
OMNI
JANUARY 1982 $2.50
1981's WORST SCIENTIFIC ACHIEVEMENTS
JAPAN'S NEW ROBOT CULTURE, SCIENCE VS. MALE STERILITY, BROWN FAT DIET, DECODING NOSTRADAMUS, AND WHERE TO FIND BURIED TREASURE

OMNI®

JANUARY 1982

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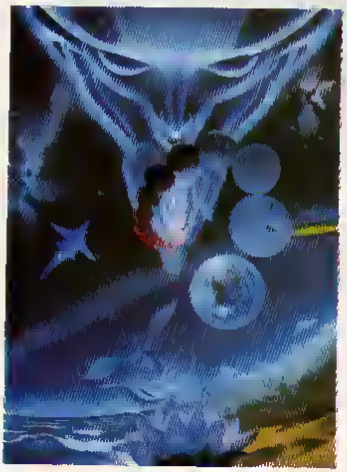
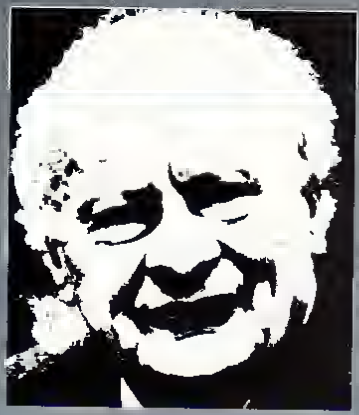


Surrealism predominates in German artist Fred-Jurgen Rogner's cover this month. One of Europe's most prolific painters, Rogner has illustrated more than 100 covers for various publications. His flamboyant work was featured in a recent television show filmed in Bavaria.



FIRST WORD

By Hans A Bethe

"The Age of Oil is nearing its end The Energy Department projects that a barrel of crude will cost $100 by 1990"

Two simple facts could end our energy problems Nuclear power can be produced at least as safely as any other form of energy, and the waste created by nuclear operations can be disposed of without endangering future generations

Interestingly enough the United States is the only highly developed nation that has not approved plans to increase greatly its use of nuclear power Even if nuclear power were abandoned in the United States other countries would continue to rely on nuclear power France, the USSR Japan, and Argentina for example are increasing their nuclear-generating capacity substantially The United States is obviously falling behind in the development of this vital source of energy This will not make the United States a safer place to live It means the United States is going to have less energy, fewer job opportunities and greater economic hardships than those nations now avidly developing nuclear power

The Age of Oil is nearing its end The U S Department of Energy projects that the price of oil will rise to $100 a barrel in this decade, and some experts predict an even higher figure But even more important than the high cost of petroleum are the instability characteristic of the major oil-producing countries in the Middle East and those nations limited oil resources While for the moment there is a surplus of oil in the world, it will not slow the soaring cost nor avert the inevitable depletion of the world's oil fields

We might be able to reduce our requirements of imported oil within ten years through a combination of conservation, the manufacture of synthetic fuels and particularly the substitution of other kinds of energy for oil

In many cases the substitute for oil will be electricity There are three ways to produce electricity efficiently from waterpower from coal, and from nuclear fission (I do not include solar power because it is prohibitively expensive by present technology nor do I include fusion which will not be a practical source of energy in this century)

Of the three power sources hydroelectricity has been almost fully exploited in the United States and most other industrial nations. Coal is an abundant resource in the United States and in the Soviet Union, but not in other industrialized countries As far as we are concerned therefore electricity will have to come from coal and from nuclear power The principal worry about nuclear power since the Three Mile Island accident in March 1979 has been the safety of nuclear-power plants This fear does not seem justified The presidential commission that investigated the accident under the chairmanship of Dr John Kemeny, was in general very critical of the incident's handling But the commission's report stated We conclude that in spite of serious damage to the plant [illegible] contained, and the actual release [of the contaminated water and air] will have a negligible effect on the health of individuals

A significant release of radiation was avoided because the plant's safety mechanisms worked This incident proved the reliability of multiple barriers against the release of radioactivity If one barrier fails, the next barrier will take over its job This principle makes nuclear-power plants very sturdy structures of the sort that can continue to serve the public safely even in the face of repeated errors by the operators A meltdown didn't occur at Three Mile Island

Contrary to widespread misconceptions (such as were fostered by the movie *The China Syndrome*), even a meltdown of the fuel in a nuclear reactor would not present a serious danger to the public The surrounding population would be threatened only if a meltdown were followed by a breach in the big dome that encloses the reactor the containment building This is extremely unlikely

Reactor safety has been further improved since the Three Mile Island accident The Nuclear Regulatory Commission has tightened its procedures, but the greatest changes have been made by the power industry itself Of these, the most important is the creation of the Institute for Nuclear Power Operations, to supervise the training programs for nuclear-reactor operators and to inspect directly the operations of the power companies

People also worry about the disposal of nuclear waste There is no reason to doubt that waste disposal can be accomplished safely, so that future generations will not suffer damage from the nuclear waste we now generate

Ultimately nuclear safety is a matter of people the operators and engineers who operate the machine safely Not enough young persons enter nuclear engineering and operation There is a grave peril that antinuclear proponents may have brought about a self-fulfilling prophecy By claiming that nuclear reactors are unsafe they may have made a career in nuclear power so unattractive to young people that in the future reactors may really become unsafe

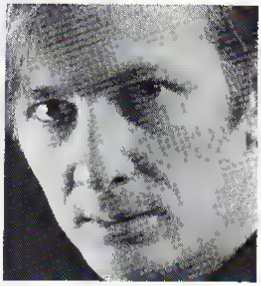
The energy crisis is real It has not been fabricated by oil companies or by public relations experts The problem of energy is solvable but not by any single solution Rather, it will be solved by a combination of partial solutions working together Nuclear power must be a part of that answer. It is both safe and economically feasible If civilization is to progress we must draw upon our ingenuity and harden our resolve to develop all our energy options including nuclear energy

Dr Hans A Bethe, a Nobel laureate is professor of physics emeritus at Cornell University

CONTRIBUTORS

OMNIBUS

ARISMAN



SHIRLEY

ROSE

LONGYEAR

Robots have a special status in Japan's work-oriented culture. Because of their increasing intelligence, coupled with voice and tactile recognition, these humanlike automatons have come to be embraced with the same affection given household pets—even children. "Their acceptance in society is universal," reports *R. Bruce McColm* who traveled via Japan Air Lines to Tokyo robot center of the world for a firsthand look at the impact of these new members of the labor force. While staying at the Tokyo Hilton, next to the shogun's temple, McColm quickly perceived that these mechanical servants were no longer restricted to industry. The author details, beginning on page 42, their diverse occupations, from robotic kendo players that thrust and parry bamboo staves, like Samurai of old, to a new breed of metallic men whose sole function is to produce more of their own kind.

There are Nobel prizes for the giants of science but few awards for those unsung heroes of the lower echelons—men, women, and even machines that have made lesser contributions to the noble pursuit of progress. Consider, for example, a group of dedicated doctors who battled to save the life of their country club's gravely ill golf course. Or take the first conscientious objector of the silicon variety—a computer that attempted suicide as a protest against nuclear energy. In recognition of these and other fine achievements that have hitherto gone unpraised, *Omni* announces its Laurels (and Hardys) awards, starting on page 74.

In "Where Flesh and Steel Mesh" (page 58), *Marshall Arisman* offers a disturbing vision of technology's influence on our lives. His paintings, characterized by their aura of surrealism and violent themes, have been featured on the covers of *Time* magazine, in *Penthouse*, the *New York Times*, and numerous other publications. Arisman, whose cheerful countenance belies his gloomy outlook on modern life, explains that aggression—directed against ourselves, our fellowman, and the environment"—is his major source of inspiration. Would he still create had he been born into a world free of war, hunger, and social unrest? "No," says the artist. "I'd probably be playing the saxophone."

Roger Billings converted his car engine to run on hydrogen when he was sixteen years old. Since then he has become a leader in the crusade to transform the United States into a hydrogen-powered society. Billings has already begun to adapt the homes and vehicles in one small Missouri town to run on this abundant source of fuel. He hopes that his model community will set a national trend, freeing us from OPEC domination.

"Billings isn't just spouting hot air," says *Kenneth Jon Rose*, who became interested in the scientist's pioneering work while waiting on gas-station lines during his undergraduate years. "What turned me on to hydrogen," Rose recalls, "is the fact that it's obtained from water and that when it's burned, the exhaust product is water." His exclusive profile of "The Hydrogen Man" begins on page 50.

After 25 years of writing his popular games column in *Scientific American*, Martin Gardner is retiring—to work harder on other projects. In a rare, exclusive interview, *Omni* senior editor *Scot Morris* talks to Gardner about *Alice in Wonderland*, perpetual-motion machines, Uri Geller, ESP, hoaxes (including Gardner's own), Fermat's last theorem, the fourth dimension, calculators, computers, and nearly a googol other topics. Turn to page 66 for the fun and amusement when *our* games editor talks to *their* games editor.

Barry B. Longyear's first attempt at science fiction writing earned him a nomination for the John W. Campbell Award in 1978. "The Tryouts" became the basis for Longyear's many short stories and two novels that chronicle the adventures of a spacefaring circus shipwrecked on the planet Momus. Longyear fans will not want to miss *Omni*'s excerpt from his upcoming book, *Elephant Song* (page 46), which is about the circus's adventures before it is marooned on Momus—or, in Longyear's own words, "it's a prequel!"

Finally, *John Shirley* makes his debut in these pages with his short story "Triggering" (page 54). Shirley has written a new novel, *Cellars*, due out this spring. He also performs as the lead singer for the New York rock band Obsession, whose lyrics touch on fantasy themes.

LETTERS

COMMUNICATIONS

Happy Anniversary

I have read *Omni*'s October 1981 issue from cover to cover and am still as impressed as I was when I read the first issue three years ago. *Omni*'s articles capture the powerful feelings people have for science and the future.

Bruce Kauffman
Gillette, Wyo

Omni has now earned the respect of general readers and the scientific community. Your unique blend of fact and fiction is irresistible to one and all.

Jerry Yule
Richardson, Tex

The advent of *Omni* has probably done more to promote science than any other media event. Your ability to explain the latest advances in modern science to the nonscientist is very impressive.

Thomas D Gillespie
Department of Geological Science
Rutgers University
New Brunswick, N.J

RACTER Reaction

Chills ran up and down my spine as I read "Soft Ions" [October 1981]. It's frustrating to think that a machine can get its first piece of fiction published while I sit here staring at a wall of rejection slips. Where do I go for my silicon-chip implant?

Marlette West
Oakland, Calif

RACTER is the first computer I've ever come across with a sense of humor. "Soft Ions" is *funny*!

Roy Milisa
St Petersburg, Fla

Let people write stories and let computers crunch numbers. "Soft Ions" is the poorest excuse for science fiction I've ever attempted to read.

David L Senum
Minneapolis, Minn

If you had run "Soft Ions" in April, I'd have said you were pulling my leg. Come back, HAL, all is forgiven.

Phil Stracchino
Audubon, Pa

It's not how well the dancing bear dances but that it dances at all. —Ed

Mystery Solved

I wish to identify the "mystery ship" described in Antimatter [October 1981]. It is a floating cultural arts center christened Point Counterpoint II, and Pittsburgh's American Wind Symphony Orchestra uses it for concert performances at various shoreside locations every warm-weather season. The photograph of the ship on Lake Ontario caught it between engagements.

The forward section of this extremely interesting ship houses the crew. The middle serves as the stage, complete with a roof that raises and lowers for concerts. And the aft section holds a children's minitheater.

Hundreds of people along the banks of the Ohio and Mississippi rivers and the shores of the Great Lakes are familiar with this ship.

Mark T Epling
Columbus, Ohio

We'd like to thank Mr. Epling for his information. The 20 photographs he sent us were quite convincing. We hope he can persuade other readers who have ideas of their own. —Ed

May I point out that the "mystery ship" mentioned in Antimatter is quite definitely a paddle steamer.

Anthony J Romain
Edinburgh, Scotland

One morning last summer as I was driving along highway M-43 about two miles east of Bangor, Michigan, I saw ahead of me above the treetops the "mystery ship" described in *Omni*'s October 1981 issue. There were portholes and what looked like battlements at both ends. It was huge and long and grayish-brown. I don't know whether it is the "mystery ship" you mentioned, but it was very similar.

W V Krohn
Grand Junction, Mich

Erratum

Omni regrets an error in last month's feature "Biochip Revolution," which inaccurately reported that Bethesda Research Laboratories (BRL) had just bought 30 percent of the shares of EMV Associates. The correct account is that BRL had made only a bid, which was subsequently declined.

DIALOGUE

FORUM

In which the readers, editors, and correspondents discuss topics arising out of Omni and theories and speculation of general interest are brought forth. The views published are not necessarily those of the editors. Letters for publication should be mailed to Omni Forum, Omni Magazine, 909 Third Avenue, New York NY 10022

Paradoxically Speaking

Mr. Ben Bova expounds on the either/or fallacy in *Omni*'s October 1981 issue. But in 1933 Count Alfred Korzybski wrote a book entitled *Science and Sanity*, in which he set forth the fundamentals of general semantics and non-Aristotelian multivalued logic. Count Korzybski repeatedly points out that one of the basic fallacies of Western thought is the either/or imperative: heredity or environment, intellect or emotion, instinct or reason, true or false.

All action involves both intellect *and* emotion, both instinct *and* reason. A proposition may be true on one level and false on another. Discussing the either/or fallacy, without mentioning Korzybski, is like talking about relativity without mentioning Einstein.

William S. Burroughs
New York, N.Y.

Peace First

Omni's letter to President Reagan in the October 1981 issue is a masterpiece. Never have I seen such a succinct and timely argument for space exploration.

I fear, however, that any effort by space organizations will have little effect at a time when world leaders are more concerned with global domination or the prevention of it. Our intercontinental differences will have to be resolved before we can expect to tap the unlimited resources of space.

Lieutenant Steven P. Smolinski, USN
U.S.S. *Mahan* (DDG-42)

Progress Postponed

In the "Breakthroughs" feature [October 1981], *Omni* incorrectly reported that the OTEC-1 project had just entered its second year of operation. The project, which involved the conversion of the S.S. *Chepachet* to an experimental Ocean Thermal Energy Conversion (OTEC) facility, began operation in July 1980 and was decommissioned in April 1981. Exactly why the Department of Energy decided to abandon this project midstream remains a mystery.

Although the project operated for less than a year, its 1-milliwatt-rated heat exchangers proved capable of converting four times that rating. Fears of excessive heat exchange, biofouling, and thermal pollution were largely negated. The only side effect was the phenomenal fishing off the deck of OTEC-1 because of the release of nutrient-rich water.

Michael Zahradnik
Alternative Directions in Energy and Economics
San Francisco, Calif.

Ant Update

I read about the unsuccessful attempt to launch an ant into outer space in Forum [September 1981] and decided to take up the challenge.

One Sunday my friend and I launched a ten-stage model rocket with not one, but three, ant astronauts. Though they didn't quite make it into outer space, they did fly to an altitude of 1.8 miles and were recovered 3 miles from the launch site. We found our antronauts A-OK.

That's one small step for an ant, One giant step for insectkind.

Michael Sims
Memphis, Tenn.

Buy or Rent

As the originator of the real estate industry's first and most sophisticated "Lease-Buy Analysis" program, I am offended by Professor Michael S. Johnson's "Equivalent Rent Analysis" in *Omni*'s Continuum section [November 1981]. It is only because of the recent availability of economically priced computer systems that Professor Johnson is able to offer his service for a $5 fee. When my associate and I introduced the program in 1970, the fee was a loss-leader at $250 per printout.

In short, your readers can save their $5 and apply the following formula: Does rent exceed the monthly payment for owning, minus the interest payment times the buyer's tax rate? (Rent = mortgage payment − interest × marginal tax rate.) If yes, buy. If not, does it exceed the same amount, less the interest that could be made on a down payment? If not, rent.

W. Lawrence Lipton
Harrington, Me.

The Phantom Knows

The morphogenetic hypothesis proposed by Dr. Rupert Sheldrake in Life [October 1981] may shed light on the phantom-limb phenomenon.

Could it be that when a limb is amputated, morphogenetic resonance is responsible for the sensation not only of the nonexistent limb but also of the pain?

A Kirlian photograph of a leaf that has been cut in half shows an aura of the whole leaf. Are "memories" lingering in the area where the leaf used to exist? Could a force field of some kind be transmitting the pain from where the limb used to be to the intact portion of the body?

Donald A. Eisner
Covina, Calif.

Lancelot Debunked

The magnificent "unicorn" goat pictured in Antimatter [October 1981] is not as Harry Lebelson reports, "the first living unicorn in modern times." He's not the result of duplicating past research through interbreeding," and he is not the offspring of an Angora goat and an as-yet-unidentified animal.

Lancelot is the offspring of two perfectly ordinary goats. When he was a few weeks old, his horn buds were removed in a routine way. Then the two buds were bisected, half of each was discarded, and the two remaining halves were placed together in a small wound in Lancelot's forehead. Pliny describes the technique clearly in his *Natural History*, Book XI. As recently as 1933, Dr. Franklin Dove created a unicorn at the University of Maine.

Dr. Draper Kauffman
St. Louis, Mo.

ECO-ESPIONAGE

EARTH

By Eric Schwartz

The 200-foot former North Sea fishing trawler *Sea Shepherd II* leaves Glasgow, Scotland, in April 1981, to attempt a rendezvous with the Soviet whaling ship *Zevezdny* in the Bering Sea. Captained by thirty-year-old ecological activist Paul Watson [Earth, February 1981], the *Sea Shepherd II* will head out on a mission to prevent the *Zevezdny* from carrying out her annual slaughter of 200 California gray whales. The Soviet whalers, Watson contends, are violating an International Whaling Commission (IWC) mandate that forbids the killing of the California gray whale except by natives "who use the whale meat exclusively for their own consumption." The whales taken by the *Zevezdny*, Watson maintains, are used commercially. He plans to put the whaling ship out of commission by snagging its propeller with a steel cable.

Four months and 14,500 miles later, after stopping at Los Angeles, Vancouver and Nome, the *Sea Shepherd II* enters Soviet waters. If arrested, Watson and his 29-member, all-volunteer crew might face a long sentence in a Soviet gulag.

"This whole thing scares me," says Ben White, twenty-nine, a tree surgeon from Virginia. "I'm about to be married, and there are a lot of other good reasons why I shouldn't be here. But I believe in Paul Watson, and I love these animals."

But after several hours of scanning, Watson's radar is unable to locate the *Zevezdny*. Still determined, he orders the *Sea Shepherd II* to head for the small Soviet port of Lorino, where he suspects the illegally slaughtered whales are processed as food for the nearby mink farms. Drifting 1.5 miles offshore, Watson scrutinizes the harbor through binoculars and decides to lower a boat to obtain a closer look. Watson, Bob Osborne, from the engine crew and I descend gingerly through the barbed-wire defenses draped over the sides of the ship and get into a tiny inflatable rubber boat and shove off.

Each year gray whales numbering between 11,000 and 13,000 migrate along the 6,000-mile coast between Baja California, Mexico, and the Arctic. The animals congregate in the Bering Sea in the summer to feed on the plant life on the nutrient-rich bottom. It is here, along the Chukotskiy Peninsula, that the whales are hunted down.

"The economics of Russian whaling are the economics of extinction," says Craig Van Note, executive vice-president of Monitor, a consortium of 35 environmental groups. The Soviet Union has consistently voted with Japan and a few other recalcitrant nations in IWC conventions to sabotage efforts at whale management. Van Note cites numerous examples of Soviet greed: destroying halibut fisheries in the Antarctic, engaging in pulse fishing (a method whereby an area is fished until there are no more fish left), and the taking of as much as twice the quota of whales. "When it comes to the oceans," Van Note says, "the Russians have a record of rapacity that is unparalleled."

As we head toward shore, several gray whales surround our small boat, but none of us smile. We look toward the beach.

"Two armed Russian soldiers!" calls Osborne. He peers again through his binoculars and nods grimly.

We head away from the soldiers, but they follow slowly and casually. Thirty feet from shore, I stand in the boat and begin photographing the illegal whaling operation.

Three women with sleeves rolled carve whale meat on the shore. Pens that could only house animals stand at the top of a nearby hill. The soldiers suddenly appear in my lens. Young and Mongolian in feature, they seem bored by our presence. I realize that they think we are Russians. Some children come down on the beach.

Watching us drift to within 15 feet of the shore, the soldiers begin motioning us to land. Within easy shouting (or shooting) distance, Watson jovially calls to them in English and asks them what they want.

"They're aiming their rifles!" Osborne exclaims. "Let's get the hell out of here!"

Back on board the *Sea Shepherd II*, Peter Woof, our chief engineer, from Australia, cranks up the engine and we are under way. An investment researcher, a director of marketing, and a harpsichord builder listen to Watson's order to try to

CONTINUED ON PAGE 119

A Soviet spotter plane over the Bering Sea keeps an eye on the Sea Shepherd II

LIFE

By Dr. Bernard Dixon

A curious gathering took place recently at an imposing old Scottish hotel, Dunblane Hydro. It was a meeting of scientists more concerned to analyze (and sniff) whisky than to drink it. Their enthusiasm for the Gaels' water of life was unbounded. Yet this passionate interest centers on laboratories, not on bars where the sublime liquid is consumed. Whisky, it seems, is currently passing through a paradigm shift.

As with other serious alcoholic drinks, the most important component of whisky is not alcohol. It is the myriad minor ingredients that give any fine malt its unique flavor. Unlike noble clarets, hocks, and burgundies, however, this great spirit has attracted comparatively little scientific attention. Enshrouded in the mists and mystiques of antiquity, distillation had long been revered as art rather than precise technology. That is what is now changing. And the pace of change is sufficient to induce acute anxiety in anyone who values both science *and* whisky.

Take those indescribably subtle flavors of a great malt. Over two centuries ago the Swedish naturalist Carl Linnaeus tried to devise a system for classifying odors. But connoisseurs have never been keen about applying exactness to food or drink—least of all to the Spirit of Scotland. In recent years, however, computers have advanced the science of identifying the individual odors that constitute complex mixtures in natural products.

By exploiting this technology, one of the Dunblane researchers, John Piggot, from Strathclyde University, Glasgow, has developed an entirely new language with which to describe whiskies. He began with traditional terms, but then attained finer and finer discrimination by employing a panel of assessors. At first tasting, but then simply smelling, different brands, they evolved a vocabulary of 26 flavor notes that trained assessors can reliably employ to characterize particular tipples.

The way Dr. Piggot worked was to invite a team of assessors to sample commercially available whiskies—10 at first, but eventually as many as 70 different brands. Before doing so, Piggot scoured the world's literature about this delectable drink and developed record forms incorporating the commonest epithets.

The assessors then tried to score each tipple on a 0–5 scale for each quality listed on the form. They did this for flavor by mouth, after first testing the scented flavor.

Gradually, as his guinea pigs became more discriminating, they were able to discern differences that were not apparent from the initial list as well as to discard terms that proved to be synonymous. Like well-trained tea tasters, they eventually acquired exquisite precision in distinguishing closely related, but distinct, flavor notes.

But, unlike tea tasters, they found that odor itself was sufficient for their task. Even untrained assessors can now use Piggot's scale to fingerprint whisky with great accuracy and without even tasting it.

So we now have the following list of descriptive terms for scotch whisky: pungent, solvent, spicy, grainy, malty, moldy, fruity (estery), fruity (other), floral, smooth, vanilla, soapy, sour, nutty, buttery, grassy, phenolic, hydrocarbon, oily, woody, metallic, meaty, sulfury, catty, fishy, and sweet. Piggot has gone further, correlating each adjective with its corresponding reference chemical. *Pungent* is defined by formic acid, for example, and *buttery* by a compound called diacetyl.

Whisky is now passing through a paradigm shift

This novel piece of applied biology can be used in quality control and to help whisky blenders make delicate adjustments when a raw material or process is altered. Most interesting of all, it can be harnessed in market research. Piggot has already discovered that people seem to fall into three distinct groups, with preferences for corresponding whisky types. The opportunities for improving on nature are now obvious.

From other papers delivered at the Dunblane conference, it's clear that this is only a "taste" of what's to come. One by one, products from Scotland's countless distilleries are being put through gas chromatographs, and their chemical signatures are being charted. We now know that the classic malt Laphroaig (best enjoyed, like brandy, in minuscule portions) is rich in isopentynol, together with significant traces of isobutanol and N-propanol. Other precious fluids have differing analyses, and manufacturers of ordinary, blended whiskies are beginning to boast about the proportions of these more aristocratic spirits in their own brands.

Where will it all end? With synthetic whiskies concocted in laboratories from shelf chemicals, by law cataloged on the label? No. This new scientific emphasis is actually good for scotch. It has already helped me to track down one constituent that I *don't* like in certain blends (that catty odor). And even the combined efforts of odor experts and chromatographers are confirming the irreplaceable artistry of the yeasts and the men who create the water of life.

Science can improve scotch, but it will never succeed in quantifying the most vital ingredient in any great spirit—a touch of alchemy. ∞

SKY PAINTING SPACE

By David Monagan

One dawn last April a Virginia sheriff pulled off the road to make his stand against the red cloud descending upon him from outer space As the huge luminous sphere appeared to close on his car, the sheriff called in reinforcements—to no avail What they were watching was a brief and little-noted NASA experiment 115 miles out in space

Stranger close encounters are on the way Sometime in 1986 the whole nation may wake to find vast crimson waves glowing across the continent and brilliant yellow streaks arcing mightily toward the stars Other mornings gorgeous comets may swirl out of nowhere and half the northern lights may go black

This cosmic light show, if Earthbound budget-setters permit it, will be the culmination of 30 years of arcanely magnificent research Its aim is to seed the faint winds of the ionosphere with luminous chemicals so that scientists can track the invisible electromagnetic currents of space

Physicists see these vast paintings which would cost about $15 million for the first mission and less thereafter as a cut-rate opportunity to explore the stuff of infinity The experiments value could be argued on aesthetic terms Studies that should open our eyes to the grandeur of the heavens would cost as little as 4 cents per U S citizen, a total equal to say the cost of 20 Jackson Pollock paintings

But it now appears that this fundamental quest of science and the imagination is about to take a military turn The skies it seems will be splashed with color primarily to reveal such things as the workings of spy satellites and the repercussions of nuclear war

Earth is like a bubble floating in an infinite sea of plasma—the electrons and positive ions that fill the emptiness of space Touching the outer limits of our atmosphere—the ionosphere that reaches up to 250 miles into space—this plasma bends and pulses before the magnetic and electrical forces of the earth moon and sun This dance of charged particles can have strange side effects It ignites and douses the northern lights Sometimes it blocks radio signals at other times it echoes them to distant corners of the earth Much of our long-distance radio communication relies on such reflections.

Patterns in this flux were once all but impossible to comprehend Then in the early 1950s scientists began to fire sounding rockets into the ionosphere where they released clouds of lithium, strontium, and—later—barium ions These gases take in solar energy and reemit it as light Drifting traces of these chemicals the researchers found could create swaths of gold dust in the sky hundreds of miles long. Currents that no instrument could measure were now lit up so that cameras on the ground could snap their exact dimensions To space scientists across North America and Europe it was as if the Elizabethan or Spanish seafarers had learned to chart the Gulf Stream with dyes

It turned out that the chemical releases offered far more than the chance to watch these once-invisible electric fields By altering the mass and velocity of the releases, scientists could generate ionospheric winds and acoustic waves of their own changing the movement of plasma at the fringes of our atmosphere In more than 350 separate firings the ionosphere became a physics laboratory in which scientists teased out answers to huge questions What causes electric fields to form at the borders of space? How does the flow of solar plasma into the ionosphere affect Earth's weather? How is plasma itself created?

As some questions were answered, other unknowns appeared Over the years many chemical releases knocked temporary plasmaless holes in the ionosphere—an effect that scientists figured was about as harmful and enduring as a footprint on the beach But then the biggest chemical release of all the exhaust from the *Saturn 5 Skylab* launch in 1973 knocked out ionospheric layers from Chicago to Iceland for several hours In theory it should have disrupted all the long-distance radio signals reflected from the ionosphere

For some reason not yet understood it didn't But, according to Dr. Morris

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Strontium released in the ionosphere created pink UFOs over Wallops Island Virginia last April

READING FACES

MIND

By Stacy N. Gould and Michael G. Patterson

The inscrutable, enigmatic Mona Lisa! Is she smiling, smirking, or sneering, or is she merely being coy? After centuries of puzzlement over Leonardo da Vinci's mystery masterpiece a new system of reading faces suggests why La Gioconda stirs such fascination.

Dr. Leopold Bellak, a psychology professor at New York University and psychiatry professor at Albert Einstein Medical College, has spent the past 30 years studying people's faces, with interesting results. In his recent book (coauthored with Samm Sinclair Baker) *Reading Faces* (published in paperback by Bantam Books, 1982) Dr. Bellak offers an approach to evaluating people psychologically by using the Zone System of reading faces.

Splitting a face down the middle vertically, delineating the left half from the right half, is the first step," Bellak says. "On the picture of Mona Lisa [below] cover *her* left zone with a piece of paper. Note that the expression in Mona Lisa's right eye is subtly sardonic, perhaps even disdainful. The right half of her mouth is set tight. As a psychiatrist I interpret that tightness as controlled sensuality.

"Now cover her right zone. Her left eye is slightly pensive, almost squinting. The left half of her mouth is relaxed, softened in the semblance of a smile," he notes.

Repeating the process horizontally, other characteristics become apparent. Bulging lower eyelids add intensity to her gaze. The full cheeks, as with all roundness, transmit a simple kind of sensual pleasure.

"In the *Mona Lisa*," he says, "the suggestion of sensual indulgence by the cheeks, and the implication of a lack of stricture by the weak chin, add up to a lot of promise to a roving male eye."

Whether La Gioconda is flirting with male viewers cannot be proved, Bellak admits. The Zone System, with its 101 Traits Checklist, needs a great deal of validation and consistent reliability to be accepted by the psychological community. But Bellak uses the system regularly and successfully in his own analytical work as a diagnostic tool.

Judging character by reading faces can be traced back to Aristotle. Its leading practitioner was an eighteenth-century Swiss theologian, Johann Kaspar Lavater. Lavater was the first to propose that a person's "inner self" could be revealed scientifically by scrutinizing facial characteristics.

In the twentieth century a German psychiatrist, Dr. Werner Wolff, discovered that the human face is far from symmetrical. He juxtaposed two sides of the human face, using simple photographic techniques, and showed that right and left halves were often dramatically different. Dr. Wolff's research attracted the attention of renowned Harvard psychologists P. E. Vernon and Gordon W. Allport.

By the 1940s, however, disciplines such as behaviorism and psychoanalysis rapidly dominated the mental health field. The study of bodily expression, physiognomy, soon lost the attention of most psychological researchers.

Bellak continues the research. He is convinced a person's face records that individual's experiences over a lifetime. "Although one's face is influenced primarily by genetic factors, experience alters one's facial features considerably. These changes take place in the underlying bone and muscle structure and are modified through the repetition of emotional responses."

A fundamental part of the Zone System is the 101 Traits Checklist, comprising adjectives that describe both emotional and physical characteristics. The key is to evaluate a face by employing the trait adjectives provided.

Bellak practices his system on the faces of famous personalities, then compares his impressions with their public image. For instance, it is well known that Marilyn Monroe had a difficult childhood and several failed marriages and that she died from a self-administered overdose of pills. Using a newsphoto from a courtroom appearance late in the actress's life, Bellak drew up the following analysis.

Splitting the face vertically, her left zone appears sad, perplexed, pained, and inward looking. She seems vulnerable, lost. Her right zone bears a slight suggestion of a smile around the eye, disclosing the likelihood of a sense of humor. This side is more calm and self-possessed, somewhat peaceful—with little sign of either depression, high spirits, or sensuality. In the top zone the eyebrows are curious, quizzical, drawn up in a kind of pain. Her eyes are inner-directed and contemplative. Her nose is firm, with tight nostrils, suggesting an effort at self-control. The bottom zone has a surprisingly tight mouth, in contradistinction to the many movie roles in which her lips looked softer, looser, and especially sensuous. Her jaw is rather firm, belying the soft, rounded appearance she portrayed."

In short, Bellak has discerned characteristics that fit neither the stereotype of a sex queen nor the media image of a suicidal actress. It is clear that from an examination of a face's component parts, fascinating perceptions emerge.

THE ARTS

By Robert Rivlin

In the world of special effects, three-dimensional model making is one of the most powerful illusion makers. From carefully articulated dinosaurs and monsters that appear to live and breathe to brilliantly detailed spacecraft that maneuver gracefully through space operas, models enable movies to portray completely imaginary things as if they were real. And the audience is compelled to suspend disbelief.

In Michael Crichton's latest film, *Looker*, released last fall, viewers for the first time saw the late-twentieth century advance beyond the cinema's clay and plastic modeling techniques of the past. Special effects in *Looker* depend on three-dimensional computer simulation. A model of actress Susan Dey—one of the live stars in the film—was created by programmers and exists solely as a series of bits and bytes inside the data-base memory of a computer. But this model, including detailed renditions of Dey's hand, face and entire body, is so accurate that the simulacrum, or copy, can almost play alongside the other stars of the film—Albert Finney and James Coburn—without the audience's realizing it.

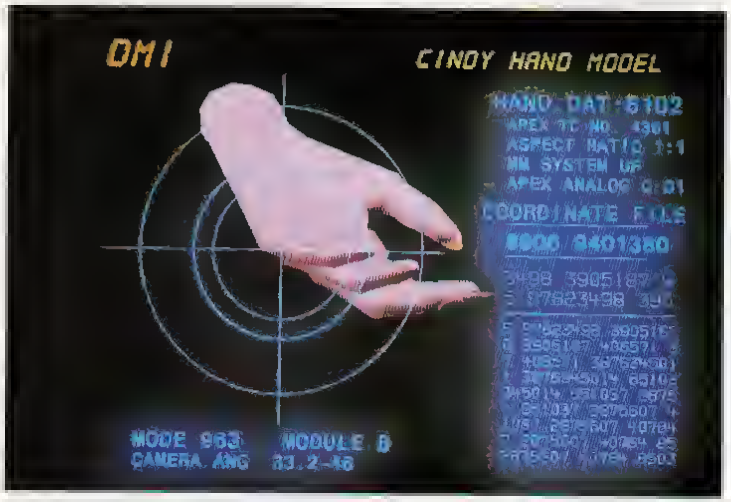
The computer's synthesis of the human form actually is part of the film's plot line, which director/writer Crichton describes as "a thriller, set against the world of television commercials and technology." In the movie, Digital Matrix, Inc. (DMI), a fictitious high-technology and research company, sets out to produce computer-generated TV commercials that manipulate the viewers' minds far more powerfully than the standard hucksterings. To accomplish this, actresses who are exceptionally beautiful are brought to DMI to be "measured." Then the data base from their bodies is employed to create computer simulations for use in political commercials. Once replicated, the real actresses are put into a hypnotic trance by interfering with their brain-wave patterns; ultimately they are eliminated—via "suicide."

"Television commercials already manipulate us," says Crichton. "That's exactly what they're supposed to do, and advertisers wouldn't spend the money they do on them if they were not doing the job. We've been bombarded with the manipulation for so long that we've learned to deal with it. But what if someone with a bit more scientific information started tampering with commercials? That's what our film asks."

A valid question, considering that the special-effects company that created the digital simulations in the film—Information International, Inc.—began in part as a special-effects producer for TV commercials. Consider also that the film is based on a Texas company that actually creates human simulacra for commercials. "*Looker* is not an expose or a documentary," Crichton quickly points out. As the writer/director of such SF films as *Westworld* and *Coma* and the author of *The Andromeda Strain*, he ought to know his fact from fiction. But he is an M.D. who formerly worked at the Salk Institute. His scientific curiosity was piqued by the anatomical possibilities, not to mention the license for cloning and replication inherent in computer modeling.

For Richard Taylor, director of digital scene simulation at Triple-I—as Information International, Inc., is called—the line between technical innovation and the commercial exploitation of special effects is less clear. Triple-I's work on *Looker* is at the tip of the salient in the science of computer-simulated three-dimensional modeling. Though *Looker* advances the kind of technology that Triple-I used for such films as *Futureworld* (where its computer simulated Peter Fonda's face by using a data base provided from scanned-in photographs), Crichton's movie employs an electronically more complex approach.

In *Looker*, the actress played by Dey stands nude on a lighted Plexiglas circle that is lowered into an "electronic chamber" while her body slowly rotates. DMI's computer projects a pattern of grid lines onto her body, then reads the contours into its data base as it "measures" her. Taylor's technique at Triple-I was remarkably similar. Dey was dressed in a white body suit, her exposed parts painted white. Black grid lines were



The hand can be rotated on any axis, compressed, expanded, torn apart, viewed from any angle

drawn over her body and face forming the characteristic polygons of mathemafical models She was phofographed from four different angles and the pictures were projected directiy onto fhe computer s magnetic drawing fablet From that it was a simple matter to trace over the lines with fhe magnetic stylus thus entering the results into the compufer s memory

At this point the mathematical information in the computer was essentially the same as it would be for any fhree-dimensional computer modeling project That is, it consisted of a series of polygons and quadratic surfaces accompanied by rules for combining them into a specitic form or series of forms As if it were the design of an automobile or an airplane engine Dey s skelefal model could be rotated on any axis compressed, expanded torn apart reassembled and viewed from any vantage point—all in mathematically precise representations of three-dimensionality The computer simply plotted the changing shape of each polygon as the model rotated and then displayed the result on a computer terminal s screen

The process is exactly the same as that used in CAD (computer-aided design) where models of machinery tor example, can be manipulated by the computer to provide multiple perspectives and display the results of test conditions And as in modeling an airplane engine the next step is to put some kind of covering on the frame In this case skin Again the result of advanced compufer programming each polygon and quadratic surface is filled in with whatever "material and color the programmer selects—whether a highly metallic-looking effect for engine parts a velvetlike effect for turniture, or fhe flesh tones for Dey s body

Different polygons in Dey's body and tace models were given individual "patches so that the lips and eyes for instance could be treated difterently trom the rest of her face And each polygon was provided with a program to reflect light differently allowing the nose to cast shadows on the cheek if illuminated from the sides and the cheekbones to stand out from the rest of the face The computer also simulated the source or sources of illumination and so it was possible to view the model lit from any angle with soft or hard shadows depending on what time of day it was supposed to be or on the prevailing mood

At this stage the image resembled a cubist painting, with each of lhe polygons still keeping its original angular shape even though each was covered with fhe skinlike flesh color Another computer program then rounded off the appropriate angles adding additional shading to heighten the three-dimensional effect The actual modeling of the form was completed with this step Thus was generated an accurate totally three-dimensional female body, it could be rotated along any axis a full 360 degrees it could be viewed from any angle and it could articulate with separate movements any of its limbs so specified

This technique was used to chilling effect in *Looker* In one scene the rotation of the computer-generated model Dey twisting slowly in a computer-generated cube was matched precisely by the rotation of the "real-Dey" as she was being "measured at DMI headquarters

However impressive Triple-I s work has been with the *Looker* modeling, it still represents the first stage in computer-generated 3-D figuration Further innovation will soon enable a digitally created image to share the spotlighf wifh a flesh-and-blood screen performer and no one will be able to tell the difference (except tor the producer who will find that the digital characfer despite the enormous costs of creation is still cheaper than the $1 million superstar)

"With grid lines and texture patches representing a figure, and the motion program commanding the action, a computer-generated image could move with total human verisimilitude."

Triple-I itself is the source of much advanced work One of its most startling breakthroughs is Adam Powers a human figure attired in a tuxedo who stands on a 3-D grid of squares projecting back into infinity and who juggles brightly colored cubes spheres and pyramidal polyhedrons The character like the geometric shapes he fosses is completely simulated yet his arms move with a realism never before realized in computer graphics and he even flips a rather agile somersault

Data on simulating the human form have been supplied in part by robotics research which includes extensive mathematical analysis and the systematizafion of every possible human movement Like Labonotation a set of graphic symbols developed a century ago to describe dance movements these mathematical robotics data may soon be programmed into the graphics compufer With grid lines and texture patches representing a tigure model and the movement program commanding action a computer-generated image could move with complefe human verisimilitude It could walk right through a wall

Another source of information for three-dimensional modeling has been computer mapping programs such as those developed by James Blinn, of the Jet Propulsion Laboratory in Pasadena (who executed many computer simulations of *Voyager* s maneuvers around Saturn) Mapping is a technique for projecting a flat texture pattern onto a three-dimensional surtace—the equivalent of what happens when a lighf beam from a slide projector spills off the screen and is retlected on objects in the room The difference, of course, is that the bending and the shaping are done entirely in the computer s processing unit based on mathematical models and the description ot the texfure pattern and the object on which it is falling

This mapping technique will soon find its way into movie theaters At the New York Institute of Technology (NYIT) on Long Island, work is under way on a film featuring a computer-simulated robot that trundles down a simulated hall, the simulated lights along the way reflecting off its highly polished body in precise mathematical models of how such reflections would look if they were real The creation of NYIT s Lance Williams the movie (entitled *The Works*) will also employ mapping techniques in making the three-dimensional model of a gigantic ant The construction machine of the tuture with huge rock crushers for mandibles and a control room in each geodesically shaped eye the robot ant completely articulated moves over the landscape with breathtaking precision The texfure maps on its thorax reflect in mathematically accurate configurations the changing terrain around it

Mapping can of course, be used effectively to clothe computer-generated human models since one need only fashion the "clothing" as a single small square then "order" the compufer fo drape it about whatever part of the body has to be covered Mapping techniques can construct an incredibly lifelike rendition of flesh itself Further as an outgrowth of some of the research in the visual properfies of metals one can now program with total realism a "map" of tin-silver- gold- or copper-textured surface Metallic surfaces can be programmed onto a three-dimensional vase shape a machine or a human figure The object will appear solid enough to touch

Today s Hollywood model maker is a combination of sculpfor computer programmer mathematician, and biotechnologist This artisf/scientist has at hand all the tools and instruments necessary to duplicate the human body and to make it move and interact with the most gifted cinema actors In time the reality of Hollywood might catch up with that depicted in *Looker* And how long before the public queues up to see Adam Powers in his nexf feature role?

EXPLORATIONS

By Delta Willis

In a picturesque village in Oxfordshire, England, a unique team of scientists is developing photographic techniques that will change the way we view the world around us. Biologists by training, the cinematographers of Oxford Scientific Films (OSF) employ time-lapse, high-speed micrography and macrophotography to capture actions not observable by the naked eye and unknown to the common man. With lenses that pitch, yaw, fly through, and encircle the filmmakers catch the pounding muscles of an embryonic heart, pollination seen from a flower's point of view, or a honeybee's bungled landings.

What began 20 years ago as research has blossomed into award-winning films for television and beyond. OSF credits include the BBC's *Horizon* series, Jonathan Miller's *The Body in Question*, *World of Survival*, David Attenborough's *Life on Earth*, and a number of hour-long network specials, including an Emmy-winning documentary about their own pioneering work at OSF's studios entitled *The Making of a Natural History Film*.

When these talented scientists evolved into talented filmmakers, they also became crack engineers in the process. The hardware they needed simply didn't exist. Designing and building their own equipment, they fashioned lenses, optical benches, and special lighting from the shelves of their in-house workshop. Unversed, they tinkered and improvised, achieving one innovation after another. "It is sometimes best," says Gerald Thompson, the senior member of the group, "to not know what is considered impossible."

Modestly resisting credit as the first to overcome various optical problems, Peter Parks, recipient of the 1980 design award from the Society of Motion Picture and Television Engineers, claims, "What we're really doing is combining a number of ideas known to other specialists in a completely different context."

Nevertheless, OSF's latest innovations are not patented, because of the detailed drawings required, and parts mysteriously disappear before a visitor can pull out a sketchbook. Certainly OSF's range and application of equipment remain unparalleled. Behemoth contraptions dubbed Cosmoscope, Pathfinder, Astroprobe, and Stellaglide loom from steel rafters and dolly at the touch of a finger. They glide across the studio floor filming one-eighth inch off the deck, or catapult over a model landscape, taking the viewer on a 360-degree ride.

As masters of cinematic wizardry, OSF members have been called upon to conjure special effects for such box-office hits as *Altered States*, *Alien*, *Excalibur*, and *Superman I* and *II*. Yet these commercial successes have not altered their scientific bent or their life-style, which remains turn-of-the-century calm, time-capsuled in the English countryside. Field research takes the men to locations around the world, but most filming is done under controlled conditions in their informal studios, located nine miles from historic Oxford.

Few places on Earth could be farther removed from the gilt and glamour of Hollywood. Designer jeans are replaced by khaki shorts and knee stockings, starlets by tarantulas and beetles, and mogul jargon by the naturalist's terminology, equally baffling to the uninitiated.

The founder of the group, Gerald Thompson, looks the part. Bespectacled with a neat crop of white hair, he speaks with a master's demeanor about the rich variety of insect specimens that clutter his desktop. As a forest entomologist, Thompson was intent on filming the wood wasp and its parasite, the ichneumon fly. In 1960, with little encouragement ("The BBC said, 'It's too difficult, don't try it.'"), Thompson invested his savings in a Bolex and recalls "studying the handbook to figure out how the camera worked. That was the easy part."

To film in color you need bright lights that can generate enough heat to bake small specimens. "To an entomologist," Thompson remarks, "it was obvious that the caterpillar's wriggling in the Disney films was not normal behavior. Rather the subject was being fried alive."

Thompson devised a set of clear filters

CONTINUED ON PAGE 116

Dalton's photos of insect flight reveal a surprising finding. Insects defy the laws of aerodynamics.

CONTINUUM

Edited by Dick Teresi

NEAR DEATH

It's the last exit. A buzzing in the ears, perhaps, then the journey through a tunnel toward a radiant light. There is a fast-motion slide show of your life . . . an aerial view of your forlorn discarded body . . . unearthly serenity. But this is no land of vapors, no empyrean of cumulus clouds, though here and there are old friends planning your reception.

The prototypical near-death experience (NDE) was popularized a few years ago by Raymond A. Moody, M.D., in his *Life After Life* books. Dr. Moody's rapturous catalog of those who "died and returned to tell" didn't pretend to be objective, and most scientists scoffed. Now many have stifled those scoffs.

Something like forty percent of those who come close to death appear to have an NDE. It's a reliable phenomenon, not a freak occurrence,' notes psychologist Kenneth Ring, of the University of Connecticut, home of the International Association for Near-Death Studies. 'We're no longer philosophizing, we're talking about empirical observations that can be verified.' It was Ring who codified the 'core' features of the NDE: the sensation of traveling through a dark tunnel, seeing a brilliant light, floating out of the body, an uncommon peacefulness, and so on.

The new favorite son of NDE researchers, however, is an Emory University cardiologist named Michael Sabom, who is no Raymond Moody. It is the very rigor of Dr. Sabom's analyses of more than 100 NDEs that threatens to topple the traditional skeptical stance of doctors and hints, instead, that the NDE might be a true foretaste of the hereafter.

Not everyone is convinced yet. The high prophet among NDE nonbelievers is probably Ronald Siegel, a UCLA psychopharmacologist. Laboring in the altered-state vineyards at UCLA's Neuropsychiatric Institute, Siegel has mapped the visions of LSD users, returned war prisoners, isolation-chamber dreamers, UFO 'hostages,' children who have imaginary playmates, hypoglycemic hallucinators, tertiary syphilis sufferers, and NDE survivors. He even claims to have severed the mind from the body, NDE fashion, with a potent relative of Angel Dust called ketamine. His conclusion? The so-called NDE is a hallucination like any other and 'just isn't an experience of the afterlife.' Oxygen starvation, the progressive death of organs, or perhaps unbearable deathbed anxiety turns the dying person's consciousness inward to mirages of heaven, Siegel maintains. After all, he points out, even elephants may long for eternal life, judging from the way they bury their companions with fruit and flowers.

No way, says Menninger Clinic psychiatrist Glen Gabbard, who, with Stuart Twemlow, has scrutinized a hefty 339 out-of-body experiences (OBEs). Siegel never supports his theory that NDEs come from the same 'neural status as hallucinations,' he argues. 'NDEs have occurred in thoroughly oxygenated patients, in undrugged patients more often than in intoxicated ones, and in people with unclouded minds.' Ring reports that NDE travelers who had prior experience with hallucinogens 'just laughed' at the notion that the two were the same.

But the most compelling case for NDEs comes from Sabom, the author of *Recollections of Death: A Medical Investigation*. Sabom interviewed patients who had suffered 'clinical death' but who were subsequently revived. 'I thought Moody's claims were ridiculous,' he recalls, but his attempts to refute Moody soon led him toward the other shore. Patients who "died" on the operating table and found themselves floating above it later gave detailed accounts of the surgery, confirmed by the doctors involved. Another man, whose heart stopped beating for several minutes, told Sabom about the intricate movements of the defibrillator dial as his heart was shocked back into action. Since the machine had been out of his visual range and an oxygen mask obscured his view anyway, the patient could only have been describing the view from above, Sabom claims, as he hovered outside his body. These and about 30 other well-documented tales that Sabom has scrupulously compared with doctors' reports add up. 'Of course we can't prove the afterlife since these patients, though unconscious, didn't actually die,' Sabom says. 'But Dr. Siegel admitted to me that my data wouldn't fit his hallucination theory.'

Are NDEs a glimpse through the portals of the next world? Certainly those who have had one think so. 'But we make a mistake in assuming that death has to be just one thing,' notes Arizona State University death-and-dying researcher Robert Kastenbaum, an agnostic on the NDE question. 'You might go to Christian Heaven 1B. I might be reincarnated as a shoehorn. I will say that somewhere down the pike—and Sabom's work is bringing us ever closer—there's going to be a wonderful crisis in the minds of scientists.' —*JUDITH HOOPER*

CONTINUUM

EMOTION AND SUDDEN DEATH

It is a popular notion that emotional stress can induce a heart attack Until recently however doctors had to rely on post-mortem reports from distraught relatives when attempting to assess the role that emotions play in sudden death

Now psychiatrist Peter Reich and a team of doctors at Brigham and Women s Hospital, in Boston, Massachusetts have asked 117 survivors whether they experienced an acute emotional disturbance" during the 24 hours preceding their heart attack Twenty-five of the survivors (21 percent) had been in an "intense emotional state ' before the onset of their attack Most of them were in this condition for less than 1 hour but some had been in a state of panic for up to 24 hours These 25 patients had no previous heart trouble Reich says suggesting that it was emotional stress that triggered the attack

Reich says that the heart attacks were prompted by any one of a number of things public humiliation a divorce a death in the family and even ordinary fights One hospitalized patient experienced a life-threatening arrhythmia (heartbeat irregularity) whenever his wife left after visiting him He feared that she would be mugged on her way home

—Eric Mishara

Science is my passion politics my duty
— Thomas Jefferson

It is not the business of science to inherit the earth, but to inherit the moral imagination, because without that man and beliefs and science will perish together
— Jacob Bronowski

Does emotional stress really lead to heart attack? A study of 117 survivors points a finger at humiliation divorce and ordinary fights

BROWN-FAT DIET

Can a diet of high-carbohydrate foods, such as pasta and cookies, help a person to lose weight? The

A potential new diet food for the next decade pasta

idea may not be as crazy as it sounds although dieters are advised not to trade in their cottage cheese for Twinkies—not just yet

The secret is brown fat which researchers may ultimately exploit to fight obesity Unlike the familiar white fat, which is merely a storage depot for calories, brown fat *burns* calories to provide heat Found mainly in the neck and kidney areas and between the shoulders, it gives small mammals and newborn humans vital protection against the cold

Until recently it was believed that adult humans, with limited need for defense against cold have almost no brown fat at all But a celebrated British study showed that overeating stimulates brown fat production

Spurred by these findings researchers like Elliot Danforth of Vermont University and Lewis Landsburg, at Beth Israel Hospital in Boston, began investigating ways to manipulate brown-fat levels through nutrition Danforth demonstrated that volunteers in prison who were overfed gained less weight than expected, largely because their brown-fat production sped up burning off most of the extra calories Skinny inmates had more difficulty than obese ones both in gaining weight and in keeping their new weight One reason They had more brown fat

The researchers now agree that some people are naturally obese and some are naturally thin fat people do not produce sufficient brown fat to burn off extra calories but thin people produce it in superabundance

How can fat people have more of what skinny people have? What foods if any might speed up the production of brown fat? One answer may be carbohydrates In the Vermont study the test subjects were fed cafeteria diets high in carbohydrates—pasta Spam, wienies and cookies The carbohydrates activated an especially high volume of brown fat Still, it is not yet clear whether a high-carbohydrate diet will someday be a key to human weight reduction, most of the studies thus far have been done on rats The important testing on human subjects is just getting under way

—Mark Teich

STONE AGE SCALPELS

Surgeons may soon be using a Stone Age tool updated by modern techniques to perform delicate operations. Scalpels modeled on blades that the ancient Mayans crafted from obsidian (volcanic glass) not only are sharper but they are also much less expensive to produce than steel or diamond blades.

Scalpels made of volcanic glass are not only sharper than steel and diamond blades but less expensive to produce as well

Anthropologist Pacon Sheets of the University of Colorado, practicing what he calls "applied archaeology," is currently working with an eye surgeon to test the effectiveness of the obsidian knives.

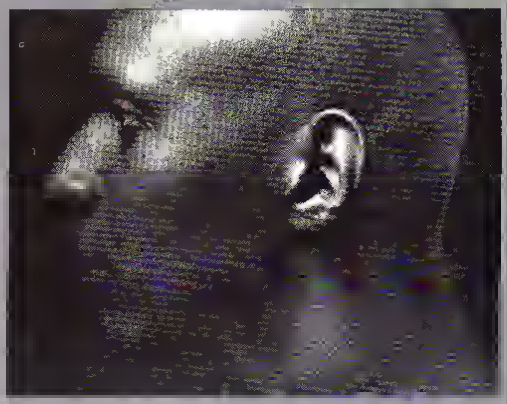
"The fractured glass edge is vastly sharper than anything commercially available with a honed edge," Sheets says. "The obsidian blades are roughly only ten silicon dioxide molecules in thickness (three billionths to four billionths of a centimeter)."

"We're combining the best qualities of the obsidian with modern techniques, such as cast-molding bronze and improved glass composition, to get a tougher edge," says Sheets.

Though the blades are still experimental and Sheets produces them for free, he believes it might be possible to make them commercially available for about $20. Diamond scalpels cost $800 and up. The eye surgeon testing the blades finds them vastly superior to what he can get on the ophthalmic instrument market.

Sheets, who did graduate field work on ancient Mayan technology in the early Seventies, says the use of obsidian blades has been traced as far back as 2000 B.C. They have been found from central Mexico to Guatemala and El Salvador. "So what we have here is almost four thousand years of research and development," he says. "Most of them were effectively eliminated by the Spanish conquerors, who disliked the ritual aspects of the manufacture of stone tools by the natives. They also wanted to make the natives dependent on steel so that they could trade for locally produced items. It was a bad time to be an Indian," Sheets comments.

—Allan Maurer



The ear is supposed to receive sounds, not transmit them. But research indicates that as many as half of us may have noisy ears

WHISTLING EARS

One day at the Central Institute for the Deaf in St. Louis, psychologist Patrick Zurek stuck a microphone into his right ear canal to investigate a rather routine aural phenomenon. To his surprise he heard a distinct, high-pitched teakettlelike *whistling*.

Fascinated, Zurek tested 32 volunteers. Amazingly, half of them also broadcast sounds from one or both ears. Most of the ear music was audible only by microphone, though a few subjects' ears carried on so loudly as to be heard by the naked ear. Biochemical events in the organ of Corti of the cochlea, Zurek says, are responsible.

A twenty-two year-old Dutchwoman was celebrated in a medical journal for ears so noisy that her sister complained of the din during their piano duets.

If Zurek's subjects are representative of the general populace, apparently half of us have noisy ears. Zurek theorizes that the phenomenon represents very subtle ear damage caused by pervasive noise pollution. A goodly number of chinchillas also betray the whistling-ear syndrome, Zurek reports, but chinchillas raised in quieter environments do not. —Judith Hooper

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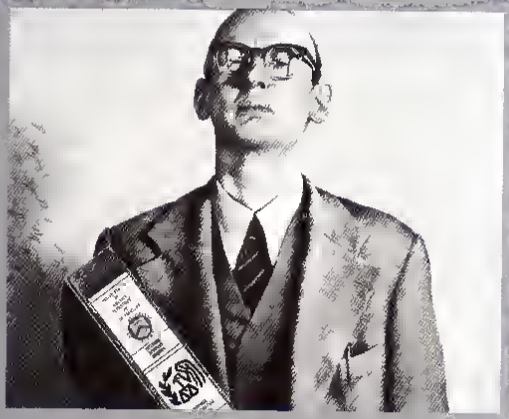
"We must treat ideas somewhat as if they were baby fish. Throw thousands out into the water. Only a handful will survive, but that is plenty."

—Anne Haywood

CONTINUUM

RED-TAPE MEASURES

Next time you confront a bureaucrat take a careful look If his hair is thin, you can reckon he has a big budget behind him A bushy pate means his department is penniless A high forehead? The chances are good that he directs droves of employees



A new science projects symbolic portraits to characterize bureaucracies A high forehead symbolizes droves of employees

These unlikely images do not belong to real bureaucrats Instead, they are *symbols* that come from the new science of bureaumetrics, the brainchild of social scientists Christopher Hood and Andrew Dunsire who contend that bureaumetrics does for public administration what econometrics does for the financial world Their system subjects every aspect of bureaucracy to intense scrutiny, analyzing every agency expenditure every employee's workload and even the qualifications of the specialists within a department

Because it injects statistics into areas traditionally clogged with folklore, bureaumetrics can also be used to make historical analyses The researchers recently discovered, for example that during the *laissez-faire* era of Queen Victoria when minimal government was the rule the British civil service grew twice as fast as it would grow from 1920 to 1970 when government participation is said to have reached unprecedented proportions

What does all this have to do with faces? Actually, the faces are computer drawings meant to help analysts characterize individual bureaucracies Each facial feature, like a bar on a bar graph is the measure of one critical quality, such as department size or efficiency To glimpse his own image, an agency director can feed bureaumetric data into a computer equipped with a special program built by Dunsire and Hood

All this the researchers have put into their new book *Bureaumetrics*, which might become required reading for prime ministers and presidents keen to cut the flab out of their governments

— Peter Evans

ENERGY TRAIN

Imagine a train burrowing deep under Paris or Rome at 400 mph Floating on a bed of magnetism, this speedy vehicle will carry a quarter of a million tons of concrete instead of passengers and it will never stop It is intended to provide 100 000 families with electricity during the busiest hours of each day by storing excess energy during the night

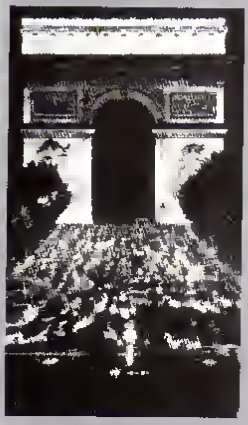
The train is called KRESS, for Kinetic Ring Energy Storage System, and if some British physicists are correct, it will soon be generating power for people all around the world

Mike Russell, of Rutherford Laboratory, in Didcot, England explains During the night, when utilities produce more electricity than anyone can use, they will funnel it into the motors that propel the train in a circle As the train glides with ease along the layer of magnetism, its huge concrete mass will literally absorb the motion and store it in the form of kinetic energy In the daytime, when consumers require *extra* electricity, the utility will flip a switch that converts the motors into electrical generators The train will slow down as its store of kinetic energy turns the wheel of the generator providing an entire city with power

Today most utilities store power with the help of hydroelectric systems At night they use their extra energy to pump water up a mountain, where it is stored behind a dam During the day they open the dam, and as the water flows back down it turns a generator that produces electricity The chief problem with this method is that you need a mountain handy

Russell believes that KRESS will be far more practical for almost everyone The British researchers are studying the economics of the system they hope to build a working model in about three years

— Anthony Tucker



Paris at night The real action may someday be underground

SETI AXED

If advanced civilizations are colonizing our galaxy, why haven't we heard from them? That was the question that Senator William Proxmire posed when he persuaded Congress to ax SETI, NASA's Search for [illegible]

P[illegible] est in [illegible]

[illegible] nce. The [illegible] ng am [illegible] Pr[illegible] [illegible]

[illegible]

win congressional funding but NASA kept a modest effort alive under its exobiology program.

Proxmire, who recently discovered this remnant of SETI, obliterated it with an amendment to the Housing and Urban Development and Independent Agencies appropriations bill for the fiscal year 1982. Speaking on the floor of the Senate on [illegible] 30, he said: "We should [illegible] [illegible] that almost [illegible] [illegible] concern. However [illegible] taxpayer [illegible] The appropriations [illegible] Proxmire's [illegible] passed [illegible] Congress in Sep[illegible]

[illegible]

— [illegible] id

[illegible]

— [illegible]

[illegible]

— Herb C[illegible]

TALKING CHECKOUT

If the checkout counter starts talking to you the next time you visit the supermarket, you're not hallucinating. It's just the latest use of electronic technology to imitate human speech.

Electronic circuits that can generate signals which, when fed through a speaker, become intelligible words have found increasing use during the past few years. One example is the Speak and Spell electronic toy made by Texas Instruments, Inc. Another maker of speech synthesis circuits, the National Semiconductor Corporation of Santa Clara, California, also makes laser scanners that automatically read the striped codes on food packages at supermarket checkout counters. So it was probably inevitable that the two technologies would get together.

Tests of talking scanners began last summer in a San Jose, California, supermarket, and the first permanent installations were to begin this past fall.

The speech circuit is intended to tell customers the price of each item they buy. With a 274-word vocabulary, the circuit can also be programmed to say such things as "Thank you for shopping with us today." The speech capability "will bring back an old friend to the counter," proclaims a National Semiconductor press release.

However, the endless chattering of a bank of talking scanners might make customers long for what one observer called "the soothing banality of Muzak." So might the clerks who would be left with the traditionally mechanical job of moving things while the machine did the talking. —Jeff Hecht

Sa[illegible] supermarket checkout. A laser scans the price, and an [illegible] circuit with a 274 word vocabulary reads it out to you.

CONTINUUM

MICROWAVE DEATH

Samuel Yannon, a technician who tuned transmitters atop the Empire State Building, began to suffer the bizarre symptoms of microwave sickness in 1965. He lost weight and couldn't remember details, blinded by cataracts and prematurely senile, he wasted away to his death in 1974, at sixty-two.

Recently Yannon's widow was awarded the sum of $30,000 plus $57 a week for life by the New York Workmen's Compensation Board. The board declared that Yannon had died from 16 years of exposure to microwaves. This decision marked the first time a state board has admitted that such radiation can be lethal.

According to U.S. occupational safety standards, Yannon was working in a safe environment. The maximum acceptable microwave dosage is 10 milliwatts per centimeter, and he worked at a level of 1.5 milliwatts.

Milton Zaret, an ophthalmologist who testified on Yannon's behalf, says his symptoms were similar to those of other people he has treated for microwave sickness. The early signs, which Western doctors tend to shrug off as simple stress, include insomnia, poor sexual performance, sweating and anxiety. By the time cataracts, heart pains, and memory loss set in, the disease is no longer reversible. "It's repeated, chronic low-level exposure that does people in," Dr. Zaret says. "We don't know what safe levels are yet." —Sandra Dorr

FETAL KICKS

During a normal pregnancy, a woman gets used to the frequent kicks and movements made by the fetus in her womb. The motion tells her that the baby is healthy and growing. But if movement in the womb stops or slows, an Israeli gynecologist says, the baby may be sending out a cry of distress.

According to Dr. Eliahu Sadovsky, of Hadassah Hospital in Jerusalem, the average pregnant woman feels between 50 and 2,000 weak and strong kicks and rolling movements during each week.

But if a woman reports that movements have suddenly decreased to half their average rate within two or three days, her unborn baby may be critically ill or even on the verge of death. To diagnose the condition of the fetus, Dr. Sadovsky immediately performs lab tests and, then, if there is any immediate danger, quickly induces delivery.

Some fetal health problems stem from the complications of a mother's ors

When a fetus stops kicking, it's time to start worrying.

ease, diabetes, for instance, or hypertension. Other fetal problems are due to unpredictable conditions, such as abnormal pressure on the umbilical cord.

—Madeleine Lebwohl

OM SWAT TEAM

In Atlanta, gentle Transcendental Meditators are serving as a sort of astral auxiliary police force.

A group of 28 to 40 TMers meditating together nightly for two weeks reduced violent crime—murder, rape, and aggravated assault—by 20 percent in Atlanta's crime-ridden Grant Park section, according to social psychologists Elaine and Arthur Aron. Felonies reportedly jumped back to normal levels as soon as the meditators returned to their own affluent neighborhood.

Arthur Aron claims, "The probability is almost nil that these results happened by chance." So what accounts for the 'Maharishi effect' (after TM founder and guru Maharishi Mahesh Yogi)?

The unseen "field of consciousness" affected even nonmeditators within its range, Aron says. In Atlanta, the "neural coherence" generated by TM practitioners permeated a neighborhood of 70,000 people with "pure consciousness," producing "measurable social effects."

All of the Atlanta meditators, like the Arons themselves, were graduates of the TM Siddhi courses which teach meditation-propelled "flying" and other spiritual powers (*siddhis*) like "knowledge of hidden things" and "growing larger or smaller at will."

In 1978 Maharishi sent goodwill meditators to transmit pure vibes in five world trouble spots, including Iran and Nicaragua.

—Judith Hooper

FURNITURE TECHNOLOGY

Did you ever wonder why even cheap furniture is increasingly more comfortable? The explanation is new furniture design which makes chairs and sofas as strong as their nineteenth-century forerunners yet lighter and often less costly

The new furniture may have parts of cardboard or plastic, pressed wood tubular steel or aluminum Chairs may have hydraulic or pneumatic levers that allow someone instantly to adjust the height or the pitch of the back Various firm yet resilient foams have replaced springs Better ball bearings have made chairs and sofas more maneuverable

Much of the impetus for change has come from changing life-styles researchers say People sit differently today than in the Victorian Era ' says a report by the Smithsonian Institution which has studied changing furniture technology They want to sit lower and they want to slouch Thus straight rigid couches and chairs have been replaced by cushioned sofas and easy chairs

A change in clothing styles has also prompted less formal furniture A lady wearing a bustle and sitting in a sling chair is unthinkable says design expert Robert Lynes in the Smithsonian study Leisure suits and jeans have spurred canvas director s chairs and pillowed furniture replacing the more severe models originally made for women in stiff corsets and men in dress suits

The trend toward smaller apartments and a more efficient use of space has led to new multifunction designs including a freestanding structure with a loft bed on top bookshelves and a desk underneath, and closets on the sides —Stuart Diamond

Sling chairs and other modern designs have been instigated by changes not only in clothing styles but in life styles as well

CRIB-DEATH CURE

Most new parents are terrified by stories they have heard about presumably healthy babies who suddenly stop breathing during the night The syndrome, called crib death results when infant lungs simply forget to keep working Now help is on the way in the form of a device that "reminds" babies to breathe

According to inventor Marianne Schlaefke of Ruhr University in Bochum West Germany any infant can momentarily forget to breathe When this happens the fluid that surrounds the lungs becomes extremely acidic and in normal babies jogs a control mechanism in the central nervous system The control mechanism tells the lungs to restart but in some babies this mechanism is defective and instant death occurs

Schlaefke s solution is to teach infants to react to changes in acidity *without* help from the control mechanism Her new system consists of a fan and an instrument for injecting acid into the lungs of sleeping infants Whenever the acid is administered, the fan (directed toward the baby s face) creates a slight breeze that stimulates breathing The infant soon learns to associate acid with breathing and after a while the device is no longer needed

Technician wires up baby with high risk of crib death Now there's a way to remind babies whose lungs forget to keep working

The instrument is now being tested in a Munich hospital According to Schlaefke, however, parents will eventually be able to use the system at home

—David Clutterbuck

It s unpleasant to be able to turn certain ideas over in your mind that nobody suspects you of having '

—Ugo Betti

CONTINUUM

JOGGING PIGS UPDATE

Are pigs that jog less likely to suffer heart attacks? Three years ago researchers at the University of California at San Diego studied *healthy* pigs and answered no. More recently they repeated the experiment by using pigs with heart trouble and this time the answer was yes.

To start the recent series of experiments, Drs. Colin Bloor and Frank White placed a balloon around one of the three main arteries leading to each pig's heart. When expanded, the balloon squeezed the artery restricting the flow of blood and in a short time the pigs developed heart disease. Ten of the diseased pigs exercised daily by running on a treadmill; another ten lazed about.

In the active pigs, Bloor and White say, arteries leading to the heart enlarged and sent out new branches bypassing the vessels damaged by the balloons. In the inactive pigs, however, crippled arteries changed only slightly and the heart muscle deteriorated.

Conclusion: Exercise helps prevent heart attacks, especially when heart disease is already present, because exercise increases circulation to the heart. But be forewarned: If you have heart trouble, exercise only on your doctor's approval. And don't overdo it. Two pigs died of excessive jogging.

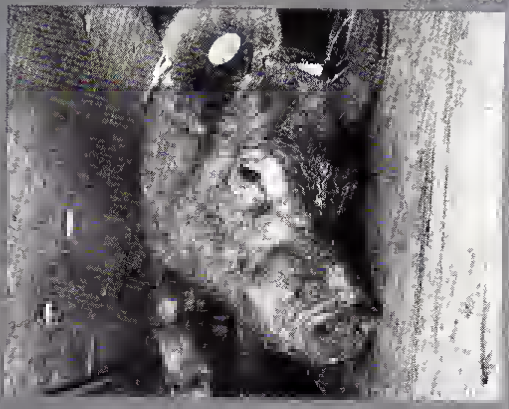
—Carol A. Johmann

Violence breeds more violence, and it is predicted that by 1990 kidnapping will be the dominant mode of social interaction.

—Woody Allen

Thoughts, like fleas, jump from man to man. But they don't bite everybody.

—Stanislaw Lem



Electronically monitored jogging pig. While two pigs did overexertion running seems to benefit swine with heart t[illegible]

BLINDSIGHT

Pole, eleven o'clock, eight feet.

That could be the mechanically spoken message to a blind person wearing a device that warns about obstacles and gently taps the wearer to indicate the direction and distance of the obstacle.

A prototype of the system is being tested by Dr. Carter C. Collins, a biophysicist, and Michael F. Deering, of the Smith-Kettlewell Institute of Visual Sciences in San Francisco, with funds from the National Science Foundation.

A TV camera on the blind person's shoulder produces an image of the path ahead. This information is instantly translated by microprocessors into machine-generated speech about obstacles or landmarks and delivers gentle taps on a belt the person wears. The taps clue the user to the direction of the obstacle: one tap for something distant, more taps as the object comes closer.

"The cutting edge of electronic technology is being utilized," says Dr. Collins. The prototype is bulky, but an easily portable system performing more recognition tasks is the goal. Collins says, "We've already constructed, debugged, and demonstrated most of the hardware and software for the present system, but the more sophisticated miniaturized system will need further development." —Alton Blakeslee

Blindsight system. It not only verbally warns the wearer of obstacles but also taps him to indicate direction and closeness.

Truth is the object of philosophy, but not always of philosophers.

—John Churton Collins

The product of mental labor—science—always stands far below its value because the labor time necessary to reproduce it has no relation at all to the labor-time required for its original production.

—Karl Marx

Japan reaches for a future world, written in this symbol for robots

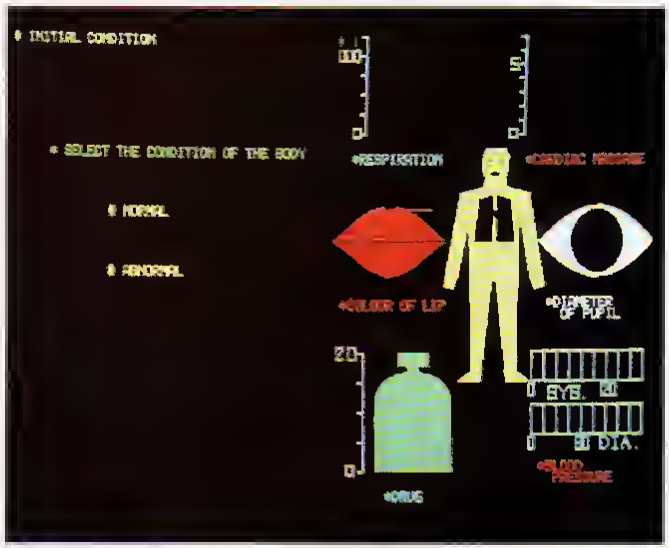
ロボット

BY R. BRUCE McCOLM

The silvery six-foot-tall robot resembles a benign metallic Frankenstein monster with television-camera eyes, an artificial ear built into the stomach, and a deep synthetic voice. It's made of high-strength aluminum alloy, weighs about 130 kilograms, and comes apart easily. All last summer its long legs were stored in a laboratory filled with disembodied mechanical hands, arms, and computer components. But the robot's maker, like many modern Japanese, treats it as part of the family. Witness the home movies.

PHOTOGRAPHS BY MALCOLM KIRK

"Its skin sweats. The robot's pupils dilate. But its health can be instantly reset to normal."



The films shot by Waseda University's Ichiro Kato, proud developer of the Waseda Robot or Wabot, are like any rough chronicle of the early years of a new baby. There are the first two uncertain steps, requiring a full 110 seconds to complete. There is the later, smoother gait, covering the same ground in nine seconds. The soundtrack (this is a modern Japanese home movie) preserves some of the early words. "What is your order?" the Wabot asks an operator, who tells it to move a step to the right. And the machine does more than merely obey. "Now I start," it boasts.

In one scene the Wabot moves its upper torso, and Kato, the wispy and paternal chairman of the graduate school of science and engineering at Waseda, could not be more pleased if he were watching one of his students reinvent the transistor. "There you have a one-and-a-half-year-old toddler," he says. "And he dreams a father's dream about what his precocious toddler might become as it grows up.

"When a child becomes seven years old, he has an ability equal to the adult. My goal is to build a robot that will have a seven-year-old's ability. Even though it's not possible, I'm trying to do it."

Kato is one of a number of Japanese scientists working on the generations of robots to come of age in the twenty-first century. They will be quite different, he predicts, from the rivet-punching drones of today. "The industrial robot today is the mainstay of all robots," Kato said over tea. "They are simply laborers or function oriented. But in the next twenty years we will witness the emergence of the robot in service areas such as medicine. The robot will take over in everyday situations and will closely resemble human beings with the integration of artificial intelligence, voice, tactile recognition, and bodily functions. Through this mechanization of the human being, we will know more about ourselves. And to know yourself is the long pursuit."

Ever since the Czech novelist Karel Capek coined the word *robot*, man has dreamed, like Professor Kato, of creating an intelligent machine to liberate him from the drudgery of work. No other country has pursued this vision quite so vigorously as Japan. Since it first imported an American-made industrial robot in 1967, Japan has emerged as the robot center of the world, the model of future societies.

Today there are more than 77,000 industrial robots in Japan, nearly 70 percent of the world's robot population, most of them tucked away and turning out products in factories. But thousands of new robots never go to work. There's a Japanese cat robot for sale, for instance, that uses artificial vision to avoid obstacles. Masked and menacing robots (like the one on the previous page) compete with humans in the sport of kendo, thrusting and parrying with pliable bamboo swords. Students at a Tokyo medical college give mouth-to-mouth resuscitation and injections to a robot programmed to suffer cardiac arrest on demand. Its soft skin sweats, its pupils dilate, and its pulse trips appropriately. A monitor (in the photo above) provides a readout of its health, which can be instantly reset to normal.

The craze for machines like these is only just beginning. In 1980 Japan's businesses invested nearly $3 billion in robotization. Japanese experts predict that in a mere three more years total investment in robots will be at least 12 times as much. This is the kind of mammoth expenditure that might be expected to make some people queasy, raising a specter once presented by Isaac Asimov that humans are the first creatures capable of building their own replacements. But Japanese futurists are quite smug about the prospects of turning robots loose on the streets.

"In Japan we have a tradition of having things similar to slaves in the village, such as a horse and a cow," says Sakyo Komatsu, future planner and science-fiction writer. "These were considered a part of the family. When machines such as the automobile and electric trains were introduced into Japan, they were considered living creatures. Even in the villages today, especially during the New Year celebration, you can see cars being decorated with paper ornaments. So, for the Japanese, to witness this emerging of robots is like watching small children who are there to help their parents."

The motif was repeated during *Omni*'s visit as often as the musical theme from *Star Wars*, piped over Muzak. Robots are good for the family. Tokyo TV station NHK broadcast one typical robot success story in a documentary about a mom-and-pop manufacturing firm. Facing bankruptcy because of the cost of labor, the owners rented two robots and hired their son back from a job in Tokyo to automate their parts-making plant. In an offbeat switch on Alvin Toffler's electronic cottage-industry idea, the family was reunited, the business turned a profit, and the mother liked the robots because she didn't have to serve them tea all the time.

Bigger Japanese companies are in many ways simply extended families, with plenty of room for exotic mascot machines. "Instead of the great feudal families," one government employee says, "we now have the large corporations like Mitsubishi that protect the country and their own workers." In times of recession or runaway inflation, these companies improve industrial efficiency instead of laying off workers. They buy more robots. Like Samurai warriors

CONTINUED ON PAGE 107

FICTION

Little Will was born to survive—and to lead

ELEPHANT SONG

BY BARRY B. LONGYEAR

The Admiralty Office of the Tenth Quadrant Federation today announced that the circus starship *City of Baraboo*, enroute to the planet H'dgva, in the Tenth Quadrant, failed to report in accordance with its flight plan four days ago. Ninth and Tenth Quadrant deep-space radio searches detected neither distress calls nor automatic

PAINTING BY MICHAEL PARKES

emergency beacon signals Standard trade-route sweeps have been begun

The ship, housing the entire company of O'Hara's Greater Shows, the first of the interstellar circuses, is presumed to have been lost with all hands

—*Billboard*
May 29, 2148, page 1

In the darkness above the atmosphere of the strange planet, ten smaller craft detached themselves from a great ship, fired their entry burns, and fell toward the planet's surface When the shuttles were little more than points of reflected light the great ship seemed to wobble, then roll For a moment the ship's movement seemed to stabilize, then its powerful engines gave a brief, blinding flash the ship nosed over and dived toward the planet

A huge man with a bandaged head moaned and opened his eyes as he felt the reality around him shaking, then slamming to a devastating halt He closed his eyes as pains shot through his head

Noises The smell of acid The smell of smoke

He drove awareness from his mind There was so much to drive away A dying ship a dying show a dying daughter—

"Get these two patched up fast! I need them back on the radios '

Are we down?"

Are we down Mange? Hell, yes we're down! Just put a dent in a goddamned mountain!

So much to keep away a dying show a dying daughter, dying itself the bulls—

He opened his eyes and stared blankly at the blur of rushing, screaming bodies Someone had said something about the bulls—

'Fire control, down to the main carrousel! Pony? Pony Red where are you?'

Unintelligible crackles words

"Get down to the main carrousel! The bulls and horses've broken loose and are shredding the place Fire control, where n the hell are you? Flame in the port carrousel!

The bulls Something about the bulls And fire

He lifted an arm, tingling numbness covering his body Data began to enter the blank circuits of his mind The bulls Have to get to the bulls

"What about the atmospheric readings?

'Screw 'em! If the air out there's no good, it doesn't matter much, does it?'

"That was some great landing, Fireball "

"You try and deadstick in one of these bastards, punk It's got the glide angle of a brick '

"I said it was a good landing—'

"Where n the hell are the others?'

'Try the radio, stupid Wait What's that call?'

It—it's the Baraboo, *skipper It's out of control It's diving into the atmosphere Signal's dead*

He pushed himself up from the couch and stumbled toward the voices But now the control cabin was silent

There was a breath of fresh air on his face, and he inhaled His vision cleared a bit and he could make out the shuttle crew standing like statues before the controls

'You Fireball What is it?

The command pilot of the Number Three car turned her head and looked at him She seemed not to notice the blood dripping from her forehead "The *Baraboo* It just got exed We got away just in time"

Fireball nodded at another crewmember "Try to raise the other cars "

The crewmember stabbed at some buttons "Any cars this is Number Three Where are you?" She listened, then tried again "This is Number Three Any cars where are you?"

He rubbed his eyes sat down on the edge of a couch, and looked at the shuttle's

> *"The frantic calls from the control cabin were drowned out by the screams of animals An emergency light flashed in his face, then, out of the darkness and smoke, a voice yelled"*

pilot "Somebody said something about the bulls "

Fireball Hanah Sanagi squatted next to him "Bullhook it's hell down there The outside hatch to the loading runs is jammed The bulls are going crazy"

Bullhook Willy got to his feet and supported himself against the couch's backrest as a crackle filled the compartment "Hey! It's Number Ten! One Four Five and Ten are within sight of each other near a big body of water The crewmember talked rapidly into the communications system "We're pretty bunged up Came to a stop against a mountain Heard anything from the others?"

He squinted his eyes against the light coming through the cockpit observation ports Through them he could see bright sky, green trees hung with golden hair a range of mountains

"Wait! I'm getting a strong signal from Number Six Six can see Number Eight Eight can't see Nine but is getting a good signal Number Two? Where are you Number Two? Can anyone get a signal from Two? What about Seven?" Crackles desperate calls silence "Okay let's try to figure out how far we are from each other and in what relation"

On the couch rested a meter-long gold-tipped hook Bullhook Willy picked it up, turned pulled himself through the compartment door and headed down the dark companionway The smell of it Hot insulation boiling hydraulic fluid and overpowering every other odor the smell of burning flesh

The frantic calls from the control cabin were soon drowned out by the screams of the animals He turned into the companionway that led to the huge cage of rotating tubes that held the elephants An emergency light flashed in his face then out of the darkness and smoke someone yelled

"Pony! Pony Red! It's Bullhook! The boss elephant man is here!"

Bullhook held his hand between the light and his eyes "Waxy you want to get that damn light out of my face"

The beam of light dropped as Bullhook supported himself by placing a hand against a bulkhead The bulkhead was hot Too hot That was the smaller port carrousel containing half of the remaining Perches Bullhook withdrew his hand "Waxy what about the horses?"

The dark shape holding the emergency light shook his head "No good Pony Red had to seal off the port carrousel to try to contain the fire Doesn't look good There's no fire in the starboard horse barn and in the main carrousel but the smoke and lack of air are driving the nags and bulls crazy"

'There'll be air soon"

Another shape joined the one holding the lamp "Mother Machree but it's the hell of Hartford down there" The voice belonged to Pony Red Mitra boss animal man "Waxy why'd you put out the call?"

The one holding the lamp pointed at Bullhook "The boss elephant man"

Pony Red moved next to Bullhook and placed a hand on the boss elephant man's shoulder "Are you okay? Last time I saw you the back of your skull was caved in"

"I'm on my feet We got to get the stock out of here Why aren't the bay doors open?"

The boss animal man shook his head "The last I heard from the crew back there the doors are jammed They can't get to the control that blows the damn doors off because of the bulls Two of 'em are loose in the runs tearing up the place Now we can't raise the aft crew at all"

Bullhook rubbed his eyes "Can the carrousel still rotate?'

'Sure, but—"

"Get some lights on and move Tube Number One to the bottom facing the doors I'll get 'em open"

Pony Red shook Bullhook's shoulder "You can't get through any of the tubes especially Number One Six of the eight bulls in there have broken loose We're trying to get a crew around now to open the doors from the outside"

Bullhook began to pull himself down the

CONTINUED ON PAGE 96

His fuel of the future can be drawn from your faucet

THE HYDROGEN MAN

BY KENNETH JON ROSE

In Missouri there's a man who likes to drink his car's engine exhaust in front of company. He sips slowly, relishing its flavor as if he were sampling fine wine. Then he passes it around to his wide-eyed guests. Most of them politely decline the offer, but there's always someone curious enough to taste it. Anybody who does is amazed at the discovery. It's water! "It's water!" the person exclaims. "Plain, ordinary water!"

That's usually the reaction Roger Billings gets when he offers his guests a sip of exhaust from his hydrogen-fueled car. It's been that way ever since he converted his first car to hydrogen when he was sixteen years old. Since then he's converted just about every kind of engine, from car engines to tractor engines, to run on hydrogen. He's even built and lived in a hydrogen-powered home.

Billings is a man with a vision. He sees hydrogen as the fuel of the not-too-distant future, and he's been spending his time and energies coming up with a technology that makes it easier to use, whether for fueling the vehicles we drive or heating our homes or generating electricity.

At the age of thirty-three, Billings is a director of the International Association for Hydrogen Energy, an organization that includes some of the top hydrogen researchers in the world, and he's the president, chairman of the board, and director of two corporations: Billings Computer Corporation and Billings Energy Corporation.

Fresh out of college with nothing more than $400, he formed the Billings Energy Corporation in 1972. At the beginning it had only one employee: himself. Today it employs more than 250 people, including George Romney, a former governor of Michigan and former head of American Motors Corporation.

In its short life the Billings Energy Corporation has become one of the most respected and most successful hydrogen-technology companies in the United States—so successful that several oil companies have tried to buy it, without any luck. "We want our technology to be bought, but we don't want to be bought," Billings says. Roger Billings and his little crew of creative people are just not for sale.

Since he built his first hydrogen-powered car, Billings has nurtured a dream of seeing the United States become energy independent. The fuel that's going to give us that independence, he's convinced, is hydrogen. He has been devoting his expertise, and the profits from his computer corporation, to bringing that about. His is a fervor that impresses his colleagues.

"We see hydrogen as a fuel for the distant future. Billings sees it as being used more immediately," physicist Walter Stewart says. Stewart is a hydrogen fuel expert at Los Alamos Laboratory in New Mexico.

As a future fuel, hydrogen has a lot to offer. It's the most abundant element in the universe. On Earth it is mostly bound up in water, which makes it almost inexhaustible. It's also highly efficient. It produces more energy per pound than fossil fuels do. Best of all, hydrogen can easily be substituted for

PHOTOGRAPHS BY DOUGLAS KIRKLAND

"Hydrogen is not a fuel you convert a home to. It's a system you convert a community to."

natural gas, diesel fuel, and gasoline.

Up to now the greatest problem has been how to store it. Once it could be put only into a pressurized bottle in its gaseous form or cooled to −253°C (−423°F), at which point it becomes a highly explosive liquid. But in the last 15 years there's been a breakthrough in what are called hydrides, metal alloys that absorb hydrogen gas the way a sponge does and release the gas when they're heated. Both the safety and the limitations on the amount of gas that can be squeezed into a container have been improved so that it's now possible to build hydrogen-fueled vehicles.

While just a high-school senior Billings converted his father's old Model A Ford ("he wouldn't let me touch his new Chevrolet") to run on hydrogen. That feat won him the Gold and Silver Award at the 1966 International Science Fair, in Dallas, Texas, and a scholarship. His fascination with hydrogen continued when he studied systems engineering at Brigham Young University, in Utah. While there he continued his work on hydrogen technology with a grant from the Ford Motor Company.

Today much of that has paid off in the work he's done on hydrogen vehicles. One of his pet projects has been to take a compact car, a Dodge Omni, and make it a two-fuel car that can use either gasoline or hydrogen. In addition to a regular gas tank it has a hydride tank specially designed by the engineers at the Billings Corporation. About the size of a spare tire, it fits snugly under the trunk and has enough fuel capacity to take you about 100 miles.

To make you go farther, Billings installed a simple switch on the car's dashboard. Flick it one way and you're driving on gasoline. Flick it back and you're on hydrogen again. Billings made the cars dual-fueled for the simple reason that it's tough to buy hydrogen at your neighborhood service station. "If a driver happens to go on vacation, he's got to have some other fuel. So this is a way of being able to get one foot in the door with out converting the whole world," he explains. So far he's converted ten automobiles to his dual-gasoline-hydrogen system.

As a car fuel, hydrogen can't be excelled. It's clean, and the engine also wears better. "The gasoline engine," Billings says, "operates at almost the same efficiency on methane, methanol, or gasoline. But when you convert the engine to run on hydrogen, you get a forty percent boost in efficiency. The Environmental Protection Agency rates the Omni's overall fuel economy at 30 miles per gallon of gasoline. The hydrogen-powered Omni averages 44 miles per gallon and can hit a top speed of 80 miles an hour.

Billings plans to sell his two-fuel Omnis to anyone willing to pay the steep $30,000 price tag. After the first 10 have been tested out in the marketplace for a year, he hopes to build 100 more, at less than half the original price. In the meantime he's designing conversion sets for those who want to change their engines to run on hydrogen. The kits might be out by the mid-1980s.

Meanwhile the news has got around that what Billings does, works. "We have a lot of people who write us letters saying 'I want to convert my car today. I want to convert my helicopter, my boat. How much will it cost?'" He's even been contacted by the Los Alamos Scientific Laboratory asking him to help convert the engine of a Buick Century so it could run on hydrogen fuel.

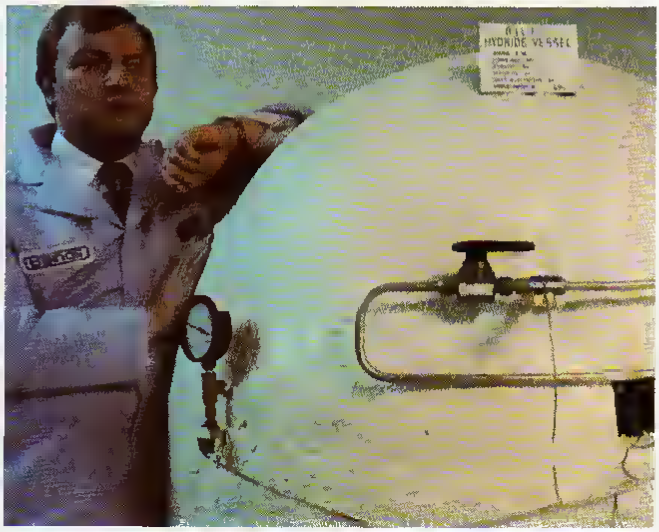
Billings has designed a ready source of at-home hydrogen. When the driver wants to refuel, he simply connects his car to a Billings electrolyzer. Overnight the unit splits water coming from the tap and pumps hydrogen into the tank. By morning he's ready to go. But making hydrogen with house current *is* expensive—more expensive in most places than getting gasoline at the pump. That would change if the country converted to a hydrogen economy.

Today the most exciting break in hydrogen technology might come from solar-energy research. For instance, at the third International Conference on Photochemical Conversion and Storage of Hydrogen Energy sponsored by the Solar Energy Research Institute (SERI), scientists announced that it may soon be possible to produce hydrogen from sunlight.

For example, Nobel Prize-winning chemist Melvin Calvin, from the University of California at Berkeley, announced that he had developed a synthetic chloroplast, a man-made copy of the part of the plant cell that is responsible for photosynthesis, converting solar energy into stored energy in the form of a sugar, glucose.

In nature, the plant chloroplast uses the energy of sunlight to split water into hydrogen and oxygen. The hydrogen then fuses with carbon dioxide from the air to build carbohydrates, and oxygen is set free into the atmosphere. In Calvin's design, the man-made chloroplast produces molecular hydrogen instead of carbohydrates. Calvin has a way to go before his process can be used commercially, but solar experts are convinced that he, or someone equally ingenious, is going to come up with a system that will effectively extract hydrogen from water, using sun power. One SERI official adds, "We're almost there."

Meanwhile Billings has grand energy plans of his own. With the help of an old technology he hopes to make this country totally energy independent by the turn of the century. Billings



Billings stands beside one of his hydride tanks, able to hold 63 pounds of hydrogen

calls his master plan for this self sufficiency Project Liberty

A sort of modern-day Manhattan Project Project Liberty is Billings s answer to OPEC Since we have vast coal reserves in this country, Billings wants to build coal-gasification plants to change coal into hydrogen The 40 coal-gasification plants now operating throughout the world make only synthetic natural gas with hydrogen as a by-product Not only is it more energy efficient Billings says, to gasify coal into hydrogen but it's also cheaper

By the year 1990 this hydrogen-minded Johnny Appleseed wants to sprinkle the country with enough coal-gasification plants to offset all foreign oil imports He figures that it will take 50 hydrogen plants to replace just the gasoline made from imported oil and that another 50 will be needed to eliminate foreign oil imports completely by the year 2000 We could do it faster than that And I'm unhappy to say, he adds, "that we could have done it at least ten years ago "

The U S government bears much of the blame for frustrating Billings's dream There is a tinge of bitterness in his voice when he talks about the Department of Energy "The DOE is a joke It really is" he complains "Government research is so much less efficient than industrial research If a company were to spend money like that on research it would go broke When I see all those resources wasted it really really bothers me "

Other nations however are more enlightened India has established a Hydrogen Energy Task Force as part of its governmental effort to reduce oil imports Japan is planning to produce commercial hydrogen, first it will use nuclear energy in the 1980s then solar energy in the 1990s West Germany already has hydrogen-fueled buses in service in both Stuttgart and West Berlin and the West Germans are involved with newer hydrogen technology as well Three years ago the West German government sponsored an international symposium on hydrogen in air transportation, at which aerospace experts discussed developing a small fleet of hydrogen-fueled wide-body jets

Not one to be easily discouraged, Billings is not waiting for our government to get going In 1980 he moved his corporation from Provo, Utah, to Independence, Missouri to begin Phase 1 of Project Liberty a hydrogen-powered community He is in the process of changing 20 homes and 100 vehicles in Independence to run on hydrogen Even the mail delivery vehicles, donated with the blessing of the U S Postal Service will be hydrogen-fueled Since there isn t any coal-gasification plant in Independence, his company is going to supply the city with hydrogen by piping it in from firms in the area that produce the gas as a manufacturing by-product

Billings is modeling the homes after the one he and his family lived in for two-and-a-half years before they moved to Missouri

CONTINUED ON PAGE 85

FICTION

Reincarnation is a tricky business and a costly one for some

BY JOHN SHIRLEY

It was one of those protectiplated Manhattan brownstones, rewired in the Nineties, every square inch evenly coated with a thin, flexible preserving plastic. The old building was a jarring sight, snugged between the glassy high-rises. It was the distant past all neatly wrapped up and embalmed. It seemed appropriate, considering the job I'd been sent there to do.

I went up the slippery hall stairs, one hand on the plastic-coated wooden railing, wondering what unprotected wood felt like. They'd even preserved the quaint twentieth-century graffiti spraypainted in bright crimson on the faded walls: NUKE REAGAN BEFORE HE NUKES YOU and DEATH TO THE COMPROMISE SOCIALISTS.

I pressed 2-D's doorbell. An eye goggled through the old-fashioned glass peephole. The place apparently had no inspection cameras. The door opened—on real hinges—and I was looking down at a four-year-old boy.

TRIGGERING

PAINTING BY PIERO FASSONI

Behind him was the chair he'd been standing on. He pushed it aside.

He glanced at my clingsuit, at the department's suit-and-tie stenciled sharply on the front (the painting of the white hankie and the tie clip were beginning to fade) and chuckled grimly. He noticed my dark eyes, my short black hair, my duskiness, and his recognition of me as an Americanized East Indian showed in his face: a flicker of suspicion. It was a very adult expression.

I stared. They hadn't told me what the Tangle was. I had a feeling it began here. With the boy. The boy had curly brown hair, big blue eyes, a pug nose, and pursed lips. He wore a formal spiral-leg suit. It was an adult's suit, in miniature. In his mouth was clamped a black cigarette holder containing a Sherman's Real Tobacco burnt nearly to the butt. Smoke geysered at intervals from his nostrils.

A midget? But he wasn't. He was a four-year-old boy.

"You're staring at me," he said abruptly, his voice high-pitched but carefully articulated, accented almost aristocratically. "Is there some specific reason for this intrusive scrutiny, or are you simply a man who practices his penetrating glance on any unsuspecting citizen he encounters?"

"I'm Ramja," I said, nodding politely. "I'm from the Department of Transmigratology. And your name?" I covered my astonishment well.

He frowned at his cigarette, which had gone out. "Care for a smoke?"

"I don't smoke, thanks."

"Self-righteous, the way you say that. But you federal men are always self-righteous bastards. There was another here, fellow named Hextupper or something. You're the follow-up. Very orderly. You can go and dance with Dante for all I care, friend. But if you must know"—he gestured me inside and moved to close the door behind me—"my name's Conrad Frampton. How-do-you-do, salutations, and et cetera."

"You're overcompensating your self-consciousness about being a little boy," I said, returning his hostility.

He shrugged. "Could be. If you were a forty-one-year-old man trapped in a four-year-old body you'd feel like overcompensating, too. You'd feel like leaping out the window now and then. Believe me." He led me to a couch and I sat beside him.

"When did you die?" I asked, watching him. He made me nervous.

"I died in 1982," he said, not even blinking. "Care for a drink?"

"No, thanks. You go ahead."

"Damned right I will." There was a low yellow table beside the couch. He punched for a cocktail on the table's programmer.

I looked around. The room wasn't antique; it seemed like a broken promise after the outside of the building. It was a standard decorbubble, done in various shades of pastel yellow, the curved walls blending cornerlessly into the concave ceiling; the floor was more or less flat but of the same spongy synthetic. The walls, floor, ceiling, and furniture were all of a piece, shaped by the inhabitants. The room spoke to me about those inhabitants.

Who else lives here? I asked. The department had told me nothing about the people involved in the Tangle, except the address. It's better that way.

Conrad took a silvery cigarette case from a table, his infant fingers struggling for smooth movements; he lit a thin Sherman sulkily with a thumbnail lighter. "A couple of degenerates live here," he said, blowing smoke rings, "who call themselves my parents. *Fawther* is a musician, George Marvell, snooty concert guitarist. Plays one of those hideous flesh guitars. They're both flesh-machine fetishists. Mother works at the genvats, helping make more genetic-manipulation horrors. She's not so bad, really, though it nauseates me when she looks at me with her big brown eyes welling, hoping I'll turn into her widdoo Ahmed again. Her name's Senya. They named me Ahmed, but I make them call me by my real name," he said defensively.

"I take it you don't approve of flesh machines."

I sensed there was a flesh machine near at hand. A big one.

He made a something-smells-bad face. "Soulless things. Ugly. I don't know which is worse: the flesh guitar or that living *pit* they call a bedroom. They *are* soulless, aren't they? You're from the Department of Transmigratology. So you're allegedly an expert on souls. What's your stand on flesh machines, old boy?"

Depends on what you mean by *soul*. We don't use the word. We say *plasma field composed of tightly interwoven subatomic particles, capable of recording its host's sensory input*. And capable of traveling from body to body, evolving psychically so that species survival is more likely. It's not religion. It's a function of the first law of thermodynamics, but we use certain *mystical* techniques to work with it. Training for seeing life patterns, that sort of thing. Karma-buildup release. But if we use words like *karma* and *soul* in our reports to the National Academy of Sciences, we'll lose our funding. It took us twelve years of regressing people, and tracing facts, to get them to admit it was a bona fide science."

"I don't know about science. But in my current circumstances—" He made a bitter face. "I'm forced to believe in reincarnation." He looked at me. "Why the hell are you here? Level with me."

"We had a report of a rather nasty Tangle here. The lines of spiritual evolution tangled. Sometimes a gross emotional trauma from one life surfaces in the next. The people involved in the trauma are reborn in close circumstances in the next life, and the next, until the thing's cleared up."

I considered telling him more. I might have said I came because a Tangle needs a Triggering. And they sent me, Ramja, specifically because I'm part of the Tangle. Not sure how yet. But I'm one of the few department staffers who can't remember his last life. Part of it's repressed irretrievably. The computer model connected me with this tangle. They sent me, though they know that there's a big probability that someone involved will die.

But I didn't say that. Instead: As for flesh machines, I don't know how much so-called soul they have. Or even how much awareness. The department believes that they're part of the evolution of the lower orders. Animal minds, animal souls." I shook my head. "I'm not sure. Conrad, what do you remember of your death?"

He shakily relit his cigarette. "I... I drowned. Scuba... uh, scuba-diving. Sickening circumstances. Trapped underwater. My air ran out. Big pain in my chest. Gigantic buzzing in my ears. And a white rush. Next thing I remember is hearing this sad guitar song. Only it was a flesh guitar, so it sounded like they do—like a guitar crossed with a human voice. I looked around, and there was Senya looming over me, her arms outstretched, and I was staggering toward her. It must have looked like toddling. And then the guitar *screamed*. That's what brought me to myself. I remembered who I was. My *real* parents are Laura and Marvin Frampton. Were. They died together in a nursing-home fire, I'm told."

He crossed his small legs and propped an elbow on one knee, his cigarette holder poised continentally between thumb and forefinger. "George would like to have me adopted. He doesn't like me, and neither does his room. But then the room is rude to George, too. It shakes when he strokes it. Unpleasantly. I'll show you the damn thing."

We got up. I followed him to a doorway on the right and into the bedroom.

The room was in pain.

The cavelike walls were all rosy membranes touched with blue, pulsing. Across the room and near the living floor was a blue-black bruise, swollen and pustulent, a half-meter across. Conrad carefully didn't look at it.

"You're just full of hostility, Conrad," I said softly. "You've been kicking the wall there. Or hitting it with something."

He turned to me with a very adult look of

> *"For a few minutes I couldn't talk. I felt as if I were choking, though it hadn't been me who had drowned on that occasion. I drowned later, years later."*

CONTINUED ON PAGE 109

THE NEW FRONTIER

Three years ago OMNI magazine pioneered a revolution in science publishing. Travelling to and beyond the known horizons of our world, returning with fascinating and fantastic stories, in language we could all understand. OMNI looked inside the atom and across the breadth of the universe, discussed black holes, dissected the human mind, searched for UFO's soberly and described genetic engineering simply. And OMNI continues to journey the new frontier—that space and moment straddling our incredible todays and our even more exciting tomorrows.

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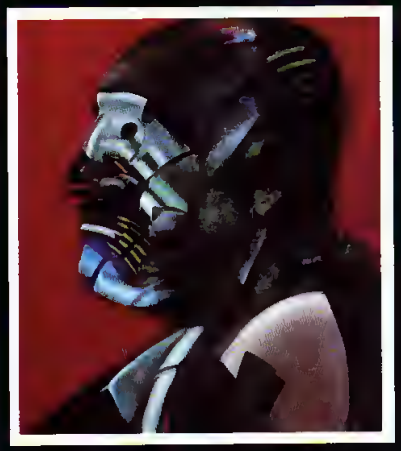
WHERE FLESH AND STEEL MESH

BY DOUGLAS COLLIGAN



An eerie mixture of organic and man-made textures characterizes the art of Marshall Arisman, whose inspiration springs from the social unrest wrought by science and technology. Arisman's paintings, with their surreal aura and futuristic sheen, convey the trapped, helpless feeling of men who have been reduced to cogs in a machine. His emotional reaction to the mechani-

zation of society is perhaps best exemplified in his series Genetic Man (preceding page and above), currently being exhibited at a one-man show in a San Francisco gallery. The androidlike faces are smothered with metallic skin, with only a hint of human features. The pictures combine the painter's observations of disgruntled workers on assembly lines and the dispirited derelicts he sees so often wandering the streets near his Manhat-

tan studio. Another negative aspect of technology is highlighted in *The Observer* (the first painting in this grouping), a symbolic rendition of the impotence of individuals confronted by war and other violent acts, which have increased with the advent of ever more sophisticated weaponry. Two of Arisman's most striking works, *Turtle Tank* (above) and *The Cage* (next page), were born of his fascination with genetic engineering. "When I

visited labs that were doing this work," he recalls, "I realized that the real horror was not the possibility that we might all develop eight arms but that these experiments are being conducted on test animals in artificial situations." Referring to *The Cage*, he adds, "That happens to be a dog, but it could just as well be a man in there." Similarly *Transformation* (opposite page) is the culmination of Arisman's experience at a rehabilitation center

where shattered bodies are repaired with steel and glass. Through the use of intense colors, a mechanical arm stands out in stark contrast to an otherwise organic body. Despite the futuristic overtones of his work, the artist is not a fan of science-fiction art based on fantasy. He explains, "My hope is that people will relate to my art not as part of the fuzzy world of the future but as something relevant to their own lives here and now."

Baked Apple.

Last Thanksgiving, a designer from Lynn/Ohio Corporation took one of the company's Apple Personal Computers home for the holidays.

While he was out eating turkey, it got baked.

His cat, perhaps miffed at being left alone, knocked over a lamp which started

a fire which, among other unpleasantries, melted his TV set all over his computer. He thought his goose was cooked.

But when he took the Apple to Cincinnati Computer Store, *mirabile dictu,* it still worked.

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Photograph by Scot Morris

The quiet wizard of recreational mathematics reflects on 25 years of brain-twisting the scientific establishment

INTERVIEW

MARTIN GARDNER

The *Washington Post* once called Martin Gardner's home office "the mathematical center of the earth." Gardner laughs at such hyperbole, but to followers of his Mathematical Games columns in *Scientific American*, it is not so outrageous a description at all. As chief guide through the endless labyrinth of mathematics, Gardner has led millions gently down the fascinating corridors—games, paradoxes, higher dimensions, infinity—illuminating all with clarity, wonder, and a sense of fun. Last year some of the top mathematicians in the country, all devoted Gardner fans, gave him a surprise birthday present by publishing *The Mathematical Gardner*, a book of papers all dedicated to him.

Even outside the realm of mathematics, Gardner's range of interest and his expertise are remarkable. His most successful work, *The Annotated Alice*, with comments and amplifications on Lewis Carroll's timeless Wonderland tales, still sells approximately 40,000 copies a year, 22 years after it was first published. An accomplished amateur magician, Gardner has designed numerous magical effects, and many of his books and pamphlets, often written under other names, are available only in magic stores. In *Confessions of a Psychic*, for example, written under the calculated pseudonym Uriah Fuller, Gardner divulges some of the most carefully guarded secrets of the phony-psychic trade. Writing in *The Ambidextrous Universe* on abstruse areas of modern science, he is the explainer *extraordinaire*, enlightening without overpowering. Most recently there is *Science: Good, Bad, and Bogus*, a collection of irreverent articles on talking animals, psychic surgeons, children who see through their fingertips, and other pseudoscientific phenomena that Gardner first wrote about in the 1950s in *Fads and Fallacies in the Name of Science*. As always, the subjects in his new book are served up with wit, understanding, and ruthless devotion to the truth.

Last month *Scientific American* printed Gardner's farewell piece—a refinement of the mathematics behind "Reaganomics"—marking the end of 25 years of Mathematical Games. At sixty-seven, Gardner has "retired," with his wife, Charlotte, to a new home in the hills of North Carolina to devote his attention to a book about his first love—not mathematics but philosophy.

A quiet, private man, Gardner shies from publicity. He never performs his magic tricks in public, never gives speeches, and so far, has turned down all invitations to make public appearances. And although he rarely gives interviews or poses for pictures, he did both for *Omni* senior editor Scot Morris.

"Knowing Martin Gardner has been one of the delights of my life," says Morris. "I first wrote to him nearly twenty years ago, and the generosity he showed then, in writing back to a presumptuous fan, continues to this day in the regular sharing of ideas and brain teasers, many of which find their way into the *Omni* Games column."

Gardner is shown here perched on the statue of Alice in New York's Central Park—an updating of the jacket photo on the original *Annotated Alice*. Morris's interview begins with a subject appropriate to the setting.

Omni: How did a mathematical games expert come to write a book about *Alice in Wonderland*?

Gardner: I have always found Lewis Carroll a fascinating person. He was a professional mathematician whose books are filled with all kinds of logical and mathematical jokes. The chapters of *Through the Looking-Glass* actually are based on a series of chess moves.

Omni: Will you ever revise your book?

Gardner: I have a big carton filled with letters, pointing out things that could supply me with additional notes. Enlarging *Alice* is just one of the projects I'll be able to do now that I don't have to worry about preparing a monthly column.

Omni: You were recently awarded an honorary life membership in the Mathematical Association of America, yet you say that you don't consider yourself a mathematician or a scientist.

Gardner: I can't think of any definition of the words *mathematician* or *scientist* that would apply to me. I think of myself as only a journalist who knows just enough about mathematics to be able to take low-level math and make it clear and interesting to nonmathematicians. Let me say that I think not knowing too much about a subject is an asset for a journalist, not a liability. The great secret of my column is that I know so little about mathematics that I have to work hard to understand the subject myself. Maybe I can explain things more clearly than a professional mathematician can.

Omni: You've taught mathematics to millions. Surely that makes you a mathematician, wouldn't you agree?

Gardner: I wouldn't be capable of teaching mathematics on the college level. I have specialized only in recreational mathematics, which is very, very low-level math. I could teach a course in recreational mathematics, but that's like saying I could teach a course in puzzles. I couldn't solve a problem in calculus if my life depended on it.

Omni: Just a few minutes ago you were on the phone saying, "Oh, this is embarrassing. You've caught me off guard. This is terrible. I don't know what to say." And, overhearing you, I thought someone had called to say, "Listen, you made a terrible goof in your column." And you get off the phone and tell me that a university in Pennsylvania wants to name you Scientist of the Year and have you go down and accept an award that had previously been given to such people as Carl Sagan, Margaret Mead, and Linus Pauling.

Gardner: They shouldn't have offered me such a thing in the first place. That was a mistake on their part. I think they were fooled by my writing into thinking that I am a highly trained and true mathematician.

> *"Some people at* Scientific American *suspect me of deliberately making mistakes to increase my mail. Of course I don't, but occasionally I give a problem that has never been solved."*

Omni: Many people call themselves mathematicians and teach in colleges, and they would defer to your opinions.

Gardner: That's true, and it's embarrassing. They overestimate my knowledge. Professors write to ask me technical questions that I'm absolutely incapable of answering. Sometimes I don't even *understand* the questions.

Omni: What got you interested in writing about eccentrics and frauds and pseudoscience?

Gardner: Ever since I was a boy I've been fascinated by crazy science and such things as perpetual-motion machines and logical paradoxes. I've always enjoyed keeping up with those ideas. I suppose I really didn't get into it seriously until I wrote my first book, *Fads and Fallacies in the Name of Science*. I was influenced by the Dianetics movement, now called Scientology that was then being promoted by John Campbell in *Astounding Science Fiction*. I was astonished at how rapidly the thing had become a cult. I had friends who were sitting in Wilhelm Reich's orgone energy accumulators. And the Immanuel Velikovsky business had just started, too. I wrote about those three things in an article for *Antioch Review*, then expanded that article into a book by adding chapters on dowsing, flying saucers, the hollow-earth theories, pyramidology, Atlantis, early ESP research, and so on. It took a long time for the book to start selling, but it really took off when they started attacking it on the *Long John Nebel Show*.

Omni: The radio talk show from New York?

Gardner: Yes. For about a year, almost every night, the book would be mentioned on the show by some guest who was attacking it.

Omni: Is it time for a sequel?

Gardner: I have pasted up a kind of sequel. It's called *Science: Good, Bad, and Bogus*. It's a collection of all the articles and book reviews I've done on eccentric science over the past thirty years. I really don't take pseudoscience very seriously in spite of the fact that lots of people think I spend most of my time attacking it.

Omni: What's wrong with pseudoscience? Is there any harm in believing something that's not true?

Gardner: Generally, I think a culture is better off if people are well educated and able to distinguish good science from bad. For example, pseudoanthropology contributed largely to the rise of Nazism. Once the Nazis got control of the German educational system, they were able to bring up almost a whole generation who took for granted that the Aryan race was superior to all other races, and that blacks, Jews, and gypsies were genetically inferior. There was no way a young person in Germany could find out that Aryan anthropology was pseudoanthropology because orthodox anthropology was excluded from German textbooks.

Another general point is that a modern society has to make decisions constantly about where funding should go. A culture with a poorly educated citizenry will waste large sums of money on crank research. The spread of Lysenkoism in the Soviet Union under Stalin is a prime example. The science of genetics disappeared in that country because of widespread acceptance of Trofim Denisovich Lysenko's crackpot theory that you can inherit certain traits from your ancestors.

Omni: What effect does pseudoscience have on individuals?

Gardner: I think the only serious damage is done to persons who believe something crazy in the health field. Quack medical beliefs—psychic surgery, fad diets, Laetrile, and so forth—can be definitely harmful to your health if they prevent you from going to a reputable doctor. Some popular reducing diets can be very damaging to those who try them. The Beverly Hills Diet is the latest instance.

Omni: What about a pseudoscience such as inventing a perpetual-motion machine?

Gardner: Well, that's nonsense, of course, but I don't see that it does any social harm. One should be tolerant of most pseudoscience, because there's always the possibil-

ity someone with a weird point of view may have latched on to an important truth that scientists are disregarding. It's a small price to pay. I think I am violently opposed to any kind of government legislation that would prevent pseudoscience from being published, either in magazines or in books.

Omni: Does a widespread belief in such psychics as Uri Geller do any harm?

Gardner: Ironically, the greatest harm that Geller has done has been what he has done to parapsychology. Almost all parapsychologists now recognize that Geller is a charlatan and a fraud. But they didn't at first. So many parapsychologists went on record saying he was a genuine psychic that they made fools of themselves. And a lot of people lost respect for them.

Omni: Some mainstream scientists were taken in, too.

Gardner: Yes, and I think their reputations were damaged, most notably John Taylor, the mathematical physicist in England.

Omni: What are the most popular areas of pseudoscience today?

Gardner: Of course people are still interested in occult phenomena and parapsychology. I regard most parapsychology as not sufficiently confirmed to justify calling it a science. Aside from that, I suppose ufology is the most widely believed bit of pseudoscience.

A fast-rising branch of pseudoscience is the revival of the creationist view of evolution, which is part of the recrudescence of Protestant fundamentalism. There are millions of people who now think there is substantial scientific evidence against evolution. They believe that fossils found in the ground are from animals and plants buried by Noah's flood. I call it pseudoscience, because the evidence against a worldwide flood's having produced all the fossils is overwhelming. And the evidence that evolution actually took place is likewise overwhelming. True, there is scientific debate about the mechanisms by which evolution operates, but that's not a disagreement over the fact of evolution. The number of intelligent people who promote this fundamentalism is rising very rapidly. I imagine if you took a poll to find out how many people believe the theory of evolution is false, you'd find millions of people saying yes, they believe that. We even have a President in the White House who is dubious about evolution. He's on record as calling it only a theory, one with great flaws, and saying that creationism should enjoy equal time in the classroom.

Omni: Do you believe in God?

Gardner: Yes. I do. But that answer doesn't mean much unless I explain what I mean by God. I'm writing a book in which I will defend the kind of theology I believe in, but for now I'll just say I don't consider myself an atheist and that my beliefs are not connected with any established religion.

Omni: You were raised in a fundamentalist family, weren't you?

Gardner: My mother was a devout orthodox Methodist, but my father was more of a pantheist and skeptic.

Omni: Did you ever follow your mother's direction?

Gardner: I was a Protestant fundamentalist when I was in high school. This is reflected in my only novel, *The Flight of Peter Fromm*. But I got over that when I went to the University of Chicago.

Omni: Getting back to your thirty-year campaign against pseudoscience, do you think you're making a dent?

Gardner: Oh, I think not much of a dent. Our Committee for the Scientific Investigation of Claims of the Paranormal puts out a lively quarterly journal, *The Skeptical Inquirer*, which, so far as I know, is the first magazine devoted to pseudoscience from a skeptical point of view. But the circulation is still small. I think *Fads and Fallacies* was read and enjoyed mainly by people who shared my point of view before they read the book. I doubt that it had much influence on changing anyone's opinions.

I have always gone on the assumption that it's impossible to convince a person of anything by rational argument. Take a prominent figure who doesn't believe in the theory of evolution, Oral Roberts, say. It's inconceivable to me that a geologist could sit down with Oral and present a series of arguments that would cause him to say, "Amazing! Evolution must be true after all! You've given me so many facts and so

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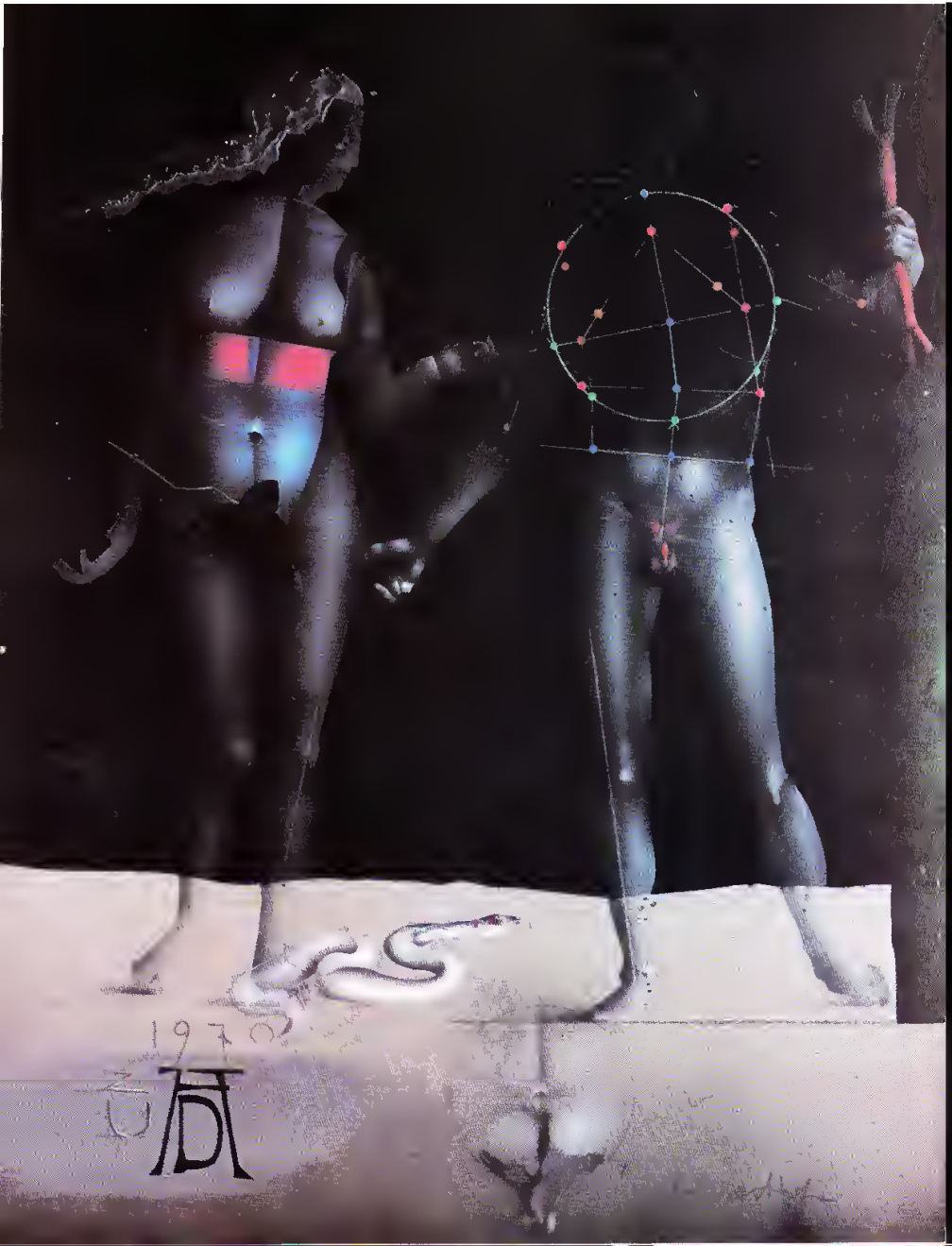


Ingenious doctors are putting new technology to work against the most intimate ills that plague mankind

WHEN TECHNOLOGY BEGETS THE FATHER

BY CARLA FINE

Thirty-three years ago Jim Stevens was born without testicles. Doomed to live as a eunuch, he would never be capable of performing normal sexual functions. But now Jim is the father of an infant son and has a second child on the way. What is his secret? Three years ago Jim became the first recipient of a testicle transplant. Donated by his otherwise identical twin, the gland has given Jim a new life.

In this and many other revolutionary medical procedures, doctors are applying modern technology to solve male reproductive problems that until recently were almost unknown. For centuries the woman alone bore the blame for a barren marriage. Impotence, it was thought, must be attributable solely to psychological problems.

Suddenly these incorrect attitudes are changing. Doctors have found that the man in at least half of all childless couples is at fault; in another 30 percent of childless unions both partners share in the failure; and more than half of all impotence results from organic disorders.

Now that they know it can be done, physicians are beginning to remedy both conditions. Other doctors, using drugs and surgical techniques, are working to give men the same control over their fertility that contraceptive drugs and devices have given women.

There are many causes for male infertility, most of them still mysterious. In some men, varicose testicular veins, called varicoceles, are to blame. In many others, something blocks off the epididymis, the tube through which sperm travel from the testicle to the vas deferens. Often the vas deferens has been blocked deliberately; several thousand men each year seek to have a vasectomy reversed. In all these conditions spectacular breakthroughs have been brought about by microsurgery.

Dr Sherman Silber, the author of *The Male: From Infancy to Old Age* (Scribner's, 1981), has

PAINTING BY PAUL WUNDERLICH

OMNI THE NEW FRONTIER
STATION LISTINGS

WRGB/NBC	Albany/Schenectady
KLKK/IND	Albuquerque/ Farmington
WBAL/CBS	Baltimore
WBMG/CBS	Birmingham
WCVB/ABC	Boston
WLS/ABC	Chicago
WCPO/CBS	Cincinnati
WKYC/NBC	Cleveland
KRDO/ABC	Colorado Springs
KOMU/NBC	Columbia/ Jefferson City
WFAA/ABC	Dallas/Fort Worth
WXYZ/ABC	Detroit
KVIQ/ABC	Eureka
WFFT/IND	Fort Wayne
KJCT/ABC	Grand Junction
WOTV/NBC	Grand Rapids
WLRE/IND	Green Bay
WGHP/ABC	Greensboro/ High Point/ Winston-Salem
WCTI/ABC	Greenville/New Bern
WLYH/ABC	Harrisburg/ Lancaster
WVIT/NBC	Hartford
KPRC/NBC	Houston
WJKS/NBC	Jacksonville
WJAC/NBC	Johnstown/Altoona
KMBC/ABC	Kansas City
KADN/IND	Lafayette
KVVU/IND	Las Vegas
KABC/ABC	Los Angeles
WLVY/ABC	Louisville
WTVJ/CBS	Miami/Ft. Lauderdale
WITI/CBS	Milwaukee
KMSP/IND	Minneapolis
WABC/ABC	New York
WAVY/NBC	Norfolk/Portsmouth
KETV/ABC	Omaha
KMIR/ABC	Palm Springs
WEEK/NBC	Peoria
KYW/NBC	Philadelphia
KPHO/IND	Phoenix
WTAE/ABC	Pittsburgh
KPTV/IND	Portland
WDDD/IND	Paducah
WPTF/NBC	Raleigh/Durham
WROC/NBC	Rochester
WORF/IND	Rockford
KOVR/ABC	Sacramento
KPLR/IND	St. Louis
KUTV/NBC	Salt Lake City
KFMB/CBS	San Diego
KGO/ABC	San Francisco
KCOY/CBS	Santa Barbara/ Santa Maria
KING/NBC	Seattle
WTOG/IND	Tampa
WWTV/CBS	Traverse City/Cadillac
KVOA/NBC	Tucson
KGCT/IND	Tulsa
WRC/NBC	Washington, D.C.
KTVH/CBS	Wichita/Hutchinson
WKBN/CBS	Youngstown

devised many of these delicate operations. It was Dr. Silber who performed the testicle transplant for Jim Stevens (not his real name). When Jim first consulted him, Jim had been receiving monthly testosterone injections which helped keep him healthy but caused severe mood swings from which he was desperate to escape. In addition, Jim had recently got married and wanted to have children.

His brother, who already had three children, was eager to give Jim a chance to lead a normal life. "These men are more than brothers; they're good friends as well," Silber says. "I had been thinking about such a case for a long time, and we all decided to go ahead."

Using microsurgery for the eight-hour operation, Silber removed one of Jim's brother's testicles and placed it into Jim's empty scrotal sac. Then he connected Jim's spermatic artery, neighboring veins and the vas deferens to the donated organ. Within seconds after the transplant was completed, Jim's testosterone supply went from castration levels to normal levels. Three months later, normal sperm production began.

"The blood vessels that supply the testicle are one seventieth of an inch in diameter, the size of a pinpoint," Silber comments. "The inner channel of the vas deferens is even smaller. There is no way you can do a transplant without using microsurgery to hook up these tiny vessels."

The body will reject a testicle from anyone but an identical twin, and so the operation is rarely possible. But Silber has found another use for it: autotransplants. A few boys are born with undescended testicles, lodged in the abdomen. Left untreated, this condition can cause life-threatening complications. But the only treatment has been to remove the testicles.

"Now we can take the testicles out," Silber says, "and replant them in the scrotal sac. The patient still has his own testicles, but now they're where they belong, instead of up near his kidneys. This operation can be done on patients at any age. Our patients range from two to twenty-one years old."

Several of the urologist's operations are fantastically delicate. In one, he restores fertility after sterilization. During a vasectomy, the vas deferens is cut and the severed ends are turned back on themselves and sealed. To rejoin them, the obstructions must be clipped away and the ends stitched together. If the tube's inner channel, only one hundredth of an inch in diameter, is not perfectly aligned, there is no way for sperm to pass through. Before microsurgery, the patient had perhaps a 10 percent chance of regaining his fertility. Silber, by using the microscope, has given his patients about a 90 percent chance of being fertile.

An even more delicate operation, called the vasoepididymostomy, is used to remove obstructions from the epididymis. "Although the epididymis is twenty feet long," Silber explains, "it extends only one inch from end to end, because it's coiled up like spaghetti. We must find the point where the blockage is, then go beyond it in order to find sperm.

"The tubule there is tiny, only one three-hundredths of an inch in diameter, with walls one one-thousandth of an inch thick. Looking under the microscope and using thread five times smaller than a strand of hair, we can actually stitch the inner canal of the vas deferens directly to the opening of the epididymal tubule in order to bypass the blockage. Then, for extra strength and support, we stitch the muscle layer of the vas to the outer wall of the epididymis."

Silber has used this procedure on more than 1,500 men and made 9 out of 10 of them fertile. He has also begun to test it on men who have few sperms in their ejaculate but many normal sperm precursors in the testicle. This is common in infertile men.

"In the field of fertility, all this is brand-new," Silber asserts. "In three or four years most urologists will still think of it as the future, even though it is already happening."

And yet a few other urologists are also pioneering new fertility operations. One is Dr. Richard Amelar at the New York University (NYU) School of Medicine. Dr. Amelar, working with Dr. Lawrence Dubin, has perfected the varicocelectomy. Varicose testicular veins are a leading cause of infertility. Varicocelectomy disconnects these from the rest of the testicle, improving the number and quality of sperm.

"In the next decade," Amelar predicts, "we'll learn more about the varicocele and how it interferes with sperm production and develop new ways to deal with it. Some radiologists are now trying to block varicoceles with probes and catheters from outside the body. This is very exciting."

Even more exciting is the possibility of restoring fertility without operating at all. One nonsurgical approach comes from Dr. Adrian Zorgniotti, also at NYU. The testicles are located outside the body itself because they must be relatively cool in order to produce vigorous sperm. While the body temperature is 36.7°C, the testicles' temperature should be at 33.5°C or lower. Some physicians believe that varicoceles and certain other conditions cause infertility because they warm the testicles.

Dr. Zorgniotti's answer is to cool them. He and Andrew Sealfon, an engineer, have devised a scrotal covering that resembles a jockstrap. A small pump worn on the waist moistens the covering with water and alcohol, and evaporation cools the testicles.

So far, 30 men have worn the device—during the day only—after more conventional treatments had failed. One in four now has a child or one on the way. "Interestingly enough," Zorgniotti says, "four of the five children born so far have been girls. It seems that the Y chromosome may not be able to survive if one wears the device. If this is so, we might use this device to better the chances of having a girl baby."

Zorgniotti also expects the cooler to aid such people as pizza chefs and brick-kiln

CONTINUED ON PAGE 94

Nobel made a bang. Now we offer a blast with our own set of prizes To the victors go Omni's

LAURELS (AND HARDYS)

OMNIBUST

At the Chicago World's Fair of 1893, the California Pavilion displayed a statue of a medieval knight on horseback made entirely of prunes. A brochure informed visitors that the soft-skinned statue represented the fact that "prunes of that state are being introduced victoriously into all lands."

It is with something of the spirit of that statue that we selected the first soon-to-be-lionized winners of the *Omni* Laurels (and Hardys). These winners are the fruits that fell from the great tree of 1981. And beneath appearances, these are the pits—the seeds of future and comparable achievements.

To anticipate your question, several features distinguish the *Omni* Laurels (and Hardys) from the Nobel prizes. For one thing, *Omni* did not invent dynamite. Alfred Nobel did. For another, our winners retain amateur status. They receive nothing at all. It is doubtful that reporters will wake them up, or TV crews trample their grass. Our winners don't have to fly to Stockholm.

How, you might ask, did we cull the award-winners from the thousands of scientists, inventors, technicians, big wheels, and their spokespersons who tried to leave their footprints on the ponds of time? Like some of the Nobel Prize committees, our chief judge—writer Mike Edelhart—would not reveal anything but his expense account.

But the final choice could not have been difficult. After all, 1981 was the year when politicians decided when life begins and survivalists advised us to stay alive by putting a plastic bag over our heads. It was a year when doctors fought to save the lives of their golf greens, when a robot recovered from an attempted suicide, cows ate books, and a diet expert convinced millions that fruit can make you free.

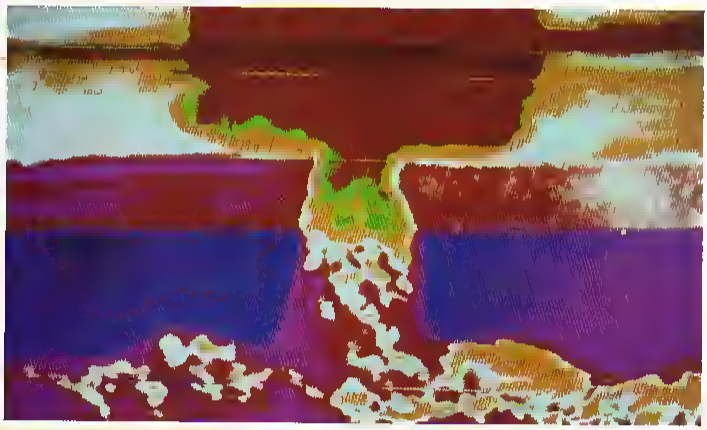
All of these millstones and others on the path of progress receive a just citation on the pages that follow.

SILVER LINING

Our award for supreme optimism, a medallion formed of rose-colored glass set in a frame of silver, is presented to the firm of Hark Northgreaves, Ltd., of England. Engineer K. R. Northgreaves has perfected a splendidly hopeful invention, a portable pop-up nuclear shelter that fits inside a valise.

The shelter consists of an inflatable plastic room with a low-power ventilation unit that, according to the developers, will filter radioactive dust or chemical-warfare gases from the family's air supply, keeping living quarters springtime fresh.

People can remain safely inside their snug plastic bag for two weeks, the engineers say, after which they can emerge into a smoldering and desolate world and use snippets of the plastic to open a dry-cleaning business.



ONE-UPMANSHIP CUP

It was inevitable that the wave of high-tech high-rise architecture that has recently swept the country should break into the bedroom as well.

Biosonics, Inc., fittingly of Philadelphia, has announced plans to sell shares for development of a device called MEGS (for male electronic genital stimulator).

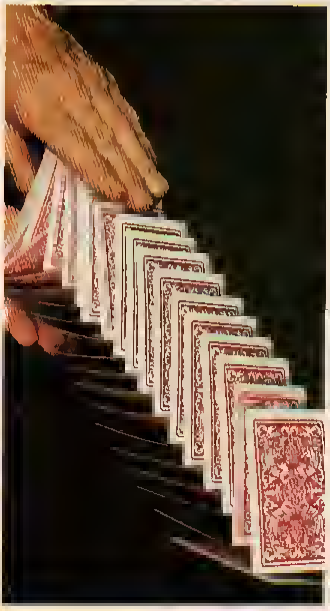
Delicately put, a MEGS, when inserted into the male posterior, is supposed to enliven the male anterior.

The *Omni* judges thought that the company's plans were brave, considering the softness of the market.

GOLDEN HAYES AWARD

When organizers of the Ohio Hazardous Materials Workshops and Exposition began scouting for speakers, their thoughts turned naturally to football.

Getting rid of hazardous wastes is, after all, something like sacking the quarterback. As conference officials, including people from the Ohio Environmental Protection Agency realized, it takes a team to generate and use dangerous material and then punt it when you're done. That's why the organizers of the technical conference and trade show on hazardous materials—a sort of superbowl of sludge—chose Woody Hayes as its keynote speaker. The choice of Hayes, former football coach at Ohio State University, makes eminent sense. After striking an ABC television cameraman in 1977 and punching a Clemson University player during the 1978 Gator Bowl, Hayes himself was declared something of a hazard, and he was dumped from his job.



PRESTO PRIZE

It's heartwarming to see so great a return to the use of under-the-table imagination in reporting research results.

Our winner is Elias A.K. Alsabti, not because he was any worse than dozens of other contenders, but because he came first. It was Alsabti's quick and unceremonious departure from medical programs affiliated with the University of Virginia and Boston University that released the spate of plagiarism and cheating accusations that have animated the past few months. It was claimed that Alsabti had built his career most cleverly upon other people's work, in one case magically getting his own version of a paper by two other researchers into print well before the original authors were able to

INTERFACE MARRIAGE KEY

Want to get married with no muss, fuss, or human participation? Try the Reverend Apple of Sunnyvale, California. The Reverend Apple is a computer program devised by Ron Jaenisch, that performs weddings. Man and woman come before the video screen. There they respond to all the usual questions by pressing the Y button, signifying yes.

After the groom has placed the ring on his bride's finger, the computer prints. Now you may kiss the bride. Unhappily, Jaenisch has not yet figured out how to get his computer to throw rice.

LAURELS (AND HARDYS)

GREEN RIBBON

One of the main concerns of the medical profession today is not interferon, Laetrile, or vitamin C. It's C-15. C-15 is a special kind of grass developed for golf courses. And it's dying, meaning that doctors on their days off are obliged to gaze on the horror of brown golf greens.

Failure to save the greens, according to one doctor battling the problem, would be like all the Lincoln Continentals and Mercedes-Benzes dying at the same time. Luckily science has found an antidote: tetracycline. And it's nice that doctors still make house calls, provided the patient is green and close-cropped and has a flag in its hole.

BRAZEN BRICK

When the Air Force built itself a laboratory in Tennessee recently, it gave the building contract to one firm and the interior-equipment contract to another. Everything went smoothly until they tried to insert B (equipment) into A (the building). B turned out to be too big to fit into A.

The Air Force's response? In the spirit of any child not able to assemble a new toy, it pouted. It said legislators could ante up more money to redo the building. Or else it would leave all the expensive equipment sitting outside to be rained on while generals sulked inside, refusing to play.

TREMORLESS PREDICTION AWARD

No contest on this one. Brian Brady, a U.S. government geophysicist, puts all others to shame. It was Brady who predicted about a year ago that an earthquake of 7.5 on the Kanamori scale would occur in Peru on June 28, 1981, to be followed by two others later in the summer.

Thanks to his amazing willingness to foretell events, Brady single-handedly terrified the Peruvians for an entire summer.

Of course, in the end, no earthquake struck, not even the teeniest subterranean tummy rumble. (You can see it not happening in the photo at left.) Brady blames some of the problems caused by his prediction on the press, which reported it, and he says he will make no further predictions, which we think is too bad. We wish he'd predict a major recession and drought, famine and pestilence, followed by the end of the world.

LEAKY SPACE SUIT LAUREL

We have heard rumors that the writers of science-fiction films have gone off en masse to study under a great yogi so that they may more easily type with their feet in their mouths.

The winner of this year's commendation for shallow thinking in deep space is *Outland*, a film about blood and guts in a mining colony on Jupiter's moon Io, a place as dreary as Sandusky, Ohio. The plot was a ripoff of *High Noon*: a sheriff in a tough town, corrupt officials and the big gunfight that confirms the good guy's manhood. The only thing missing is the horseman hollering "Io, Silver, awa-a-y!"

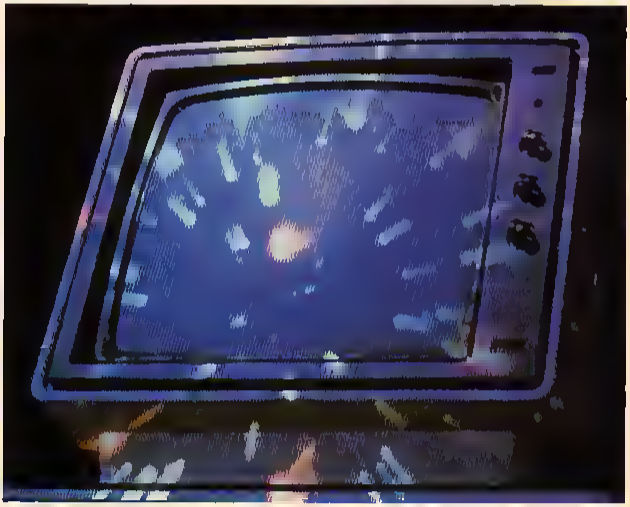
The boners come with simple, practical matters. For instance, the space mine is supposed to be a thin, pressurized shell, surrounded by zero atmosphere. At one point in the film a big deal is made about breaking a piece of the shell, leading to the evacuation of one of the baddies into the void.

But throughout the movie dozens of characters are running around shooting *rifles* with *bullets*. One stray shot could puncture a wall and suck the whole cast out into space, but naturally it doesn't. How convenient.

And *Outland* cowboys wear helmets that have rows of lights running around the edges so they can work in the dark. Next time you're driving your car at night, turn on the inside light and see how much you can still see outside. No wonder they couldn't hit the broad side of a barn.

HEMLOCK CUP

If you don't think machines are becoming smarter, consider the case of a Florida robot designed for missions inside nuclear-power plants. Apparently after considering this perilous future, it "worked its arm into an unnatural posture," a lab worker told us, and then began beating itself to pieces—the world's first attempted electronic suicide. Happy ending: The robot is back together and lately has been dating one of the Stepford wives.



GRANGE-BUT-TRUE PRIZE

Down on a federal research farm in Beltsville, Maryland, uncomplaining cattle are learning to eat a tasty diet of manure, dried into pellets and garnished with succulent shredded telephone books. Rumor has it they're in training to dispose of back issues of the *Congressional Record*.

LAURELS (AND HARDYS)

SENATORIAL SALUTE

We present a pair of handsome golden nitpicks to Senator Jesse A. Helms (Republican of North Carolina) for his proposed legislation defining life as starting at conception.

The bill, aimed at outlawing abortions, drew predictable fire from those who had not had the benefit of two full days of hearings into the subject, conducted by Senator John East, also a Republican and from North Carolina.

Doubters pointed out that the bill would prohibit the use of intrauterine devices, because they prevent the implantation of fertilized eggs. The law would also make it illegal for surgeons to operate on a possible malignant group of cells called a hydatid mole, actually a fertilized egg gone wrong in the uterus. Not removing the mole could endanger the life of the woman carrying it, scoffers like Dr. Leon E. Rosenberg, of the Yale University School of Medicine, pointed out.

But what is the woman's life in comparison with life itself?

And, besides, the bill would boost the flagging economy.

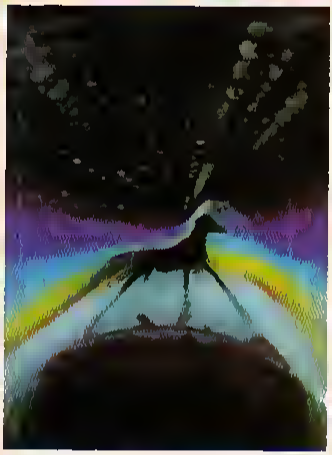
It would engender dozens of exciting products, from conception-day cards to presents for conception showers. Sales of cakes, candles, funny hats, and noisemakers would double.

Lawyers would be able to buy a third BMW from all the wrangling over citizenship cases that will flood the courtrooms when life begins in London but gets born in New York.

(To settle such cases, Senators Helms and East are about to announce *where* life begins, at third base.)

KUDOS D'ETAT

A juggling-and-contortion award goes to the many in Washington who used strong-arm tactics to get government off the backs of the people while they spoke out of both sides of their mouths. The Office of Management and Budget, for instance, was reported ready to seek a $1 billion-a-year slash in NASA's budget, grounding the space program, while politicians continued to vote for farm price supports, boosting consumer costs into high and stable orbits. Meanwhile, the Transportation Department recently advertised that it was seeking design specifications for an "advanced anthropomorphic dummy family." Have they taken a good look around Washington lately?



EQUINE RIGHTS PRIZE

The trophy this year goes to a one-horse vehicle from England that actually uses one horse. Philip Barnes of Cambridgeshire, filed a patent application for a minibus powered by a horse tied up in the center aisle. The horse walks on a loop connected to a gearbox and an alternator.

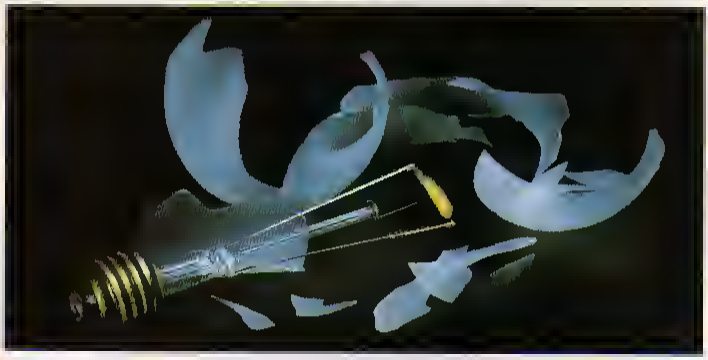
Barnes asserts that his bus idea is a boon for horses. They would no longer have to walk on soiled streets, for instance, or be subject to the jarring din of trucks and autos. Nor would they be forced to ride in the back of the six-person bus. Of course, the back of the horse would be in the back of the bus, but its nose would be in the front. Horses wouldn't have to worry about steering themselves. The driver would do all the turning with a wheel.

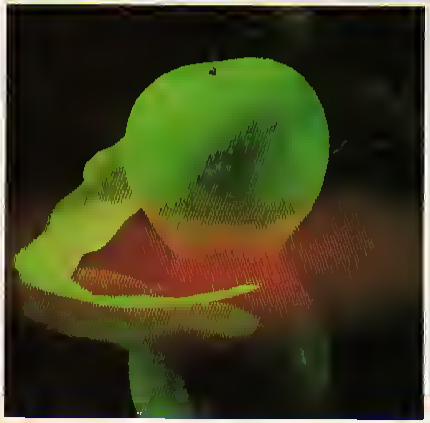
The accelerator is a marvel of simplicity. It's a mop that can be jiggled by the driver to prod the horse.

We hope NASA picks up on the idea. Horses are reusable and, unlike the shuttle's engines, make only the most meager whinnying noise at launch.

DIM-BULB MEDAL

The 1982 World's Fair in Knoxville, Tennessee, will focus on the theme "Energy turns the world." A government study suggests the United States Pavilion at the fair could turn the world *off*. The building was supposed to have gotten all the energy it needed on a yearly basis from rooftop solar collectors and other components. But several of the systems were downgraded or removed. A report from Energy Department officials said the building could turn out to be "a significant embarrassment," requiring a lot of utility-supplied power. Cutting the solar collectors and other energy items means the new pavilion will have to rely more on a traditional energy source: the old tax collector.





EMPTY BOWL

Judy Mazel used to be just a workaday diet consultant, telling her clients' pounds to get lost. Now she is making gravy. Her book, *The Beverly Hills Diet*, is a runaway best seller about how pineapples and papayas can make your body look less like a watermelon and more like a banana. Mazel deserves a giant raspberry for devising a regime that sells millions of books and, doctors say, is lean on science. Dr. Sami Hashim, of St. Luke's Hospital, in New York City, offers a testimonial to her achievement: "I can't find one single scientific fact in the book," he says.

CONTINUED FROM PAGE 69

many good arguments I'll change my point of view It's inconceivable he would do that His mind-set is something he's acquired over a lifetime and he probably doesn't know enough geology even to understand the arguments I think it was John Dewey who said that nobody is ever convinced by argument to give up a foolish belief, that the most you can hope for is that a person will outgrow it By *outgrow* I think he meant that people may go through a process of self-education that will cause them to change a point of view If they don't go through that process they're not likely to change

Omni: Certain people say Martin Gardner is close-minded You couldn't convince him that UFOs exist if one landed on his porch He wouldn't believe in ESP if he experienced it every day' How would you respond? Do you feel you're close-minded on these subjects?

Gardner: That's a complicated question Let's go back a bit and say that, in science, nothing is ever known with certainty Every statement in science has a certain degree of probability of being true It can always be contradicted by a future counterexample You can say of scientific statements that they have, in your opinion, a very high probability of being true or a very low probability of being true depending on the weight of the evidence For example it's extremely unlikely that the earth is hollow and open at the poles and inhabited by people on the inside If I believe a theory has a very high probability of being false—if the evidence against it seems to me overwhelming—then I'm close-minded about it in the sense that I'm not going to change my opinion unless there is very very strong evidence to make me change my mind The sociologist Marcello Truzzi has a crisp way of putting it He says, "Extraordinary claims demand extraordinary evidence"

I regard myself as being open-minded on all questions about which there is no overwhelming evidence For example if you ask me whether I think there are black holes out in space, I'll have to say I don't know I hope there are Is there some type of microscopic life on Mars? I have no opinion one way or the other But on the main hypothesis of Velikovsky for example that a comet erupted from Jupiter swung around close to the earth within historic times, and became the planet Venus I'm very dogmatic in calling that nonsense The scientific evidence that Venus is an old old planet is just too overwhelming

However if you ask me whether I think ESP is a possibility I would have to say yes of course it is The only reason why I don't believe in ESP is that I haven't seen anything yet that strikes me as sufficient evidence to warrant my belief in it When I look at the reports of parapsychologists I find it easier to explain their results in terms of fraud, self-delusion, and sloppy controls than to explain them by postulating a force called ESP

Omni: Looking back on your Mathematical Games columns, which ones stand out?

Gardner: I should mention one article on hexaflagons that predated the column These are fascinating structures folded out of strips of paper that were invented by a group of Princeton students including Richard Feynman who later won a Nobel Prize for his work in quantum mechanics This was a feature article that ran in the December 1956 issue of *Scientific American* It inspired the publisher Gerard Piel to ask me whether I wanted to do a regular column on mathematical games I said yes and rushed out to put together a column in time for the next issue That was what started it all

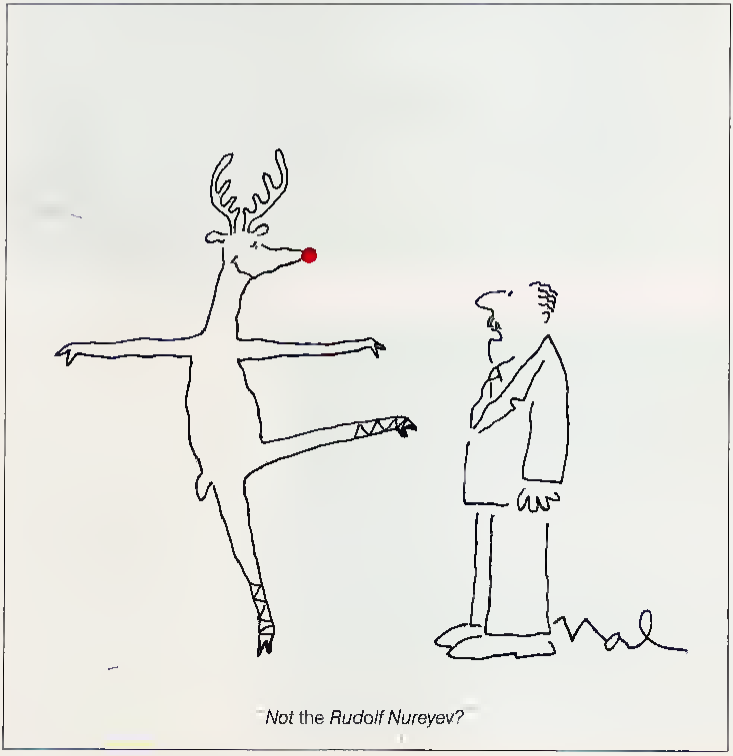
I have been fortunate enough to do the first popular articles on some topics—John Conway's computer game Life for example—and I was first to report on the development of new kinds of unbreakable codes I devoted two columns to Newcomb's paradox a curiosity of decision theory that seems to touch on questions about free will and determinism Those columns drew a tremendous amount of mail But I suppose the column that caused the biggest stir was my April Fool's hoax article in the April 1975 issue

Omni: That was the one about breakthroughs that somehow had escaped public attention Didn't you have Leonardo da Vinci inventing the flush toilet?

Gardner: That's right and I told how to build a psychic engine that rotated when you put your hands near it and concentrated I said that computer scientists had proved that the player who moved first in a chess match could win every game and I printed a map that supposedly required five colors What came as a complete surprise to me was that so many people took these things seriously I got several thousand letters most of which said something like "Thank you for the very interesting column about new breakthroughs but I think you made a mistake on one of them and that would be the one in which the person had some expertise Physicists wrote to question my disproof of the relativity theory but they accepted everything else I couldn't believe it

Omni: Have you ever made a big mistake in your column?

Gardner: Oh yes Wasn't it Fiorello LaGuardia who said, "When I make a mistake it's a beaut"? Well when I make a goof in the column it's usually a whopper One of my recent mistakes involved trisecting a cube, that is cutting a cube into three identical and equal parts I gave a rather tricky method of doing it then asked readers to find a second method The solution I had in mind was the obvious one of just cutting straight slices through the cube, which a lot of people don't think of But I made the



"Not the *Rudolf Nureyev*?"

mistake of saying that, so far as I knew there was no third method of cutting a cube into three congruent shapes. As it turns out there are an *infinite* number of ways to trisect a cube. So I missed by a long way.

Some errors are just careless ones, or are due to the fact that I'm usually writing a bit over my head. I love to do a column on a topic I don't understand very well, because it gives me an incentive to read up on it. One nice thing, of course, is that if I make a blunder, hundreds of readers write me about it, and then I can correct it before a column goes into a book.

Omni: Is that when you get the most mail—when you make a mistake?

Gardner: Yes, that always brings a flood of letters. Some people at *Scientific American* have suspected me of deliberately making mistakes to increase my mail and to impress the editors with how many readers I have. But of course I don't do that. Also, occasionally I give a problem that hasn't been solved but that can be cracked with a fairly simple computer program. That will bring lots of letters from people with access to a computer.

Omni: How much mail do you estimate you receive in a week?

Gardner: It varies enormously, but I guess it would average about one hundred letters a week. I try to answer as many as I can, but I can't answer them all. I have a form letter that I use for certain stock replies. It says, "Mr. Gardner regrets that he cannot ..." and I check off an appropriate reply.

Omni: For example?

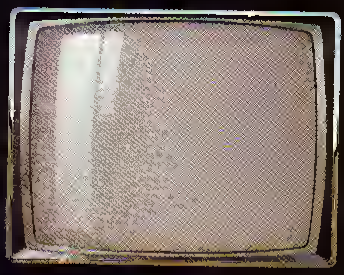
Gardner: If someone sends me a ten-page proof that he's trisected an angle, I don't even read it. There's an easy-to-understand and ironclad proof that an angle can't be trisected using only a straightedge and compass. People have been working on that problem for centuries. So it's unlikely the person has even found a clever new *bogus* way of doing it.

Omni: Are there other classic problems you don't look at?

Gardner: Yes. Another ancient problem is squaring the circle, that is, finding a method by which you can, with a compass and straightedge, draw a square that will have exactly the same area as a given circle, or vice versa. Another classic problem is duplicating the cube. Given a cube of a certain dimension, you try to construct the side of a cube that would have exactly twice the volume of the original one, again with compass and straightedge. That's also been proved impossible.

Omni: Do people send you proofs of Fermat's last theorem?

Gardner: They do. That's the famous conjecture that the formula $A^n+B^n=C^n$—which is the model for the Pythagorean theorem—has no integral solution for exponents larger than two. This is still an open problem. But the probability that an amateur will find a proof is so remote—considering that the world's greatest number theorists have worked on it for such a long time—that I don't bother to follow



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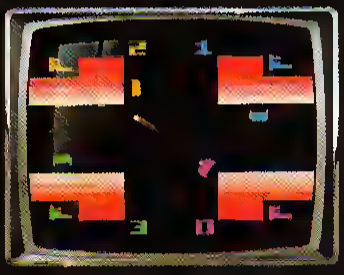

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proofs I get in the mail. It might take me two or three days to work through it just to find out where it went wrong. Life is just too short to waste that much time going through a complicated proof when the probability that it's wrong is so extremely great. I return them unread also, although there is a very very faint possibility that some amateur might hit on a proof and might send it to me.

Omni: The four-color theorem?

Gardner: This is the classic conjecture that four colors are sufficient for coloring any kind of map on the plane—that you can't have a map that requires five colors. That has recently been shown true, although it was still unproved when I did my April Fool's column in 1975. The theorem's truth wasn't a surprise. Almost everyone believed that it was just a matter of time before a proof could be found. The surprise was that the proof was so horrendously complicated that it required massive computer printouts. It's such a simple theorem that you would think there would be some simple way of proving it. The computer proof is so complicated there's still a faint possibility it might not even be valid. Also, it's still possible someone will come along tomorrow and invent a simple, tricky, intuitive proof that won't require a computer.

Omni: What's your opinion on the use of electronic calculators in the classroom?

Gardner: I side with those people who think the introduction of calculators into the classroom is a good thing in the long run. A great deal of time is wasted in math classes learning how to do such chores as extracting roots to solve trigonometry problems and so on. There really isn't any need even for a great mathematician to be skilled at this kind of drudgery when a calculator will do it instantly. If mathematics is taught right, the teacher can concentrate on basic ideas, not computation, and students will come out with a much better knowledge of mathematics.

Omni: What about the shortcomings?

Gardner: One shortcoming is the risk in the lower grades that children will grow so dependent on the calculator that they don't learn how to perform basic arithmetical operations—the multiplication tables, for instance. The result is that they'll make all kinds of trivial, stupid errors. If they happen to hit a wrong button and make a big blunder, they won't even know it.

Omni: Or if they find themselves without a calculator.

Gardner: Yes, but that's becoming increasingly unlikely.

Omni: You don't have to be a pre-high schooler to become too dependent on the calculator.

Gardner: Oh, no. I had a problem in my column recently—to arrange the first nine positive integers to form a nine-digit number such that the number formed by the first two digits was divisible by two, the number formed by the first three digits was divisible by three, and so on, until the entire nine-digit number was divisible by nine. There is only one solution. I have now received about three hundred letters saying, "I read there was a unique solution. I have found two more!" Well, none of the new numbers sent to me had the first eight digits divisible by eight. For a long time, I couldn't figure out why so many readers made this obvious mistake. Then it dawned on me. They were all using calculators with eight-digit readouts. When they divided by eight, the calculator didn't show any remainder. Not one of them bothered to divide by eight on his own.

Omni: Do you have a computer?

Gardner: No. I have just a cheap, fifteen-dollar pocket calculator.

Omni: And an abacus. I see.

Gardner: Yes. Actually I prefer the Chinese abacus when I'm adding up my checks at the end of the month. It's more fun. I like the feel of the beads and the way they click. You can use the abacus in all kinds of strange ways. For example, you can turn it upside down and flick those double beads to do operations in the binary system. That's the level the Chinese call heaven.

Omni: Have you ever been tempted to purchase a computer?

Gardner: I've been tempted to buy an inexpensive, programmable computer, but I haven't got around to it. At this stage of life, I'll probably just pass it up.

Omni: Do you find that the kinds of problems dealt with in your column are different now because of the widespread use of computers?

Gardner: I haven't much changed the sort of problems I write about, but it certainly is true that in the last ten years I have heard more and more from readers who have programmed a computer to solve a problem. In many cases it will be a problem so simple that they don't need a computer, but they'll use one anyway.

Omni: What are some examples?

Gardner: Well, one problem comes to mind that I ran across recently. Can you take the nine positive digits and scramble them in such a way as to make a number that is a prime? Is there a prime that consists of just the nine digits? Now you know that the number can't end in an even integer, because then it would be divisible by two. It also can't end in five. Most people know some of these divisibility rules. But there is a tendency if you have a computer to run through all combinations of the nine digits and let the computer determine whether any numbers on the list are prime. But you can instantly know the answer if you remember the rule for testing a number for divisibility by nine. You sum all the digits and if you get another number of more than one digit, you sum those, and finally you come out with a single number, which is called the digital root of the number. The rule is that any number with a digital root of nine is divisible by nine. Now no matter how the nine digits are scrambled, they're going to add to forty-five. And four plus five

equals nine. So any number formed by the nine digits will be divisible by nine and therefore can't be a prime. If you don't know that divisibility rule, you might be tempted to write a complicated program that could take a long time to tell you that the answer to the question is no.

Omni: How important is recreational mathematics for children who are learning the basics of mathematics?

Gardner: I've always thought that one of the best ways to motivate young students is to give them recreational problems—problems with a strong element of play. They enjoy working on them and can learn some significant math in the process. I think the value of recreational math is coming to be recognized more and more by teachers and by textbook writers.

Omni: Do you find areas of recreational math that are especially appealing to students, as opposed to professionals?

Gardner: I think children like mathematical games that are competitive—games they can play with each other. Many such games can lead into significant areas of higher math. The simple game of tic-tac-toe, for example, can lead to a dozen branches of important math—into topology or game theory or combinatorial math or set theory, or number theory.

Omni: I found in school that the notion of a fourth dimension was far more interesting than algebra or plane geometry.

Gardner: Yes, lots of young students get interested in that. For example, there is a theorem that if you draw any two closed figures of any shape on a two-dimensional plane, you can always find at least one line that will exactly bisect the two figures. In three dimensions, you can take any three objects of any shape and place them anywhere in space, and you can always find a plane that will exactly bisect their volumes. It's called the ham sandwich theorem, because it's like bisecting two pieces of bread and one piece of ham with one slice of the knife, even though the three pieces are placed anywhere in space. Then you go to four dimensions. If four four-dimensional shapes are placed anywhere in four-space, you can always bisect them with a single three-space hyperplane. The theorem has been proved for all dimensions, four, five, six, and on up.

Omni: Most people, when you speak of a fourth dimension, say, "Oh, you mean time? Einstein meant time." But you're talking about a fourth *spatial* dimension.

Gardner: Yes, these are all Euclidean dimensions. You just imagine that there's another coordinate that's perpendicular to the three familiar coordinates of space.

Omni: If there were a four-dimensional creature, what would it look like to us? Could we see it?

Gardner: If it passed through our space, we would be able to see it in three-dimensional cross sections. By analogy, imagine a sphere passing through a plane. Any two-dimensional beings on the plane would see it in cross sections—first as a point, then as a small circle, then as larger and larger circles, then as smaller circles, again down to a point, and then it would disappear. In a similar way, if a hypersphere—a four-dimensional sphere—passed through this room, we would first see it as a tiny spot, and then it would expand and become a little ball. It would grow larger and larger until it reached a maximum size. Then it would contract again down to a pea-sized ball, then to a point, and then it would vanish completely.

Omni: Has anyone ever worked out a way to visualize four dimensions?

Gardner: I don't believe so. Some people have claimed they can visualize four dimensions, but I think they are just so familiar with the mathematics of four dimensions that if you give them a four-dimensional geometry problem, they can intuitively see how to go about solving it. I don't think they really visualize it in their mind, but there's no way of knowing. You can't get inside a person's mind to know what he or she is visualizing. That's truly impossible.

> *"The 'aha!' experience is a psychological mystery. You can't train people to think creatively. Whether it's a genetic trait or the product of childhood experiences, I don't know."*

Omni: Is there any serious speculation that there may really be a fourth dimension?

Gardner: Oh, yes, lots of speculation both by scientists and by people who are into spiritualism and psychic phenomena. But the idea that there are actual hyperbeings who can enter our three-space is not taken seriously by anyone I know.

Omni: You have written a book entitled *Aha!* about puzzles that can be solved only through sudden flashes of insight, where the pieces suddenly fit together. Is this kind of thinking—the "aha!" experience—something people can learn?

Gardner: I don't think it is. I think the "aha" experience is pretty much a total psychological mystery. I don't think you can train people to think creatively. It's something some people do and some don't do. Whether it's a genetic trait or a product of childhood experience, I really don't know, and I don't think anybody else does either. I'm skeptical about books that purport to train people to think creatively or courses that teach creative thinking.

Omni: How does the "aha!" experience translate into daily life? If people are good at creative solutions to puzzles, will they be creative in other areas, too?

Gardner: There may be some connections, but most studies I've seen are inconclusive. When I think about the lives of famous mathematicians, I don't see much indication that their creativity extended outside their particular field.

Omni: Will machines ever think creatively?

Gardner: I'm not sure we'll ever recognize what a machine does as being truly creative, but, of course, it all depends on what we mean by the word *creative*. Right now the game of chess, which is a form of recreational mathematics, is playing an important role in the investigation of artificial intelligence. It's not just that people in A.I. are trying to write programs that will play good chess. It's not that frivolous. It's that finding a way to play good chess on a machine is basic to a thousand other problems that involve artificial intelligence. The combinatorial possibilities of chess are so great that it's absolutely impossible in any future to construct a machine that will play a perfect strategy. The challenge is to devise a machine that will play chess by doing something similar to what grand masters do when they think about chess. It may be something peculiar to the human mind, or it may not be. I think it's likely that machines will play grand-master chess before the century ends. But I still doubt that they will make moves that we would call creative in the same sense that we would apply the word to moves made by a grand master. Airplanes don't fly like birds. Computers may win chess games against masters only because they can process information faster. Most chess programs now will beat any grand master if the time limit is a few seconds per move, playing what is called blitz chess or rapid-transit chess. The reason is that the kind of creative human thinking that goes into playing top-level chess requires a certain amount of time.

Omni: How would you like to be remembered by posterity?

Gardner: As a writer, but not for writing on parapsychology and pseudoscience. I'm tired of that. I'm really bored by it. And actually not for my Mathematical Games columns, either, though I've had great fun doing them. I would probably most like to be remembered for a book I haven't written yet. It's a philosophical book I've entitled *The Whys of a Philosophical Scrivener*, in which I'll sound off on all my philosophical views. It will be a sort of culmination of everything I've thought hard about for the last forty or fifty years. I'll be lucky if it sells five hundred copies, but from the way the writing is going, I think I'll be more pleased with it than with anything else I've done. I intend to discuss such things as truth, science, beauty, goodness, free will, economics, politics—the big questions—topics about which I have nothing new to say, but maybe some new ways of saying it.

And then, well, maybe I'll finally have a chance to get back to *The Annotated Alice* and do her up right. ∞

"Up to a dozen UFOs maneuvered overhead, rising and falling in organized formation."

ANTI MATTER

UFO UPDATE

A U S. Air Force captain employed by the Los Angeles Air Defense Sector noticed unusual jolts of light moving across his radar screen with a rhythm that seemed eerily intelligent. The bewildered military officer directed his first tentative comment to the control tower at Edwards Air Force Base in southern California. "We're getting a radar signal just east of [you]," he said. Immediately he received a reply.

"There *should* be two there," barked a deep voice, cracking with excitement. "I've been observing them for almost three hours," he added.

"I have two more north of those over the rocket site," the agitated captain in Los Angeles blurted out.

"I can see *three* more," said the observer at Edwards. "[Our radar] is painting all kinds of data."

The conversation comes from a tape made on October 7, 1965, when a group of servicemen watched a dozen unknown objects maneuver above an airstrip at Edwards. The tape, and an accompanying written report, were made in conjunction with Project Blue Book, a U.S. Air Force investigation of unidentified flying objects.

During its 20 year probe, Blue Book amassed 13,000 UFO accounts. When its inquiry ended in 1969, the findings were classified; then it became impossible for persons without special authorization to examine Blue Book documents—or to check the government's assertion that there was no evidence of any alien presence.

Then, in 1976, a team of civilian investigators gained access to the material through the Freedom of Information Act. They soon learned that nearly 10 percent of Blue Book sightings had never been scientifically explained; some of the most jarring reports had come from officers stationed at U.S. military installations. One of the most enigmatic accounts was the Edwards incident.

According to Captain John Balent, the Edwards officer who produced the written report for Blue Book, he and a few others watched up to a dozen UFOs for four and a half hours. The unknown objects looked like "ordinary stars," he wrote, but they kept "rising and falling" in organized formation; their flight paths varied constantly, and one of the bright moving objects even seemed to be pushing a small cloud in front of it.

An Air Force jet finally attempted to intercept the moving lights, but as soon as the jet swept close to one UFO, it rose out of reach and disappeared.

If one accepts Balent's report, those who saw the UFOs at Edwards were sane, reliable, and "proficient at their jobs." They could not have been confused by stray air traffic or by balloon releases, for there were none that night. There were, moreover, several eyewitnesses, and visual observations were confirmed by radar.

This was not the only UFO story to come out of Edwards. Ex-astronaut Gordon Cooper, stationed at the base in the early 1960s, remembers the day when something landed out on the dry lake bed in front of a camera crew who filmed it. The film was then sent to Washington for safekeeping, "never to be seen again."—*LEE SPEIGEL*

MERMEN AND MERMAIDS

When Waldemar Lehn saw an armless figure with a bulging head rise above the surface of Lake Winnipeg, in Canada, he knew exactly what he was looking at. It was a merman, and he took a photo to prove it.

Lehn's picture, in combination with a clever computer program, showed that ancient sailors who reported mermaids and mermen were telling the truth. The men did see something: ordinary marine creatures whose images were distorted by changes in the atmosphere.

Lehn, an electrical engineer at the University of Manitoba, developed a computer program to simulate image distortions under a variety of weather conditions. When he duplicated stormy-weather images of a walrus and a killer whale on the computer, he wound up with merman shapes. Thus, he concluded that sea mammals, seen in a storm, would fit the descriptions of half-human and half-fish creatures.

The cause of the distortion, according to Lehn, is a temperature inversion that occurs when a mass of warm air moves over cold air. This bends the light, so that objects are distorted beyond the horizon. As the inversion disintegrates, the image begins to look fuzzy.

As for the merman of Lake Winnipeg, Lehn finally learned that it was a foot-high boulder on the shore of the lake. —Douglas Colligan

ASCENT OF MAN

Jeremy Cherfas and John Gribbin, two British science writers, are monkeying around with a new theory of evolution. The monkey descended from man, they suggest, not vice versa.

Their argument is based on evidence that the DNA in both monkeys and humans was rather alike a mere 4.5 million years ago. This contradicts the fossil record, which suggests that a close kinship between man and monkey has not existed for 20 million years.

To account for the new genetic evidence, Cherfas and Gribbin hypothesized that approximately 4.5 million years ago a common ancestor of man, chimpanzee, and gorilla—a race of walking apes—split into two groups. One branch adapted itself to a rigorous life on the plains, eventually evolving into upright protohumans. The other branch preferred to hang out in the trees and eat fruit. They "de-evolved" into the simians of today.

If this sounds like sheer monkey business, it is. "We don't really believe in the descending-ape theory," Cherfas says. "We simply wanted to show how many gray areas there are in fossil evidence. We'd like paleontologists to consult the molecular clock and then reconsider their findings."

So far the writers have heard from preachers and politicians, but the fossil people have remained silent. —Phoebe Hoban

That which is incapable of proof itself is no proof of anything else.
—Percy Bysshe Shelley

VOODOO TRAFFIC

British drivers nettled by receiving many traffic-violation tickets have found a way to needle the traffic wardens. They are displaying voodoo dolls that look like constables.

In the area of Nottingham motorists have purchased hundreds of Witch Doctor kits. Each package contains dolls attired to resemble police officers. There are also five voodoo needles in each kit. Pinning their hopes on the psychological effect, drivers hang the dolls from rear-view mirrors or dangle them from the windshield.

This, the *Glasgow Herald* reports, warns the police that the motorist is "ready for action" and will seek pointed revenge. —Allan Maurer

"We are waiting
for the UFOs
We know that
they're there."
—Graham Parker

DOGU SPACE SUITS

Dogus are small clay statues with pointy heads, insect eyes, and torsos marked by intricate patterns of dots and stripes. They were made in Japan between 7000 B.C. and 520 B.C. Some people think they represent Japanese fertility gods. But, according to Vaughn Greene, author of the book *Astronauts of Ancient Japan*, these artifacts actually depict space-suit-clad visitors from another planet. The most striking evidence to date, Greene

says, is the similarity between dogu markings and the new NASA space suit—the extravehicular mobility unit (EMU)—to be worn by space shuttle astronauts outside their ship.

For instance, Greene says, the chest-pack control units on the EMU are in

roughly the same place as circular knobs on a dogu chest. These knobs probably controlled life-support systems on the dogu space suit, he asserts, just as they do on the EMU. And the stripes surrounding the dogu knobs are simply markers to calibrate the quantity of water or oxygen being dispensed to the person in the space suit. Greene theorizes that the top and bottom of the dogu space suit were put on separately, just as the EMU is.

One NASA scientist notes that an advanced civilization would probably design space suits far more sophisticated than what Greene sees on the dogu. But Greene suggests that if our space suits could get us to the moon, they could also get us to another planet.

—Madeleine Lebwohl

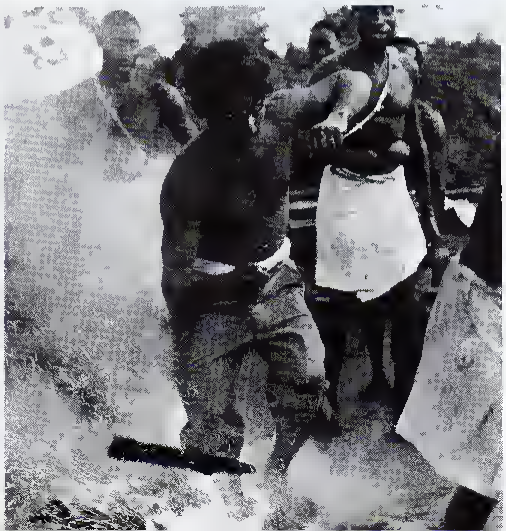
SOLE ON FIRE

When neurologist Christo Xenakis, of Athens General Hospital, studied firewalkers in Langadhas, Greece, he assumed that prolonged contact between human feet and scorching coals would cause third-degree burns. But physical examination of the firewalkers, he says, "proved that exposure of less than one second produced only small blisters on the sole of the foot." After monitoring the Langadhas firewalkers with thermometers and film, the neurologist concluded that "no deception was involved in their ritual, they used their minds," he says, "to combat the feeling of pain."

Xenakis's claims were recently bolstered by George Mills, a vacationing American scientist who tested the coals himself. "I figured that if I had the right psychological attitude, I could beat it and get off with merely a few minor burns," he says. But like Xenakis, Mills was unable to fathom the firewalkers' secret. He is now convalescing from third-degree burns on both of his feet and, adding insult to injury, the firewalkers have accused him of profaning their ceremonies.

Nevertheless, skeptics continue to offer scientific explanations for the practice, including hallucination, pain-inhibiting drugs, and the use of ash to insulate the coals. According to researcher James Randi, who investigated the ritual thoroughly, the successful firewalker uses "coals so hot they emit a blanket of dry steam to protect the feet."

—Harry Lebelson



URI GELLER, WHERE ARE YOU?

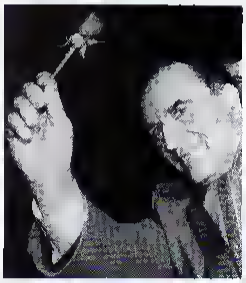
In November 1980 the Israeli psychic Uri Geller offered $100,000 to James "the Amazing" Randi or any one else who could duplicate the "miraculous" acts of telepathy Geller performed

at Stanford Research Institute during the 1970s. Randi accepted the offer on behalf of *Omni*, and we have been waiting ever since for the chance to watch him reproduce Geller's feats. Randi says that he, like Geller, can "appear" to bend a spoon or read the contents of a sealed envelope with the skills of the professional magician—not magic, just trickery. A year has passed since Randi accepted the offer, and there's still no word from Geller. We're not holding our breath.

"I feel there is a real world corresponding to our sense of perceptions. I believe that Minneapolis is a real city and not simply a city of my dreams."

—John Zeleny, former chairman of the Yale Physics Department

NOSTRADAMUS INTERPRETED



The cryptic prophecies of the astrologer-mystic Nostradamus confounded interpreters in France for five centuries. To escape the menacing eye of the Catholic Inquisition, Nostradamus, a Christian who claimed to be inspired by God, employed a baffling array of rhetorical stratagems that disguised his predictions and ensured their perpetuation. Throughout the years his verses sparked some 400 works of interpretation, none of which apparently broke the code.

Then entered the computer. Jean-Charles de Fontbrune, a pharmaceuticals manager who had picked up the hobby of Nostradamizing from his father, fed the fruits of his years of labor into a national computer network. Thus, he was able to measure the repetition of letters, words, phrases, and other key linguistic devices.

De Fontbrune realized that Nostradamus thought in Latin structures and wrote those structures directly into French. He also plumbed Latin poets, such as Vergil, for countless word-play techniques, such as anagrams and aphaeresis (dropping the initial letter or syllable from a word).

Soon de Fontbrune had solved 600 of Nostradamus's 1,100 verses. De Fontbrune published a book in 1980 on his findings, but at first nobody much noticed. Then chaos broke loose. Nostradamus de Fontbrune's book showed had predicted that the year the Rose flourished would coincide with an uprising of Moslems against the Western powers. When the Socialists (whose symbol was the rose) took power in France and when the U.S. embassy in Tehran was seized, the eyes of Paris hastily turned to de Fontbrune's pages. Readers soon realized that Nostradamus had prophesied the death of Henry II in a tournament, the rise of Napoleon Bonaparte, and the overthrow of the shah of Iran by "religious zealots."

The book has now caused a panic in Paris; people are even pulling up roots and leaving. According to de Fontbrune's interpretation, before this century ends, Islam will destroy the Roman Catholic Church. Then the Arab world will team with the USSR and invade Western Europe. Paris will swim with blood, and the world will be plunged into a terrible war.

De Fontbrune says that Nostradamus's predictions were intended only as a warning, however, and if all the nations simply shake hands, the cataclysm will not occur. —Mark Teich

'An abnormal number of all reported paranormal phenomena appear to have happened to holy idiots, fools, or crooks."

—C. P. Snow

REMEMBERING BIRTH

In our mother's womb we were kept warm and secure. No pain, no fear, just peace and quiet, and a comforting heartbeat to soothe us. Then, suddenly, we were thrust into a new environment. Noise, light, pain, terror, all came crashing down on us at once. To say the least, being born was traumatic. Why then don't we remember that event?

"The fact is," says clinical psychologist David Chamberlain, "we do." Chamberlain, of the Anxiety Treatment Center in San Diego, hypnotized children and found they remembered their birth in detail. Many recalled their mother's hairstyle and emotional state, the surgical instruments used, and even conversations among hospital attendants.

In most cases, according to Chamberlain, descriptions given by both mother and child were nearly identical. "The accuracy of recall," he says, "suggests sophisticated mental activity from the beginning of life."

Most other obstetricians and psychologists say hogwash. They attribute these "memories" to pure fantasy, explaining that infants simply do not have the intellectual ability to remember anything occurring so early. Nevertheless, Chamberlain is adamant. His research has convinced him, he says, that "memory probably can go all the way back to the womb and may even go back as far as conception." —Marc McCutcheon

TECHNOLOGY

CONTINUED FROM PAGE 72

workers whose overheated professions may induce infertility "There are many men who are infertile for unknown causes Now maybe they can be helped "

For some men, however simple infertility might even be an improvement These men, some 10 million in fhe United States alone, are impotent For years most were shunted to the psychiatrist s office to uncover emotional problems that probably didn t even exist Poor circulation the nerves and glands, and developmental disorders may all cause impotence "We can find an organic as opposed to a psychological cause for impotence in ninety-five percent of the patients we see," reports urologist William Furlow of the Mayo Clinic, in Rochester Minnesota

When a healthy man with an active sex life finds himself slipping into impotence for six months or a year, if s fime to discover whether there is a bodily cause for it according to Dr Arnold Melman, director of the Center for Male Sexual Dysfunction at New York s Beth Israel Medical Center He ll find a host of physical and psychological tests to help make the diagnosis

One ot the newest is the center s sleep clinic, where patients spend the night in order to have their nocturnal erections monitored Normal men have four to five erections a night, each lasting from five to ten minutes," Dr Melman says "If these erections do nof occur, we can usually assume the problem has a likely organic cause

Vascular problems are a probable suspect Nearly one third of all impotent men cannot sustain an erection, because too little blood reaches the penis during stimulation Here too microsurgery is helping Dr Vaclav Michal of Prague has discovered that many ot these patients suffer from obstructed arteries in the penis

To correct this problem he has devised a two-hour operation much like a coronary-artery bypass He takes a vein from the leg and aftaches it on one side to a branch of the groin s main artery and on the other to the delicate arteries in the penis The procedure can more than double the flow of blood fo the region Dr Harry Reiss, a New York urologist studying the penile blood vessels, believes that it will soon be possible to perform a similar "revascularization" with a single incision

Surgery is not the final answer however Physicians are looking for drugs to cure both intertility and impotence Amelar believes that male tertility drugs may be only a few years away Some of these drugs might not be hormones but chemicals that stimulafe hormone production ' he suggests Already a male fertilify pill called Tamoxifen, is being tested in Europe and evaluated by the Food and Drug Administration in the United States

Antiimpofence drugs are further off We are looking at the neurotransmitters in the tissue of the penis itself" Melman reports One cause of impotence is nerve damage fhat prevents nerve signals from reaching the erectile tissues during stimulation Perhaps the receptors for the chemicals that carry these signals in the penile tissue were lost or damaged through disease If we can find ways to improve receptor function fhere s a real possibility that we may discover drugs that produce an erection

At London s Hammersmith Hospital Dr Julia Polak and her colleagues have already made what could prove to be the crucial breakthrough Most nerve impulses are carried from cell to cell by either of two chemicals, acetylcholine or adrenaline Physicians have always assumed that one or the other controlled erection But there is a third kind of drug, discovered only ten years ago at Sweden s famed Karolinska Institute, the home of the Nobel Prize These drugs transmit their messages using a protein called vasoactive intestinal polypeptide (VIP) in the digestive system VIP relaxes smooth muscles and opens up arteries and veins, allowing blood in

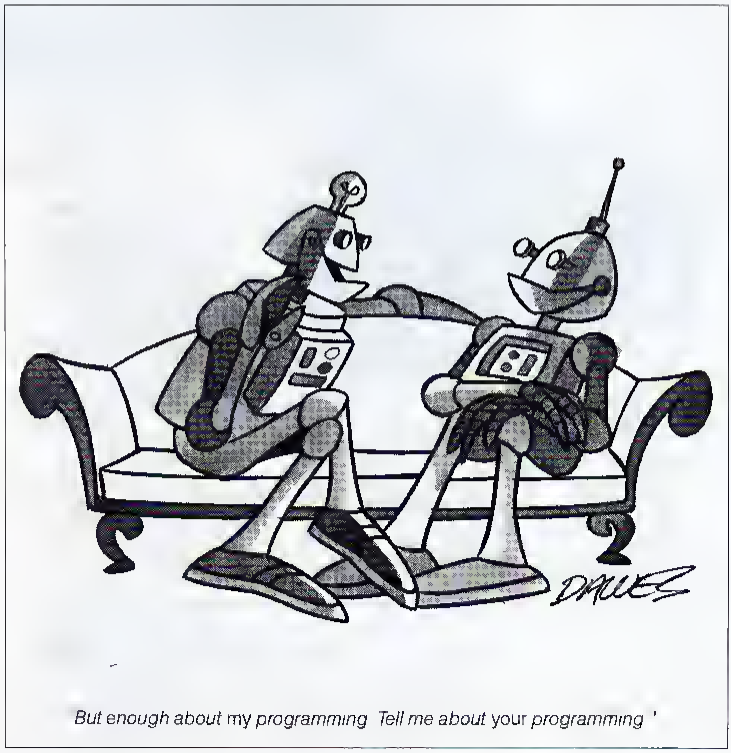
What the Hammersmith physicians did was look for VIP-sensitive nerves in 30 sets of male genitalia removed during sex-change operations The nerves are present and they are strongly concentrated in the erectile tissue Someday soon Dr Polak believes, a drug that mimics VIP will produce an erection even when the body won t cooperate And a VIP inhibitor might spell relief for the rare sufferers of priapism a permanent and painful erection

But drugs to confrol the workings ot the male reproductive system have long proved elusive Researchers have sought practical male birth-control drugs for nearly 20 years with frustratingly little success Even mechanical devices to give men reversible birth control are only now being tested

One of the most promising is a valve developed by Dr Charles Lynne a urologist at the University of Miami in Florida Implanted into the vas deferens through a small incision in the scrotum the valve is a half-inch piece of gold and stainless steel It s like putting a valve in a garden hose," Dr Lynne notes "If the patient wants his fertility restored the valve can be opened with an electromagnet allowing sperm to pass

At the University of Illinois Medical Center, in Chicago biophysicist Lourens Zanaveld is working on a removable silicone plug that could also block the flow of sperm "The plug is much easier to reverse than a vasectomy because we don t have to sever the vas" he says Tested only in monkeys, fhe plug has proved very effective but is hardly ready for human use

These new medical techniques will help millions of men who once were forced to accept sterility and impotence For the patient it means a normal life For sexual medicine it means a revolution



But enough about my programming Tell me about your programming '

HYDROGEN MAN

CONTINUED FROM PAGE 53

Everything in it, from the hot-water heater and the barbecue to the garden tractor and the family car, ran on hydrogen. A computer system that the Billings Computer Corporation manufactures monitored the hydrogen production and storage as well as the inside controls for heating and cooling and even the security of the place. Besides the 19 homes he is converting in the community, Billings is building a new hydrogen home for himself, this is not something he recommends to the individual homeowner. Hydrogen is not a fuel you convert a home to," he says. "It's a system you convert a *community* to."

Project Liberty is a small step in that direction. His next project is a wholly hydrogen-powered town in Iowa. A few years ago the town leaders of Forest City, Iowa, heard of Billings's work. They wanted some kind of inexpensive energy alternative. They couldn't produce their own electricity because the town's generating plant needed expensive, hard-to-get diesel fuel. Their only alternative was to buy the electricity they needed, at high rates, from another utility system. They told Billings about their situation. He went in and looked the place over and decided to build his first Project Liberty coal-gasification plant in their town.

Iowa coal is so cheap that Billings estimates it would be the equivalent of producing gas at 50 cents a gallon. The hydrogen-fueled plant is expected to provide all the industrial and domestic electrical needs of Forest City's 4,000 residents and still have power to spare to heat every home there and to fuel every car. Billings is confident that his plant is going to be up and operating by 1984.

Further in the future he has grander hydrogen dreams: a mammoth hydrogen/electrical complex, where he will gasify coal and pipe it to facilities 2,000 miles away, and another large plant he wants to construct in southern California.

There he envisions a hydrogen-powered Los Angeles: a city that has no energy shortages, no gasoline lines, and, ultimately, no smog. ∞

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ELEPHANT SONG

CONTINUED FROM PAGE 48

companionway. "Damn it, Pony, if they won't open from the inside, they sure as hell can't be opened from the outside. Not in time. Just get Tube Number One facing the doors. I'll get through."

"Why Number One?"

"Ming is in Number One."

Bullhook walked between the two men and felt his way down the corridor until he reached the port to the main bay. He pulled himself through and began working his way down the access ladder. Half the way down, nausea and dizziness washed over him as the pain in his head flashed lights before his eyes. He hung on to the ladder, resting his cheek against one of its cleated rungs. The smoke covered him like a hot blanket, the screams from the animals numbed his ears.

Crying. Just barely audible, there was crying among the screams. Lights went on in the access tube, turning the blackness into a dark gray pall. Bullhook Willy lowered himself another rung, then another, until he stood in the lower-deck-access compartment to the main carrousel. The air was a bit better. He could see the hazy outline of an open maintenance port. Through the man-sized doorway he could see green grass. He turned from the ladder and lurched toward the closed doors that opened into the tubes as the rumble of the main carrousel vibrated the shuttle.

Before the doors three figures knelt over a fourth.

Bullhook forced his eyes to resolve the images before him. Packy Dern was holding him. Waco Whacko and Dot the Pot were kneeling over the still body of Haystack Harry. "What happened, Packy?"

The bullhand nodded toward Haystack. "Waco and I managed to pull him out of the Number Four tube. Too late. There's some others still in there."

"What about the rest of the bullhands?"

Packy shook his head. "I don't know. They must be out of the shuttle by now."

Bullhook closed his eyes. "Waco. Get Dot out of here. Go through that open maintenance port."

The snake charmer looked over his shoulder at the boss elephant man. "What about you?"

Bullhook moved over and pulled Dot the Pot to her feet. "Haystack's been exed, Dot. You have to get out of here."

Dot wiped the tears from her cheeks. "I can't just leave him."

"Packy and I'll take care of him. You go with Waco now."

The snake charmer studied Bullhook with dark, narrowed eyes. "There aren't any heroes in the circus, Bullhook. Just dead troupers and live ones."

"Get going, Waco." He placed a hand on the snake charmer's shoulder. "I'll be all right."

Waco spat on the deck and turned Dot toward the maintenance port. As the pair moved toward the opening, Bullhook pointed at the body. "Packy, grab Haystack and get out of here."

Packy Dern shook his head. "I heard the big cage turning. Bullhook. If you open those doors, it'll take about two seconds for this compartment to fill up with damned mad pachyderms."

The boss elephant man motioned with his bullhook toward the body. "Get Haystack and beat it. I have to get to the other end and open the main hatch."

"There's a crew working on it now."

"Packy, there's no time to work through from the outside. Now get moving."

"You can't make it!"

"Ming and I can. So beat it."

Packy lifted the dead bullhand's shoulders. "Maybe I can help."

Bullhook stared at the closed doors leading to the main carrousel. "Beat it. And get that crew away from the doors."

Packy pulled Haystack's body away and just before he reached the maintenance port, Bullhook called out. "Hey, Packy!"

"What?"

"Little Will. Take care of her. You know."

"Yeah, I know." The bullhand lowered Haystack's body through the port, then dropped himself through to the outside.

Bullhook weaved before the closed doors, looking at the red square that needed to be pressed to open them. "Just hope to hell Ming is the first one out."

He reached out his left hand, slapped the red square, and stumbled to the right of the doors as they hissed open. The sound of the screaming bulls deafened him. A panic-driven elephant thundered through the open doorway, her shredded left ear dripping blood. It took only a split second for Bullhook to recognize Cambo. As Cambo rumbled around the compartment looking for a pachyderm-sized exit, she was immediately followed by Queenie, whose trunk was almost severed.

Bullhook looked around the edge of the door and screamed. "Ming! Here, Ming! God damn it, Ming, where are you?"

Down the length of the tube, three bulls were in the aisle on their sides, either dead or dying. The five remaining bulls were stampeding in the confined area.

"Ming! Damn it, Ming!" Bullhook sagged against the open door. One of the five bulls paused, turned toward the forward end, then began walking toward the compartment. "Ming. That's it, baby. Right here."

Bullhook felt a thunderous whack across his shoulders, his face smashed against the bulkhead. He stopped himself from dropping to the deck, grabbed the rungs of an access ladder and began pulling himself out of danger. Queenie rushed at him again and tried to pull him down, but she could not raise her injured trunk. Just as he managed to pull himself above her, Queenie rammed the ladder.

Ming entered the compartment and trumpeted. Bullhook called from his perch upon the ladder. "Ming! Over here, girl! Get Queenie away from the ladder! C'mon, Ming, you beautiful thing!"

Ming looked up at him. The sound she made was a blast of relief and joy.

"That's right, Ming. I'm here. Come on over and save old Bullhook's ass."

Ming lowered her head, tucked her trunk down, and charged at Queenie's side. The impact shook the entire compartment, almost causing Bullhook to lose his grip. Frightened by the attack, Queenie moved away from the ladder.

"Over here, Ming!" He smacked his bullhook against the bulkhead, and Ming moved toward the ladder. The pachyderm presented her port side to the boss elephant man when she saw him whirl his bullhook in a circle. When she was close enough, Bullhook Willy leaped from the ladder and landed on Ming's back. Painfully he pulled himself forward until he sat straddling the great beast's neck, the toes of his boots behind her ears.

"All right, babe! Let's get us the hell out of here!" He tapped Ming's right shoulder with his bullhook. "Shy, babe! Shy!"

The elephant turned to the right, and when she was facing the doors, Bullhook lowered himself until his right cheek was against Ming's head. The stink of burned flesh filled his nostrils. "Let's go, babe!"

Ming went through the doors and entered the Number One tube of the main carrousel, first at a fast walk, then at a trot. With screamed commands and taps with his bullhook, the boss elephant man steered Ming around the three dead elephants. With butts of her head, swats with her trunk, and goads with her tusks, Ming bulldozed the frightened elephants out of her path. One of the bulls fought back, and Bullhook felt a tusk enter the calf of his left leg. "Go, damn it! Go, Ming!"

At the other end of the tube, the smoke was still thick. "Tut, babe. Park that thing until I can find the doorknob."

Ming stopped, and the boss elephant man tried to clear his vision. "Great Boolabong, show me the doorknob. Show me." He shook his head, but the motion did more to increase the pain in his head than it did to clarify his vision. "Hell!" He leaned to

> *"The sound of the screaming bulls deafened him. A panic-driven elephant thundered through the open doorway, her shredded left ear dripping blood."*

his right reached down, and tapped the front of the elephant's shoulder.

"Give old Bullhook a kneel, babe. Let's go. Down, Ming."

As the elephant slowly knelt, Bullhook slid from her neck until his feet touched the hot deck plates. His left leg collapsed, and he crawled on his hands and knees until he came to the aft-tube doors. Pulling himself up, he felt for the door panel. Once he found it, he pounded it with his fist, causing the doors to hiss open. On the other side of the door, the two bulls that had broken loose from the Number Four tube were screaming and stampeding up and down the runs that led from the three carrousel doors to the main hatch. The bulkhead panels above the port carrousel door radiated orange heat. The remains of two human bodies smeared against the cleated surface of the runs explained why Pony Red Miira hadn't been able to raise the aft watch.

Bullhook pushed away from the bulkhead, collapsing on the deck. He looked at the bull. Ming stood patiently awaiting further instructions. The boss elephant man thought he blacked out for a second, then was brought wide awake by the blinding pains coursing through his leg, back, and head. The pains eased for a moment, and Bullhook called out. "Ming. I can't make it. Get that durante out and log me out of here!" He smacked his bullhook against the deck. "Ming, let's go!"

Ming stood still for a moment, then she lowered her head, lifted her trunk, and gently shoved her tusks beneath Bullhook's body. The boss elephant man held out his gold-tipped bullhook so that it would not be out of the elephant's sight. "Remember me, Ming. You gore me and it's liable to ruin my whole day."

The elephant's trunk wrapped gently around Bullhook's waist as her head came up. "Okay, babe. Let's lead this parade out of here. Go, babe, go!"

Ming moved out toward the main hatch. The two bulls rampaging in the runs moved toward her. Ming crossed the runs and stopped before the huge hatch door. The heavy metal door was warped from the impact against the bottom of the shuttle. Nothing short of blowing the whole thing off its bolts would open it. "Shy, babe! Shy! Get me over! Shy!"

The elephant moved Bullhook to the right, and the boss elephant man reached out and flipped open the cover on the emergency switch. He pulled down the bright red handle inside and then blacked out as two hundred exploding bolts went off at the same moment a bull smashed into Ming's side. When Bullhook opened his eyes, his body was being shaken unmercifully as Ming stampeded through the open air and tall grass of the strange planet. Voices called after them, but Ming wasn't listening.

"Ming! Ming!" The elephant slowed to a trot, then to a walk. "Tut, babe! Put me down, honey. Tut!"

The huge beast shuddered and then lowered her head, depositing the boss elephant man on the grass. Her head lifted, and she stood, snorting and shaking her head. "Good girl. Good girl."

The voices again. Louder. Feet running through the grass. Bullhook opened his eyes and looked at the clear, blue sky. "Parade weather. Damn, but it's a beautiful day." Packy Dern's face came into view as the bullhand knelt and quickly examined the boss elephant man. Bullhook sensed something being placed beneath his head and felt pressure being applied to his left leg. Other hands, other faces. Waco Dot, the Pot, Madman, Pony Red, Moli.

Packy's face looked at him and smiled. "Whatcha been up to, Bullhook?"

"A little this, a little that."

Bullhook felt a needle being poked into his arm. Packy nodded. "Well, it sure looks like it was fun."

"You know what they say. Packy. Life with the circus is just one long dee-light."

"The boss elephant man thought he had blacked out for a few seconds, then he was brought wide awake by the blinding pains that coursed through his legs, back, and head."

The blue sky grew black. Packy's face faded, and the sharp jags and angles of pain smoothed into a calm night sea of slow motions and soft sounds.

There was more touching against his body, dim voices, a bullhand singing "Elephant Kindergarten" to her pachyderm. That's Kim's voice. That's right, honey. The car crashed. I don't know where in the hell we are. No one will ever find us. Don't know where our next meal is coming from, but calm down. Some things are still the same. I'm still here, and mule up still means trot.

And life? It's the same as it's always been. Life with the circus is just one long, uninterrupted dee-light.

Yowzuh! Yowzuh!

Step right up and feast your little bug eyes on the wondrous monsters from the planet Earth! Peruse the ponderous pachyderms—

That's what I said, sir or madame, or thing, as the case may be. Pachyderms—

'Cause that's what they're called, sonny.

One quarter credit, a mere twenty-five percent of a one note, will admit you to feast your eyes, bulbs, sensors, or whatever the hell it is you use—

Beat it, boy, you bother me.
Now, folks, slither right up.

On the evening of that first day across the huge lake, into the thin edge of the swamp just visible beyond it, the sun was setting. Packy Dern sat on the dew-weighted grass with his arms wrapped around his knees. The few clouds in the sky were black-red, edged with gold, placed against a sky as scarlet as blood. And, lordy, there had been plenty of blood.

He closed his eyes and held his head down for a moment. "Hell, yes." He lifted his head and looked at the near shore of the lake. The V-shaped trough cut by the menagerie shuttle's belly began there. It ended in the trees far to his left. To the right of the trough were rock-capped hills. To the left was a ravine cut by the exiting waters of the lake as they flowed downhill toward the south. Considering the alternatives, Fireball had made a great landing.

A practical landing, too.

Bullhook Willy and the thirty-two other troupers who had died had been laid out in the short stretch of trough a hundred yards from the shore. There weren't any dozers or shovels with which to dig graves. And after the bodies were arranged at the bottom of the trough, all those who weren't injured gathered on the two sides. The boss animal man had stared at the bodies for an instant and then began kicking clods of dirt and grass into the cut. The two hundred twenty-six troupers standing with him then became animated. With feet, hands, sticks, and tears they covered the dead.

Packy shook the image from his mind. Without looking at it, he picked up the mahogany-handled, gold-tipped bullhook that was on the grass next to his own steel-and-rubber affair. With the warmth of the fine wood against his rough hands, he remembered. Poison Jim Bolger used to carry that hook before his trunk was put on the lot. Poison Jim was a lush, and nobody wants a bullhand with a nose like a fire alarm in control of tons of pachyderms.

So he was fired. Then, fifteen years later, the gold-tipped bullhook returned. It was in the hands of a skinny, eighteen-year-old Johnny-come-lately named Willy Kole. The kid never let that bullhook out of his sight. That's why they called him Bullhook Willy. And only ten years later, Pony Red made Bullhook boss elephant man, even though there were other hands older and carrying more years with the bulls. No one ever questioned the boss animal man's decision, because the bullhands knew Bullhook Willy and Bullhook Willy knew which end of a bull the tail was on.

"Hell!" Packy picked up his own bullhook, pushed himself to his feet, and brushed the seat of his trousers. He turned and moved up the gentle incline, halting at the crude fence that the bullhands had constructed out of rocks and the trunks of trees uprooted by the landing of the Number Three car. The fence formed one side of a rough triangle. The second was formed

by a sheer wall of stone that seemed to extend forever upward. The third side was formed by a cliff.

"You don't have to worry about a bull walking off a cliff, boy. Bull's got more sense'n a man. Don't you, I say, don't you know nothin'?"

And Bullhook would laugh.

Packy reached the fence and climbed up the rocks and logs until he could look over the top. Ghostly beams of white light in the shadows below the reflected red of the rock wall testified that the show's vet, Mange Ranger, was still working on sewing together Queenie's trunk. Several hands were helping the vet work on the anesthetized pachyderm while two bullhands stood between the operation and the remaining bulls. Just in case.

Packy's bull, Robber, was contentedly yanking up and munching the grass of the compound. Thank the Booiabong for small favors. The grass was edible. Most of the hay and grain feed had been tossed out to lighten ship long before the *Baraboo* had burned.

Out of seventy-five bulls, thirty-four survived. Most of the others had died in the parent ship's bad air, and their carcasses were tossed out to lighten ship. Nine had died when Number Three went down. Tomorrow would begin the job of hauling the dead bulls and the eighty dead horses from the port carrousel out of the shuttle to join the others in the big ditch. The one hundred twenty-two surviving horses. Percherons and performing were strung out at the edge of the trees below the kraal. One hundred twenty-two horses remaining out of three hundred fifty. None of the thousand or so other animals—big cats, camels, giraffes, apes, birds, snakes—none of them had made it down.

The human survivors were setting up housekeeping in grass shacks and caves. Packy felt a chill, climbed down from the fence, and looked toward the rough long house that had been put up as a makeshift infirmary to shelter the injured. Somewhere in there, fighting for her life, was Little Will, Bullhook's twelve-year-old daughter. Footsteps came from the direction of the still-smoldering shuttle. It was Pony Red Miira, the boss animal man.

"Packy?"

"Yeah?"

"You're boss elephant man."

"I don't want the job, Pony."

"Who asked you?" Pony Red climbed the fence, went over the top, down the other side, and continued toward the white lights. Mange Ranger was still working on Queenie.

Packy glanced at the final red of the sun against the sky, then looked down at the gold-tipped bullhook in his hands.

And he walked toward the infirmary.

Little Will held herself motionless in the dark. She knew that all she had to do was open her eyes and the blackness would go away. But then would come the hurt.

She smelled woodsmoke, heard a fire's quiet crackle, then noticed that someone was holding her left hand. The hand holding hers was large, warm, and gentle. She cautiously rose from the blackness, just a little, ready to recoil if the pain returned. Her head ached, but that searing, shattering bolt of agony that had always waited for her to open her eyes appeared to be gone. She let more of that cotton of blackness drop from her and opened her eyes to tiny slits.

Above her were poles and thatch. They seemed to move in the flickering yellow light. She turned her head slightly to the left. A shadow hovered over her—a shadow and half of a face. The face was familiar. Wispy gray hair, long face. She opened her eyes the rest of the way and tried to call out to the man with her thoughts.

The man's eyes were closed, his face relaxed. Little Will tried to project her thought into the man's mind as Nhissia had trained her to do. She frowned as the thought refused to form. She tried harder and then gasped when the pain returned.

"When he opened his eyes, his body was being shaken unmercifully as Ming stampeded through the open air and tall grass of the strange new planet."

She gripped the man's hand as she covered herself with the blackness.

In her dream she looked for another face, another man. The one who had deserted her. Long before she could speak.

In the brightly lit hotel room, she sat on the big man's knee, his arms around her, resting on the edge of the table, his large hands holding four cards. She looked into his sad face, then turned to see the man on the other side of the table. He was dark and was also holding four cards. His face was also sad. "Your draw, Bullhook."

The large man reached forward, picked up a card from a stack of cards, looked at it, then tossed it upon the table.

The dark man frowned as he drew a card. The dark man put the new card into his hand and hesitated.

"Throw anything you want, Waco. Anything at all."

The dark man raised his eyebrows without looking away from his cards. "You sound awfully smug for a man with bull plop for brains."

"Sticks and stones, Waco. C'mon."

The dark man touched first one card, then a second, then pulled out and discarded a third. "Chew on that, Bullhook."

The big man put down his cards next to the dark one's discard. "Ain't they pretty? How many did I catch you with?"

The dark one tossed his cards on the table. "I'm over. That's game."

The big man wrapped his arms around her and jiggled her on his knee. "How about that, Little Will? Your old man just whipped the drawers off of that horse merchant over there."

She giggled.

The dark one gathered up the cards. "Another game?"

The big man shook his head. "I can't. I have to go soon."

"Do you think you'll have much trouble rounding up the bulls?"

The big man shrugged. "Can't tell yet. Eco-Watch doesn't want to let anything off Earth—officially."

The dark one leaned back in his chair. "Unofficially?"

"Money talks. I'm supposed to come up with around two hundred bulls. I'll probably be away for two, three months." He mussed up her hair. "I sure hate to go right after you and me found each other." He kissed her cheek, then looked back at the dark one. "Waco, how come she doesn't talk? I thought kids this age could say at least a few words."

"It takes some kids longer than others."

The big man shook his head. "I wonder if it's that genetic thing. From the war. There was a problem."

"Bullhook, it takes some kids longer than others." The dark one nodded his head toward the hotel room's outside glass wall. "What were you doing out in the cold cruel for the past two years?"

"Wandered around. I saw a couple of planets. Mendik and Ourylim. Handled some animals there." He pushed a lock of black hair from the little girl's eyes. "Did you ever find what you were looking for, Bullhook?"

The big man studied her and then hugged her again. "I think so." He looked back at the dark one. "How come you came back to the show, Waco? Ssendiss sounded like snake heaven."

The dark one laughed, then sipped at a cup of herb tea. "I was a flop as a teacher, Bullhook. My course on Earth snakes bored my students stiff. The trouble with telepaths is that they have some rather startling ways to let you know that they're bored. I can tell you that the novelty of juvenile telepathic pranksters wears off quickly."

The big man bounced her on his knee. "How did you get your act together?"

"The ones I have with me are adults. They know better than to mess with someone's mind. In between classes I guess I prattled to them about the circus. When Mr. John put out the call for the star show, I decided to see what I could put together. What I have with me, Bullhook, is almost the entire faculty of the Surissa, the school where I was teaching."

When do I get to meet them?'

The dark one shrugged. 'They should be up soon. Ssendissians sleep about fifty percent of the time. Are you sure you can't stick around a little longer?'

The big man shook his head. 'Me and my crew have to be at Eastern Regional in half an hour to catch the Burma shuttle.' He lifted her and placed her on the floor. The door to the hotel room opened, and she saw her mother standing in the doorway.

Kristina looked at the big man. 'I see you two found each other. How've you been, Willy?'

Bullhook stood up. 'Fine. You're looking good, Kris.'

'No thanks to you.'

The big man looked down. 'I guess I had that coming.'

Kristina snorted out a laugh. 'That and a lot more, you bastard. Two-and-a-half years without a damned word.'

The big man turned to the dark one. 'I got to be going, Waco.' He looked at Kristina, then averted his glance and walked around her, leaving the room.

The dark one drummed his fingertips on the tabletop but remained silent. Kristina looked at him. 'Waco, can you look after Wilhelmina for another hour or so? I have a few things to iron out about the delivery of my new cat.'

The dark one shrugged. 'No problem.'

Kristina looked at the dark one for a moment. 'Do you think I'm too rough on Willy?'

'It's none of my business.'

Kristina nodded. 'You're damned right.' She turned and left, closing the door behind her.

Little Will sat on the room's carpet, and she watched as the dark one got up to brew another cup of tea. Through the open bedroom door came a long, gray serpent. It halted in the doorway and studied her. She crawled toward the serpent. When she was within arm's length, she reached out a hand and touched its warm skin. She looked up at the triangular head, weaving on that slender gray body.

'You are pretty.'

The head of the serpent weaved down until it was at the same level as Little Will's head. The serpent's eyes were violet; the pupils catlike. *'To me do you speak?'*

She stroked the serpent again. *'You are pretty. So very pretty.'*

The serpent reared up, examined the little girl, then again brought down its head. *'Thank you. I think you are pretty, too.'*

She giggled and hid her face in her hands. *'Oh, I'm not pretty. Kristina says I am a horror.'*

The serpent looked at the dark one. The dark one was absorbed in brewing his tea. The serpent looked back at the little girl. *'Who is Kristina?'*

'She's my mommy.'

The serpent's head rocked up and down. *'She is your mother.'* The serpent hissed. *'Who is your father?'*

She held her hands on her cheeks. *'I think it is the man who just left. He looks very sad to me.'*

'I am not surprised.'

Little Will frowned. *'I do not understand.'*

The serpent reared up again. *'I meant nothing.'* The serpent's head turned toward the dark one. The dark one turned toward the serpent, then picked up his fresh cup of tea. He nodded at the serpent, then left the room. The serpent turned back to face the little girl. *'What is your name?'*

'Mommy calls me Wilhelmina. Everyone else calls me Little Will.'

The serpent's head bobbed up and down. *'I am called Hassih. Little Will. Would you like to be friends?'*

Little Will clapped her hands. *'Oh, yes! Oh, yes!'*

The serpent's head bobbed again. *'Then we shall be friends, Little Will. Watch as I tie myself into a knot.'*

Little Will clapped her hands and opened her mouth to a silent laugh.

And the dream faded as the smell of smoke returned.

> *Through the door came a long, gray serpent. It halted in the doorway to study her. She crawled toward it, reaching out to touch its warm skin.*

Little Will did not see; she did not hear. But she felt the man's presence next to her. And there was another. They talked.

'I got the gang working on beefing up the kraal. All the dead stock is out of Number Three. God, what a mess.' Silence. 'Pony, some of the troupers're talking like we ought to cut up and preserve the meat.'

A longer silence. 'Put 'em in the trench, Packy. We've found enough edible stuff to get by. We're not eating our damned animals!' Silence. 'Hell, Packy, we've been covered in crap before, but this....'

'I don't have no answers, Pony. Except we do like always. Don't think about it—'

'And just move on to the next stand, Packy? Just where is that next stand? And when in blood-eyed damnation is the city going to kick us off *this* lot?'

Little Will opened her eyes to narrow slits. It was night again. Packy Dern was still sitting on the platform to her left. Pony Red Miira's huge form stood between the two platforms. He was rubbing his eyes. He lowered his hand and jabbed Packy's shoulder. 'Look, you. Keep your trap shut about this. I just need a little sleep. Haven't slept since....'

'This ain't my first May Pony.'

The boss animal man looked to his right, then to his left. In the light from a fire, Little Will could see that Pony's eyes were dark-circled, his leather-brown face deeply lined. 'There's an empty spot.' He turned his head back toward Packy. 'They get hold of Number Two yet?'

The boss animal man slowly shook his head. 'They finally got a fix on Number Seven. Kuumic says that he's in the middle of some damned desert.' He rubbed the back of his neck. 'I'm for some sleep.'

'Pony?'

'What?'

'What's the name of this planet? Just in case someone should ask.'

The boss animal man stared off into the darkness for a long time. 'Funny. Back on the *Baraboo* when the route-book man was running that damned tool name-the-planet contest, I had more important things on my mind. Never did find out what name won. A name seems a lot more important now.' He looked down at the boss elephant man. 'What did you pick?'

'Nowhere.'

'That stinks.'

'What did you pick?'

'Philadelphia.' Pony Red shrugged and let his hands fall to his sides. 'I thought it was funny.'

'Go get some sleep.'

As the boss animal man turned and stumbled off into the darkness, Packy looked down at Little Will. His long, sorrowful face frowned for an instant, then smiled. 'I'll be—' He turned away and whispered loudly. 'Mange! Mange! Come here.'

Another shadow rushed up and stopped. 'Packy, will you pipe down?'

I whispered.

Like a foghorn! The shadow nodded toward Little Will. 'What is it?'

'She's awake. Her eyes are open.'

Mange moved to the right, bent over, and placed a warm hand against Little Will's face. The hand quickly moved down her left arm and held her wrist. 'Little Will?'

She opened her mouth and tried to speak. Pain, white, stunning pain. She felt herself falling end over end into a universe where pain was not allowed.

It was a beautiful universe. All of it lights, laughter and glitter. It was a straw house on a hard lot and a warm evening. It was the windjammers playing 'The Governor's Waltz' while seventy-five bulls turned hind-ended, and kootched in unison. It was thousands of cheering voices, and they all cheered for her. Covered in spangles, she sat astride Ming's neck in the spectacular. Her father would steal an instant and look up at her.

She would always sneak a peek during the Lion Lady's performance. Center ring, the spots all turned toward her mother and the cats, the crowd hushed, applauding, gasping, cheering. No matter where they played, however alien the planet or its people, this universe stayed the same. It was like the dog that buried a bone be-

neath the treasury wagon and then at the next stand on another planet went beneath the treasury wagon to dig it up again Once she saw her father sneaking a peek at the Lion Lady's act and from then on they watched together

On the *City of Baraboo*, between planets the universe was huge gray pets Goofy Joe gossiping Mooch Movill telling funny stories clowns canvasmen tackspitters bullhands hostlers and a white-bearded giant that everyone called Mr John

But the universe had some special moments Little Will watched porter Pickle Nose Porse set up the table champagne, and glasses in the exercise run next to the main carrousel in shuttle Number Three Bullhook Willy was sitting on a haybale with his arm around Kristina and both of them were talking to Pony Red She walked through the crowd of handlers medics and animal-act performers until she stood next to Bullhook *Daddy, is it all right if I go see the bulls?*

Bullhook looked down at her "Just for a little while You don't want to miss the line-crossing ceremony

I won't She stood on her toes and kissed him then turned and kissed Kristina *'I'll be right back, Mommy'*

The Lion Lady kissed Little Will All right but don't get your clothes dirty I want you pretty for the ceremony"

"Yes, Mommy" She turned and ran through the crowd She waved as she saw Waco and his twenty Ssendissians When she reached the port to the main carrousel she stepped in and walked to the center of the great rotatable tube Within the large tube were more tubes each one independently rotatable and each one containing ten or more elephants She climbed the ladder and catwalk and entered one of the tubes Inside the smells of elephant and hay were strong In their separate stalls the bulls contentedly munched their rations Seated on a bucket in front of Robber's stall was Packy Dern *Hi, Packy!*

The bullhand jumped, turned round, then shook his head 'You shouldn't ought to sneak up on a man that way Little Will Give a fellow time to get used to you yelling at his eardrums from the inside

Little Will held her hands behind her *"I'm sorry*

Packy waved a hand It's all right He resumed his seat on the bucket Are you gonna try and talk to Reg again?

She nodded *Someday I bet I can talk to the bulls I get a feeling from Reg She's really trying to say something'*

Packy shrugged and looked up at Robber 'I been talking to Robber a lot of years now I think she understands"

'How come you aren't with everybody else?

He looked at the little girl Big moment coming up Little Will We're going to be the very first starshow to cross the quadrant line Important occasion 'He nodded then looked back at Robber 'At a time like this I can't think of anyone I'd rather be with

'I'm going to see Reg.

Packy nodded Good luck

Little Will walked around the bucket and headed toward the back of the tube When she got to Reg's stall she looked up at the great pachyderm *'Reg? Do you hear me?'*

The bull turned her head then reached out her trunk and caressed Little Will The trunk moved back to its hay

'Please, Reg! Say something to me'

The bull continued eating

Little Will moved in next to the bull reached up and stroked the animal's cheek *'Nhissia says that touching helps mind-talk with people Can you hear me now, Reg?"*

The bull stopped eating She stood motionless, then Little Will closed her eyes and felt a flood of warmth an ocean of love It covered her *'Oh Reg! You talked to me! I love you, Reg And you love me'* Little Will felt a tremble beneath her feet She opened her eyes and looked at Packy

"The universe is all laughter, bright colors, and cotton candy. And it's mud, broken bones, fights with rubes, frustration, hard work, poisoned animals, and crooked governments."

The bullhand was standing looking toward the entrance to the tube

The deck pulled out from beneath Little Will's feet and she saw Packy being knocked to his knees just before her head struck the deck *'Daddy! Daddy! Mommy! Oh, it hurts!* She looked up her vision blurred with tears and saw Reg's enormous foot swinging toward her

And the universe is all laughter bright colors and cotton candy And it's mud broken bones, fights with rubes pain, endless hard work frustration poisoned animals crooked governments It's wind-blown ice shredding the main top on a dark night, it's maimed crippled and dead friends it's the Lion Lady putting a gun to her head an instant after killing her cats it's Bullhook Willy broken and bleeding on the grass of an unknown planet It's a little girl hurt alone and afraid

The universe is what it's always been one long uninterrupted dee-light

'Little Will? Little Will? It's me, Packy'

She opened her eyes The light said that it was morning There were no feelings If you don't feel you don't hurt The little girl's stare remained fixed for a moment upon the thatched roof above She turned her head and saw Packy Dern sitting on the platform next to her own Little Will closed her eyes

'Little Will now that Bullhook's gone, I'm going to take care of you' Packy's voice broke 'Bullhook—he asked me to take care of you Is that all right?'

A stone does not love a stone does not suffer loss a stone does not hurt

Packy took her hand in both of his "We'll be okay together Little Will You'll see" He reached to his side and placed something in Little Will's hand She opened her eyes as she lifted the object It was her father's golden-tipped bullhook

No one loves a stone no one cares whether a stone suffers

Little Will clutched the bullhook to her breast and cried

Packy put his arms beneath her knees and shoulders lifted her and held her

It seems that the winner of the name-the-planet contest was the late John J. O'Hara Before he died in the bad air of the *Baraboo*, the Governor had picked the name Momus after the ancient Earth god of ridicule And they called the planet Momus

In the days that passed other things took on names Car Number Three the menagerie shuttle looked out upon the body of water they called Table Lake The waters came from the surrounding mountains, which formed a huge basin they called the Great Muck Swamp At the edge of the swamp was the lake At the southeast edge of the lake its waters drained over rocky falls forming the headwaters of what they called the Fake Foot River

The metal panels from the shuttle that formed the blades of the waterwheel were strangely shaped roughly resembling the oversized fake feet some of the Joeys once wore The waterwheel drove the stripped armature taken from the shuttle upon which speed-gear-mounted were the abrasive core blades that had been taken from the port-engine boring assembly The blades could cut the almost indestructible metal that formed the shuttle's skin To build a road there must be tools To have tools, there must be metal To have metal Number Three was devoured

The road would stretch from the three cars north of Number Three through the mountains south past Table Lake to the four cars next to the sea The northernmost car was run by cross-eyed Mike Ikona the boss reporter The southernmost car was run by the boss canvasman Duckfoot Tarzak Before it was constructed it was called the Ikona–Tarzak Road

They were making shovel blades dredges parts for the scoop assembly the bulls would pull as they carved their way through the gap in the mountains to the north A rivulet from the north edge of Table Lake fell and twisted its way through the gorge at the bottom of the gap The sheer walls of the gorge meant putting in a climb-

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Memory (RAM) Expandable to	32K	Not Available	Not Available	32K
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Programmable Function Keys	4	0	0	0
Basic Language	Microsoft Basic	$59.95 Extra	TI Basic	Extra Shack Basic
Upper/Lower Case Characters	Yes	Yes	No	No
RS-232 Interface	$49.95	$219.95	$925.00	$19.95
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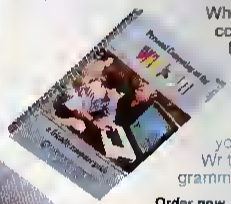

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ing twisting road to get above the walls The scouts reported that there was a lot of digging to do to make it to what the troupers in the three northern cars were calling the Emerald Valley

Southeast toward Tarzak, the expedition reported that it was mostly brush and trees to clear, bridges to throw across streams, bits of swamp to drain The Fake Foot River did flow all the way to Tarzak It was not suitable for navigation except for very short stretches Midway between Mlira and Tarzak, the river cascaded down a great cliff

Packy Dern sat on a rock outside the door of the sick shack He was looking across the dusty way at one of the crude hootches that had been built The particular hootch he had built had done worlds to convince him that his calling was pushing bull Years earlier his career as husband and father had convinced him of the same thing as wife and son hit the lot and jumped the gate to look for what they hoped would be saner surroundings Packy kicked a small stone and clasped his hands 'Can't say I much blame 'em'

"Blame who?"

Packy looked around and saw Mange Ranger standing in the sick shack's doorway 'Nothin' He looked back at his hootch 'How's it goin' in there, Mange?'

The veterinarian sat upon a stump and grinned 'I think we're going to do just fine Everybody in there is on the mend, and I just had my first good night's sleep since I don't know when'

Packy nodded once, then bent over, picked up a stick, and began breaking it into tiny pieces "Maybe we can go a couple days at a time now without burying someone'

The boss elephant man tossed the remains of the stick to the ground 'Little Will She just sits there in the hootch Now that she can talk like everybody else, she don't talk at all Even that think-talk It's like livin' with a ghost, her sittin' around starin' at that damned bullhook'

Mange bent over, placed his elbows on his knees, and clasped his hands together 'She's lost, Packy Her parents are dead A lot of her friends are dead The show is gone Her whole world is different'

'For a man that sticks his arm up a bull's hind end for a living, Mange, you sure are talking up a shrink storm"

Mange looked toward Packy's hootch "I make a better shrink than you do an architect'

Packy snorted 'That's no damned lie' He looked at the show's veterinarian 'Mange, what am I going to do with her?"

Mange thought upon it for a long time He looked up at the boss elephant man "Tell her about what she does for a living'

'You mean the show? The show's dead'

Mange shook his head 'No I don't mean the show Tell her about the bulls and the bullhands' Mange pushed himself to his feet 'I'd better get back' He grinned 'I'm going to deliver a baby'

'A baby what?'

'A baby *human*, plopbrain."

Gangs in the Emerald Valley and in Tarzak would connect their own cars with roads the best they could without bulls or horses and would then begin cutting their way toward the gangs working north and south from Mlira Pony Red Mlira bossed the road gang working south toward Tarzak while Packy Dern bossed the gang that worked its way through the shorter, but more treacherous, Snake Mountain Gap

At night Packy Dern's gang would huddle around fires and talk about nothing—old show stories, idle speculations about the next day's work, anything but the fix they were in Little Will would remain silent, watching Ming was with the Snake Mountain Gang, and it seemed that at any time Bullhook Willy might appear, swinging his gold-tipped bullhook, bellowing out his orders to the rest of the bullhands Then she would see Madman Mulligan pushing

"At night Packy Dern's gang would huddle around fires and talk about nothing—old show stories, idle speculations about the next day, anything but the fix they were in"

Ming Then she would look at the bullhook in her hands and softly cry

The sun would rise, the gang would begin the next day's work, and Little Will would remain at the camp, either staring at her bullhook or into the depths of the gorge Thirty days into the cut, and Packy began bringing Little Will with him to work

Little Will sat quietly in the back of the wagon, watching the bullhands and hostlers work their animals With harness and carefully planned avalanches, but more often with shovels and backs, the crew cut their way up the steep incline to get above the walls of the gap The boiling river at the bottom of the gorge made a constant background roar, causing both bullhands and hostlers to shout their instructions to their animals The noise the river made sounded like the crowd in the blues on a good night The river was named the Push

Packy Dern brought Robber to a stop next to the wagon "Little Will?"

She remained motionless 'Yes?'

"Honey, you can't just sit around all the time It's not good"

'I don't feel like doing anything'

She was talking now But the fact registered on no one, including herself She talked because the thoughts wouldn't talk for her That's all she knew No big deal

Packy reached out a hand and gave Little Will's back an unacknowledged pat He studied her for a moment, shook his head, then shouted 'Mile up, girl!' Robber lumbered forward where Packy turned her around to hitch her harness to a wagon recently filled with dirt and rock

Little Will wiped her eyes with the backs of her hands and turned to see Stub Jacobs backing Reg's wagonload of fill to the edge of the cliff that formed the gap wall She saw him call Reg to a halt Then Stub went back to the wagon to watch as two men placed rocks behind the wheels They waved at Stub, and the bullhand called to Reg to back up As the bull backed toward the cliff's edge, the front of the wagon rose, causing the wagon to begin emptying its load

She saw it before it happened The rock disappearing in a cloud of dust the wagon falling over the cliff—

'Wait!' Her tiny scream was drowned by the roar from the Push She began climbing up the side of the wagon 'Wait! Stop!" As the dirt and rock began falling down the face of the cliff, the rock behind the wagon's left wheel crumbled, slewing the wagon around Stub called to Reg, but the wagon's other wheel jumped the rock behind it and the wagon went over the cliff

Reg dug in as the weight of the wagon pulled her toward the gap Stub rushed behind her and began trying to free the harness from the wagon One of the men threw Stub a knife, and in seconds the harness parted The wagon fell, and Stub Jacobs fell with it, his screams muffled by the roar of the water Reg stood alone on the edge of the cliff, waiting for Stub to hand out the next order

Work stopped, and the bullhands and hostlers gathered at the edge of the cliff and looked down Little Will climbed down and walked over to Reg She stood in front of the bull, reached out a hand, and stroked her trunk *'It's me, Reg'*

Reg gently wrapped her trunk around Little Will's shoulders Little Will looked up at Reg's eyes *'I have to go get something first, Reg'*

Little Will went back to the wagon and returned carrying a mahogany-handled, gold-tipped bullhook She stood by Reg's right front leg "Let's go, Reg There's still work to do

She led the elephant away from the cliff and backed her up to the next wagon in line Little Will looked back to see Packy staring at her 'Packy I need someone to repair Reg's harness'

Packy continued staring at her, then he looked at those standing around at the cliff's edge Shiner Pete Adnelli nodded at Packy and moved off to repair the harness The rest returned to their animals and shovels **OO**

ロボット

CONTINUED FROM PAGE 44

who value honor over life. these machines work tirelessly, make few demands, and go unflinchingly to pieces when newer and more efficient generations of robots come along to replace them.

They also make a lot of money for their masters. Productivity in the Japanese auto industry quintupled—from a daily rate of 5 or 6 cars per worker to 30 or 40—with the introduction of industrial robots. The Nissan Motor Company, in Zama, about 35 kilometers south of Tokyo, turns out 1,300 cars a day, with 150 robots performing the work of 300 men.

Attracted by figures like these, dozens of companies outside of Japan's robust automotive industry have put robots to work. Machines made by Fuji Electric Company now sort out defective drugs, grade fruit, and crate eggs. Hitachi, besides making its own robots, uses them to assemble vacuum cleaners and other appliances, and Mitsubishi and Kawasaki are developing robotic divers to inspect deep-sea oil lines. And last January Fujitsu Fanuc opened a $38 million plant beneath the slopes of Fujiyama, where robots produce *other robots* in a factory coming close to full automation and the ability to operate nonstop.

Western visitors are often surprised at the warmth between Japanese people and the proliferating machines. Workers tag robots with the nicknames of movie stars and rock singers and remain fascinated with devices that frequently outperform them. By contrast, many American blue-collar workers are fearful of losing their jobs to hydraulic muscle and cold circuitry. The fears have some foundation. By some estimates, the number of blue-collar workers in the U.S. auto industry will decrease as much as 25 percent by the year 2000 because of robots. Japanese industrial experts are well aware of the potential problems of transferring tasks to robots too fast.

'An all-robotized environment is not necessarily healthy,' says Yukio Hasegawa, a professor at the System Science Institute of Waseda University. 'While workers, particularly in the auto industry, have good relationships with the robots, if you decrease the number of the work force too rapidly the workers may get demoralized. If you decrease the number of workers from sixty to twenty, for example, the remaining work force might feel surrounded by robots, which are then seen as their competitors.'

But to some extent in Japan the problem solves itself, because there aren't enough laborers. The government estimates that Japan currently needs some 840,000 more skilled workers, mostly for smaller enterprises. The shortage is likely to become more severe, according to Kanji Yonemoto, executive director of the Japan Industrial Association. By 1985 about 60 percent of the Japanese work force will be involved in service or information-oriented industries.

not in production work, Yonemoto says. Most young people won't enter the pool of skilled labor because 60 percent of them today are attending universities, headed for white-collar offices. The situation has made it somewhat easier for robots to enter larger factories, and smaller enterprises require them desperately.

It is against this backdrop of familial acceptance and economic need that researchers like Kato are planning the intelligent robots of the twenty-first century. And in their work they're challenging the stereotype of the robot as a clunky, bland-voiced android.

In one project at the Tokyo Institute of Technology, Dr. Shigeo Hirose has built a series of intelligent robots that walk on four legs and propel themselves like snakes. Originally the snakelike robots were built simply as interesting experiments. But today they are being manufactured as industrial machines, and they may serve a wide variety of functions, from inspecting nuclear-power plants to moving patients around in a hospital.

Abandoning the human metaphor often used in robotics research, Dr. Hirose spent five to six years studying the movements of snakes. "We thought of making robots by taking living organisms as an example," Hirose recalls. "Human beings are too complicated. So we looked at animals; we thought the snake would allow the robot to have a wider function than it does now."

The results are the "activated cord mechanism," or ACM, a meter-long articulated pipe that may be twisted at joints to form any shape. Computer-operated cords inside the pipe act like tendons. Someday these sinews may be used for aiming an endoscopic camera at the end of a tiny robot injected into the lower intestines. Another snakelike robot is the "soft gripper," which can grasp an object of any shape or hardness. It may be called into service soon by the Tokyo Fire Department for rescuing people from burning buildings or places filled with poisonous gas.

Hirose moved on to a boxlike structure supported by four spindly legs. "Here I was inspired by the movement of the spider," he says. The robot creeps, guided by a laser sensory system that fires 100 light pulses per second to provide a picture of surfaces up to a meter away. The next generation of the spider will carry 20 kilograms, and Hirose predicts that ultimately it might replace the baby carriage.

In Ibaraki Prefecture, some 60 kilometers northeast of Tokyo, is Tsukuba Science City, a future metropolis of some 200,000 people, mostly scientists, built in 1979 by order of the Japanese government. There, amid the farmlands and the creeping suburbs of tract houses with pagoda roofs, Dr. Eiji Nakano, the director of robot engineering, is working on a host of projects to meld artificial intelligence with the brute strength of the robot.

Some foresee a time when teams of mechanical spiders will cart fallen trees, harvested by robot lumberjacks, to automated mills. Humans will have little to do with the logging operations but plan and think.

Perhaps the most novel development in Dr. Nakano's Mechanical Engineering Lab (MEL) is the Japanese version of *My Mother the Car*, an automobile steered by microprocessor. The robot auto uses television cameras for eyes and it brakes and accelerates on cue to miss oncoming traffic. "It won't be very practical for at least twenty years," Nakano says, "because it will demand such a social investment. Perhaps it will be useful for long-distance driving. But in Japan, as elsewhere, driving is after all a very personal affair."

Other MEL projects are prototypes for aids to disabled people. One is a small vehicle on wheels, with a microcomputer brain and ultrasonic eyes, the main components of what might become a wheelchair to carry a handicapped person through narrow corridors. Another MEL project is a robotic guide dog for the blind, a small, scooting machine that warns of obstacles detected by ultrasonic sensors. Initially the robot is "taught" to use local landmarks to guide its master, but in the future the blind will be able to program the robot automatically with directions for local errands.

"Art and technology merge. We can have Marilyn Monroe sitting at a reception desk. Robot actors may replace Faye Dunaway. Basically, if a robot is an entertainer, it's human."

Touring the grounds of Tsukuba is a lesson in specialization. In the electrotechnical laboratory across a highway from MEL, Dr. Seiji Wakamatsu and his colleagues have developed one robot capable of sawing wood and building a box, another possessing the dexterity of the human hand, and still others capable of sensing moving objects.

While Dr. Wakamatsu believes that robots will continue to be developed according to their projected industrial use, Kato believes that all-purpose robots imitating humans in intelligence and bodily functions are more necessary. "There is a constant theme in science fiction that robots will destroy human beings," he muses. "They do so only at the point when they acquire emotion. If I consider emotion part of intelligence, then I don't think we can build a robot with equal ability. But for now the more versatile a robot becomes, the more it resembles a human in shape.

"When we come to a service robot, the shape will have to be similar to that of a human being. In the case of the factory, you can lay out the plant in such a way as to make it suitable to the working conditions of the robot. But when robots come into our houses, if we change our house for a robot, then it really should be the other way around."

A colleague of Professor Kato's who shares many of his ideas about the future human robot, is Shunichi Mizuno, a robot artist who works in a small studio and workshop in the suburbs of Tokyo. His creations are Disney-like characters, exhibited all over Japan, most recently at Portopia, the scientific exposition held on a man-made island off Kobe, in southern Japan. For the Tsukuba Expo in 1985, he is building a Robot Theater presenting intelligent robots equipped with pattern-recognition devices, voice, and sensors to form dancing chorus lines like the Rockettes. An earlier creation elicited a mild sensation in Japan. Mizuno constructed a robotic Marilyn Monroe, which played a guitar and danced on national television.

"In robotics, art and technology converge," he asserts while pulling the vinyl face off an old man built to promote solar energy. "Ultimately we can have Marilyn Monroe sitting at a reception desk and answering our telephones. Robot actors may replace Faye Dunaway. Basically, if a robot is an entertainer, it's human, with all the appropriate facial expressions. Once we begin to use the human form and place a computer in it, we are finally raising questions about the definition of life. If I thought about that very long, I'd be afraid to make robots."

But Mizuno will not stop making them, not even if robots become indistinguishable from people. Already robots are on the verge of taking over manufacturing, from the processing of raw materials to the final storage of the product in an automated warehouse. Soon coal miners will be replaced by snakelike robots that burrow into the earth, controlled from a command center aboveground. Diagnostic robots, propelled by magnets, will inspect nuclear-power plants, and their cousins will paint the sides of ocean liners. Robotic migrant workers will be sent to the ocean's bottom and into space as Earth's natural resources become depleted.

One afternoon in Tokyo Masaya Nakamura, president of Namco, Ltd., a maker of computer games and robots for promotional campaigns, gathered his staff around him. It was a tradition at the end of the day. The staff listened, and Nakamura mused. "What Toffler said about the Third Wave is beginning to be true in Japan," he told them. "The development of technology is meant to bring happiness to human beings. Machines are a part of us, like a partner. When you put a coin into a pinball machine, you know how it feels. It is not just a machine, but just like us." ∞

TRIGGERING

CONTINUED FROM PAGE 56

outrage "If I have it's in self-defense I sleep in the next room, but I can feel this thing *radiating* at me even in there It won't let me sleep! It wants something from me I'm half-crazy living in this kid's body anyway, and this thing makes it worse I can feel it nagging at me"

"And you kicked it to make it stop In the same spot Repeatedly"

"What do you know about it?" Conrad muttered, turning away

I felt uncomfortable in the room too It wasn't hostility that I felt from the walls It was the shock of recognition

The moist ceiling was not far over my head curvingly soft and damp It wasn't much like a womb It was more like a boneless head turned inside out The wall at the narrower end to my left, contained the outlines of a huge unfinished face The nose was there but flattened broad as my chest The eyes were forever closed milky oblongs locked behind translucent lids

The room was a genvat creation a recombinant-DNA organism expanded to fill an ordinary bedroom The old bedroom's windows were behind the eyes The light from the windows shone through the eyes as if through lampshades defining the outsize capillaries in the lids. The face's lips were on the floor puckered toward the ceiling The lips were the room's bed disproportionately wide They were soft-looking, about the size of a single bed, they would open out for two There would be no opening beneath them no teeth

"It was grown from Senya's cells you know," Conrad said "From her fingers" He deliberately ground out his still-smoldering cigarette on the room's floor The fleshy walls quivered

I controlled the impulse to box Conrad's ears as he continued "There's a tank of nutrifluid outside the window Personally, I think the creature is disgusting I can hear it breathe I can smell it You should see the lips move when Senya stretches out on them Ugh!"

The room's odor was briny smelling faintly of Woman It breathed through its nose with a gentle sigh

Returning to the main room, Conrad said "Sure you won't have a drink?"

"This time I will have one thanks" The womb-room had shaken me

I stood on a secret brink My heart was beating quickly and irregularly Spasmodic waves of fear swept through me I focused on them, brought them to a peak shuddered, and let the fear vaporize in the light of internal self-awareness Calmness temporarily wrapped the restlessness in me

I sipped my plastic cup of martini for the moment relaxing Sitting beside Conrad, I said "You said something about George's guitar being sick"

Conrad smirked "George is hoping his guitar will be better today But it won't sing

for him. I know it won't. It'll start screaming again as soon as he plays it. It sounds vicious—the most awful screams you can imagine. He may have to go back to playing electric guitar."

"It's screaming of its own volition? Maybe it's allergic to him."

"Possibly. It doesn't scream when Senya plays it."

I felt my trance level deepening. The outlines of the furniture seemed hallucinogenically to expand, softly strobing. I glimpsed ghostly human figures on flickering paths: the apartment's inhabitants had left their life patterns on the room's electric field. In those subtly glowing lines I could see the Triggering foreshadowed.

"Conrad," I said carefully, trying not to show my excitement, "tell me about your life just before transition. Give me details of the death itself." I waited breathlessly.

Conrad was pleased. He lit another cigarette and watched the smoke curl up as he spoke. "I was a copy editor for a book publisher. I was a good one, but I was becoming bored with the work. I'd accumulated a lot of vacation time, so I accepted Billy Lilac's invitation to go on a cruise with him and his friends. I felt sort of funny about it, because I was having an affair with his wife. But she insisted that it would be good because we would remain casual for the duration of the trip—four days—and that would cool Billy's suspicions about us. Billy was rolling in the Right Stuff. He owned a lucrative chain of fast-food restaurants.

"His yacht had what he called a mousetrap aquarium built into it. The boat had a deep draft, and by pressing a button, he opened a chamber in the hull. Water would be sucked into it, along with little fish and sometimes squid or even a small shark. Then the gates at the bottom would close, temporarily trapping the creatures in there, and we would watch them through a glass pane in the deck of the hold.

"There were five of us on the cruise: Lana Lilac, Billy's teen-aged wife, thirty years younger than Billy; his secretary, Lucille Winchester, Lucille's son Lancer—"

"Who? Who did you say? The last two?" My interruption was too eager.

Conrad looked at me strangely. "Lucille and Lancer Winchester," he said impatiently. "Anyway, Billy asked a bunch of us to go down and scare some octopuses into the aquarium. We were over a certain Jamaican reef where they were quite common. So we went down in scuba gear. There were me and Lana and—"

"And Lucille. You three went down," I interrupted. My head contained a whirlpool. *Calm. Perceive objectively. Perceive in the perspective of time. Evolutionary patterns.*

The mummified hurt. Tonight I would resolve the hurt.

"You three went down," I repeated, "and when you approached the gate where the hull opened, good old Billy pressed the button that opens the gate and makes the current that pulls things in, and all three of you were sucked into the mousetrap aquarium. He closed the gate behind you, and then he stood in the hold, over your heads, watching, chuckling quietly now and then. As you ran out of air."

For a few minutes I couldn't talk. I felt as if I were choking, though it hadn't been me who'd drowned on that occasion. I'd drowned later, choking to death on my own vomit, drug overdose. Years later.

Conrad's irritation visibly became astonishment.

But I was only peripherally aware of him. I was seeing myself as fifteen-year-old Lancer Winchester, hands cuffed behind me, lying facedown on the glass floor, watching as my mother drowned. My gasping and my tears misted the glass, blurring the scene for me. But somehow the blur emphasized their frantic movements as they tried to pry the gate. Their frenzied hand signals. Their fingers clawing at the glass.

While Billy Lilac stood with his hands in his pocket beside me, like a man mildly amused by a zoo, chuckling occasionally and sweetly chatting to me, politely explaining that he'd killed Conrad because Conrad had been having an affair with Lana. And he'd killed my mother because she helped them keep the secret and had permitted Lana and Conrad to use her apartment.

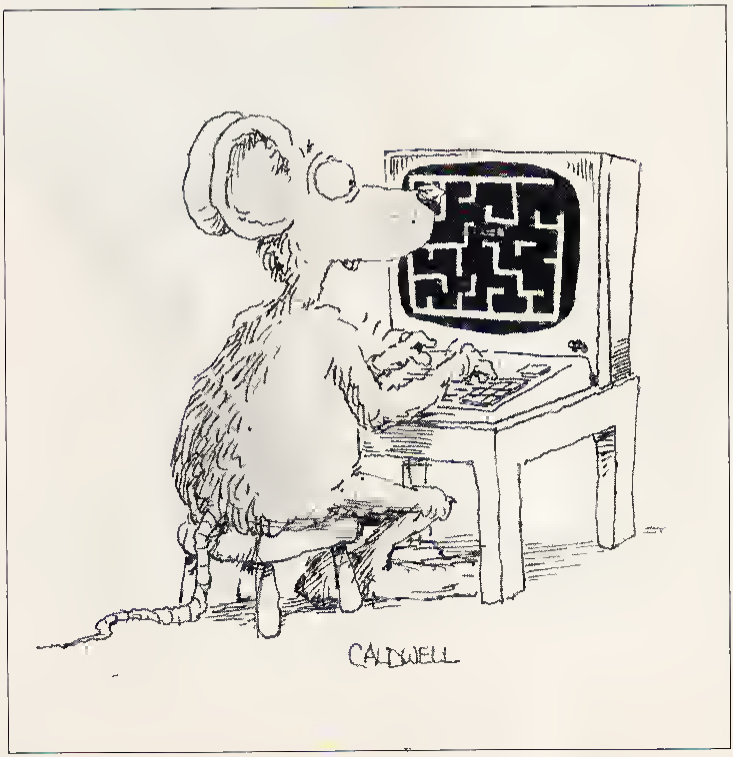
I'd expected him to kill me. But he simply uncuffed me and put me ashore. He knew that my history of emotional disturbance destroyed my credibility. No one would believe me when there were three others testifying differently. He'd bribed his two crewpeople handsomely. They claimed a mechanical failure had caused the gate to open prematurely, and Billy had been on deck and hadn't seen it. They'd been with him the whole time. Craig and Judy Lormer, husband and wife, were his crew. Only, after a while, Judy began to have nightmares about the people drowning in the hold. Judy had threatened to go to the police. Craig told Billy, asking for more money to help keep her quiet. Billy had Judy kidnapped. Craig took another bribe and left. I knew this, because Billy came to me in the asylum and told me in the visitors' room.

He enjoyed talking about it. Billy was the quintessential son of a bitch. "I drowned Judy in the aquarium in my house, Lancer," he'd said, his voice mild and pleasant. Like a taxidermist talking shop.

"You want to explain yourself, friend, hmm?" Conrad said in the present.

I was thinking about my own death. I'd been in and out of institutions for the four years after my mother drowned. Treated for paranoid dementia and drug abuse—the drug abuse, heroin, was real—till I wondered whether I *had* hallucinated Billy's quiet enjoyment as he stood on the glass, watching the bubbles, forced from his exhausted lungs, shatter on the pane between his feet.

I died of an overdose in 1987.



"No coincidences, Conrad," I said suddenly. "I'm here because I knew you in your last life. I was Lancer Winchester. I watched you die. You and Lana Lilac and Mother Strangling under glass." I paused to clear my throat. I tranced to calmness. "Really, Conrad," I said distantly, gazing down the corridors of time, "you ought to slow down on the drinking."

Ignoring my advice, he gulped another cocktail, swearing softly.

I turned my eyes toward the doors, first the front door and then the door to the bedroom. The orifice in the womb room had contracted a little, twitching, so that its blue-pink flesh showed at the open door's corners.

I felt its excitement subliminally and I shared its half-slumbering yearning. Conrad felt it, too, and glanced at it, irritated.

But only the womb-room and I were aware that George and Senya Marvell were climbing the plastic-coated steps to the apartment. Now I felt them stopping on the landing to rest, and to quarrel. I felt the Trigger near. I hadn't quite located it.

"Conrad," I began. "Senya is—"

The door opened. Senya came in, toting something behind her. She and the man I took to be George were carrying a large transparent plasglass case between them. Within the case's thick liquids, something wallowed like a pink sea animal. A flesh guitar. An expensive one, too.

But I could hardly take my eyes from Senya. She was lovely. I had a disquietingly powerful sense of *déjà vu*, taking in her strong, willowy shape. An anomalously campy Old Glory flag pattern was worked into the thick spill of flaxen hair flipped to fall onto her right shoulder. Something in the gauntness of her face excited me. There was both curiosity and empathy in her expression, seeming out of place with her black, clinging Addams Family Revival gown and her transparent spike heels.

"Who the hell is *he*?" George puffed, looking me over as they carried the flesh guitar's case into the bedroom.

"He'd be the man from the Department of Transmigratology, George," she replied offhandedly. "I had them send someone over about, umm, about Conrad."

The *déjà vu* resurged when I listened to her voice. The tone of it wasn't familiar. The familiarity was in the way she used it.

George and Senya returned from the bedroom. In contrast to Senya, George was stocky and pallid, his hair permaset into a solid yellow block over his head. His smoky-blue eyes swept over me, then flicked angrily at Conrad. "The kid's drunk again." His voice, when he spoke to me, was a distillation of condescension. "So you think you can clear the garbage from the kid's head here?"

"If there is any garbage to be cleared in this room," Conrad interrupted, "it spills from your mouth, George."

As George bent to punch for a drink, his motions set off reverberations containing within them, coded, all the actions of his lifetime. And implications of earlier lifetimes.

"Actually, I'm not here to clear anything from Conrad in particular," I said, crossing my legs and leaning back against the couch. Watching Senya, I went on. "In this lifetime my name's Ramja. In the last it was Lancer." Her eyes met mine. She was puzzled. I hadn't hit the Trigger yet. I smiled at her, felt a flush of pleasure run through me when she smiled back.

"No, George. I'm here," I continued, trying to keep the fervor from my voice, "to deal with a rather complex transmigrational entanglement. It results from a past-life trauma shared by everyone here. A memory that brought us back together. For Triggering. And the funny thing is, George, I don't really have to *do* much of anything. My being here completes the karmic equation. I'm not sure how it's going to trigger." I sipped my drink and asked, "How did your guitar perform today, George?"

George just shook his head at me. He was close to throwing me out.

Senya answered for him. "It screamed. As usual! Every time George touched it." She looked at George as if she could understand perfectly why *anyone* would scream if George touched them.

"I rather suspected that," I said. "And I suspect, too, that there's a growing alienation between you and George lately, Senya."

Since the day the guitar started screaming—and Conrad appeared in your son

"What the bad-credit do *you* know about it?' George blurted. He was tense with fear. He, too, could feel the Triggering coming.

"The man's right, George," Conrad put in, grinding his cigarette out on the table, his little-boy fingers trembling. "The guitar's screaming and my, ah, my *coming out* came close together. And then the tension between you and Senya got nasty. I saw it. But it's not like it's *my* fault. The damn guitar may not have more than the brains of a squirrel, but it knows a creep when it senses one. George was playing it, and this scream came out of it. It finally got fed up with the creep."

George said suddenly, "If you think there's some link between *him*"—he jabbed a thumb at Conrad without looking at him—"and what's wrong with my guitar, then maybe you can—I dunno, uh—clear it away so the guitar works again?'

Maybe," I said, smiling. "Let's go into the bedroom. And—clear it away."

A moment later we were standing around the plasglass case, beside the bed-sized, upthrust lips at one end of the womb-room. Senya opened the case and lifted the guitar free as the floor's lips quivered and the room's walls twitched. The guitar cried almost immediately; it was the approximate shape of an acoustic guitar, but composed of human flesh, covered in pink-white skin showing blue veins. The neck of the guitar was actually fashioned after a human arm, with the elbow fused so that it was always outstretched. The tendonlike strings were stretched from the truncated fingers, which served as string pegs. But the guitar's small brain kept the strings always in tune. Its lines were soft, feminine, its lower end suggesting a woman's hips. Where the sound hole would be on an acoustic guitar was a woman's mouth, permanently wide open, its lips thin and pearly-pink, toothless, but with a small tongue and throat. There were no eyes, no other physical suggestions of humanity.

Senya held it in her arms, leaning its lower end on her lifted knee, her right foot propped on the brim of the open guitar case. She played an E chord, her fingers lightly brushing the tendonlike strings. The strings vibrated, and the guitar's mouth sang the note. The tone was hauntingly human, melancholy, sympathetic. An odd look came over Senya's face. She glanced up at me, and then at Conrad, who reeled, drunk, to one side. And back at me.

"Well?" George said.

You play the guitar, George," I said. "Go on. I think all the integers of the equation are here, in place. You play it."

"No, thanks," he said, looking at the pink, infantlike guitar in his wife's arms.

I could feel the lines of karmic influence tightening the room. Unconsciously we'd moved into symmetrical formation around the glass case: myself, Conrad, Senya, George, and the guitar which Senya held over the case, her arms trembling with its

weight. We were the five points of a pentacle, encircled by the waiting, brooding presence of the womb-room.

"Go on, George," said Conrad, slurring his words. "Don't be a simpering coward. Play the guitar." Like a defiant midget, he sneered up at George.

George snorted and took the guitar from Senya. Its strings contracted with a faint whine when he touched it. He strummed a chord and relaxed as the notes came out normally. He strummed again, shrugged, and glanced nervously at the living blue-pink ceiling and the bruise low on the ceiling walls.

The guitar's scream shattered the glass of the window hidden behind the flesh wall and made me clap my hands over my ears. The walls rippled and from somewhere gave a long sigh. Blood ran from the lower edge of the closed eyelids like crimson tears. An ugly ripping sound made me look up: the ceiling had ruptured. Blood rained on us in fine droplets. Conrad began to laugh hysterically, his voice piping manically. His eyes rolled back into his head.

George flung the guitar down furiously. I had to look away as the flesh guitar struck the edge of its case. It howled again as something vital within it snapped. It rolled onto the floor, facedown, moaning. The room moaned with it. Panic enlarging his eyes, George looked at each of us. He looked as if we'd suddenly become strange to him. He was seeing us differently now, all his self-assurance gone.

I said loudly, staring hard at George, "Yours was the sort of crime that required a major effort at karmic justice, Billy."

"You call him Billy?" Conrad said, staring at George.

"Billy Lilac," I said, smiling at Senya. "By now you should be remembering. And wondering, maybe, why a man should be punished for things he did in another life. Was Billy the same man as George, really? He is the same man at the root. Remember what he did? That sort of crime, Billy... ah! The womb-room remembers, on some level. The guitar remembers. Their brains are small, but their memories are long. You drowned three people, and, perhaps worse, you chuckled while you watched. You destroyed my life." "Me? I was Lancer Winchester." I waited for the full impact of my words to hit the others.

The red mist sifted down on us. The floor's lips snapped open and shut soundlessly. Senya and Conrad listened raptly, their eyes strange. "You killed my mother, Billy. But she's here with us. Everyone you killed is here. It's going to be a big shock to the genvat industry when I tell them we've got evidence that human spirit-plasma fields can incarnate into flesh machines. It will shake up my department, too. My mother? She incarnated into the room that surrounds us, Billy. And Lana is here in Senya. The guitar woke up in your arms one day and remembered what you had done. So it screamed. The guitar is Judy Lorner. Remember Judy? The crewwoman you drowned when she threatened to talk?"

I didn't mention the fact that young Lancer had been genuinely in love with Lana Lilac.

George, aka Billy Lilac, wasn't listening. He was backing into a corner, making odd, subhuman sounds and swiping at his eyes. Overwhelmed by the sudden remembrance I'd triggered. Realization: who he was and what he'd done and how it had always been a shaping influence on his life.

The room's walls were closing in around us. The room itself was undergoing contractions, squeezing us. We felt waves of air pressuring us, slapping us toward the door. We staggered.

Howling, his voice almost lost in the room's keening and the dis-chording of the dying guitar, Conrad struggled on all fours after us. He looked like a frightened child.

Senya and I stumbled out into the main room, both of us fighting panic, shuddering with identity disorientation.

Gasping, I turned and looked through the shrinking entranceway. The aperture was irising shut. I glimpsed George standing over the guitar case. The bleeding flesh guitar yowled at his feet. George swayed toward us as the room got smaller around him, his arms outstretched plaintively, face white, his expression alternating terror and confusion, mouth open in a scream lost in the room's own clamor. Behind him, the fused lower edges of the lids over the room's eyes tore free; the lids snapped abruptly open. The eyes glared, pupils brimmed with blood. The room contracted again, and George tripped. He fell against the open plasglass guitar case, facedown, over churning liquids. The aperture closed.

"Ahmed!" Senya shouted, recovering herself. "Ahmed's trapped!"

She was calling Conrad by the name she'd given him. The doorway was blocked by a convex wall of tense, damp human tissue. It was puckered into a sort of closed cervix at the middle. But slowly the cervix dilated. The top of a head poked through. Conrad's head. His eyes were closed, his face blank. Gradually the room pressed him out. He was unconscious but breathing. Senya held him in her arms. His clothing was badly torn and slick-wet with the room's blood. When he opened his eyes a minute later, he said nothing, but gazed up at her, all trace of Conrad gone. Conrad had withdrawn to whatever closet of the human brain it is that erstwhile personalities are kept in.

The womb-room had shrunk to a bruised, agonized ball of flesh less than two meters across, clamped rigidly around the plasglass case. It died, mangled by the corners of the big glass case, and inwardly burst from its own convulsions.

George, Billy Lilac, died within it. He'd been forced by the shrinking enclosure into the glass case, into its glutinous transparent fluids. He died under glass. He died by drowning. ∞

EXPLORATIONS

CONTINUED FROM PAGE 30

that absorbed the infrared spectrum, reducing the heat by 90 percent. Then the stage was set with environmental props in hopes that the subject would perform. "Patience is essential to the natural-history cameraman," says Thompson, who once waited a marathon stretch of 209 hours for a shot that lasted ten seconds.

With limited funds, Thompson edited the film himself, viewing it on a projector, unthreading, snipping frames, rethreading, and testing his cut by the full screen. Thompson was inspired by the pioneering efforts of Percy Smith, who rigged alarm clocks to odds and ends for time lapse. "If he needed more distance from his subject, he never hesitated about knocking a hole in the wall."

Thompson's wood-wasp film remains a classic of natural-history documentaries, and the wasp itself stayed on as the logo for Oxford Scientific Films, Ltd., incorporated in 1968. The seven directors, having drifted together at Oxford University out of their mutual interest in filming research, survived a filming expedition to Africa the previous year, considered the ultimate test of compatibility.

Though expedition logistics may decrease when one films one insect instead of a herd of elephants, the amount of hardware tends to increase dramatically. In order to film marine organisms no bigger than one-tenth the size of this comma, OSF employs an optical-bench system that weighs 560 pounds and that took over ten years to refine.

Micrography, which films the microscopic, and macrophotography, which films the slightly larger, are processes that even the merest vibrations will upset. With magnifications of 400 times or greater, the simple breathing of the cameraman, or a truck passing in the distance, can transform the image into a frustrating blur. The bearded and Lincolnesque Peter Parks overcame this by linking subject and camera so rigidly that when they vibrate, at least they vibrate together and the image remains sharp.

Dark-field background, a technique of Victorian microscopists, allows such transparent creatures as starfish larvae to be seen as brilliant little jewels. Illuminated from behind by a hollow cone of light, the subject is seen by the camera only when and where the light strikes, as with a flash in total darkness.

Specialized flash techniques, down to 0.025 second, were developed by Stephen Dalton, the newest member of OSF. When Dalton set out to photograph insects in free flight, he discovered that the fastest flash was far too slow, as was the speediest shutter. Operating at 0.1 second, it allowed enough time for an insect to fly inches or even feet. Dalton incorporated photoelectric eyes to trigger the flashes, freezing triple exposures of sequential motion in one 35mm frame. His illustrated *Miracle of Flight*, designed as a coffee-table book but used as a textbook, compares our own flying machines to insect flight. The very first creatures to fly, insects were aloft more than 350 million years ago, defying the laws of aerodynamics. Researchers at Cambridge University were able to discern the dynamics of unsteady airflow from Dalton's still photographs.

The Cosmoscope, a 1.5-ton, electronically operated, hydraulically powered rig, requires up to 11 people to control it. Its multiaxial head is capable of pulling focus from infinity to the head of a fly and, with a snorkel lens, can submerge under water without taking the rest of the camera body—an advantage in maneuvering and reloading. Parks also sees potential medical applications, such as employing the snorkel lens to film heart surgery. "You could get right in there and not be in anyone's way."

The Cosmoscope boasts video monitors for remote control, and it shoots in actual, or real, time. "Most special-effects people work in stop frame and motion control, or they mat things in," Parks explains. "All our equipment is designed to view the results straightaway rather than to wait for a lab to combine the images." In fact, Parks and Ian Moar, a specialist in solitary bees, have developed a system capable of combining two or three images on film on the spot. Their aerial-image relay device has the ability to shoot separate planes of action, all in focus, such as miniaturized men grappling with a seemingly gigantic scorpion.

Another innovation, the Astroprobe, executes visual "flythrough," shooting through a 1mm pinhole to give a wide-angle view of the other side. The Astroprobe is the secret to the flower's point of view of a visiting bee. The instrument is inserted through a nick in the flower's cup, which opens the vista.

In that touted experiment gone mad, in *Altered States*, when Dr. Jessup makes a verb out of the word *atavistic*, the screen blasts forth with colorful vortices that climax in a perfectly formed molecule. "Simply a combination of chemical reactions," Parks reveals. Or just before Superman flies into your heart, those pulsating titles? "Brewer's yeast cells." Highly magnified, in both cases.

More than 80,000 slides for still photographs are copyrighted by OSF. They are to be found in more than 20 books, the latest *Focus on Nature*, written by the scientists themselves, and pictorial features in *Geo*, *National Geographic*, and *Omni*'s own Phenomena.

The head of the stills department, Dr. John Cooke, is a living caricature of an arachnologist. A breathless enthusiast with a penchant for anecdotes, Cooke was a regular guest on the old *Dick Cavett Show* when he was a curator at New York's American Museum of Natural History. In safari

khakis, he sits beneath a shelf of books, one entitled *British Bloodsucking Flies*.

On location beside a river, Cooke and a colleague noted a raft spider dangling a leg in the water. It was not what they had come to film, but since their other star was not performing, the spider stole the show. Fish, attracted by movements in the water, were captured and eaten by the crafty spider. The behavior had never been observed, and certainly never filmed.

Sean Morris, a specialist in time lapse, spent the last five years filming the intricate process of pollination. He went to Western Australia, where for six weeks he focused on the hammer orchid. Enter wasp.

The male wasp, intent on wooing, mistakes a hammer orchid for a female wasp. As the wasp tries to copulate with the orchid, a hinged stalk throws him forward into ripe pollinia, which adhere to his head.

Take two, fooled again. The wasp successfully pollinates the receiving hammer orchid. Somewhere there's bound to be a very impatient female wasp. If indeed there is, the cameras of OSF will record her story, too, for small, often overlooked details are OSF's forte.

Since much of what OSF tends to focus on has never been caught on film, keen observation of the celluloid record often reveals unknown behavior or explains phenomena that have long baffled naturalists. Technical difficulties notwithstanding, the biologists' perspective of the world is always related with wit and in living color. Now we can all share their sense of wonder at the vast kingdom of the tiny.

Visitors are welcome to Oxford Scientific Films, but some knowledge of filmmaking techniques or of natural history is encouraged. British Rail offers regular train service to Oxford for about $10 one way. If you rent a car, you might consider staying overnight in nearby Woodstock, and visiting Blenheim Palace, Winston Churchill's birthplace. Phone 0993 881 881 in advance to arrange a tour of OSF studios. OC

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SPACE

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Pomgratz, of the Los Alamos Scientific Laboratories, that launch was a needed warning that the ionosphere is not immune to man's chemicals. Without that warning, some of our plans might have done far more damage.

A case in point, Dr. Pomgratz says, is the proposed solar-power satellite (SPS) system. In the original scenario, he recalls, "they were talking about vehicles eight times the size of the *Saturn 5*. Each had a trajectory such that the exhaust gases would have removed something like one third of the ionosphere. They were going to do this eight times a day for thirty years. Then it might be that no one would have major radio stations, because you couldn't get any reception off the ionosphere." SPS plans have already been changed to avert this far-off problem.

Still, Pomgratz notes that even smaller chemical releases involve many unknowns. Last year, in an experiment called Water Hole 1, he and Canadian scientists sought to study the northern lights. They ended up by punching a brief 50-kilometer hole in the aurora. "That was a little embarrassing," he says with a laugh. "When we designed the experiment, we thought we'd strengthen it." Pomgratz and his colleagues plan to continue their aurora experiments precisely because of such unknowns.

Other scientists have drawn up elaborate plans to create artificial comets—one of the many grand space paintings likely to become reality as soon as chemical releases can be conducted from the space shuttle. Physicist James Heppner and his colleagues at the Goddard Space Flight Center in Maryland, have been drawing up plans for a special Chemical Release Module (CRM) to be lofted by the shuttle. Using hundreds of pounds of chemicals instead of just a few pounds, the module is designed to explain the exotic ionospheric data that physicists have been trying to piece together. According to Dr. Heppner, it would also be far cheaper than the parade of rocket-based releases that will have preceded it.

Unfortunately, federal money for pure space research is dwindling rapidly. It seems that the CRM program will be saved only because the Defense Department wants the device for its own mysterious ends. Dr. Rita Sagalyn, a staff scientist at the Air Force Geophysics Laboratory in Bedford, Massachusetts, is helping to revise the project for the department. She insists that the military's proposed launches in 1986 will probe the same fundamental mysteries that excited NASA.

Other scientists involved with chemical releases over the years paint a different picture. The Defense Department, they say, is worried that spy and military communications satellites might be put out of action temporarily by sudden ionospheric disturbances. Chemical releases have been one means to test the sensitivity of ultrahigh-frequency radio channels to brief, natural pulses of plasma in the ionosphere.

Some releases by such groups as the Defense Nuclear Agency have been used to simulate the electromagnetic side effects of atomic war on strategic defense communications. According to Heppner, still other studies have been designed to mimic the release of miniature bombs directly into the ionosphere, a bizarre possibility, but a real one to military planners.

Because many Defense Department shuttle missions will be almost exclusively military, some researchers worry that the scientific promise of exploring the heavens could be lost from the revised program. They certainly have different interests than we do," one plasma physicist says of the military. "They start out talking about basic science, but when they get down to it, they want us to be tool-and-die makers."

This research could still solve many mysteries, and scientists are understandably reluctant to miss out on the opportunity. One recalls Stephen Daedalus, James Joyce's young artist, who filled the sky with his imaginings and reflected, "Signature of all things I am." The question now is whether man's signature in the sky will be as grand as the heavens themselves or as shabby as our fears. ∞

EARTH

CONTINUED FROM PAGE 16

spot the *Zevezdny*. He still hasn't given up his objective of snagging her propeller.

"Sometimes it takes outlaws to stop outlaws," says Watson, who once sank a pirate whaler off the coast of Portugal.

"When he sank that whaler, Watson saved a lot of whales," says Brian Davies, head of the International Fund for Animal Welfare, a group that endorses nonviolence. "He has the very best credentials."

But Watson's unorthodox methods often prompt environmentalists to label him a terrorist. "We support the intent of what Paul does," says Douglas Mulhall, Canadian administrative coordinator of Greenpeace, "but we do not condone the methods. Greenpeace has proved that direct nonviolent action, combined with political action, is effective. It is our contention that if you use force, you become part of the thing you are trying to stop."

"When I was with Greenpeace," Watson, a founding member of that group, says, "we never saved a single whale by standing in front of a harpoon. The whalers would just shoot over our heads."

At some point your tolerance level is reached," says Edward Unterman, thirty-one, from Pittsburgh, Pennsylvania, "and when I decided that it was intolerable to kill whales on this planet, I decided that what the Sea Shepherd Conservation Society was doing was most effective."

The search for the *Zevezdny* halts dramatically when the lookout in the crow's nest spots a helicopter gunship in the distance. Over the ham radio word reaches us that the Kremlin has sent a diplomatic note to the U.S. embassy in Moscow, informing our officials there that we will be arrested for espionage. The U.S. State Department immediately responds by declaring it is "maintaining an observer's status."

The red star on the helicopter's fuselage becomes clearly visible as the aircraft circles overhead. "Wave! Keep waving!" shouts one of our officers.

Another helicopter appears, and together they shadow us like vultures after carrion.

A ship shows up on our radar, moving rapidly toward our position. Watson says it's a warship capable of making three times our speed. He decides to turn back.

Minutes later we watch the warship pull up alongside us. We can see the serious faces of the crew and the barrels of their 75mm cannons.

"*Sea Shepherd*, stop!" shouts a thick Russian accent over our radio.

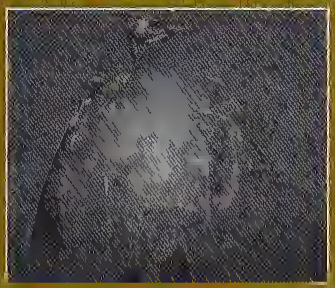
"Why?" Watson asks innocently.

"I am boarding ship! Stop! I am boarding ship!"

"Negative. We are going home."

Some of our crew apply grease to the sides of the ship underneath the barbed wire to dissuade the Soviet party from attempting to board us. Almost at once the

NEXT OMNI



FICTION

DEATH EXPERIENCE

SINCLAIR

THE INCREDIBLE SHRINKING SINCLAIR—Briton Clive Sinclair has got very big by thinking small. Smash! Sinclair makes TV tubes of the thickness of a magazine. Crunch! He turns out a tiny home computer with a price below $200. As *Omni* shows in an incisive profile next month, Sinclair is like one of the small, wily animals that existed when dinosaurs still ruled. He invents in the shadow of giant corporations and survives on his wits. Next, *Omni* has learned, Sinclair may take on Detroit.

OUR LADY OF THE ENDORPHINS—In 1973, when Candace Pert was a twenty-six-year-old pharmacology graduate student working under Solomon Snyder at Johns Hopkins, she startled the neuroscience community with her discovery of the opiate receptor. In the ensuing decade she's continued to make groundbreaking discoveries in brain chemistry. Next month in *Omni*'s interview Pert discusses such vital questions as: How does the brain regulate behavior? What is the locus of the Valium (or Hoffmann-La Roche) receptor? Why does Angel Dust twist perception?

SPARE GENES—Within the next ten years, machines may routinely scan the genes of a fetus, searching for odd "fingerprints" that warn of problems ranging from color blindness to cystic fibrosis. And when scanners detect a problem, doctors will go to a stock of 'good' genes for replacements. Researchers today can inject DNA into a cell by using wispy glass needles, changing the cell's 'blueprints.' In the future they may be able to combat human disease with related techniques. Next month's *Omni* reports the potential—and potential problems—of gene therapy.

RECOLLECTIONS OF DEATH—A brilliant light, a serene landscape, the spirits of long-departed loved ones—all these figure in the tales told by people who recover from clinical death. In next month's *Omni*, cardiologist Michael B. Sabom discusses the results of his five-year investigation into NDEs, or near death experiences. Dr. Sabom's study, the first scientifically rigorous examination of the NDE, calls into question our beliefs about the practice of medicine and the nature of human life.

SCIENCE FICTION—In February, a historian chronicles events after the death of God, in Greg Bear's "Petra." Two exobiologists discover a mystery on the planet Aton 17, in Scott Sanders's "The Audubon Effect," and a victim of a rare illness is driven to capitalize on his affliction, in Gregg Keizer's "I Am the Burning Bush."

helicopters dive at our ship, firing flares, and the warship plows across our bow. They seem undeterred.

"*Sea Shepherd*," shouts the Russian seaman again, "stop immediately!"

"Stop killing whales!" Watson shouts back. As we look at our adversaries, prepared for the worst, a whale, glorious, enormous, surfaces and swims steadily between our ship and theirs as if drawing with his body a line of truce. Almost immediately the Russians stop dead in the water.

They seem uncertain of what to do next. They drop back farther. The two helicopters disappear.

Jubilant and somewhat dazed, we reenter American territorial waters.

But the mission is not yet over. Watson tacks a note to the mess hall door listing the objectives that have been accomplished and the single objective that has not: "Finding and intercepting the whaling vessel *Zevezdny*."

The question of whether to return is put to a vote, and the majority decide on continuing our mission. We spend the entire night and the next day anchored in American waters near St. Lawrence Island; early the following morning we head for the Soviet coast again.

Once again the *Zevezdny* is nowhere to be found, and as we leave Soviet waters a second time, a lone Soviet helicopter gunship appears and pursues us.

We have now repeatedly covered the entire area in which the *Zevezdny* operates, and Watson suspects that the Russians have taken the ship out of service because of our presence. "Every attempt must be made to find the *Zevezdny*," Watson vows.

The next morning a third mission begins, but radar indicates two warships blocking the *Sea Shepherd II*'s path. Running low on fuel and provisions, Captain Watson calls it quits.

He describes the mission as "eighty percent successful" and decides to take the photographic proof of the illegal Soviet operation to the infractions committee of the International Whaling Commission.

"If what Watson says is true," says Tom Garrett, acting whaling commissioner for the United States, "it certainly makes liars out of the Russians. The United States has asked the Russians several times for documentation of what is going on there, but we have not received it." Garrett says that when the IWC meets next summer in England, the United States will ask that international observers be allowed to visit that part of Siberia.

Finding no shortage of challenges, Watson and his crew will carry on. In February the ship will reach Iki Island, northwest of Kyushu, Japan, and try to stop Japanese fishermen from spearing and clubbing hundreds of dolphins that, they claim, are cutting into their profits.

"There is no justification for killing any marine mammals," Watson asserts, "and I will do whatever is necessary to end the killing everywhere it exists." ∞

THOUGHT TRAVEL

STARS

By Patrick Moore

Is interstellar travel possible? My answer is always the same: By our present methods, it isn't. This is quite different from claiming that reaching the stars will be permanently out of the question.

Let me start by briefly looking back. In 1840 Dr. Dionysius Lardner, an eminent scientist, stated that reaching the moon was an idea as absurd, and as unlikely, as crossing the Atlantic by steam power. Even earlier the prospect of traveling in a train at the staggering speed of 30 mph had caused misgivings. And after the Wright brothers had successfully flown, Dr. Simon Newcomb, another eminent scientist, claimed that the only possible heavier-than-air machine was one powered by birds. As for space travel . . . well, it was ridiculed right up to the time of *Sputnik 1*, and that was a mere quarter century ago.

My point here is that once a proposed experiment goes beyond the range of contemporary science, it is bound to be greeted with skepticism. So it is today with the concept of interstellar travel.

Where are we likely to go? The nearest stars are those of the Alpha Centauri system, not much over four light-years away, but candidly they aren't very promising. Instead I would prefer to consider Barnard's Star, two light-years farther off than Alpha Centauri. Here we have a dim red dwarf, possibly attended by several planets. To find stars similar to our sun, we must go beyond ten light-years, but I am content with choosing Barnard's Star. Six light-years is the critical distance—something between 30 million million and 40 million million miles.

An unmanned rocket probe does not seem particularly useful in reaching Barnard's Star, simply because it would take a very long time and we would have no hope of keeping track of it. Actually several probes have been launched already. *Voyager 2* will bypass Uranus and Neptune before 1990 and will then leave the solar system; we can keep in touch with it for only another few years. About 340,000 years hence the probe will be within one light-year of Sirius.

If we are to make an interstellar journey in a spacecraft by 1982, we must be prepared for a journey of many thousands of years. Space arks are beloved of storytellers, but I doubt that they will ever become practical. There would probably be no shortage of initial volunteers, but what would happen after a prolonged period? As generation succeeded generation, the whole aim of the mission would be lost.

Hibernation is another alternative. Putting a crew into deep freeze is also a popular theme. Whether the human body would stand up to such treatment is, I believe, very questionable.

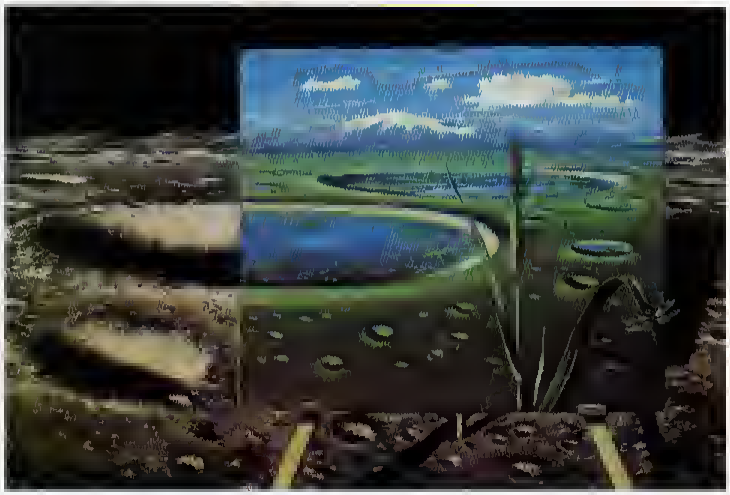
Space warps, time warps, and so on have become popular as suggested methods of interstellar travel, particularly since the arrival of black holes in astronomical science. But how does one enter a warp of any kind? We have to admit that we have absolutely no idea; so, for now, speculation is endless.

Rather less implausible is the concept of a spacecraft that can move at a velocity approaching that of light. Here we have to cope with the time-dilation effect.

So where does this leave us if we really believe in a community of worlds many light-years apart, and yet in close contact with one another?

This is where I become controversial! It seems we have no chance if we restrict ourselves to sublight speeds. Material things cannot exceed this limit. So travel must be *nonmaterial*. How fast is the speed of thought? I can easily conjure up a picture of the surface of Mars, with the Viking lander sitting placidly in the middle of the rocky, orange desert of Chryse; it takes me no time at all to transport myself there mentally. And if we could adapt this ability to transferring our bodies as well, every obstacle in the way of interstellar travel would disappear.

It sounds like science fiction. At the moment it *is* science fiction. Yet cast your mind back to the time of Julius Caesar, or William the Conqueror, or even Shakespeare. What would these gentlemen have said about the idea of sitting in one's study, twiddling a knob, looking at a screen, and seeing men walking on the surface of the moon?



The skepticism and speculation of science ignite the mental engines of interstellar travel

PHENOMENA

Six kittens, nestled *in utero*, are revealed by a high-voltage, flash X ray. The cat, Buttercup, became a mother and model for photographer Howard Sochurek while she was the plant mascot of a high-technology firm in Oregon. Two exposures were combined to achieve this image. Buttercup's X ray and her silhouette. Sochurek outlined the cat by backlighting it with strobes and simultaneously photographed the x-ray plate behind Buttercup. By controlling the pulse and dosage of the X rays, Sochurek was able to visualize only fetal bones because their density is different from the mother's mature skeleton. With Ektachrome 64 film and a 5.25-inch Ektar lens, Sochurek photographed this prenatal scene as Buttercup prowled around the plant, looking for a secluded spot in which to give birth. The kittens were born the day after the photography session. ∞

Solve these riddles, find the gold!

GAMES

By Scot Morris

The pure challenge of an unsolved puzzle: the satisfaction of wrapping one's mind around a problem and seeking a way through it; the sheer intellectual joy of finding a solution! Set aside such noble emotions this month while we look at three unsolved puzzles that appeal to a more universal motive—greed.

For the past two years puzzle fans and treasure hunters have been digging up the English countryside. They have tried to dredge a lake in Derbyshire and to dig up a topiary in Tewkesbury. One woman was arrested after breaking into the Taunton fire station, where she believed the treasure would be found.

What they're all looking for, in case you haven't heard, is the lost prize of Kit Williams's charming children's book, *Masquerade* (Schocken Books, $9.95). It is a gold-filigree rabbit with a ruby eye fashioned by Williams himself and buried by the light of a full moon in August 1979, "somewhere in the British Isles." The jewel, now valued at over $30,000, belongs, Williams says, to whoever discovers its hiding place. When *Masquerade* was published, with all clues to the treasure concealed in Williams's beriddled fable and his intricate, Botticelli-like paintings, a national obsession began. The *London Times* reported that in a Gloucestershire park called Harefield Beacon, where harebell flowers bloom in summer, "holes the size of table-tennis tables were being dug up in the dead of night." Williams had to donate £50 to erect a sign stating that the prize was elsewhere.

The book is now becoming a worldwide best seller, largely because of Williams's assurance that no knowledge of English geography is required to discover the solution and his steadfast insistence that "the riddle can be solved by a child of ten as easily as by a mathematics professor." Everything one needs is in the book, he says, and he has offered to send, at his expense, an airline ticket to England to the first person who solves the riddle.

At least one copy of the book has been purchased by the FBI. Its cryptanalysts, FBI spokesman Ed Gooderham says, "will use it for training purposes, to keep abreast of cryptographic styles published around the world."

Is the treasure still in its hiding place? "It is," Williams says. "I went to the site recently and the ground was undisturbed." Has anyone come close? "Someone has gotten about eighteen feet away from it."

Schocken Books is at 200 Madison Avenue, New York, NY 10016.

WHERE THERE'S A WILL

As Williams's royalties approach the $1 million mark, the financial potential of exploiting gold fever is not going unnoticed. Three New Jersey authors—Thomas Dowd, Ronald Franks, and Dorothy Newton—have published *their* book, *The Will: A Modern Day Treasure Hunt*. In it are clues based on chess, astronomy, astrology, mathematics, geography, and hieroglyphics, all leading you to *their* treasure: a box containing 49 one-ounce South African krugerrands, a cache worth about $25,000. The box, they say, is within a 100-mile radius of the Empire State Building. You can claim the prize, without physically retrieving it, by sending the authors the correct solution in the mail. The privately printed booklet lacks the stunning visual quality of *Masquerade*—its prose and production are also amateurish—but if you're after gold, not art, you won't much care. It is available by mail for $6.95, plus $1.50 for postage and handling, from Tricore Associates, Inc., 69 Route 23 South, Riverdale, NJ 07457.

A TON AND A HALF OF GOLD!

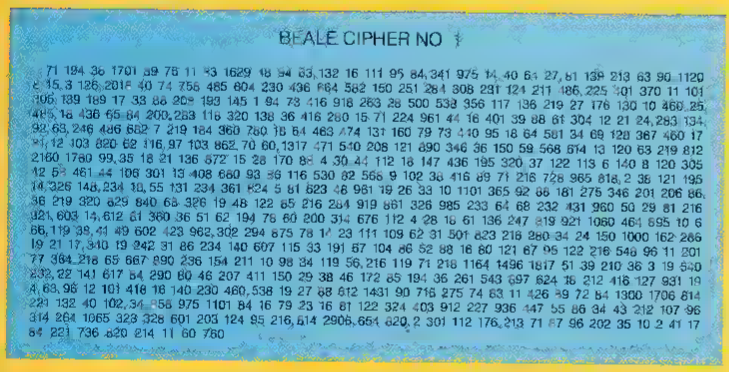
If you want to hunt for *big* treasure, work on the number code on page 127, which has been called the greatest unsolved cipher in U.S. history. Untold thousands of man- and computer-hours have been spent trying to crack it, with no known success. These numbers have defied the best cryptanalysts for well over a century.

In 1818, the story goes, one Thomas Jefferson Beale and a party of 29 other adventurers found huge deposits of gold and silver in the territory that would become Colorado. Beale and a few others brought the treasure east by wagon train and buried it in Bedford County, Virginia, near the town now called Montvale, about 15 miles northeast of Roanoke. In 1822 Beale went west again to rejoin his partners. He left a locked iron box with Robert Morriss, who ran a hotel in Lynchburg. Later that year he wrote Morriss, saying that if he did not return for it within ten years, Morriss should open the box and follow the instructions therein. Neither Beale nor any of his party was ever heard from again.

Williams with painting. Where is the hare?

The scrupulous Morriss waited 23 years before finally breaking open the lock. Inside were three long sets of numbers—ciphers—and a letter from Beale explaining how and where the gold was to be found and promising that the keys for deciphering the three codes would be forwarded to Morriss in 1832. The keys never arrived.

Of the three ciphers, the one traditionally called No. 2 was cracked in the 1860s by James Ward, a trusted friend to whom Morriss gave the papers shortly before he died. The message was found to be keyed to the Declaration of


BEALE CIPHER NO 1

71 194 38 1701 89 76 11 83 1629 48 94 63 132 16 111 95 84 341 975 14 40 64 27 81 139 213 63 90 1120
8 15 3 126 2018 40 74 758 485 604 230 436 664 582 150 251 284 308 231 124 211 486 225 401 370 11 101
305 139 189 17 33 88 208 193 145 1 94 73 416 918 263 28 500 538 356 117 136 219 27 176 130 10 460 25
485 18 436 65 84 200 283 118 320 138 36 416 280 15 71 224 961 44 16 401 39 88 61 304 12 21 24 283 134
92 63 246 486 682 7 219 184 360 780 18 64 463 474 131 160 79 73 440 95 18 64 581 34 69 128 367 460 17
81 12 103 820 62 116 97 103 862 70 60 1317 471 540 208 121 890 346 36 150 59 568 614 13 120 63 219 812
2160 1780 99 35 18 21 136 872 15 28 170 88 4 30 44 112 18 147 436 195 320 37 122 113 6 140 8 120 305
12 52 461 44 106 301 13 408 660 93 86 116 530 82 568 9 102 38 416 89 71 216 728 965 818 2 38 121 195
14 326 148 234 18 55 131 234 361 824 5 81 623 48 961 19 26 33 10 1101 365 92 88 181 275 346 201 206 86
36 219 320 829 840 68 326 19 48 122 85 216 284 919 861 326 985 233 64 68 232 431 960 50 29 81 216
821 603 14 612 81 360 36 51 62 194 78 60 200 314 676 112 4 28 18 61 136 247 819 921 1060 464 895 10 6
66 119 38 41 49 602 423 962 302 294 875 78 14 23 111 109 62 31 501 823 216 280 34 24 150 1000 162 286
19 21 17 340 19 242 31 86 234 140 607 115 33 191 67 104 86 52 88 16 80 121 67 95 122 216 548 96 11 201
77 364 218 65 667 890 236 154 211 10 98 34 119 56 216 119 71 218 1164 1496 1817 51 39 210 36 3 19 540
232 22 141 617 84 290 80 46 207 411 150 29 38 46 172 85 194 36 261 543 897 624 18 212 416 127 931 19
4 63 96 12 101 418 16 140 230 460 538 19 27 88 612 1431 90 716 275 74 83 11 426 89 72 84 1300 1706 814
221 132 40 102 34 868 975 1101 84 16 79 23 16 81 122 324 403 912 227 936 147 55 86 34 43 212 107 96
314 264 1065 323 428 601 203 124 95 216 814 2906 654 820 2 301 112 176 213 71 87 96 202 35 10 2 41 17
84 221 736 820 214 11 60 760

Independence. Beale had numbered each word consecutively from 1 to 1,322. When 1 in 2 the, 3 course 4, of 5; human 6, events 7, and so on. He then replaced the letters of his message with the appropriate numbers. The letter *W*, for example, could be encoded with a 1 or with the number of any other word beginning with *W*.

Cipher 2 told exactly what was buried: 2,921 pounds (not ounces) of gold, 5,100 pounds of silver, and a quantity of jewels, securely packed in iron pots with iron covers . . . six feet below the surface of the ground." It said that message 3 gave the names of the men to whom the treasure belonged. It concluded: "Paper number one describes the exact locality of the vault, so that no difficulty will be had in finding it."

Interest naturally has centered on cipher 1, at right. Would-be cryptanalysts have tried to unlock it by using a variety of documents that might have been available to a Lynchburg innkeeper in the 1820s—the Constitution, the Mayflower Compact, the Magna Carta, parts of Shakespeare and the Bible, "The Star-Spangled Banner," the Virginia Charter, even the 1733 Molasses Act. Nothing has worked. They have tried complicated and unlikely cryptographic techniques—offsets, add-ons, multiplicative factors, group numberings. They have tried the Declaration forwards and backwards, from various starting points, using first letters, second letters and last letters. Some still think the answer is in the Declaration, but in a way yet to be discovered.

Most who seek the Beale fortune work alone, but a few have opted to pool their findings and ideas. Last September we sat in on a meeting of the Beale Cipher Association (BCA), in Arlington, Virginia. It was a lively, curious crew that included David Kahn, author of *The Codebreakers*; Carl Hammer, director of computer sciences at Sperry-Univac, a former CIA cryptanalyst, a code expert from the National Security Agency and a hodgepodge of other fortune seekers, including college professors, researchers, students, clairvoyants and dowsers.

The opinions expressed at BCA were as diverse as the members' backgrounds. Some argued that Beale never went west, that he was a pirate with Jean Laffite in New Orleans, and that the vault contains plunder from the high seas. A few felt that the code has already been cracked—perhaps by the National Security Agency—and that the vault when found will be empty. Some wonder whether there ever was a vault—or a Thomas Beale. Maybe the tale was concocted by the government in order to generate the methodology to crack this kind of code, or perhaps it was a hoax perpetrated by Edgar Allan Poe, who was an expert cryptographer and who attended the University of Virginia briefly in the 1820s.

Computer analysis of the cipher's internal structure—the pattern of evens and odds of repeated numbers, of ascending vs. descending sequences—has led to the conclusion that this code does contain a message and is not just a random series of numbers. Analysis also suggests that the method used for encoding the unsolved ciphers 1 and 3 was similar to that used for 2.

For those who think there is no gold to be found, or never was, the fascination of the Beale cipher is basic: the pure challenge of an unsolved puzzle. There it sits, a cipher purportedly 160 years old this year, taunting our sophisticated technology, daring us to try to crack it.

For more information on the cipher and for literature available on it, send a stamped, self-addressed, business-size envelope and $1 to The Beale Cipher Association, P.O. Box 216, Medfield, MA 02052.

COMPETITION #22 HEADLINES

Years ago, it was reported, a California newspaper printed a picture of Aristotle Onassis being shown Buster Keaton's estate for possible purchase. The caption under the photograph: ARISTOTLE CONTEMPLATING THE HOME OF BUSTER.

A bare-breasted woman caused a ten car collision when she went for a drive along the Hollywood Freeway in an open convertible. The incident was reported in a local paper with this headline: BARES 2, RAMS 10.

Here's your chance to enter the challenging and rewarding world of headline and caption writing. Set the scene, real or imagined, and compose one devilishly clever headline. Postcards only please, with one entry per card. All entries become the property of *Omni*, none will be returned. The grand prize-winner will receive $100; runners-up (2–10) will receive $25 each. Send entries, which must be postmarked by February 15, 1982, to Omni Competition #22, 909 Third Avenue, New York, NY 10022.

LAST WORD

By Gurney Williams III

Jules Verne's classic will become a brief story called Two-and-a-half Leagues Under the Sea and Ready for Launch

Microsurgery technology shrinks scalpels to the size of fingernails. Computers shrivel from behemoth to chip. Sedans are cut to coupes as fuel dries up. Some of the biggest breakthroughs of the past decade have turned our toys and tools from brobdingnagian to lilliputian.

Yet there is room for further contraction. Opportunities for nearsighted inventors and people who like to look in the big end of their binoculars to shrink the view. Here are some of the ideas writ small on today's drawing boards that could change the face of tomorrow, or at least a portion of its left eyebrow.

Simulated toothpaste. In recent years simulators costing millions of dollars have permitted trainees to survive simulated space fires, supertanker collisions, ruptures of cooling-water pipes in a nuclear-power plant, and wind shear disasters near airport runways. The new generation of $5.98 pocket simulators for the home will simulate the petty workaday disasters average people are heir to. The cap on the simulated toothpaste tube, for example, appears to fall down the drain as soon as it is removed. Cracks developing in the lower end of the tube release a steady flow of simulated toothpaste onto the inside of your wrist, just like the real thing. Yet neither person nor property suffers. Children cannot draw with this toothpaste, and women will not be kissed or fondled after each brushing. Naturally, the simulated paste has no ill effect on cavities, either.

The One Wonder of the World. To save space and prevent awfulness, the three great pyramids will be combined into one underground structure, pointing down and revolving slowly. The cancellation of two of the pyramids continues a centuries-old tradition of doing away with the original Seven Wonders. For instance, after an earthquake toppled the Colossus of Rhodes, a 100-foot-high bronze statue, in A.D. 225, Arabs sold off the scraps to a Houston-based builder of offshore rigs. Incidentally, if the remaining pyramid nits oil, the Exxonmobilshell Company will do everything possible to clean the black gunk from the tomb walls after the well is emptied. A TV commercial will show a hard-hatted oil-company worker sponging crude off a stony mass. "My family lives down the road from this tomb—ne will drawl—and a few of my grandparents are dead, too, just like this king. And that's why I wouldn't do anything to permanently deface this ol' cophagus."

The hydrogen miser clock. Hydrogen maser clocks developed by NASA and costing hundreds of thousands of dollars are now capable of splitting the second into a trillion parts and displaying readouts digitally. The hydrogen miser clock, on the other hand, costs only $10.95 and splits water into hydrogen and oxygen through electrolysis, saving money and hydrogen. The tiny clock has no digital readout, or even hands, and it keeps no time at all, considerably less than anything NASA has come up with. The clock will find particular favor with critics who think the exploration of space is a waste of time. Instead of mounting a mission to send a probe to Halley's Comet in 1986, for example, they will build a little hydrogen-filled balloon. Floating in a gondola, they will be able to view the comet from several hundred feet up, except when their view is obscured by the balloon.

Modling tech. As the cost of high tech rises, a new class of antepenultimate-tech devices will become available. Buyers will not exclaim, "Gee whiz!" about these items, although a few will say, "Oh, *that*." One middle-tech toy, New Jersey Invaders, a computer game about a bus from Newark that tries to force its way through New York City's dreaded grid-lock without falling into a black pothole.

The U.S. Department of Park. All national parks will be converted into shopping malls with nearby motels. To reduce the scale of this conversion and eliminate the need for traveling, all malls and motels will be identical in every detail, including the simulated medieval King Arthur's Court restaurants featuring the Fisherman's Batter Platter. This parsley-decked specialty will consist of different-sized lumps of deep-fat-fried batter devoid of fish. Replacing the previous network of parks around the country will be a single federal park at Fifth Avenue and Forty-second Street in New York City, for trucks only.

Two and a half Leagues Under the Sea. Guardians of morality will continue to excise from books ideas that shouldn't enter the small heads of children: notions like excitement and sex. Consequently, books will be brief. Lewis Carroll's *Alice in Wonderland* will be abridged and retitled *Alice in Des Moines*, to avoid any references to orifices and foreigners. One great Jules Verne classic will undergo a change of focus to become a brief story called *Two and a half Leagues Under the Sea and Ready for Launch*. It'll be about a nuke sub commander capable of reducing Moscow to something that would have to be mopped up by a giant sea sponge. But to avoid upsetting the kids, the only action will occur when Captain Nemo tells wide-eyed children aboard his sub they should go enlist in the Army.

Some other literature for adults will also bend with the times. *Moby Dick*, for instance, will undergo condensation to reflect the extinction of the whales, although for economy the revised edition by Melville, Long Island, will include some subliminal advertisements.

"Call me Ishmael after 11 P.M. or all day Sunday," the novel will begin. And Captain Ahab will be portrayed eating the Fisherman's Batter Platter (see above) with a tiny harpoon and hollering to a steward, "Hast seen the white wine?"

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