then plunged back into his narrative.

"He says that it's lucky he met us because he's here on location himself," Betty said. "Kinema Junpo—that's his boss—is shooting a remake of *Throne of Blood* in Scotland. He's been, uh... appointed to check out some special location here in Bolton."

"Yes?" Jackie said

Said the local English won't help him because they're kind of superstitious about the place," Betty said. She smiled. "How 'bout you, Smithie? You're not superstitious, are you?"

"Nah," Smith said. He lit a cigarette. "He wants us to help him?" Jackie said.

Betty smiled. "They have truckloads of cash, the Japanese."

"If you don't want to do it, I can get some mates o' mine from Manchester," Smith said, picking at a blemish. "They're nae scared of bloody Bolton."

"What is it about Bolton?" Jackie said.

"You didn't know?" Betty said. "Well, not much. I mean, it's not much of a town, but it does have the biggest mass grave in England."

Over a million," Smith muttered. "From Manchester, London—they used to ship 'em out here in trains during the plague."

"Ah," Jackie said.

"Over a million in one bloody spot," Smith said, stirring in his chair. He blew a curl of smoke. "Me grandfather used to talk about it. Real proud about Bolton they was. Real civil government emergency and all, kept good order, soldiers and such. Every dead bloke got his own marker, even the women and kids. Other places, later, they just scraped a hole with bulldozers and shoved 'em in."

"Spirit," Baisho said loudly, enunciating as carefully as he could. "Good cinema spirit in city of Boruton."

Despite himself, Jackie felt a chill. He sat down. "Inauspicious. That's what we'd call it."

"It was fifty years ago," Smith said, bored. "Thirty years before I was born. Or Betty here either, eh? Bovine Spongiform Encephalopathy? Mad Cow Disease. So what? B S E will never come back. It was a fluke. A bloody twentieth-century industrial accident."

"You know, I'm not frightened," Betty said, with her brightest smile. "I've even eaten beef several times. There's no more virions in it. I mean, they wiped out scrapie years ago. Killed every sheep, every cow that might have any infection. It's perfectly safe to eat now, beef."

"We lost many people in Japan," Baisho offered slowly. "Tourists who ate[illegible] ate. Engrish beef, here in Europe. But trade friction protect most of us. Old trade barriers. The farmers of Japan." He smiled.

Smith ground out his cigarette. "Another fluke. You're old granddad was just lucky, Baisho-san."

"Lucky?" Bobby Denzongpa said suddenly. His dark gazelle-like eyes were red-rimmed with hangover. "Yaar, they fed sheeps to the cows here! God did not make cows for eating of sheeps! And the flesh of Mother Cow is not for us to eat."

"Bobby," Jackie warned.

Bobby shrugged irritably. "It's the truth, boss, yaar? They made foul sheep, slaughterhouse offal into protein for cattle feed, and they fed that bloody trash to their own English cows. For years they did this wicked thing, even when the cows were going mad and dying in front of them! They knew it was risky, but they went straightaway on doing it simply because it was cheaper! That was a crime against nature. It was properly punished."

"That is enough," Jackie said coldly. "We are guests in this country. We of India also lost many fellow countrymen to that tragedy, don't you know."

"Moslems, good riddance," Bobby muttered under his breath, and got up and staggered off.

Jackie glowered at him as he left for the sake of the others.

"It's okay," Smith said in the uneasy silence. "He's a bloody Asian racist, your filmstar walla there, but we're used to that here." He shrugged. "It's just—the plague, you know, it's all they talk about in school, like England was really high-class back then and we're nothing at all now, just a shadow or something. You get bloody tired of hearing that. I mean, it was all fifty

bloody years ago.' He sneered. 'I'm not the shadow of the Beatles or the fucking Sex Pistols. I'm a working professional modern, British musician and got my union papers to prove it.'

'No, you're really good Smithie,' Betty told him. She had gone pale. 'I mean, England's coming back strong now. Really.'

'Look, we're not "coming back," lass,' Smith insisted. 'We're already here right now, earning our bloody living. It's life, eh? Life goes fucking on.' Smith stood up, picked up his deck, scratched at his shaggy head. 'I gotta work. Jackie Boss, eh? Can you spare five pound, man? I gotta make some phone calls.'

Jackie searched in his wallet and handed over a bill in the local currency.

Baisho had five Japanese in his crew. Even with the help of Jackie's crew, it took them most of the evening to scythe back the thick brown weeds in the old Bolton plagueyard. Every half meter or so they came across a marker for the dead. Small square granite posts had been hammered into the ground fifty years ago, then sheared off clean with some kind of metal saw. Fading names and dates and computer ID numbers had been chiselled into the tops of the posts.

Jackie thought that the graveyard must stretch around for about a kilometer. The rolling English earth was studded with plump, thick-rooted oaks and ashes, with that strange naked look of European trees in winter.

There was nothing much to the place. It was utterly prosaic, like a badly kept city park in some third-class town. It defied the tragic imagination. Jackie had been a child when the scrapie plague had hit, but he could remember sitting in hot Bombay darkness, staring nonplussed at the anxious shouting newsreels, vague images, shot in color no doubt, but grainy black and white in the eye of his memory. Packed cots in European medical camps, uniformed shuffling white people gone all gaunt and trembling, spooning up charity gruel with numb, gnarled hands. The scrapie plague had a devilishly slow incubation in humans, but no human being had ever survived the full onset.

First came the slow grinding headaches and the unending sense of fatigue. Then the tripping and flopping and stumbling as the nerves of the victim's legs gave out. As the lesions spread, and tunneled deep within the brain, the muscles went slack and flabby, and a lethal psychotic apathy set in. In those old cinema newsreels, Western civilization gazed at the Indian lens in demented puzzlement as millions refused to realize that they were dying simply because they had eaten a cow.

What were they called? thought Jackie. Beefburgers? Hamburgers. Ninety percent of Britain, thirty percent of Western Europe, twenty percent of jet-setting America, horribly dead. Because of hamburgers.

Baisho's set-design crew was working hard to invest the dreary place with proper atmosphere. They were spraying long white webs of some kind of thready aerosol across the cropped grass and setting up gel-filtered lights. It was to be a night shoot. Macbeth and Macduff would arrive soon on the express train.

Betty sought him out. 'Baisho-san wants to know what you think.'

My professional opinion of his set,

> "Jackie had been a child when the scrapie plague had hit, but he could remember staring nonplussed at the anxious shouting newsreels."

as a veteran Indian filmmaker?' Jackie said.

'Right, boss.'

Jackie did not much care for giving out his trade secrets but could not resist the urge to cap the Japanese. 'A wind machine,' he pronounced briskly. 'This place needs a wind machine. Have him leave some of the taller weeds, and set up under a tree. We've fifty kilos of glitter dust back in Bolton. It's his, if he wants to pay. Sift that dust, hand by hand, through the back of the wind machine and you'll get a fine effect. It's more spooky than hell.'

Betty offered this advice Baisho nodded, thought the idea over, then reached for a small machine on his belt. He opened it and began to press tiny buttons.

Jackie walked closer. 'What's that then? A telephone?'

'Yes,' Betty said. 'He needs to clear the plan with headquarters.'

'No phone cables out here,' Jackie said.

'High tech,' Betty said. 'They have a satellite link.'

'Bloody hell,' Jackie said. 'And here I am offering technical aid. To the bloody Japanese, eh.'

Betty looked at him for a long moment. 'You've got Japan outnumbered eight to one. You shouldn't worry about Japan.'

'Oh, I don't worry,' Jackie said. 'I'm a tolerant fellow, dear. A very secular fellow. But I'm thinking, what my studio will say, when they hear we break bread here with the nation's competition. It might not look so good in the Bombay gossip rags.'

Betty stood quietly. The sun was setting behind a bank of cloud. 'You're the kings of the world, you Asians,' she said at last. 'You're rich, you have all the power, you have all the money. We need you to help us, Jackie. We don't want you to fight each other.'

'Politics,' Jackie mumbled, surprised. 'It's... it's just life.' He paused. 'Betty, listen to old Jackie. They don't like actresses with politics in Bombay. It's not like Tulsa Oklahoma. You have to be discreet.'

She watched him slowly, her eyes wide. 'You never said you'd take me to Bombay, Jackie.'

'It could happen,' Jackie muttered.

'I'd like to go there,' she said. 'It's the center of the world.' She gripped her arms and shivered. 'It's getting cold. I need my sweater.'

The actors had arrived in a motor-driven tricycle cab. The Japanese began dressing them in stage armor. Macduff began practicing kendo moves.

Jackie walked to join Mr. Baisho. 'May I call on your phone, please?'

'I'm sorry?' Baisho said.

Jackie mimed the action. 'Bombay,' he said. He wrote the number on a page in his notebook, handed it over.

'Ah,' Baisho said, nodding. '*Wakanmashita*.' He dialed a number, spoke briefly in Japanese, waited, handed Jackie the phone.

There was a rapid flurry of digital bleeping. Jackie, switching to Hindi, fought his way through a screen of secretaries. 'Goldie,' he said at last.

'Jackie! I've been asking for you.'

'Yes. I heard.' Jackie paused. 'Have you seen the films?'

Goldie Vachchani grunted, with a sharp digital echo. 'The first two. Getting your footing over in Blighty, yaar? Nothing so special.'

'Yes?' Jackie said.

'The third one. The one with the half-breed girl and the Moon and the soundtrack.'

'Yes, Goldie.'

Goldie's voice was slow and gloat-

CONTINUED ON PAGE 92

Imagine that a Fifties beat club went electronic, and you have some idea of a Telepoetics night at the Electronic Café International in beachside Santa Monica, Los Angeles. As I sipped my wine, the candles on the table seemed to flicker in time to the hard-edged rap poetry emanating from the speakers: while on a giant video screen at the far end of the room, I watched an image of the poet who at that moment was performing live at a club in Phoenix, Arizona. After the remote bard had finished, it was L.A.'s turn, and our Telepoetic hostess, Marilene M. Murphy, took the floor to introduce the next performer, a princely looking African American with a voice that sounded like rubble and silk. This time we'd be seeing the action live, and Phoenix would be receiving it electronically.

Telepoetics is one of a whole series of artistic and cultural events that take place regularly through the Electronic Cafe International (ECI). I say *through*, rather than *at*, since all these events involve the participation of a number of different locations, often stretched across the globe. At any given event, the Café in Santa Monica may be communicating

ARTICLE BY MARGARET WERTHEIM

Electronic Café

PHOTOGRAPHS BY DANIEL FISHMAN

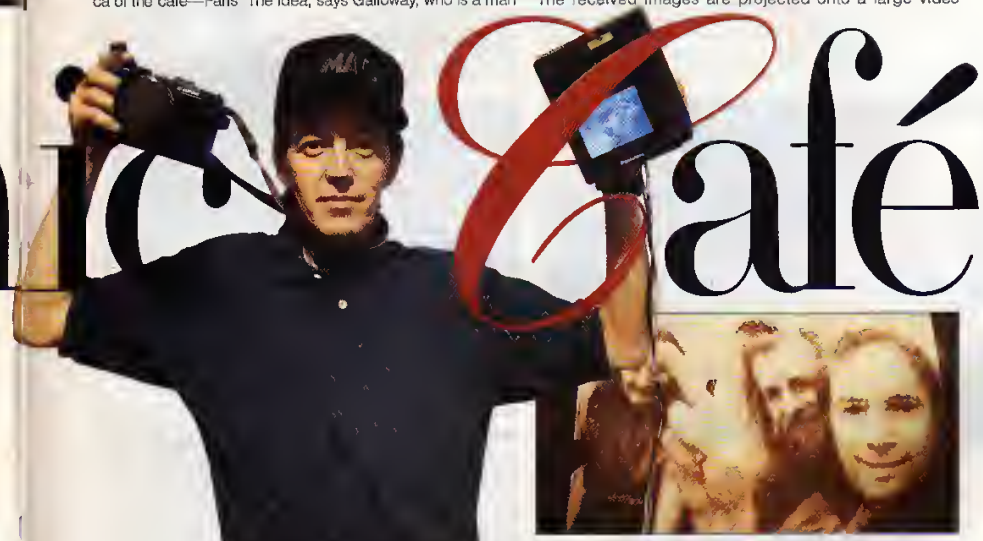
Special events at the Electronic Café: Celebrating Mexico's Day of the Dead festival which honors ancestors (top), and the annual New Year's Eve party (left) that collects electronic celebrants as it goes. The Café celebrates the New Year time zone by time zone—starting in Australia and ending up 18 hours later in Los Angeles.

with other cities across America and Canada, or some place in Russia, Japan, Europe, South America, or Africa. Here, you can not only mingle with fellow Los Angelinos, but through the power of technology, also with people all over the world. At ECI, the *local* community is *global*.

ECI is an innovative concept that offers sophisticated telecommunications facilities in a relaxed café environment, complete with coffee, cakes, wine, and quirky decor. One night that I visited was Valentine's Day, and all the tables were adorned with chubby golden Cupids. As you walk in the door, it's the cafe you encounter first, then your eyes are drawn to the racks of equipment and video screens at the far end of the room. Contrary to its name, in the flesh, the *café* comes before the *electronics*. But it is the fusion of both that makes this place so unique. Indeed, Electronic Café International is more than just a name, it's a whole concept—one that is now a registered trademark.

ECI is the brainchild of Sherrie Rabinowitz and Kit Galloway, two American artists who originally met in that mecca of the café—Paris. The idea, says Galloway, who is a man with a mission, is "to take telecommunications technology out of the corporate and business context and put it into a cultural context." They wanted to create a place where people could access the technology themselves, for they believe that if communications facilities are widely available, then "whole new ways of being in the world can be created." The couple, who are both in their early forties, have been working with communications technology since the mid Seventies. They are using Nineties technology to actively realize their visions—a kind of twenty-first-century techno-idealism, an idealism for the Digital Age.

The Café in Santa Monica utilizes a range of different technologies, some permanently installed and others which are brought in for special events. Probably the most commonly used devices are the video phones, which transmit still pictures along with voice. It was via video phones that I could see the poets performing in Phoenix during the Telepoetics evening, and it is generally video phones that provide the links between the Café and other cities around the world. The received images are projected onto a large video



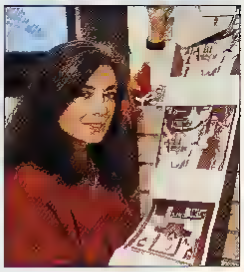
From the beginning, Galloway (left) and Rabinowitz (next page, lower left) have explored ways of using communications technology to benefit all people—not just those with fists full of dollars. They are using Nineties technology to realize their visions—a kind of 21st-century techno-idealism, an idealism for the Digital Age.

At the Café, the local community is global.

screen so that everyone can see who's talking at the other end. The permanent equipment includes electronic mail and computers for creating and exchanging graphics. For special events, they've brought in electronic music equipment, virtual-reality systems, and brain-wave scanners, which, at a recent event, were used to drive synthesizers in Los Angeles and Germany, creating what Galloway and Rabinowitz call "collaborative brain-wave music."

As a concept, ECI is proving enormously catchy, and there is now a global network of 50 affiliated locations around the world. Some are permanent, but many just come online for special events. True to the communal spirit of the endeavor, many are located in real cafés or community centers. The one in Phoenix operates out of an alternative art space and bookstore, while one in Managua, Nicaragua, operates out of Pepito's, a café cum art gallery cum children's center. The network is growing all the time, and Rabinowitz and Galloway are constantly being asked to advise on setting up new nodes both here in the United States and overseas.

Next year, new locations will be opening at Telluride in Colorado, in Japan, and in Bulgaria. One recent addition to the network is a sophisticated venue with state-of-the-art technology that opened in May 1991 at the world's largest science and industry museum, La Cité in Paris. This venue is rather like a "communications laboratory," and it maintains links with several European universities. Because it can make use of ISDN phone lines—a new superpowerful telephone technology more widely available in Europe than in the United States—its video phones work with full-color, full-motion images. (This became available in Santa Monica in late 1992.)



But Rabinowitz and Galloway—now husband and wife—are well aware that not everyone can afford state-of-the-art "wet dream" technology, and they have been careful to design the facilities so that the network can also include very-low-budget nodes as well. This is particularly important, Rabinowitz says, for communicating with Third World countries. "It wouldn't be very interesting if it were just for the rich countries like the United States, Japan, and Germany," says Rabinowitz, with her gently compelling intensity. "The high-end ones must be able to talk to the low-end ones." So La Cité must be able to talk to the simpler facilities and vice versa.

Putting this philosophy into practice, Rabinowitz and Galloway have organized events with Nicaragua, South Africa, and what were then East Bloc countries, including Russia and Bulgaria. In the case of South Africa, they had to arrange to get the video phone to the people in Grahamstown. During that link up, visitors to the Café in Santa Monica got to talk to South Africans about life in their strife-ridden country. And South Africans had the opportunity to talk to African Americans about the experience of being Black in the United States. Because video phones transmit pictures as well as words, each side got to see who they were talking to, thus providing a powerful personal link. Such events are a wonderful demonstration of how technology can be used to bring together people from very different cultural environments and backgrounds.

The Café's network makes it possible to have global round tables where artists, technologists, and philosophers from around the world can participate in discussions on relevant issues such as the use of virtual space, co-ownership of collaborative electronic artwork, and virtual reality.

In an early attempt to put this idea into practice, the couple staged an event as part of the activities surrounding the 1984 Olympics in Los Angeles. They hooked up a system for seven weeks which connected together different ethnic communities in the City of Angels. Operating over the phone lines, it was an immense success, and they realized that they needed a permanent base to serve as a communications hub. So they set up the Cafe in Santa Monica.

As well as providing a facility to enhance global interaction, Rabinowitz and Galloway also wanted to provide a means so that artists around the world could collaborate on artwork using electronic media. Indeed, it was through their own art—both were originally video artists—that each was drawn to the technology. Over the past decade they've pursued their artistic goals in several prestigious arenas. In July, they set up a temporary ECI facility at SIGGRAPH, the world's premier computer-graphics conference, which in 1992 was held in Chicago. Another was set up at Documenta 9, an important art festival held in Kasel in Germany. They organized a series of events which linked artists at these locations with each other, and also with artists at Santa Monica and La Cité. Together the art-

ists explored collaborative image creation and collaborative music, and held international forums to discuss "art in the age of technology."

Collaborative image creation is a process by which artists in many locations work together to create images on computers. But the interesting thing is that at any time, everyone is working on the *same* image. All the locations involved were connected together via ISDN phone lines, which will one day be the standard. Whatever someone in, say, Germany did to the picture was immediately seen by everyone else, and they could then respond with their own contributions to the evolving image. This technology sets up what Rabinowitz calls "a visual dialogue among artists"—a dialogue that transcends language barriers. The images created are now part of the ECI archives and can be accessed by anyone in the network.

As well as giving artists the chance to collaborate on works, the ECI network also makes it possible to have "global round tables" where artists, technologists, and philosophers from around the world can participate in discussions on relevant issues. During SIGGRAPH, they organized a series of international round tables on topics such as the use of virtual space, co-ownership of collaborative electronic artwork, and virtual reality. The point, says Galloway, is to bring the creative community together "to solve the aesthetic problems of the new technology."

Other ECI events have involved collaborations on performance-art pieces. In one event, dancers were located in several different locations and videotaped while they danced. The video images were then composited so that the performers appeared to be dancing together onscreen. Rabinowitz points out that with such multilocation performances, the whole piece only comes together in "virtual space." It's never realized in actual physical space. The "stage" is the ethereal realm of bits and bytes. Exploring the possibilities of "virtual space" is one of the pair's primary aims. Indeed, ECI Santa Monica, now serves as the headquarters for the Los Angeles Special Interest Group for Virtual Reality.

In pursuit of their artistic goals, Rabinowitz and Galloway have also established an ongoing relationship with the Center for Experiment in Art, Information and Technology at the California Institute of the Arts (Cal Arts), with whom they do joint projects. One in November linked musicians in Los Angeles with others at the Centre International de Recherche Musicale in Nice, France. Using music software, each side was able to control the other side's synthesizers, so they were able to have international electronic jam sessions between stellar lineups at each end. Rabinowitz and Galloway will also continue collaborative artistic activities in the international arena through the use of the mobile ECI facility which was set up for Documenta 9. Now that that event is over, the equipment, which is housed in a shipping container, will travel around Europe to other arts festivals. Forthcoming events to which it is going include the Venice Bienale.

True to their egalitarian philosophy, the couple is concerned to make their facilities available to as wide a range of people as possible. Rabinowitz sparkles with pride as she tells of one event in which they assisted a group of developmentally challenged people. This group came to the Café in Santa Monica and used its facilities to talk to a similar group from the Little City Foundation in Chicago. "They really got it," she says. "They ran the system and used the video phones." Galloway adds that "usually these people are kept in their own constituency groups." Getting all sorts of people together and giving them access to the technology in a nonintimidating environment is what ECI is about. Says Rabinowitz, "We want *all* people to be able to come here and imagine what is possible, and what they can do together."

From humble beginnings, the ECI network is reaching out tentacles into ever more arenas. There is now a videophone link with Biosphere II in the Arizona desert, and during some events, visitors to the Santa Monica Café can talk to the Biospheareans about life in their sealed bubble. Because of their early experiment during the 1984 L.A. Olympics, Rabinowitz and Galloway have also been invited to set up an ECI facility in Atlanta, Georgia, during the 1996 Olympic games. In the international arena, they're talking to an Ethiopian university about setting up an ECI facility which they hope will become one of many permanent bases in Africa, and plans are underway for one at a new arts center outside Beijing. Talks are also being held to set up one in Prague in the spring of 1993 during the city's "Let the Sun Shine" cultural festival.

At a time when the international scene is changing dramatically and when traditional barriers between nations are crumbling, telecommunications can surely play a role in helping us establish a harmonious new order. Electronic Café International is a wonderful tool we can call on in this difficult task ahead. ∞

CONTINUED FROM PAGE 96

friction holds it there. When enough sand has fallen to the bottom, the hourglass begins to float upright, and then it rises.

(An antihourglass, mentioned in October's column, has enough sand to just barely sink. When inverted, this glass remains wedged in at the top of the tube until the hourglass becomes bottom-heavy and sinks.)

That's all there is to it. Congratulations to the 415 readers who got it. Five, selected randomly, will receive one-year subscriptions to *Omni*. John Burke of Darien, Illinois, Bill Cembor of Atlanta, Georgia, Stephen Godby of Centreville, Virginia, Chris Mills of Guelph, Ontario, Canada, and Jim Stewart of Salt Lake City, Utah.

I promised copies of the book *Omni Games* to the five "most interesting" entries. Correct answers to this puzzle aren't very interesting because they're all virtually alike. Therefore, I awarded books for *incorrect* answers only.

1. Pete Roche of Chicago foresaw this and sent both a correct theory and this incorrect alternate: "The hourglass has a small clasping mechanism at each end. The momentum of rising provides enough energy to engage the mechanism as it reaches the top of the cylinder, while the weight of the falling sand is required to release the mechanism."

2. John J. Gagne of Eglin Air Force Base, Florida, supposed that sand blocked the hole, and air in the bottom of the hourglass became compressed until "a jet of air shoots into the top half of the hourglass, imparting just enough lift to overcome inertia and start the glass moving up."

3. "The hourglass is composed of a flexible material such as Nalgene," wrote Timothy R. Dinger, Ph.D., and Daniel E. Edelstein, Ph.D. The two share a prize for having the confidence to submit their incorrect theory on company stationery. IBM's Thomas J. Watson Research Center in Yorktown Heights, New York.

4. Cliff Oberg of Clarkdale, Arizona, theorized that the tube's caps are hollow and that the fluid must flow from the tube through a hole into the cap below before the glass can rise.

5. Finally, a theory about the density gradient of the liquid was signed "Bob Saville, Physics Teacher, Shoreham-Wading River High School, Shoreham, New York." He added, "P.S. If this is wrong, then my name is John Holzapfel and I teach chemistry." The fifth book, therefore, goes to Holzapfel.

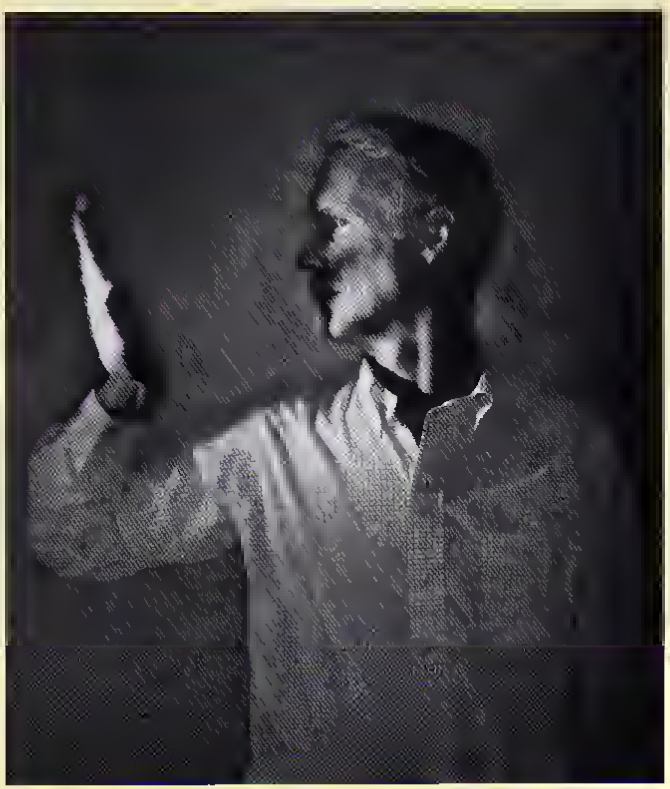
INTERVIEW

Striding to his Caltech office, John Joseph Hopfield spies the silvery trail of a snail that had been scouting for food at dawn. The telltale strip goes in a straight line, a circle, and then a straight line again. That, says neural-network theorist Hopfield, means "the wind changed while the snail was following the scent." He ought to return again before daybreak, he muses, with video camera and spotlight to track the snail's movements and correlate them with shifts in the wind.

Strange activities for a computer theorist, perhaps, but Hopfield has little respect for boundaries. Snails are central to his latest project, working out the math of a system that will smell the location of an object—as does a snail heading for breakfast. It's all part of Hopfield's neural networking, an approach to computer architecture whose goal is a machine that may even imitate human consciousness.

Conventional computers are superhuman only in the speed they apply to tedious, brick-by-brick logic, sorting mountains of spoon-fed data. Hopfield's systems learn and judge for themselves, and he's confident they'll eventually simulate emotions and creativity. If computers someday paint, compose music, write novels, and run governments, Hopfield will have to take some of the blame.

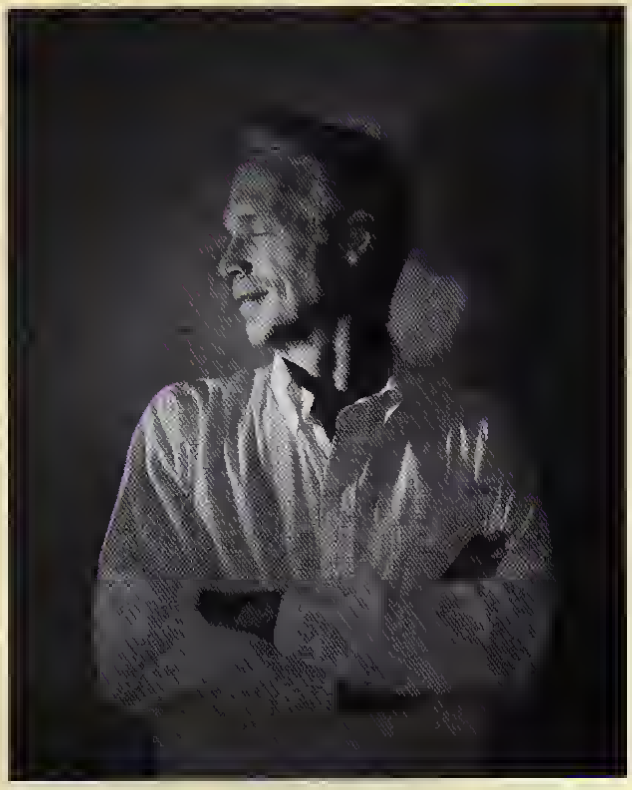
The son of a Polish physicist, Hopfield inherited his father's can-do philosophy that everything in life—from smelling roses to the workings of the mind—can be fathomed with math and logic. So when artificial intelligence (AI) in digital computers reached a roadblock in the late Seventies as it bumped against the limits inherent in its design, Hopfield opened a new way. He worked out a math model of associative memory in large networks that functioned in a way equivalent to neurons in real brains. Efforts to engineer neural nets into silicon circuitry began at Caltech, Bell Labs, and



JOHN J. HOPFIELD

With an array of electronic sensors that measure the physical things being done to them, you have the means whereby consciousness could be an issue.

PHOTOGRAPHS BY DAN WINTERS



A COMPUTER COULD BECOME TRULY SELF-REFERENTIAL; IT WOULD HAVE A WAY TO MEASURE ITS OWN HEARTBEAT.

MOTTO:
"Let me define it operationally."

YES, BUT CAN THEY OUT-CURSE A PARAKEET?

Neural nets can now play backgammon, recognize faces from parts of photos identify airplanes on radar, learn languages, score credit for loans and mortgages, analyze fingerprints, read databases, calculate aerodynamic flow schedule airline flights test Pap smears, detect abnormal heartbeats, predict stock indexes, diagnose symptoms and prescribe medication, aim missiles, read handwritten zip codes talk from written texts, play Ping-Pong, and read lips. Soon systems will check the faces of individuals going into secure buildings, enable industrial robots to pick among parts to fashion a product, someday imitate consciousness or be conscious

elsewhere. By 1988, even the grand guru of AI, Marvin Minsky of MIT, at first skeptical, predicted that "neural technology is the way of the future." A defense official said neural-modeling technology would be "more important than the atom bomb."

Hopfield's systems compute by association, detect patterns, and form judgments. Like the human brain, they learn, generalizing from examples. Unlike strictly logic-based AI, they handle the random perceptions of the everyday world—recognizing faces and objects and understanding human speech. Like humans, they have hunches and intuitions. A conventional computer will struggle to make sense out of *bat ball* and *diamond*. A neural network will *catch* the ball in its *glove*.

No wild-eyed visionary, but a sober mathematician, Hopfield nonetheless predicts that we will have computers that will either imitate consciousness or be conscious—depending on your definition of that concept. So far, nearly all of these systems are software run on conventional computers that only simulate in slow motion the performances of neural-net hardware. Several companies, however, have made prototype neural chips.

Sample neural cubes decorate Hopfield's desk: jewel-like squares the size of a quarter, gold wiring glinting against blue borders. Like the brain's neurons and synapses, neural chips respond and send signals according to the strength and frequency of the signals passing through them rather than simply switching on or off in digital fashion. Actual neural nets built so far are much less powerful than a cockroach's brain. Yet when neural chips are mass produced and hardware built they should compute millions of times faster than conventional machines.

Hopfield is a tall, lanky figure who spews ideas with great precision and vitality. As interviewer Anthony Liversidge crossed the door of his office, Hopfield sprang up from a knee chair at his computer, shook hands vigorously, and gave his full attention. Hopfield has no financial participation in the infant university-military-industrial neural-net complex his ideas have spawned. He has, however, won his share of prizes, from a MacArthur Foundation grant in 1983 to the Wright prize Harvey Mudd College awarded him, he jokes, for "being a dilettante."

Omni: How do snails in real life compare to your computer models?

Hopfield: My mathematical slugs are simple neural networks that correspond with the real slug's anatomy. They can easily produce the same kinds of learning behavior as snails. My colleagues at Bell Labs have stud-

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ANTIMATTER

UFO UPDATE

ALIEN BODY COVER

When your deep-space probe finally lands on GX598 and you step out, what sort of creatures will you see? The pundits have proposed aliens both large and small, agile runners or plodding hulks, creatures with two legs, four legs, or more. But one of the most critical characteristics debated by the experts is body cover. When we finally meet up with intelligent life from on high, will the species we find be smooth-skinned or furry, covered with

downy feathers or flat, bony plates? It all depends on the environment of the alien planet. But given the laws of evolution, it seems likely we'll find some of the same outer body characteristics already found on creatures of the Earth.

Many people argue that since extraterrestrial life is genetically unrelated to us, extraterrestrials will look nothing like us or anything we can imagine. That argument is based on the assumption that our form is strictly genetic, and that it results only from chance mutations. If, on the other hand, much of what we are is rooted in logical and physical laws, then those laws may turn out to be universal and may constrain aliens in the same way and to the same extent that we are constrained. If that's the case, we may be able to make some very solid predictions about the way intelligent aliens will look.

One example of a feature that might be under strong constraint is body cover. Any alien, no matter where it lives and no matter what its shape (as long as it has a shape), will have a point where the individual ends and space begins; in other words, the individuals in an alien species are likely to have a body surface.

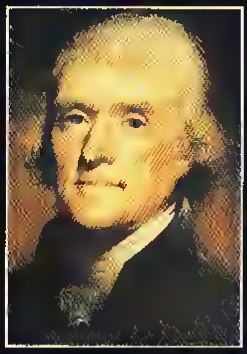
It is also reasonable to assume that an alien will have some sort of developmental scheme—that is, that it developed from a simple form into something more complex. What is true for the alien as a whole must also be true for its body cover. Early in its development, alien body cover must have been flat, the simplest form it can attain. Then, in accordance with physical laws, the alien skin could have become more complex through time.

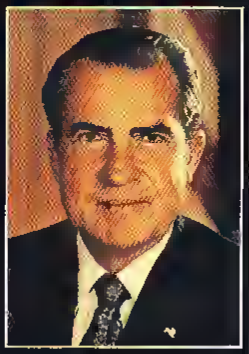
In becoming more complex, skin has only three choices. It can remain flat, it can thicken or fold out (evaginate), forming structures such as feathers or scales; or, it can fold in (invaginate), giving rise to hair, teeth, claws, or nails.

There are many reasons why animals develop hard dermal appendages. These structures aid in sensory perception, protect the organism, and help to regulate body temperature by acting as insulation. Indeed, just as in a house, the better the insulation, the less the energy required to maintain a constant temperature. The importance of thermoinsulating appendages is particularly clear in light of the fact that they have evolved independently here on Earth several times among terrestrial organisms. Look at the panoply of Earthly life, and you'll see an abundance of insulating feathers and hairs.

So, travelers to GX598, stand prepared! When we encounter that alien, it is likely to have a body cover resembling skin. And, unless its world is unusually hospitable, we're also likely to see a combination of fur, feathers, nails, teeth, and scales.—Trent Stephens

Editor's note: Trent Stephens is associate professor of anatomy and embryology at Idaho State University in Pocatello





Both Jefferson and Nixon lost to Harvard grads named John

PRESIDENTS ON PARALLEL PLANES

We've all heard the chilling parallels between the lives of Abraham Lincoln and J.F.K. You know, Lincoln was elected in 1860; Kennedy was elected in 1960. Lincoln and Kennedy were both assassinated. Lincoln and Kennedy were both succeeded by vice presidents named Johnson, and so on.

But John Leavy, a computer programmer for the Texas State Attorney General's Office, doesn't think these parallels are chilling at all. In fact, says Leavy, "You can take any two U.S. presidents at random and come up with just as many coincidences as those between Lincoln and Kennedy. If Lincoln and Kennedy had not been killed, no one would give a damn about these coincidences or think they were spooky at all."

To prove his point, Leavy has found a number of startling and less-than-startling similarities among 16 U.S. presidents, including William McKinley and James Garfield, James K. Polk and James Earl Carter, and Woodrow Wilson and Dwight Eisenhower.

Take McKinley and Garfield. Both were Republicans born and raised in Ohio who served in the House of Representatives. Both supported the gold standard. Both were shot, and both died in September, in the first year of their respective terms. And both were succeeded by mustachioed vice presidents from New York City. Coincidentally, both vice presidents—Chester Alan Arthur and Theodore Roosevelt—had 17 letters in their names.

Another pair on parallel planes is Thomas Jefferson and Richard Nixon. Both Nixon and Jefferson had vice presidents who left under a cloud of scandal (Aaron Burr and Spiro Agnew); both lost a presidential election to a Harvard graduate named John from a wealthy Massachusetts family. The next president elected after each was named James. And finally, both Nixon and Jefferson end with "on."

Commenting on Leavy's findings, Kendrick Frazier, editor of the *Skeptical Inquirer*, the official journal of the Committee for the Scientific Investigation of Claims of the Paranormal, says, "His study shows you can always come up with amazing findings after the fact. There are so many events going on all the time, it would be even more amazing if these apparently extraordinary coincidences could not be found."—Anita Baskin

ABNORMAL OBJECTS

What would it take to get parapsychology some respect? Writing in a recent issue of the *Journal of the Society for Psychical Research*, parapsychologist Cesar Tort says that neither past attempts to demonstrate survival after death, nor the dry, statistical approach of experimental psi research has convinced the skeptics. Instead, he proposes his colleagues pursue the study of "permanent paranormal objects," or PPOs.

To date, says Tort, no one has proved the existence of a true PPO. But if a PPO *could* be documented, it would be an object that "could not have been produced normally no matter how ingenious the forger and no matter what its origins." A set of seamlessly joined metal rings could qualify as a PPO, explains Tort, as could Spain's House of Faces, where human features purportedly appear on the walls. If the Shroud of Turin had been authenticated, that would have been a PPO as well. In shorth, says Tort, a PPO would literally *prove* the paranormal, legitimizing parapsychology once and for all.

Psi researchers come down on both sides. Stanley Krippner, psychology professor at the Saybrook Institute in San Francisco, says, "A concrete paranormal object that people could actually study would be enormously helpful." And researcher

The Shroud of Turin

George Hansen says that while the study of a single paranormal object might be problematic, "If there were an entire series of them, it would be a different story."

Meanwhile, parapsychologist Brenda Dunne, manager of the Princeton Engineering Anomalies laboratory, contends that the study of PPOs could not replace controlled research in the lab. "The problem is," says Dunne, "that one man's proof is another man's evidence for fraud."—Paul McCarthy

ANTIMATTER

OPERATION RIGHT TO KNOW

Fed up with the alleged U.S. government cover-up of UFOs? If so, you might be interested in joining Operation Right to Know, a group set on wresting hidden information from government vaults. Toward that end, members recently took to the streets of Washington, DC, to express their concern.

Executive Committee members Mike Jamieson of California, Ed Komarek of Georgia, and Elaine Douglass of Washington, DC, this summer rallied with other members on the ellipse behind the White House to distribute UFO information, show UFO photos, and make the case for disclosure. They also dropped off information packets to members of Congress and picketed on Pennsylvania Avenue.

This activist approach is a must, according to Jamieson, "if we hope to enlist the aid of scientists and journalists in our work for disclosure." Certain UFO researchers had reservations about pounding the pavement, Jamieson adds, but they have now "loosened up."

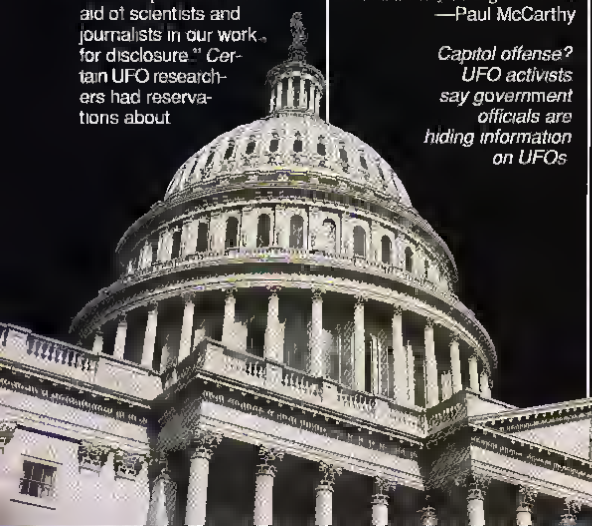
To become increasingly effective, the protesters have even begun to forge a more formal organizational structure. But that costs money, so like most political-action committees, Komarek says, "We have been kicking around the idea of direct-mail solicitation of funds."

And they may need them. UFO advocates nationwide have expressed interest in joining the protests, and Jamieson believes his movement may eventually spur protests in Las Vegas, Gulf Breeze, Florida, and other places where UFO interest is strong.

What's holding people back? "The fear of ridicule is the biggest barrier," says Jamieson. Those not intimidated, however, can contact Jamieson and Komarek at Operation Right to Know, Route 3, Box 1076, Thomasville, Georgia 31792.

—Paul McCarthy

Capitol offense? UFO activists say government officials are hiding information on UFOs



CROP-CIRCLE CONTEST

Some crop-circle enthusiasts believe the cryptic pictographs that have materialized in British fields over the past several years must be the work of space aliens, spirits, or bizarre weather patterns. But there could be a simple explanation. A recent contest proves that mere mortals, working silently and in darkness, can create huge symmetrical images in the cereal fields.

Sponsored by the Koestler Foundation, the German magazine *PM*, *The Guardian* newspaper, and the British journal *The Cerealogist*, the summer competition drew 12 teams of one to six people who labored for up to five hours at night in a High Wycombe, England, wheat field to make pictographs much like the ones people have been finding. According to contest organizer Chrstine Rhone of *The Cerealogist*, which reports on crop circles, contestants could use any tools as long as they worked without noise or light in their 70 × 180 foot plots.

A team of five judges awarded the £3,000 first prize to three design draftsmen who created their crop circle with rope, ladders, and pipes. The second place £500 award went to American Jim Schnabel, who flattened grain with rope, planks, and a special steamroller-shaped garden tool.

Although contestants did a credible job, Rhone says they didn't produce *exact* copies of the "real thing." The contest participants frequently broke the grains, for instance, even though grains in apparently "real" circles were merely bent. And, adds Rhone, "the masterly, flowing quality" associated with the supposedly authentic crop circles "was not duplicated."

Cereal sculptor

British plant physiologist Rupert Sheldrake, who helped organize the event, insists the crop-circle phenomenon remains unsolved. "Although the contest shows that hoaxers could do more than some people previously believed possible, it leaves the question open," Sheldrake says. "The fact that you can forge a twenty-dollar bill doesn't mean that all twenty-dollar bills are forgeries."

He notes that three new crop circles appeared in England the night of the contest. "Certainly," Sheldrake adds, "all the hoaxers involved in our competition had perfect alibis."—Sherry Baker

The Artist

WALKING

CONTINUED FROM PAGE 38

position waddles from side to side and tends to lurch forward to where gravity tugs at its midline. Dart's humanapes, at first glance, probably looked and acted very much like an odd strain of chimpanzee or gorilla, but deep inside, beneath the flesh of outward appearance, they held the secret formula, it seems, to the pathway of human development. He dubbed this 2- to 3-million-year-old ancestral contender *Australopithecus africanus*, and the rest is, shall we say, prehistory?

Not only did Dart's and subsequent discoveries reveal that the human species was far older than had previously been considered, it also implied that long before big brains and superior intelligence acquired the reins of our planetary destiny, early human prototypes were walking. For whatever reasons, much the same way we walk today in all our highbrowed splendor. Bipedal walking has been with us, has *characterized* our kind since the proposed evolutionary beginning, since those fateful moments when we climbed down from the trees and took to striding freely along the broad, sun-drenched savannas of the African frontier.

Consider the relative ease with which we acquire the ability to walk. It's like learning to speak—a function clearly associated with the superior intellectual capacity of the human brain. Like speaking, walking is a learned behavior that involves the mastering of a standard complex of built-in response mechanisms, in this case stemming from the motor and sensory regions of the cerebral cortex. The capacity for walking, like that of language acquisition, is no accident. It is the result of perhaps millions of years of biological adaptation and genetic selection. The *capacity*, in other words, is specified in the very design of the human structure. The individual's job, usually in the toddler stage, is to figure out how to use it, generally through the process of trial and error like we do everything else. By the time we reach adulthood, walking has become such an intrinsic part of our everyday routine that, like breathing (and to a certain extent speaking), we tend to take it completely for granted. The way we walk becomes as much a part of our individual identity as the timbre of our voices—distinct, perceptual reflections of who we are and how we happen to be feeling at any given moment.

The question of what came first in human origins remains a sizzling topic of controversy in the forefront of anthropological research. The implications range from dental gaps to gender gaps and seem constantly to fluctuate between the swirling folds of our own generation gaps. We will never know the exact sequence of events which led to our formation. If we did—if we had, for instance, all the facts right before our noses—we would probably fail to agree on their precise arrangement.

We can, however, agree on certain highly consistent physical markers such as the architecture of bipedalism and the measure of brain growth, and we can place them in a rough chronology based on *solid* evidence and high-tech verification methods. In this context, we can safely determine that although it may not be *the single evolutionary key* to a human-from-apelike divergence, habitual bipedal walkability is certainly one of the most crucial notches in the doorjamb and became so long before consciousness could account for it.

Today we live in the aura of our intellectual achievement. We drive in automobiles, fly in airplanes, create arbitrary worlds in pictures, sounds, and words, and even computer programs. We design great cities and live in complex dwellings replete with electricity, plumbing, heat, and refrigeration, and yet we who walk bipedally do so in ways and amounts that elude our conscious perception. We are in constant motion, perpetual two-legged verbs engaged in the occupation of carrying out the sentences of our experience across the landscape of evolution.

And while we drive our automobiles, peck at the keys of fantastic computers, and design great buildings to house our intellectual geniuses, we never stray too far from the context of those two unparalleled columns of human eccentricity. We are all—brilliant, mundane, healthy, or ill—inextricably linked forever by the footfalls of our own primordial design. ∞

"After all we could get on very happily if aviation, wireless, television and the like advanced no further than at present. . . . The sum of human happiness would not necessarily be reduced if for ten years every physical and chemical laboratory were closed and the patient and resourceful energy displayed in them transferred to the lost art of getting on together and finding the formula for making both ends meet in the scale of human life. Much, of course, we should lose by this universal scientific holiday . . . but human happiness would not necessarily suffer."

—Edward Arthur Burroughs
Sermon at Leeds, September 4, 1927

INTERVIEW

CONTINUED FROM PAGE 76

led real slugs and found oscillations in activity in the brain area that processes olfactory signals. We're hoping this oscillation corresponds to those we see in mammalian systems. Every time you take a sniff, the olfactory bulb, the first stage of olfactory processing, bursts into a kind of oscillation, a rapid excitatory and inhibitory activity of groups of neurons. Those oscillations are part of the computation. Other parts of the brain oscillate, too.

Omni: How does oscillation process information or yield answers?

Hopfield: Or code information in some fashion? For example, if different parts of the brain oscillate at the same frequency but in different phase, information is contained in that difference. Maybe the oscillation is a carrier, a way of several pieces of information on one communication pathway. Perhaps this oscillation is used to mark information so that two things in different places in the brain are oscillating in the same way because they represent different parts of the same object. We've used oscillations as a way of amplifying and selecting information.

Omni: Would oscillation work to compare samples at different times?

Hopfield: Possibly. The sensor might want to take samples at different times because the smells in a room fluctuate. Otherwise, it would get an average smell that wouldn't tell you much about what was in the room. Or it might be useful as an amplifier of signals. The oscillation in the olfactory bulb of mammals, in the level of electrical signals in the neurons, goes on every time you sniff, breaking into about 40 cycles per second, 40 hertz. There is also the oscillation of breathing itself—say, 1 hertz. The slug oscillates about once a second, and it isn't clear if this is used like the mammal breathing cycle to make independent samples of the air.

It would be astonishing if oscillation were a mere epiphenomenon, but there's not yet a definitive statement about what it does in processing. One paper argues it is the beginning, the essence of consciousness. Oscillation represents richer dynamics, and computation *is* dynamics. Dynamics, the change of activity with time, is better than true-false logic for describing neural computation. Harnessing oscillation is an important challenge.

Omni: But will you be able to build a system that smells?

Hopfield: Oh yes, even a system to pull apart mixed smells just as animals can. Others have used neural nets to identify a smell in isolation but never in a mixed environment. Their simple olfaction model has one test. It presents one single odor to see if an animal can decide if it's good or bad by moving toward or away from it. But in the natural world, odors are usually mixed up. I'm working out how the system deals with that complexity.

Previously we thought that a single odor is the same problem as taste, a proximal sense. You decide what's in your mouth—is it a mushroom? But olfaction is a form of remote sensing. That's why scents are intermingled. Now if the mixture were constant, there'd be no way of unscrambling the odors coming from different objects. But if odors are intermixed in a fluctuating way, you can possibly unscramble them because the relative amounts are changing. In the simplest case,

> "Why are people put together as they are? In some sense, it's an accident. You could have equal intelligence in something that looks like a cow."

when the background is fixed and the template odor comes and goes, you can evaluate whether what comes and goes has the same ratios of components as the template. If you go into a kitchen that stinks of cabbage, say, 30 seconds later that odor has disappeared. Then if the cook puts something else under your nose, you smell it in a relatively normal way.

Omni: If you could equip a robot with smell, how close would that be to human brain activity?

Hopfield: Smelling for humans is extraordinary for the kinds of memories it evokes. Gee, that smells like grandmother's house, and so on. To copy humanlike behavior, you'd need not just the sense of odor identification, but also to combine it with the rest of knowledge. Some sets of memory are strongly odor associated and often emotionally charged. Smell is linked to emotion much more than vision—for reasons relating to sex, fighting, and food.

A problem in making humanlike systems is that there's no simple correspondence between the artificial math model and real neurons. We can already imagine vision systems that do what we do when we see, including the "errors." Visual illusions, for instance, are caused by improper shortcuts in the algorithms biology uses—things that are wrong. You're not going to get illusions in an artificial system until it has an uncanny similarity to human vision. It will be getting close when the engineered system also suffers from biology's mistakes, has biology's illusions.

Omni: Will neural networking be more influential than the atom bomb?

Hopfield: They will certainly be more used! There isn't much technology yet, just the algorithms we run on digital machines to simulate neural networks. Real neural-net hardware will be much faster than emulating neural networks on digital machines. People are doing things. Du Pont has plastic sheets rolling out rapidly while an engineer tunes the process for quality. Du Pont is using networks in some aspects of measuring and predicting product quality.

Omni: That's pretty mundane.

Hopfield: Utterly mundane, but if you're turning out millions of dollars of product a year and a neural-net algorithm helps you, you know neural nets are not just imagination. Process engineers can be concerned with things like the texture of materials, fiber for fabric. Texture is slightly nebulous—it isn't a nice physical measurement. Texture is a more ethereal measurement. You look and judge. No, it's not quite right. A neural system can learn to recognize texture in some sense, even though you haven't given it a set of rules. Unlike a digital system, you can't quite tell it what to do; it has to decide for itself.

Omni: What other kinds of systems have a big future?

Hopfield: Practical databases. People are working on networks to recognize English words in natural speech or to take written words and speak them naturally. Speech is tough. There's a lot of natural variation. It is hard to give a rule for what a sound wave should be so that it can recognize, say, the word *six*. But give a network many, many examples of *six* and *no six*, and after a while it constructs its own procedures and becomes very effective at recognizing the difference. Getting a machine to generate speech is easier than getting it to listen to speech.

Turning typed text into speech is easier. *Speak and Tell*, made by Texas Instruments, has a set of rules to get from letters to pronunciation. There's a lot less natural variation in typed text. At Caltech, we've been working on neural hardware for a speech-interpreting

network. We talk into it and it recognizes the word we said. We work with a small vocabulary. If you can do it small you can do it large. Question is can you do it with all the natural variation? You, Anthony, speak with a residual British accent that's quite different from a ten-year-old girl's from the South. The network has to solve what is similar between the two.

Omni: Will we soon get a phone anyone can speak a number into and it will dial?

Hopfield: That is totally doable now at great expense. But can you do it for ten bucks on a single low-electric power chip? That's the real intellectual and technological challenge. Intel is doing interesting things. They've recently marketed a neural-net chip with "synapses." 64 neurons and 8,192 continuously adjustable connections—synapses. It probably costs about ten dollars to make. Previously, chips needed already-made connections or else connections of discrete strengths, like zeros and ones. In use, such connections are either made or not made, unlike the continuously adjustable connections of biology.

In a neuron, an action potential arises on an axon terminal, then releases some neurotransmitter over to the other side to the dendrite, and an electrical current flows into the dendrite. How much electrical current flows depends on how much transmitter is put out, how many receptors are on the other side, and so on. There is modification, and that modification, for example, is what goes on when you learn. The strength of that synapse is fairly adjustable.

That is what the Intel chip represents. The connections in the chip don't have to be fully turned on or off. With a certain voltage at the gate, the transistor is partially turned on and a partial connection made. The resistance is adjustable according to the charge at the gate. Before this, the control of these charges on the gates was not good. Either you had a lot of charge and it was turned all the way on and a 1 was stored, or the charge was not enough, and you stored a zero somewhere. Intel's technology allows a partial charge, providing a way of controlling the connection in a continuously adjustable way.

Omni: Will simulated synapses ever mimic the internal workings of the brain cell—second messengers, protein synthesis, and so on?

Hopfield: That's not the way electronics will go. Biology has all those things available and so uses them very cleverly in the way it gets neurons to compute. We will use the physics that is available in the electronic chip in the same way that neurobiology capitalizes on the structure of the cell.

Omni: Mathematician Roger Penrose says you need quantum mechanics to explain consciousness. Do you agree?

Hopfield: There has long been a romantic notion among physicists such as Niels Bohr, Eugene Wigner, and others that quantum mechanics is the secret to the complications and richness of thought and neurobiology. I fundamentally disagree. The real mysteries of neurobiology are essentially problems described by classical physics operating in large systems.

To look at two atoms colliding is not interesting. But with 10 to the 43 atoms colliding—all the complications of wind and weather come into being. A simple set of equations—but describing a large system—can produce a hugely complicated set of phenomena completely unlike what you'd have expected from the microscopic laws if you hadn't studied the hell out of them mathematically. These collective or large-system phenomena are often astonishing, but they come from the huge numbers of molecules or synapses, not the intrinsic complexity of the underlying physics.

There is nothing mystical in the collective behavior of large systems, and the brain is one. Many physicists have made the wrong choice about what's important in neurobiology. Penrose is the most recent example of a noble but wrong-headed line.

Omni: But can you be certain quantum mechanics doesn't affect the brain?

Hopfield: There's simply no evidence for it and considerable analysis to show why this should be true. Any thinking chemist or condensed-matter physicist takes the same position I do. Penrose never worked on large, complex systems whose behavior now is determined by many details that happened in the past. Why are humans intelligent? In some sense, it's an accident. You could have equal intelligence in something that looks like a cow. Biology as we see it has a huge number of frozen accidents in it. To understand the most evolved part of biology, clearly the intelligent mind, you have to know something about the frozen accidents.

Omni: Have you proved your point by making computers that can be called conscious?

Hopfield: They are much more like biology, but, of course, you could say they are still only programs in digital machines. They as yet have no consciousness. But what *is* consciousness? The term is so ill-defined. I can conceive of nothing at present as having consciousness, because I'd have to be able to

define consciousness to describe whether it was present. Three years ago, I started asking friends what their attitude was about it. Richard Feynman's view was that consciousness is not a scientific subject because he couldn't define it well enough to get his hands into it and ask, "Is this object conscious?"

Omni: So physics per se can't define consciousness?

Hopfield: It's the old Turing problem. If you communicate with a keyboard at a terminal that communicates with something at the other end of a line, is the thing you're communicating with conscious? I can easily conceive of a digital machine clever enough to have a dialogue with you for, say, five minutes. You'd have horrible trouble deciding what was at the other end. Or suppose you had a playful computer science student at the other end saying, "I'm going to be machinelike."

Consciousness has something to do with attention, but that's a vague start and not good enough.

Omni: If attention is a part of consciousness, much of the human race may not be conscious.

Hopfield: A large part of what humans do is highly intelligent behavior but not conscious. You drive home along a route you know well and you have a choice at each corner to turn left to deviate from your usual route, and you don't, you're unconscious of your choices. Consciousness may be a simple add-on somewhere along the line. Marvin Minsky views consciousness as not very interesting because most powerful computations you do in a nonconscious fashion.

I often put some research problem away and don't think of it for a while and return to it to find it's much more developed than it was. Intelligent processing has been going on. While consciousness must be in some sense a collective phenomenon, that doesn't explain what it is. It only explains where to look for it. It's collective within the physics of the operation, something that comes from the very large number of nerve cells and not Planck's Constant.

Omni: You mean consciousness is just the result of having so many neurons in the cortex—a hundred times as many as rats do?

Hopfield: There are certain behaviors that don't take place in a small number but that in large numbers are fundamentally different. Look at the social interaction of two people. There's nothing in the behavior of a pair of people conveying the idea that if a thousand people get together, a riot can take place. A riot can only take place above a certain size group. It isn't because people interact differently, but the consequences of those interactions are different when you have large rather than small numbers. Physics is full of these phenomena for economic systems, weather, and other things.

Omni: Isn't consciousness shown by the ability to interact with oneself?

Hopfield: That's a part of the story, but how do you tell whether you think about yourself or not? The issue partly involves the fact that there exists a physical as well as a mental you. Your arm is not just a word, it's a physical object. The interaction between symbols and physical objects is part of the difficulty in describing consciousness. If you insist on having a dialogue only on a computer line and describe everything only with language, the physical world "out there" is only apparent in terms of words. But when humans think and experience the world, they have independent sensors of touch, vision, and smell that give them direct descriptions. Then the world is not just words.

Omni: Isn't a computer that says, "Help, I'm being damaged!" conscious?

Hopfield: For the computer to actually do so, it would need sensors that observe or measure the physical things being done to it. With an array of such sensors, you begin to have the means whereby consciousness could be an issue. The computer could become truly self-referential: it would have a way to measure its own heartbeat.

Omni: Do you dare advocate building emotions into machines?

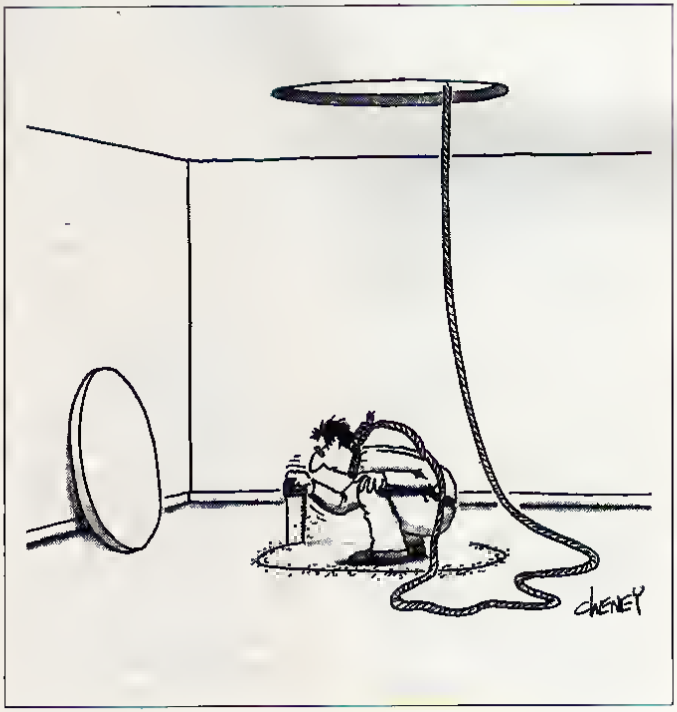
Hopfield: All higher animals have emotions that serve a biological function. I think I understand crudely how to insert the essential idea of them into physical systems. They're not built particularly easily in hardware, but the principle is relatively simple. It goes back to the question, "Why, when you are hungry, do many things remind you of food that otherwise wouldn't?"

Omni: But hunger isn't an emotion like regret, fear, or hope.

Hopfield: What do you mean by hope? Somebody who has hope will take a persistently positive view of a situation and do actions identifiably in one class. Someone without hope will take a different class of actions.

Omni: Isn't that reducing it to a very low digital computer level?

Hopfield: To make progress we must have operational definitions. I can't explain that "feeling of hope," but the operational side of hope is easier to describe. If you are in the operational state of "hungry," certain things remind you of food, which if you're not in that



biochemical state won't Hope will have to do with hormonal states influencing choices as will be true of hunger Particular hormones or neuroactive substances will be more present at one time or another If you learn in the presence of one, it will tend fo make you remember those general structures when it is present once again I think hope and hunger are related phenomena I can't say why you feel hungry or hopeful or what those *feelings* are But I can try to undersfand why you act under certain circumstances as though you are hungry or hopeful That's operational I can get into that

Omni: Everything we feel can be reduced to engineering?

Hopfield: Some things described as feelings can be operationally reduced to engineering But what we feel is difficult Specific drugs are known to result in a feeling of pleasure. We even understand the molecular sites to which they bind This does not answer the question, "What is pleasure?"

Omni: So future computers or robots may not show consciousness but will show some consequences of emotions? Perhaps awareness of emotions?

Hopfield: Nobody has dealt with arfificial neural networks that make measurements of themselves If a network could do thaf, it could have an internal dialogue about emotion because it will know something about its internal state

Omni: Doesn't this ability to self-monifor potentially free compufers from human control?

Hopfield: Computers already talk to themselves about their internal state All machines theše days do a self-check when you turn them on They say "I am okay, Jack!" after exercising their logic and memory That's a beginning They check fhemselves with procedures already out of the user's control If you could have more of a dialogue with them, they mighf begin to tell you in whaf sense they don't feel well.

Omni: Won't emotions be complicated to build in?

Hopfield: Operationally, emotions would be relatively simple fo construct It s only self-dialogue that's hard The presenf state of emofion in biology is very provocative Depression for instance, has biochemical symptoms But that leaves fofally unanswered the question of mechanisms by which depressing thoughts are caused by a chemical state Nobody in biology really works on that Marvelous topic

Researchers working on ways of treating depression do it in the sense of the auto mechanic who tells you that a normal car has gasoline in if, and yours does not and if gasoline is added, the car will probably work When we fix this biochemistry, the sign of depression it will probably go away With the automobile, the mechanic is nof addressing how the engine works, nor is the neuroscienfist asking how the lack of a chemical gives rise fo depressed thoughts No one in clinical neurobiology asks what's the difference between exalting and depressing thoughts such that now you can have one and not the other—how the brain thinks

Omni: What about the Japanese?

Hopfield: They are a real force in fhe field They feel they have a language problem that the world is not going to learn Japanese and that they'd be at less of a disadvantage if they could speak Japanese at one end of a felephone and have English come out the other And vice versa. They see artificial neural sysfems as an important approach to this problem

Many of their electronics companies have small neural biology groups and are working on the same problems we are The Japanese and Chinese are specifically working on software to recognize kanji, or written characters There are two Japanese alphabets phonetic and real pictographs In one direction,

they'd like a system to read writing and in the other direction, to type. At present, it's slow to type with a thousand symbols, so they'd like to type phonetically and have these symbolic characters appear correctly in context.

Omni: What about military applications?

Hopfield: There's promise in aspects of pattern recognition for feature surveillance where millions of pictures are shot to monitor missiles in other countries. People are not going to look at all those photos. You want to select by fast pattern recognition the 1 percent most relevant.

Omni: Star Wars stuff?

Hopfield: There are much more exciting ways to spend technological money. Simple pattern recognition. Why should you have to pay attention on the freeway? You could probably teach your dog to drive adequately on the freeway under most circumstances. Why can't neural nets do the early part of the visual processing well enough so that a digital machine could finish it off—keep you on the road, not running into the car ahead of you, and staying in lane?

Omni: In computer chess, why not build the best players you can and get them to play each other and learn to become the best by playing hundreds of thousands of games?

Hopfield: In theory, you could do it if the networks were sufficiently complex. But then your game is tailored around your opponent's. I've heard about the problem in humans. Two brothers played only with each other and didn't develop chess as it's normally played. They both learned an abnormal, highly stylized game, and they could be clobbered by anybody playing normal chess.

Omni: Your father was always thinking physics, wasn't he?

Hopfield: One day I was with Father rowing on a river with one of my older sisters. Her one-year-old child stood up in the back of the boat and fell out into the very muddy water. My sister screamed, and my father stood up but didn't move. She cried, "You're not doing anything!" He said, "Don't worry, she'll float." He waited until she came up into view before diving in. It was his immediate rational calculation that everything was going to be fine, and the operational thing to do was wait until the laws of physics came forward—because the child was fat!

Omni: Do you have that attitude?

Hopfield: Well, I'm afraid my family would say that I tend to be overly rational. There is always the question in life as to the balance between rational and emotional reactions. A totally rational outlook can be very unsatisfactory. Life needs poetry. ⊠

SACRED

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ing. "That one, Jackie. That one is special, yaar. It's a smasheroo, Jackie. An ultrahit! Bloody champagne and flower garlands here, Jackie boy. It's big. Mega."

"You liked the Moon, eh," Jackie said, stunned.

"Love the Moon. Love all that nonsense."

"I did hear about your brother's government appointment. Congratulations."

Goldie chuckled. "Bloody hell, Jackie. You're the fourth fellow today to make that silly mistake. That Vachchani fellow in aeronautics, he's not my brother. My brother's a bloody contractor, he builds bloody houses. Jackie. This other Vachchani, he's some scientist egghead fellow. That Moon stuff is stupid crazy. It will never happen." He laughed, then dropped his voice. "The fourth one is shit, Jackie. Women's weepies are a drug on the bloody market this season, you rascal. Send me something funny next time. A bloody dance comedy."

"Will do," Jackie said.

"This girl Betty, Goldie said. "She likes to work?"

"Yes."

"She's a party girl, too?"

"You might say so."

"I want to meet this Betty. You send her here on the very next train. No, an aeroplane, hang the cost. And that soundtrack man too. My kids love that damned ugly music. If the kids love it, there's money in it."

"I need them both, Goldie. For my next feature. Got them under contract, yaar."

Goldie paused. Jackie waited him out.

"You got a little tax trouble, Jackie? I'm going to see to fixing that silly business, yaar. See to that straightaway. Personally."

Jackie let out a breath. "They're as good as on the way, Goldie."

"You got it then. You're a funny fellow, Jackie." There was a digital clatter as the phone went dead.

The studio lights of the Japanese crew flashed on, framing Jackie in the graveyard in a phosphorescent glare. "Bloody hell!" Jackie shouted, flinging the phone away into the air and clapping his hands. "Party, my crew! Big party tonight for every bloody soul, and the bill is on Jackie Amar!" He whooped aloud. "If you're not drunk and dancing tonight, then you're no friend of mine! My God, everybody! My God, but life is good." ⊠

GAMES

FLOATING TIME
What really makes the hourglass tick

By Scot Morris

Last September, I presented a puzzling object: an hourglass that floats at the top of a liquid-filled tube (below left). Turn the tube over and the glass remains at the bottom (below right) until about half of its sand has fallen from the top compartment to the bottom. Then it slowly ascends to the top, where it rests until the cycle is repeated.

I asked readers to send in theories explaining the phenomenon. As of this writing, I have received 415 correct answers. (The correct answer appears at the end of this article.) But 618 sent *incorrect* theories of at least 15 different types. To minimize embarrassment to any of my much-appreciated readers, I'll give the names of these creative authors only if they've won the promised prizes.

About 40 percent of those readers with incorrect answers cited heat as a factor in the hourglass's behavior. Falling sand generates heat, they said. Some argued that this warms the surrounding liquid so the hourglass stays down until the liquid cools again; others, that the hourglass floats up with the pocket of warm liquid surrounding the glass's neck. But most in this category thought the heat warms the *air* in the glass, making it expand slightly and then rise.

More than 50 readers thought that the hourglass was flexible. Some reasoned that when the sand presses down from the top, the hourglass widens and wedges itself into the cylinder. Others decided that the hourglass is flexible only at the ends. "The top and bottom of the hourglass are so thin as to sag under the weight of the sand," wrote B. G. of Los Altos Hills, California. "When enough sand falls into the bottom chamber it 'bubbles' the bottom end out, increasing the hourglass's volume," reasoned D. Q. of Richmond Hill, Ontario, Canada.

Many correspondents blamed the "impact" of falling sand for keeping the glass down. Some even used mathematical formulas to show how much force a sand grain exerted first on the bottom of the glass and later on a mound of other sand grains. The theory may be correct, but the calculations have to also consider the amount of time each grain of sand is falling and weightless: the two tiny opposing forces exactly cancel each other out. Movements within the system don't alter the weight of the system.

Another line of reasoning put the emphasis on the liquid. "The solution is in the solution!" wrote H. W. of Coweta, Oklahoma. If the liquid is naturally cooler and denser at the bottom, then the denser liquid is at the top when the tube is turned over. It eventually seeps down below the hourglass and buoys it up.

A surprising number thought it's all an illusion. "It just takes a long time for the hourglass to get started," perhaps because the liquid is very viscous, wrote one reader. "The hourglass, *as a system*, is rising from the moment the column is inverted," argued P. T. of Glendale, California. They concentrated on the air bubble that constantly rises, first in the hourglass and then in the tube.

Many believed the air at the *top* of the hourglass lifts it to the top of the tube. "When enough air reaches the top chamber and exerts its pressure there, the hourglass begins to rise," wrote T. H. of Chapel Hill, North Carolina. About 4 percent of those who wrote in thought that the shape of the hourglass affected its buoyancy. When the air is in the bottom half, the water below the glass can push up only on the circular end of the glass. When the air rises to the top half, water can push up all around the inverted cone, a greater surface area. "It's the same principle that causes a snow cone to pop out of its cup when you squeeze the bottom," explained D. A. N. of Tillamook, Oregon.

The beauty of this puzzle, as I said in September, is that it can be solved by thinking about it. It requires no touching. Wise readers knew they could rule out any solution they could easily check if they had one of these contraptions in their hands. Pure gamesmanship should rule out special technologies—if the answer relied on some new kind of flexible glass or an unusual liquid, it wouldn't have been a fair puzzle to ask readers.

Ray Bathke of the Games & Puzzles shop in London, who builds the hourglasses, tells me he uses quite ordinary components. Distilled water with a drop of disinfectant added to prevent algae growth fills the tube. He makes the hourglass from ordinary glass, custom blown to specific proportions, and fills it with common air and sand. He carefully measures the weight and volume of each glass and then calculates the weight of sand needed, to within a hundredth of a gram, to make that particular glass just barely float in room-temperature water.

Now for the answer. The inverted hourglass has sand on top and air on the bottom. It is top-heavy, or bottom-buoyant, so it wants to flip over. It presses against the sides of the tube, wedging itself in, and

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