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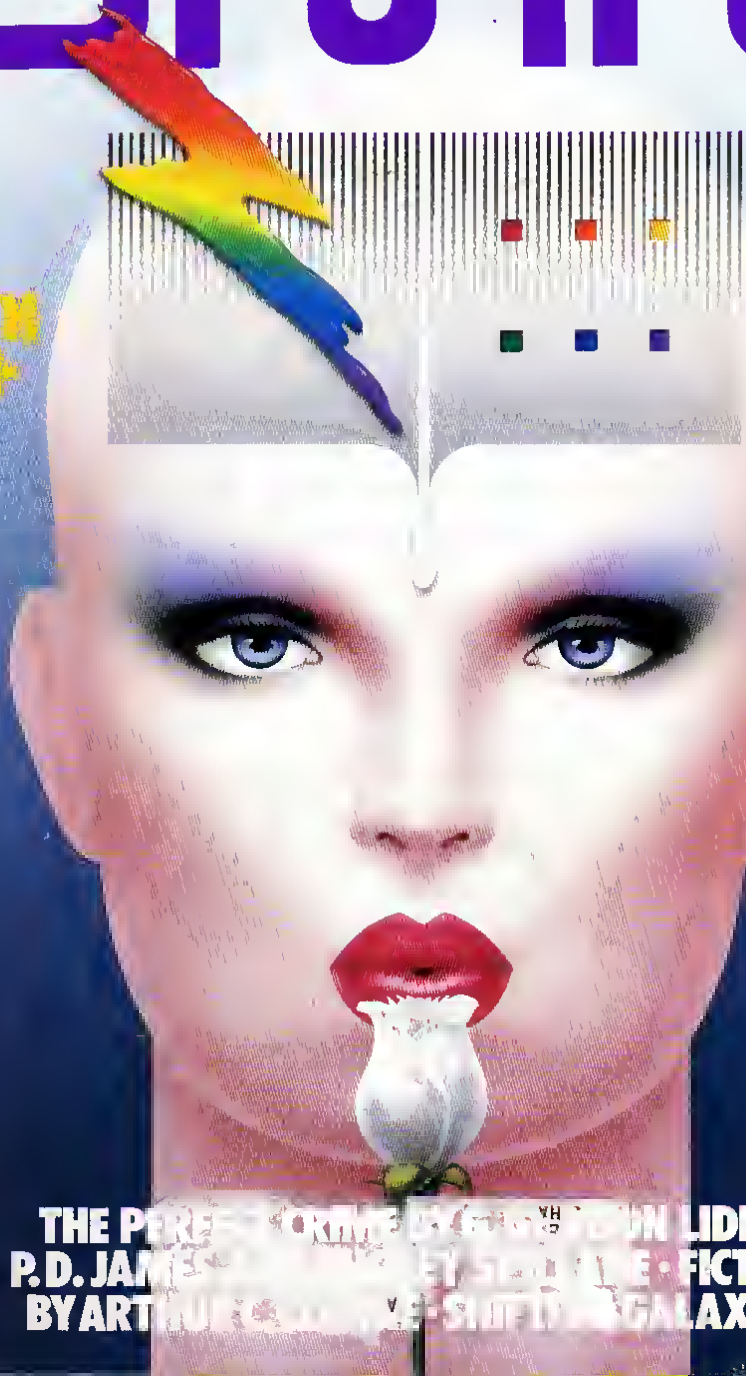
# OMNI

MAY 1987 $3.00

LIFE IN THE FOURTH DIMENSION

THE THREAT OF 'BIG BROTHER'



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OMNI®

VOL. 9 NO. 8 MAY 1987



**CONTENTS**



*The creative mind is like a brilliant palette of colors. In* The Rose, *New York–based painter Stanislaw Fernandes fuses the artistic and the logical aspects of the brain into a vision of purity and perfection, symbolized by a single white flower*

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# FIRST WORD

By Gail Marell

*"As a society we must respect and protect life. It seems a terrible waste to have the medical technology available to save a sick child's life and not be allowed to use it."*

We were excited about having another child. During the eight months I was pregnant, the baby was the center of our attention. We planned for and dreamed about the new addition to our family and were eager for our child's arrival.

Pregnancy is the most unusual time in a woman's life. It's a time filled with constant emotion, anticipation, excitement, and fear. I don't know any woman who hasn't at some time during pregnancy become obsessed with the possibility of something going wrong with her baby. Nine months is a long time—a time when almost all of your thoughts focus on the miracle of the new life growing inside of you.

It was the beginning of my ninth month when a somewhat routine sonogram revealed that the nightmare was indeed a very concrete reality. Our doctor's voice was filled with pain as he explained that our baby suffered from a birth defect called anencephaly. We listened in horror as he told us that our baby's brain and skull had not developed. There was only a brain stem. Our baby would die at birth or shortly thereafter.

As he explained our options I knew that I had to terminate the pregnancy as soon as possible. Our doctor encouraged me to carry the child to full term, but feeling the baby grow and kick for another month was more than I could bear. I needed to get through the delivery and get on with my life. Sometime during that night, as we went over and over what was happening to us, we began to think about all the appeals from the anguished parents of children awaiting liver, kidney, and heart transplants. The brain stem, we were told, is the portion of the brain that controls functions such as breathing and heartbeat, so our daughter's body organs had developed normally. We began to wonder about the possibility that any of our baby's organs could be useful to another baby. Maybe our baby's organs could give a sick child a chance to live. Maybe we could find something good in our tragic situation.

When we arrived at the hospital early the next morning, we were aggressive about our wish to donate our baby's organs. The hospital staff, however, didn't know the answers to all of our questions. They did know that removing the organs of an anencephalic infant was a clouded issue and warned us not to get our hopes up. Nonetheless, it served as a goal.

All that long day and night we grasped at the prospect of finding something positive. Our obstetrician made some inquiries, only to find out that California law would not permit us to help children desperately in need of organ transplants. All the other states have similar rulings. The law says that a person must be "brain dead" before organs can be removed for transplant. It rigidly defines this condition as the "irreversible cessation of all functions of the entire brain, including the brain stem." The law does not allow parents to donate a baby's organs as long as the "brain stem" continues to function. The absence of a brain makes no difference. It's a catch-22. Once the brain stem stops, the organs give out, and it's too late for them to be useful.

There was nothing more we could do. The next morning we tried to induce labor. That was unsuccessful, so I had a Caesarean section. Our daughter lived for three hours.

The law seemed so wrong. How could anyone consider the quality of my daughter's short life above the life of a child who could have a chance? Who benefits from this law? My daughter felt no pain. My daughter had no consciousness. But there are hundreds of babies born with birth defects that could be corrected if the necessary organs were available.

Each year 400 to 500 children suffer from lethal kidney disease. An additional 400 to 500 children have congenital heart disease. Yet another 500 suffer from deadly liver failure. There is a very limited supply of these greatly needed organs. Some of these children could be saved through transplants from anencephalic organ donors. Each year about 3,500 anencephalic babies are born in the United States. It seems such a terrible waste to have the medical technology available to save a sick child's life and not be allowed to use it.

Our sorrow did not go unheeded. State Senator Milton Marks (R-San Francisco) read in a local paper about our unsuccessful attempt to donate our baby's organs. In May 1986 Marks introduced a bill to the California legislature in which this phrase would be added to the statute: "In addition, an individual born with the condition of anencephaly is dead." To Marks's surprise, the bill was met with strong opposition and failed to meet a legislative deadline for 1986. We hope the bill will be reintroduced in 1987.

As a society we must respect and protect life. The "brain death" laws were written to protect people with severe brain damage. These laws should guard life as long as there is any hope of survival. The baby born with anencephaly, however, is born dying. There can be no reversal. There is no hope for survival. The life cannot be saved. But that life could save others.

The law should be changed. *Brain absent* should be redefined as "brain dead." Anencephalic babies should be the only exception made to the law. Hospitals and doctors should be able to present parents of anencephalic babies with the option of donating their child's organs. It's a horrible, difficult situation, but the opportunity to have helped someone else through a difficult situation would certainly have eased my mind. ☐

*Gail Marell, her husband, their four-and-a-half-year-old son, and their dog Sam live in Oakland, California.*

# CONTRIBUTORS

# OMNIBUS

CLARKE

THE E[illegible] THE MORNING AND THE NIGHT

RUDE AWAKENING

DIMENSIONS

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A cube intersecting a flat plane can be cut through a number of geometrically different cross sections says Peter Tuthy in Greg Bear's Nebula-nominated "Tangents" (January 1986). To a two dimensional creature living on that plane, he explains, the cube can appear to be either a triangle, a rectangle, or one of several other forms. If, however, a hypersphere from the fourth dimension bounced into our space, it would look like a balloon blowing up from nothing and then shrinking again.

In Bear's story, Tuthy works to break through to the fourth dimension—with dramatic results. Today, according to former *Omni* editor *Gurney Williams III* ("Dimensions," page 52), mathematicians, physicists, and computer scientists are in equally active pursuit of realities beyond our own three dimensional world. Some physicists, for example, believe there might be as many as nine dimensions. On a practical level, their work will benefit such endeavors as telecommunications, information processing through computer modems and radio links, and 3-D simulation on 2-D movie screens.

"While watching a film of 4-D structures and trying to understand what was going on," Williams says, "I had the same kind of feeling you sometimes have when you wake up and try to remember a dream but can't. Our understanding of the fourth dimension is just out of reach, but tantalizingly close. And current research may prove Plato right. There may indeed be an ideal world just beyond our grasp.

While NASA uses multiple dimensions in telecommunications to retrieve pictures from distant moons and planets, the Defense Department is empowered to seize control of all commercial communications satellite systems in the event of a national emergency. It is, moreover, attempting to keep database information not only from the public but also from industry experts, scientists, and even government officials. In "The National Guards" (page 44), investigative writer *Donald Goldberg* reports on the government's invasion of the private telecommunications sector and how new rulings affect the daily flow of information, including data relayed by banks and businesses. A former senior staff member with Jack Anderson, Goldberg—while writing the story—procured memos from secret and closed-door meetings involving the Defense Department, the White House, and such commercial communications companies as AT&T and ITT.

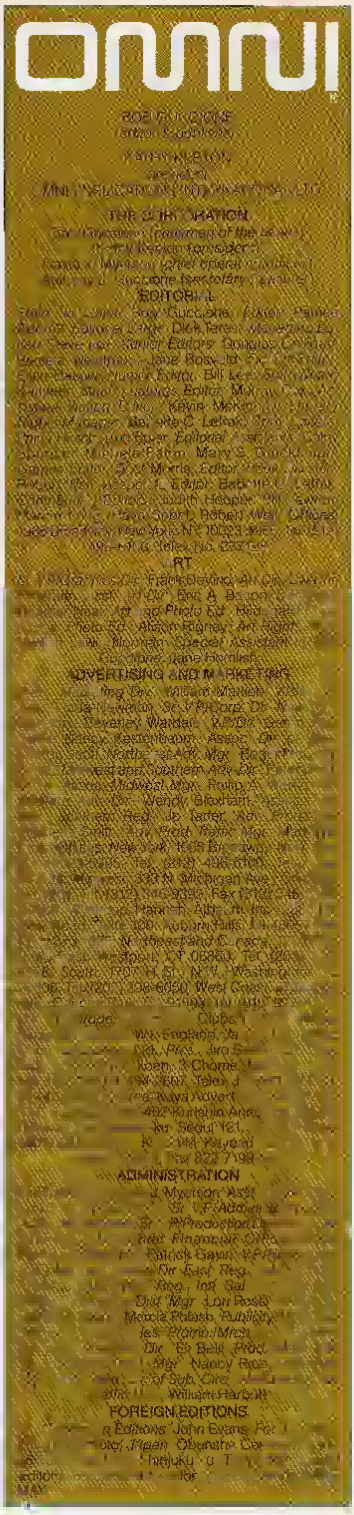
The technological breakthroughs in communications would astound Alexander Graham Bell. Likewise, Sherlock Holmes never imagined the crime solving techniques explored in *Erik Larson*'s "Getting Away With Murder" (page 72). Already the FBI has used lasers to develop, for example, a 30-year-old fingerprint from the back of a postcard and thereby prove a link between Heinrich Himmler and a suspected Nazi war criminal. Today, police departments are experimenting with portable lasers at crime scenes to uncover prints that earlier techniques would never have found. But the ultimate fingerprint is the genetic code encapsulated in every cell of our bodies.

Crime researchers don't think about death the way the rest of us do. Having lunch with them showed me what a layman comes up against in the enthusiasm forensic people have for their work. Larson comments. "They can clear out a restaurant with their talk about maggots and rotting bodies, but it doesn't affect their own appetites at all."

It might seem that Larson is becoming something of a future crime expert. His "House Arrest" (September 1986)—an excerpt from *Arthur C. Clarke's July 20, 2019* (Macmillan, 1986), for which Clarke was general editor and Larson a contributing writer—also involved murder. Now, with Clarke's "On Golden Seas" (page 88), the two writers appear in the same issue once again.

The work of author *Octavia E. Butler* makes its first appearance in *Omni* with "The Evening and the Morning and the Night" (page 56). Her novel *Dawn* will be published this month by Warner Books.

For the pictorial "Rude Awakening" (page 64), author *Thomas M. Disch* created a fantasy to accompany our portfolio that displays microscopic views of bugs and other exotic creatures. The photos in "Windows on the Mind" (page 92) are computer graphics models of brain waves and sensors.



# LETTERS

# COMMUNICATIONS

### The Energizer

Phil Patton's treatment of Bogdan Maglich and his approach to fusion ["Getting Nuked," February 1987] presents the mainstream fusion community as a gang of stick-in-the-muds. Actually, it takes 10 to 20 years for any new fusion concept—not just Maglich's—to emerge and receive serious attention.

The Tokamak, which Patton derides, was invented in 1950 and came to the fore in 1968. Compact toroids, which have provoked a lot of controversy, were proposed in 1975. The toroid program finally has been funded in the 1988 budget, and may become a major new endeavor. So Maglich's experiences are quite in keeping with this pattern.

T. A. Heppenheimer
Center For Space Science
Fountain Valley, CA

Isn't it ironic that the deathblow to communism and the triumph of democracy lie in the hands of our government and have been there for years? Imagine aneutronic energy in African villages, Central American hamlets, Russian cities—and our own basements.

Why not dump SDI [star wars] and set up a world economic recovery plan based on aneutronic energy? Instead of pouring more funds into the Pentagon budget, we could support Maglich's fusion concept and create a better place for all the world's inhabitants. Apparently, it costs too much to change.

Marge Chupa
Twin Falls, ID

### Skeptical Inquirers

Jerome Clark alleges that the Committee for the Scientific Investigation of Claims of the Paranormal [CSICOP] conducts witch-hunts, will do anything short of criminal activity, and is an inquisitional body ["Censoring the Paranormal Continuum," February 1987].

Far from burning our opponents, we invite them to present their cases at our conferences and to debate and discuss the issues. When Clark himself organized a UFO conference, he did not invite any skeptical speakers.

Yet Clark accuses us of doing "anything short of criminal activity" and quotes Drew Endacott to support this accusation. We did not support the formation of Endacott's group in Philadelphia because we disapproved of his method and approach. Clark knew the facts about Endacott but did not state them. We are opposed to censorship in any form whatsoever and are committed to open and free scientific inquiry.

Mark Plummer
Executive Director
CSICOP
Buffalo

### In the Heart of the Heart of the Country

It's easy to see why people have been calling the intriguing image on the Fostoria, Ohio, oil tank a portrait of Jesus ["Oil-Tank Jesus," Antimatter, February 1987]. While the image appears to resemble the Shroud of Turin, the background of the oil-tank Jesus has round speckles, and slashes of light paint appear across the beard and one eye.

Did the shroud image get transferred to an oil tank? Did an artist paint or wrap a photograph around the tank in the dead of night? What's the message?

J. Ashley
Manlius, NY

### Road Warriors

I am happy to report that workers on Alabama's highways are taking Professor Knutson's sage advice to leave flattened animals on the road ["Professor Splat," Continuum, February 1987]. While driving on a freshly resurfaced road between Dothan and Enterprise, I saw a scene reminiscent of the photo you ran with the article—except the new yellow line went over the dead animal instead of under it.

Neil Billings
Miami

### Correction

The attempted censorship of Jean M. Auel ("The Real Fahrenheit 451," Books, February 1987) happened in Bastrop, Texas, a town southeast of Austin.

# NOSY READERS

# FORUM

The sense of smell—the most ancient of the five senses—appears almost lost in the prefabricated deodorized hubbub of the twentieth century. In order to function today's humans must still see and hear but *smelling*—detecting molecules of odor as they float through the air—seems unnecessary in an environment where air is conditioned, food purified, and water filtered to suit predefined standards of comfort. Ongoing research, however, is reestablishing the sense of smell as one of the prime determinants of psychological mood, biological rhythms, and choice of mate. In April 1986 *Omni* ran a questionnaire on scent to aid scientists' work. Called "Test Your Scentsability," it was developed with the aid of Richard Doty, director of the Smell and Taste Center at the University of Pennsylvania. "If respondents did not have at least a passing interest in olfactory function, they wouldn't have completed the form and mailed it in to *Omni*," Doty says of the more than 20,000 readers who put their noses to the test.

According to the results, the readers' favorite scent is the aroma of flowers, especially that of roses and lilacs. Other favorite smells include cedar, pine, rainfall, baked bread, and spring air. Not surprisingly, the most commonly hated smell is decaying animal flesh, followed by vomit, feces, and sulfur.

The *Omni* survey is probably the first time anyone has ever asked a sample of people whether they smell their own bodies. "Body odor is somewhat of a taboo topic," Doty says. "So it's interesting that this survey suggests smelling one's own body—and we can assume this primarily means axillary [armpit] smells—is a regular behavior of humans."

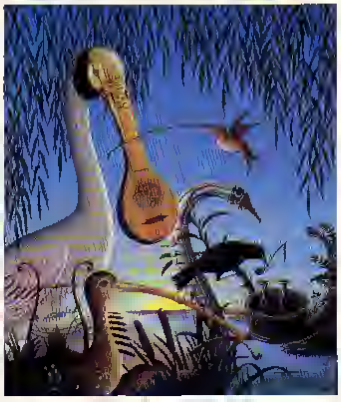
Nearly 82 percent, regardless of age or sex, deliberately smell their own bodies periodically. A third smell themselves several times a day. "Given the taboo nature of body odor," Doty says, "I'd like to ask them if they have ever observed others smelling themselves. Is this a private act? Or do people smell themselves at any time, anywhere?"

According to studies conducted at the smell lab, people can usually determine one another's sex from axillary and breath odors. Some subjects were blindfolded and asked to sniff armpits; others sampled the odors of men and women breathing through a tube.

Studies by Richard Porter at Vanderbilt University in Nashville, Tennessee, have further shown that not only can we learn to recognize one another on the basis of odor, but infants can discriminate between the scent of their own lactating mothers and that of other women.

"I'd now like to find out whether self-smelling serves psychological reassurance purposes, relates to social or hygienic concerns, or represents other processes," says Doty.

One quarter of all respondents also notice a difference between how each nostril perceives odor. And more than half of those reporting a difference believe odors have a greater effect on their right nostrils. What's fascinating, Doty notes, is that people seem to be about evenly divided on the question of whether the sensitivity changes from one nostril to the other or remains the same over time. "There's a well-known cyclical change in nasal engorgement from one side of the nose to the other, and it occurs every few hours in most people," Doty says.



Whether this causes an alteration in the olfactory function of some people isn't known, but it could be a basis for the belief that sensitivity to odors shifts over time from one side to the other.

With the questionnaire we also included a scent card and asked respondents to identify five odors. More than three quarters correctly identified the scent of spiced apple (scent 1), but only about one third indicated it made them feel nostalgic; others felt invigorated or relaxed. In addition to chocolate (scent 2) and mint (scent 4), we also included peach (scent 5), which practically nobody correctly identified. Yet slightly more than 40 percent said it made them feel free of pain—an effect researchers are investigating. Only 3 percent correctly identified the scent of lavender (scent 3). Of course, this scent is often incorporated into soaps, which is probably why half of the respondents identified this odor as such and said it made them feel like bathing.

The figures, moreover, indicate that, as a whole, *Omni* readers seem to be well kempt. "Doty says. Two thirds state they bathe seven times a week or more. Of course, 3 percent may be fanatics, taking 14 to 20 baths a week, but 8.7 percent take only three or less.

Doty and his colleagues will now further analyze the data in greater detail. They'll compare data on smokers and nonsmokers and their sensitivity to odors, for example, and the kinds of dysfunctions among those who frequently use perfumes and those who don't. It would be interesting. Doty says, to perform more elaborate studies of respondents' scent abilities, like individual threshold values to determine how strong an odor must be in order to detect it.

Anyone who has an odor dysfunction can write to the Smell and Taste Center, University of Pennsylvania Hospital, 3400 Spruce Street, Philadelphia, Pennsylvania 19104-4283. —Kevin McKinney

## OOPS

The December cover (left), *Dawn Chorus*, was rendered by James Marsh. We incorrectly identified him as John DO

# HEAVENLY DRIFTERS

# STARS

By Marcia Bartusiak

The history of astronomy is strewn with the rubble of fallen cosmological models. Copernicus with his radical doctrine of an Earth revolving about the sun, removed us from the center of the universe. Galileo, the first person to gaze at the heavens with a telescope, introduced humankind to a universe of wondrous intricacy. Now twentieth-century astronomers are challenging another dogma: our portrait of a homogeneous cosmos in which galaxies are evenly distributed.

Extragalactic surveyors have learned that the cosmos doesn't expand in as regular and orderly a fashion as previously thought. The cosmic sea appears to be awash with strong local currents—and no one is sure why. A team of American and British astronomers has discovered that the Milky Way—as well as all the galaxies, clusters of galaxies, and superclusters in a vast region of space surrounding our home galaxy—is racing toward a point in the sky marked by the Southern Cross, a prominent star group in the Southern Hemisphere. Theorists and observers alike are struggling to explain this peculiar and surprising current.

In 1929 the eminent astronomer Edwin Hubble proved that galaxies are carried outward as space-time expands. The spark that ignited this tremendous push is generally assumed to be the Big Bang, the cataclysmic explosion that, as theory has it, gave birth to our universe about 15 billion years ago.

As galaxies move along they also experience more localized, or "peculiar" motions, the result of being pushed or pulled by nearby concentrations of matter. Our Milky Way, for example, hovers at the edge of a large collection of galaxies known as the Local Supercluster and is gradually being drawn toward the Supercluster's center. Further observations had led astronomers to conclude that the Local Supercluster was in turn drawn toward another distant galactic collection, known as the Hydra–Centaurus Supercluster. And according to theories of the distribution of matter in the universe, these and other galaxies were supposed to be moving at a predictable rate.

New evidence, however, shatters this assumption. While working on an unrelated astronomical project, a team of seven astronomers using six telescopes situated on four continents discovered first of all that Hydra–Centaurus is not drawing closer. It's moving away from us. Second, it is moving at a rate faster than can be attributed to the cosmic expansion astronomers now know occurred. All the galaxies in the Local Supercluster and the Hydra–Centaurus Supercluster are streaming together through space at speeds of more than 1 million miles per hour over and above the rate of cosmic expansion. With everything in motion, it took a while to detect the additional velocities of the galaxies.

"One might think of these galaxies as moving downstream together," says team member Alan Dressler of the Mount Wilson and Las Campanas observatories. "This finding indicates that our long-held belief in a smooth and uniform universe was just an illusion."

*Supercluster racing through space. But why?*

In the tradition of so many astronomical findings, the discovery of this large-scale mass flow was serendipitous. Originally the team had set out to study the general properties of elliptical galaxies, those roundish systems of stars. It was the kind of long-term, tedious project rarely heralded in popular-science stories.

"Once we started analyzing our data, we saw the anomalous motion almost right away," Dressler says. "But it took at least a year before we were convinced."

What could be causing this galactic flow? One simple but speculative interpretation," offers team member David Burstein of Arizona State University, "is that a huge concentration of mass greater than Hydra–Centaurus exists somewhere beyond. This mass could be drawing Hydra–Centaurus, our galaxy, the entire local universe toward it." Lately, survey members think that a vast conglomeration of galaxies beyond Hydra–Centaurus—some 10,000 *trillion* solar masses in size—is one candidate.

Others wonder if this unusual surge of motion is left over from the universe's primordial beginnings, when the cosmos was generating galaxies and releasing enormous amounts of energy as newborn stars radiated and explosively died. Early last year, in extending their maps of the sky, astronomers at the Harvard–Smithsonian Center for Astrophysics did find that galaxies were arranged as though they formed the surfaces of gigantic cosmic bubbles, forged perhaps from the shock waves of primordial stars, which exploded and pushed the galactic matter into spherical shells. The same explosions are what could have sent the galaxies streaming through space. It will take more sky surveys to do it.

"The more flows and the more bubbles we find, the better," says Dressler, "because it means we are finally going to find out how the universe really works."

At some time in the future," Dressler adds, "astronomers might look back on our study and the Harvard–Smithsonian survey as turning points in the understanding of the large-scale structure of the universe."

# LONE DANGERS

## MIND

By Ruth Elizabeth Borgman

All the available data point to chronic loneliness, social isolation, and the sudden loss of a loved one as being among the leading causes of premature death in the United States," says James Lynch, psychologist and codirector of the Psychophysiological Clinic and Laboratories at the University of Maryland School of Medicine.

Lynch's assertion is backed up by the results of recent studies in epidemiology and immunology. Loneliness lowers your resistance to disease, weakening both the immune and cardiovascular systems. And lonely women are at a higher risk for breast cancer than women who have lots of social contacts.

Last year Peggy Reynolds and George A. Kaplan, epidemiologists at the California Department of Health Services, published a study on the relationship between cancer and social isolation. Drawing on an earlier survey of nearly 7,000 healthy adults in Alameda County, California, they found that socially isolated women had an appreciably greater chance of getting cancer and dying from it. (The same was not true of isolated men.)

"It wasn't only social isolation based on lack of social contacts," Reynolds emphasizes. "The important factor is perceived isolation, or the feeling of loneliness." Women who felt isolated, even though they had many social contacts, had 2.4 times the risk of dying from hormone-related cancers; women who had few social contacts *and* felt isolated were five times as likely to die. Reynolds hesitates to interpret the data any further than to say, "There is a clear correlation between emotions and high risk in specific types of cancer, such as breast, uterine, and ovarian cancer." Because emotions affect hormonal regulation, perceived social isolation may have a direct impact on the development of these cancers.

Janice Kiecolt-Glaser and Ronald Glaser, a psychologist and immunologist, respectively, at Ohio State University College of Medicine in Columbus, are conducting studies on the relationship between loneliness and the immune system. Like Reynolds and Kaplan, the Glasers have focused on the individual's perception of being lonely. In a study of 33 psychiatric patients, the Glasers looked at the activity of natural killer (NK) cells, which monitor and destroy cancer cells and cells infected by viruses. The patients who reported feeling lonely had significantly lower levels of NK cells. And in five separate studies of medical students who were preparing for final examinations, they found the same phenomenon. Those who felt lonely showed lower levels of NK cells than their peers.

"When you're lonely, you're disconnected," says Lynch. "And the feeling of isolation affects the body." At his Maryland clinic, James Lynch conducts tests on hypertensive individuals to show the link between speech and the cardiovascular system. He hooks up clients to computers that monitor blood pressure and pulse rate. The point: to convince the person that his thoughts are his body, that his speech *is* his blood pressure.

"Speech is a uniquely human bodily function," Lynch says. "The baby's first cry probably is a substitute for the umbilical cord. That cry keeps us connected to our bodies, to one another, and so in tune with our health." The lonely don't know they have a social membrane, a second skin—phrases Lynch uses to describe our interaction with others. "In human communication we literally project our hearts into what we say," Lynch says. "We want physically to be understood." Love, Lynch adds, is anchored in our bodies.

"We all experience times when we are lonely," says Paul Pearsall, psychologist and director of the Problems of Daily Living Clinic at Sinai Hospital in Detroit. "Only the lonely person can judge whether the experience is positive or negative." Pearsall objects to defining loneliness simply as a negative state. While a certain amount of stress benefits some people, the same stressful situation harms others. "What we can't predict is who will react to what," says Pearsall.

In a recently published book, *Super Immunity* (McGraw-Hill), Pearsall identifies different reactions to loneliness as "hot" (hostile) or "cold" (depressive). He believes that cardiovascular problems are more likely to occur when a person is in a hot phase; cancers are associated with the cold phase.

One of Pearsall's patients at the Detroit clinic was suffering from the recent loss of his wife and talked about how much time he was spending alone. Although everyone encouraged him to get out and keep busy, he said he preferred to be alone, reminiscing and feeling sad. One day, after therapy, the man brightened. "So what I have to do is learn to be alone better!" Pearsall is happy with that insight. "Loneliness is, after all, a beautiful adaptive response to the situation of being alone," he says. Pearsall believes that the state of being lonely is neurologically based in the oldest part of the brain, a physical response similar to the fight-or-flight response. "Loneliness is a constructive rescue phenomenon," Pearsall continues. "We act or look lonely instinctively, which elicits a response from others that will alleviate our feelings of isolation. And the more we accept it and understand it, the better off we are."

*Loneliness may be hazardous to your health*

# CIPHERNAUTS

# EXPLORATIONS

By Paul Hoffman

The bait is buried treasure a $14 7 million cache of gold silver and jewels believed to have been stashed somewhere in the state of Virginia more than 150 years ago The only clues to its whereabouts three slips of paper covered with a hodgepodge of 1 901 numbers

Some say it s a hoax but the Beale Cypher Association (BCA) isn t ready to give up its quest for the tool For 25 years the society whose members range from IBM cryptographers and CIA spooks to metal-detector hobbyists has struggled in vain to decipher the numbers that could reveal the directions to the cache One BCA member convinced that he had broken the code rushed to the prospective treasure site in Bedford County Virginia surrounded it with formidable fences hired round-the-clock guards rented a bulldozer and unearthed—lo and behold—a 1930 s car Other enthusiastic members have sneaked onto private property to dig under cover of darkness but were seen shot at and arrested for trespassing

These setbacks have not deterred the BCA I think it is fair to say that this effort has engaged a large number of the best cryptanalytic minds in the country says Carl Hammer seventy-three the former director of computer science at Sperry Univac and a pioneer in using computers to analyze the statistical properties of ciphers I myself have spent ten years on these ciphers says Hammer and I m not through yet

The man responsible for this madness was Thomas Jefferson Beale, a tall swarthy ruggedly handsome adventurer with jet-black eyes and hair who mined gold and silver in Santa Fe and hauled it back to Virginia in the early 1820 s Because he was in trouble with the law (rumor had it that he was seen leaving the room of a woman who was not his wife) Beale hid the gold and silver and disappeared leaving a locked iron box in the care of Robert Morriss, the respected owner of a tavern in Lynchburg That summer Morriss received a long letter from Beale describing unpleasant encounters with bulfalo and savage grizzlies and explaining that the box in Morriss s possession contained the coded whereabouts of a buried treasure Morriss was instructed to break the box open if Beale did not return to claim it in ten years Beale also promised Morriss that he would receive another letter revealing the key to the code so that he could decipher the papers effortlessly Needless to say the promised key never arrived and Morriss never heard from Beale again Whether he was massacred by Indians or mutilated by savage animals is only a matter for speculation

When Morriss pried open the box he found the three pieces of paper each covered with numbers along with a letter from Beale claiming that the three papers encoded the exact location of the treasure the precise contents of the stash and the names and addresses of the people who had helped him to mine the gold and silver For 17 years Morriss tried to break the ciphers but failed to make any headway In 1863 the year before he died he gave the ciphers to James B Ward a bartender and family man who had accumulated sufficient savings to be able to spend his days contemplating numerical gibberish and searching for elusive treasure

*Fortune hunters Crack the cipher and win big*

Ward decoded one of the papers after he discovered that the cipher was a remarkably simple one based on numbering the initial letters of the sequentially numbered words in the Declaration of Independence To decipher the paper Ward replaced each number with the corresponding letter in the Declaration of Independence Thus *1* stands for *W* because the first word in the Declaration is *When* and *6* represents *h* because the sixth word is *human* Once deciphered the paper read in part I have deposited in the County of Bedford about four miles from Buford s in an excavation or vault six feet below the surface of the ground the following articles belonging jointly to the parties whose names are given in [paper] number three herewith The paper also revealed the contents of the treasure (1 921 pounds of gold 5 100 pounds of silver and by today s standards some $3 35 million worth of jewels) and ended on the tantalizing note that one of the other two messages describes the exact locality of the vault so that no difficulty will be had in finding it

This teaser combined with the simplicity of the deciphered code has spurred on generations of cryptographers In the 1960 s some of the best minds in cryptanalysis formed the BCA to pool their knowledge and resources Hammer and many of the other BCA members are convinced that the coded message leading to the treasure must have been created by numbering a document like the Declaration of Independence BCA members have numbered by hand and by computer sections of the Bible the Magna Carta the Louisiana Purchase agreement, the Constitution Shakespeare s plays and dozens of other texts that Beale might have used The problem is not just finding the right text but numbering it the right way Perhaps they ve considered, it s the last letter of a

CONTINUED ON PAGE 87

# NEW EXITS

# SPACE

By Alcestis Oberg

When NASA held an escape and-rescue simulation at the Kennedy Space Center last year, press reports noted how it "raised morale" at the agency. But initially at least, it also raised some doubts about NASA's ability to handle emergencies.

The whole exercise was a dress rehearsal for evacuating a shuttle crew (some of whose members might be injured) exposed to a toxic fuel leak that could become a fire. Problems began when the "emergency" was phoned in to the launch site. The people near the orbiter could *hear* the phone but had a hard time finding it. It was in a gray box, indistinguishable from other gray boxes at the site containing various equipment.

During the simulation, the ground crew wore breathing gear to protect themselves from toxic fumes given off by the fuels that usually swirl around a launch site. Had there been real toxic fumes in the area instead of imaginary ones, the person answering the phone would have been asphyxiated; to use the phone he would have had to remove his emergency breathing gear.

Later in the same exercise, crew members attempting to climb into escape baskets had to walk out on the gantry connected to the shuttle's entrance hatch. That was made risky because the emergency sprinkler system had been turned on, making the walkway surface dangerously slippery. In the simulation, the escape baskets—designed to slide down long guy wires to the ground—were never actually used because they had never been tested with people in them.

Once on the ground, the problems continued. When the astronauts arrived at the evacuation site, they found only two aircraft instead of the three that were slated to be waiting for seven incapacitated victims. (NASA officials solved the problem by declaring one victim miraculously cured and crowding the remaining six onto the two functioning helicopters.) Finally, the helicopter trip to the Gainesville hospital took almost an hour because the copters had to stop and refuel—even though they were supposedly carrying injured passengers.

Although the simulation was fraught with hitches (170 were compiled), the space agency learned a lot from it. In the aftermath of the rehearsal, NASA decided to standardize equipment, better coordinate the activities of rescue and fire-control teams, apply nonskid grating to the gantry, and increase the number of support personnel and aircraft. Also, each astronaut will wear a parachute, have air supplies that last longer, and be issued protective clothing.

More problematic is what to do once the shuttle has been launched. Of course, the top priority is redesigning the rockets. "The safest course now," says Kennedy Space Center test director Frank Merlino, "is to try to make the solid rockets and the shuttle as safe as they can be. Roger Beaujoly and Allen McDonald [the Thiokol engineers who tried to stop the launch of the *Challenger*] were very courageous. I hope that personal integrity will translate into design integrity."

Safe rockets are critical because there is still no workable escape system for the first two minutes of flight. In those early moments, the shuttle travels too high and too fast, making it impossible for the crew members to evacuate the shuttle and survive. But their chances improve after the solid booster motors have separated from the orbiter.

*The next shuttle launch. How safe will it be?*

If it is still in one piece, the shuttle can circle back and make a landing at one of the emergency runways around the globe. If a dry landing is impossible, there are other escape options.

Officials believe the safest way to get most of the crew out would be via a special escape pod in the payload bay. The pod would have its own rocket, life-support systems, and parachutes.

This idea has been shelved, however, because of its cost and complexity. "It would take at least five years to test, build, and install in all the orbiters," says William Chandler, head of the crew-escape-system program. "It would also reduce the amount of cargo the shuttle carries into orbit." And the cost of such a system would be phenomenal—half the price of a $2.8 billion orbiter.

The option most favored is called the walkaround extraction system. A crew member appointed as the jump master fires explosive bolts to blow open the entry hatch in the side of the shuttle. Each crew member positions himself near the hatch and attaches to his body harness a small rocket that yanks him out the side, headfirst. This technique would require only relatively minor modifications.

According to Rockwell International, which will be installing the $50 million system, a crew using these rockets could evacuate the shuttle in 112 seconds. The company expects to have the entire assembly installed on an early post-*Challenger* shuttle flight.

Whatever happens on future shuttle flights, one thing is certain: Crew safety will no longer be taken for granted. As flight surgeon Josy Boyce notes, "If you look for a silver lining in the *Challenger* disaster, it's that it will change the way we do business in the future. I doubt there'll ever be any space system built without some form of escape designed into it."

# COSMIC TECH

# BODY

By Cheryl Weinstock

In the wake of the space shuttle disaster and the current U S /Soviet wrangle over star wars initiatives it might seem as if all that expensive high-tech hardware dreamed up by NASA engineers has served no useful earthly purpose

But now some of that sophisticated machinery devised to explore the cosmos is being adapted to advance medical technology here at home In fact new treatments for such life-threatening disorders as diabetes and cancer have been developed through the use of cleverly redesigned aerospace equipment

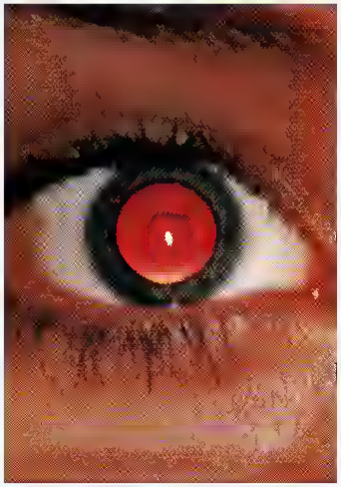
"We didn t find any Martians on Mars but we did come back from the planet with a model for an internal insulin pump that could control diabetes better than ever before " says Christopher D Saudek associate professor of medicine in endocrinology and diabetes at the Johns Hopkins University School of Medicine The pump which is placed just beneath the abdominal skin may soon replace the daily insulin injections of some of the nearly 600 000 diabetics who now require to keep their blood-sugar levels stable

The inspiration for the pump came from a device used in the 1976 *Viking* spacecraft which delivered continuous and precise amounts of chemicals to test for life on Mars The new medical application, called the Programmable Implantable Medication System (PIMS) will perform in the same way delivering carefully measured amounts of insulin to the diabetic's abdominal cavity where it can be absorbed into the bloodstream

This is just one example of the recycled technology emanating from NASA's Technology Utilization Program, which was established in 1962 The objective of the program explains Donald Friedman chief of the Office of Commercial Programs at the Goddard Space Flight Center in Greenbelt, Maryland is to bring together NASA engineers and "idea" people from private industry to utilize space technology in the private sector Friedman and about a dozen other industrial brokers around the United States act as go-betweens "for NASA and the outside companies We put together teams " he says "who can match marketplace ideas with a particular NASA technology and derive something from it that will benefit people"

It's not an easy task Less than 0 04 percent of NASAs yearly budget is earmarked for the Technology Utilization Program so its success depends on private industry s willingness to share in the cost of transferring technology from the NASA labs to their own Even so a number of companies are finding that the cost is worth the potential benefits Douglas Ritchie general manager and senior vice president of MiniMed Technologies which is marketing PIMS says that the advances that have evolved as a result of NASAs work have been very important to the growth of our company"

A number of products have already traveled from the stars to the marketplace on Earth There's NASAdent a foamless ingestible toothpaste—like the one the astronauts brush with—designed for people who are unable to expectorate A biotelemetry system originally developed to observe the vital functions of space-bound astronauts from the ground has been adapted to enable hospitals to monitor the condition of a number of patients from a single location An implantable pump much like PIMS has been developed that delivers medications—such as opiates for pain and even chemotherapy drugs—directly into a patient s bloodstream Researchers have also designed a prototype for a light-weight wheelchair constructed from materials used in building spacecraft



*Measuring the eye with telescope technology*

Perhaps one of the most interesting NASA-to-industry inventions is the LIXIscope a portable X-ray machine adapted from the technology of the space telescope Utilizing the image-intensifying system of the space telescope the tiny LIXIscope can be held up to a specific area of the body giving its user a Superman s-eye view of nearly all the body s bones and organs According to NASAs Friedman the device could examine injuries on the sporting field and might even replace the old-fashioned dental X ray because of the comparatively lower radiation dosages it yields

The space telescope is also expected to be recycled into yet another device—one that can measure the precise shape of the eye Such an instrument could be employed to increase the success of radial keratotomy an operation to correct nearsightedness But Dr J James Rowsey director of corneal services at the McGee Eye Institute at the University of Oklahoma cautions "We're far from using this operation as a replacement for glasses or contact lenses because we don t have an instrument to accurately map the shape of the cornea" In the operation several cuts are made in the outer layer of the cornea to reduce myopia An instrument that could predict exactly where the cuts should be made explains Rowsey would immeasurably improve the operation s success rate Researchers hope that such an instrument will be tested at the eye institute by next year

Other products still on the drawing board seem destined to provide us with important medical breakthroughs For instance microspheres—small beads present in rocket fuel to ensure that it will

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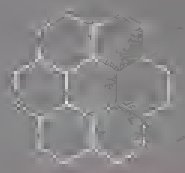

# CONTINUUM

## WHO NEEDS WOMEN?

Several years ago when I was writing a physics column for a science magazine I received mail from fans and fanatics offering everything from simple praise to elaborate disproofs of Einstein s theories As I always signed my articles "K C Cole " these letters were addressed to 'Dr Cole' or 'Mr Cole Never did it occur to any of my readers that he might be a she On occasion, a caller would ask for Dr Cole' and I would say Speaking His voice then would drop in a disappointed oooh What could a girl know about physics?

Any woman who's involved in the physical sciences knows what it s like to feel like a freak Women account for only about 13 percent of all scientists and even these are heavily concentrated in the social and behavioral sciences Minorities fare even worse Although blacks make up 12 percent of the U S population they received less than 1 percent of the physical science doctorates in 1983 Hispanics are equally scarce Yet by the year 2000 minorities will account for one third of our population

At a time when the United States faces a very real crisis in science literacy we can hardly afford exclusion on such a vast scale Already American students lag far behind their Japanese and Western European counterparts in science and math skills We aren t about to catch up if we leave the great majority of our population behind Obviously women and minorities face different sets of problems in trying to break into what has always been a white male occupation (Poverty hunger and poor schools put minority children so far behind from the start that it s not surprising they are poorly represented )

But some aspects of the exclusion are similar Consider the argument that girls (or minorities) just don t have a head for science This may be a comforting enough conclusion until you consider for example what happened to astronomer Vera Rubin—today one of three female astronomers in the National Academy of Sciences—when she first applied to Princeton for a catalog of their graduate school in 1947 She was told that Princeton did not accept women in graduate physics and astronomy In fact Princeton did not accept women in graduate physics until 1971 and graduate math programs until 1976! It's difficult to make it to the top when they don t even let you in the door

Today women are of course *allowed* to study math physics and engineering This is not to say that they are invited or encouraged Children as young as five years old according to recent studies have already been taught to accept that science is men s work Little boys play with active mechanical toys like Transformers and Hot Wheels while girls are encouraged to quietly cuddle their dolls The games boys play promote spatial awareness ability to manipulate objects mentally and mechanical reasoning The end result Boys score slightly higher on tests measuring spatial awareness

By the third grade most girls have already opted out A 1982 study by Skolnick et al reported that in elementary science classrooms, teachers ask boys more questions than girls and higher order questions Boys answers are discussed longer Girls are praised for neatness and for following the rules Boys are praised for academic achievements Boys are told to try harder Girls are told that they have done their best The results of these attitudes show up dramatically a few years later According to a 1986 National Science Foundation study roughly 60 percent of female college engineering majors made As in high school, compared with 40 percent of the males As a twelfth-grade calculus teacher put it I can t understand it Boys who are getting C's are applying to engineering colleges Girls who are getting A s say they re not smart enough to go into math

Encouragement can mean everything One Harvard freshman I know dropped out of science after her first year For the boys there was a payoff in suffering through the hard times and a kind of punishment—a shame—if they didn t For the girls it was okay not to get it, and the only payoff for sticking it out was that you d be considered a freak ' The good news is more and more girls are taking the high school math courses that prepare them for college level science majors The bad news is this isn't translating into a surge of women who pursue science careers I suspect this is because although women are now tolerated in the sciences they still aren t made to feel at home there

If science is truly to be everybody s business, then we'll have to do more than open the door to women and minorities We ll have to put out the mat and welcome them in —*K C COLE*

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*K C Cole has just completed a study on women and minorities in science for the Association of Science-Technology Centers, and has great legs*

# CONTINUUM

*Why is it that some people enjoy their work so much? According to a Los Angeles professor of public administration, happy workers display a sense of energy, an open mind, and a sense of purpose.*

## WORK SPIRIT

Why is it that some people seem to really enjoy their work and do it exceptionally well? Do these peak performers have an inborn gift? Is it just a good match between an individual and his task? Or is it something that can be adopted and applied by most people?

Los Angeles organization consultant Sherrie Connelly, assistant professor of public administration at the University of Southern California (USC), recently completed ten years of research on enjoyment in the workplace, finding that most peak performers are *not* unusually gifted but, by the process of engaging intensely in their work, develop what she has dubbed work spirit.

Work spirit is a little bit like love or courage, says Connelly. "It's the internal thing from which peak performance comes."

Connelly's research identified seven signs of work spirit: a sense of enormous energy, a positive, open state of mind, a sense of purpose and vision, a full sense of self, awareness of oneself as a creator and nurturer, a risking sense of living in the moment, and a sense of higher order and oneness.

People who dislike their work, Connelly found, tend to blame external factors. Those individuals, she suggests, should work on exploring and adjusting their self-knowledge (realizing one's skills and talents, developing self-esteem), self care (good stress management, diet, exercise), and selflessness (learning to be so involved in the work itself that one achieves a state of unself-consciousness).

Connelly concluded that more and more people seem to be enjoying their work these days. "For so many years our society was dominated by the Protestant work ethic—work is struggle," she says. "But we're moving away from that." —A. J. S. Rayl

## DREAM GRASS

Suburbanites, take note. Your crabgrass-chasing days may soon be over. A scientist at the University of Alberta in Canada has come up with a grass that not only is self-weeding but can be grown in almost any soil or climate, needs no watering or fertilizer, and has to be mowed only two to three times a year. Not only that, the grass's color is what its developer, geneticist Jan Weijer, calls a "very beautiful emerald-green."

Weijer did not set out to develop the perfect lawn. Rather, he was interested in making a lasting contribution to Rocky Mountain ecology. In 1974 Weijer went looking for a low-maintenance grass that could be used to hold mountain soils eroded by relentless strip-mining. He eventually found those grasses, called festucas and poas, growing happily at 7,000 feet in the harsh, dry climate and poor soils of the eastern Rockies. So he

*Jan Weijer sits in a patch of his low-maintenance grass.*

took them back to his experimental farm near Edmonton and began crossbreeding them. Last year he noticed that one particular plot—which had never been irrigated or fertilized—was not only lush and eye pleasing but because the grass emitted a natural herbicide, was absolutely free of weeds.

Immediately Weijer thought *lawn*. Apparently the commercial grass companies agree. At the moment at least 30 of them are bidding for exclusive rights to the seed stock, which Weijer estimates will take some six years to develop. Given a little genetic engineering, he thinks, the grasses' weed-killing characteristics could also be isolated and transferred to create self-weeding agricultural crops.—Bill Lawren

*"Opinion says hot and cold, but in reality there is nothing but atoms and empty space."*
*—Democritus*

## FLIPPERNAUTS

The movie *Star Trek IV* featured whales in space, but a visionary spacecraft designed by a Washington, DC, architect calls for dolphins and humans actually working together in orbit.

The craft, known as *Bluestar*, is actually a think tank for space inhabitants of the future. But *Bluestar*, part of a futuristic exhibit sponsored by NASA, looks like anything *but* your average spacecraft. It's a 250-foot-diameter water sphere enclosed by a 600-foot-diameter transparent globe.

Inside the water are a crew of dolphins and a computer. The dolphins program the computer according to the instructions of *Bluestar*'s scientists (who work outside the water bubble). But instead of using a keyboard to do the job, the dolphins instruct the computer via their ultrasonic sound waves. The computer then translates the results into holograms.

That, at least, is the vision of designer Doug Michels, who says the think tank's scientists will examine the data in the holograms to explore how the mind responds to weightlessness. Though there is currently no evidence to prove it, Michels feels that weightlessness has an effect on the thought process—just as it has an effect on the body.

But what do dolphins have to do with it all? "The scientists will use the dolphins as a tool to explore the unknown," Michels says. He says he's been fascinated by dolphins ever since he saw the movie *Flipper*—prompting some to call his dolphins "flippernauts."

Of course *Bluestar* is not something that most of us can expect to see in our lifetimes—as Michels readily admits. The project assumes, for instance, that dolphins and humans will one day be able to communicate. "I make no claims about this being real," Michels says. "I'm not a scientist or a neurologist. But he adds, ideas have to start somewhere.

—Devera Pin

*"A man with a watch knows what time it is, a man with two watches isn't so sure."*
*—Anonymous*

## FLY WARS

The Mediterranean fruit fly, along with a half dozen of its tephritid cousins, may have met its match at the hands of U.S. Department of Agriculture (USDA) scientists who have long sought more effective ways to halt the flies' contamination of citrus

*Doug Michels's vision of Blu[illegible] foot-diameter water sphere in which dolphins will ex[illegible] their feelings about zero g*

[illegible] fly eggs [illegible]

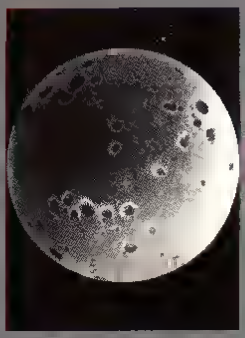
groves both here and abroad.

One solution suggested several years ago was to introduce sterile flies into the wild populations, halting the Medfly's breeding cycle. The only problem was how to breed enough of them to cover the sprawling Florida and California groves. The USDA scientists seem to have overcome that hurdle by developing a new breeding box, a device that permits them to hatch more than 1 billion Medfly eggs a week, far in excess of current capabilities.

The eggs are rendered sterile by irradiation, and when the flies hatch they are kept comatose in cold storage until needed. When they are, the sterile flies are dropped from planes into infested areas. The scientists hope the method will eventually eradicate a pest that has caused millions of dollars of damage to fruit and vegetable crops from Central America to Hawaii.

—George Nobbe

# CONTINUUM



*Micrograph of a dust particle from outer space*

## COMET DUST

Like prospectors panning for gold, scientists are mining the blue ice lakes of Greenland for extraterrestrial particles. On the pristine expanse of that island's ice sheet one astronomer reports, most of the dust hails from the heavens, not the earth.

Michel Maurette of the University of Paris correctly selected Greenland as the world's richest site of concentrated extraterrestrial particles. There are no rock outcroppings that could add their dust to the fragments of comets and asteroids raining down on Earth in quantities of about 10,000 tons per year. And unlike the ice at the poles, parts of Greenland melt annually, forming lakes with ice bottoms where Maurette anticipated stream deposits of comet dust.

According to University of Washington astronomer Donald Brownlee, who designed equipment and gave moral support to Maurette's expedition, the black sediment from the ice lakes mineralogically and chemically resembles other particles known to be of extraterrestrial origin.

The Greenland finds, frozen for up to 2,000 years and separated from the ice with panlike sifters, appear to be in considerably better shape than the more ancient extraterrestrial particles Brownlee himself collected with a 600-pound magnet dragged along the Pacific Ocean floor. He is counting on a second, as yet unscheduled Greenland expedition to bring back some really large particles (bigger than half a millimeter, say) that might suggest the shape of the parent comet's orbit. It should also be possible to find particles that entered Earth's atmosphere without melting.

In any event, "a slightly altered cometary sample is a lot better than no cometary sample," says Brownlee. What's more, he notes, experience with the Greenland particles will stand cometologists in good stead when they finally get to work with a comet chunk retrieved by a sample-return mission.

—Dava Sobel

## FLOATING FISH FACTORY

The Spanish, who consume more fish per capita than any other population in Europe and who have nearly denuded their Mediterranean coast in satisfying that mighty appetite, have finally found a way to have their fish and eat them too.

This summer they launched two unique aquaculture stations that, unlike shore-bound fish factories, will produce literally tons of fish while actually floating on the open sea.

The secret of these movable feasts—one of which is anchored off the Balearic island of Formentera, the other in coastal waters off the province of Almeria—is in their ultralight construction material, developed in Norway from a combination of prestressed concrete and polystyrene plastic.

Controlled by onshore closed-circuit television setups, each factory contains an incubation pool and three feed pools for the hatching and raising of such Mediterranean delicacies as sea bass and *dorada*.

The factories' boatlike stance gives them two important advantages over beachbound aquaculture installations. By moving from side to side, they can create artificial currents that will help oxygenate polluted waters. And surplus fish eggs can be discharged directly into the water, increasing the possibility, according to one observer, that new fish will be born in the freedom of the sea.

—Bill Lawren

*Fish obviously breed best in the ocean. So the Spanish are building fish factories that actually float on the open sea.*

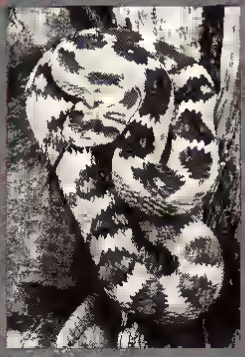
## SHOCK FOR SNAKEBITE

A group of researchers at Michigan State University has come up with a shocking new treatment for snakebites. Using a modified stun gun, they administer high-voltage electric current to the area around the bite. Amazingly enough, the scientists report in limited testing, the bizarre electric cure worked virtually every time.

Michigan State researcher Jeffrey Williams first heard of the idea from missionary Ronald Guderian in Ecuador, where local physicians told him anecdotes about the mysterious cure. In every one of 34 victims treated with shock, the pain from the bite

disappeared, and no serious complications developed Seven patients who refused the treatment soon suffered swelling, bleeding shock, or kidney failure Williams and his Michigan colleagues are now setting up a test in which snake-bitten dogs will be treated with a series of four or five high-voltage low current shocks within a half hour of the bite

The doctors are not quite sure why the treatment works but cite evidence indicating that electricity may deactivate crucial enzymes in the venom of poisonous animals In the meantime the treatment is generating enormous interest Up to now says Williams there have been no really satisfactory treatments for snakebites Antivenoms are expensive nonspecific and often unavailable Despite its promise, though, the electrocure does have one problem. It s quite painful "Still ' says Williams 'when you consider the alternatives —Bill Lawren



*New therapy for snakebite A series of high-voltage shocks*

*The Three Mile Island nuclear facility Fungi bacteria and algae find the water covering the core of the damaged reactor to be home sweet home a cozy environment in which they apparently thrive*

## THREE MILE ISLAND: JUST LIKE YOUR SWIMMING POOL

Setting up housekeeping in the middle of a nuclear accident site may not sound inviting to humans, but several kinds of microorganisms have found the radioactive water covering the core of Three Mile Island's damaged nuclear reactor makes a cozy environment they can thrive in

In fact a population explosion among the organisms (which GPU Nuclear Corporation spokesperson Lisa Robinson describes as a mixture of fungi bacteria and algae) has hampered removal of the core s once-molten fuel and other rubble According to Robinson the slimy stuff clouded the visibility of underwater closed-circuit video cameras used by cleanup workers it also clogged water filtration and vacuum systems

She insists that the radioactivity in the water has nothing to do with the rapid growth of the organisms It doesn t encourage or discourage them And they certainly aren't mutants she comments ' This is the same kind of problem you d find in a very dirty swimming pool

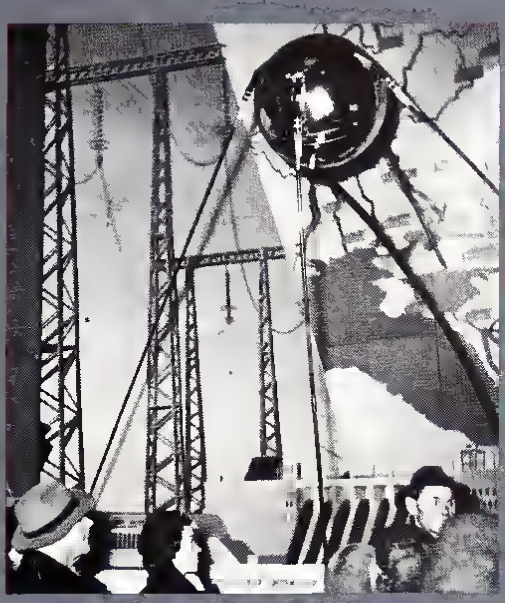
Three Mile Island workers recently figured out a way to control the proliferation of the pesky microorganisms so that the nuclear reactor cleanup can continue_they solved the problem by dumping low concentrations of hydrogen peroxide into the water "But Robinson cautions this is still a situation that we ll have to monitor —Sherry Baker

*'Like all dreamers I confused disenchantment with truth*
*—Jean Paul Sartre*

*God is back—and boy is he mad '*
*—California bumper sticker*

*"We are an impossibility in an impossible universe*
*—Ray Bradbury*

# CONTINUUM



*Model of Sputnik: it gave the Soviets the first lead in the space race. Now, 30 years later, they have, apparently regained that edge.*

## MEANWHILE, BACK AT THE SPACE RACE . . .

The controversy over the *Challenger* space shuttle disaster has obscured a simple fact: There's still a space race out there between the United States and the Soviet Union. And by some accounts, this country may be in the process of losing it.

Indeed, the Russians lately have scored a number of impressive feats that, while not attracting much media attention here, have not gone unnoticed by U.S. intelligence analysts.

This past January, for example, they watched as the Russians launched five unmanned missions from the Baikonur and Northern cosmodromes, including a *Progress 27* tanker/transport to refuel and provision the expanding *Mir* space station. The Soviet crew now inside that space station is expected to stay aloft for 290 days, to break the world record of 237 days.

As the American analysts noted, all this work took place in subzero temperatures during Europe's worst freeze in 50 years. "We were upset about some damn icicles on the *Challenger*," says one aerospace analyst. "They've been launching when it's twenty below [zero] with no problem. It makes you stop and think."

But there may be even more impressive Soviet space feats to come. Sometime next year, the analysts believe, the Russians will launch their first manned space shuttle, probably timed to coincide with the thirtieth anniversary of the launch of *Sputnik* (and not so coincidentally with the seventieth anniversary of the Russian Revolution). Known as *Snowstorm*, the new Russian shuttle is remarkably similar to its American counterpart, including a 66,000-pound payload.

An unmanned version of the Russian shuttle, however, can carry three times that payload and is almost certainly designed to help construct a huge space station that, in turn, will serve as a base for a Soviet manned mission to Mars. Soviet space authorities have made no secret of their dream of going to Mars by the end of this century.

—Ernest Volkman

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*God was satisfied with his own work, and that is fatal.*
—*Samuel Butler*

## BLACK HOLE (URP!) EATS STAR

Astronomers have long suspected that black holes act as a sort of cosmic quicksand, swallowing any object that comes within range of their enormously powerful gravitational fields. Now, for the first time, a pair of astronomers appears to have actually caught a black hole in the act of gobbling up a star.

Bradley Peterson of Ohio State University was using the 72-inch optical reflecting telescope at Flagstaff, Arizona's Lowell Observatory to study gases in space when he came in contact with a black hole's "event horizon"—its outer boundary. His records showed a curious anomaly. In June 1984 a large amount of helium suddenly appeared near the event horizon of a black hole at the center of a galaxy some 200 million light-years from Earth. Puzzled at first, Peterson related his findings to Ohio State colleague Gary Ferland, who came up with an explanation while driving along a Columbus freeway. "Because helium is made only in stars," says Peterson, Gary inferred that a star had gotten torn up [by a black hole] and was in the process of being swallowed."

Further calculations indicated that a sun-size star had indeed wandered into the black hole's event horizon and that the hole had shred-

*Black hole: A hungry one is obviously loose in the universe.*

ded the entire star- thus consuming a chunk equat to the mass of about a dozen Earths The big question of course is what happens to the matter once it has disappeared into the hole 'We think it gets condensed down to an object of infinitesimal size and infinite density,' says Peterson, "but we don t understand matter well enough to really know.'

—Bill Lawren

*'Everywhere is walking distance if you have the time'*
*—Steven Wright*

## CONSEQUENCES OF LONGEVITY

For the first time in history, Americans can expect to spend more years caring for aging parents than for dependent children In so doing they ll redefine family obligations for years to come

On average, people will spend 17 years as parents of a child and 18 as the son or daughter of an elderly parent In 1900 you would typically have spent 19 years with children and only 9 with your parents

According to Jane Menken a Princeton University sociol ogist, our long-lived society creates a situation in which caretaking doesn't end when the kids leave home. People will spend more time as part of healthier families, and as couples put off having children they ll face a greater chance of having to care for children and parents simultaneously

People will face competing demands in juggling loyalties to children and parents And in the backs of their minds says Menken they may eventually wonder "whether their primary responsibility lies with the next generation or the last

This is a critical question to ask in a society that as Menken submits, is not as predisposed toward its elderly as toward its young It we have a responsibility to both then each will need more support—both in spirit and in public policy—as this trend picks up steam

—Gregg Levoy

## X-RAY STARS AND PREEMIES

A new low-radiation X-ray machine that gives doctors more information while exposing patients to less than 1 percent of the dose given off by conventional equipment owes its existence to airport luggage scanners

Martin Annis president of American Science and Engineering (AS&E) the firm that built the first such scanner, explains 'My uncle who s a pediatrician said to me 'Why don t you take those machines and use them in newborn nurseries? That's where they re needed Although neonatal intensive-care units have reversed a medical statistic in this decade—ten years ago 80 percent of underweight premature babies died, while today 80 percent survive—radiologists fear that 20 years from now many of these patients will suffer a high rate of cancer Since X rays are one of the few means doctors have to find out how to treat these babies most receive intensive doses

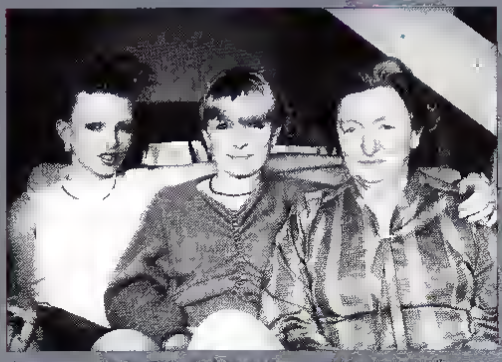
Dr Jon Shoop who has tested the low dose equipment at Geisinger Medical Center in Danville Pennsylvania, notes "My expectation is that we will see an increase in cancer and leukemia in the survivors of these newborn intensive care units Low-dose equipment will reduce the risk

Annis and his associates who also helped discover the first X-ray star and the first suspected black hole, figured that if 'we could catch these very faint X rays from space we could solve this problem on Earth Conventional machines waste 90 percent of the X rays beamed at a patient High doses are necessary to achieve a picture with usable information

AS&E's computer assisted Microdose system however stores everything a less-powerful beam illuminates, then plays it back on a television screen which can be lightened or darkened to highlight information 'This enables high-quality diagnostic images to be obtained at very low doses says Dr Arthur Upton former director of the National Cancer Institute "That really is a tremendous advance

—Allan Maurer

*Conventional X rays may be harming premature infants*



*Three generations Today s American is caught in the middle between dependent children and aging parents who also need care*

*'Alas for those who never sing but die with all their music in them'*
*—Oliver Wendell Holmes*

# CONTINUUM

## MILK WITHOUT COWS, HONEY WITHOUT BEES

It may take 20 years, but food scientists think they will eventually be able to use an enzyme-synthesizing process to manufacture milk and honey without the help of cows and bees

So says Sanford Miller director of the FDAs Center for Food Safety and Applied Nutrition undeterred by the skepticism of some bio technologists who have called the possibility pie-in-the sky technology because of the vast panoply of en zymes involved Enzymes are proteinaceous substances that act as organic catalysts to speed up specific chemical reactions

The process involves introducing genes into microorganisms and it s already used industrially for such simple transformations as turning starch into sugar Making milk and honey this way is a far more complex matter For instance milk has literally thousands of different compounds

Miller does have some supporters One is Ted La buza, professor of food science and nutrition al the University of Minnesota He speaks of cells and hormones and fermenters "We re using strawberries as a flavor model he says adding, Yes it s probably twenty years down the line Our level of technology is in the inter mediate stage right now

Both men contend that although Americans don t really need a new way to produce such staples as milk and honey other parts of the world do Africa and Asia are good examples of areas where the enzyme technology could be of immeasurable help in providing peo ple necessary nutrition

—George Nobbe

*face an uncertain future Will . zyme process put milk cows on the unemployment line?*

## DIAMOND COATINGS

Imagine a coating that would keep a knife from ever getting dull or that would prevent scratches from ruining plastic sunglasses Diamond would be the ideal choice Not only is it the hardest material known, but it is also a superb conductor of heat and is transparent to ultraviolet visible and infrared light

Most scientists used to scoff at the idea because they thought it took very high pressures and temperatures to make diamond in nature or in the laboratory That is why a decade ago American scientists didn t believe Soviet claims of having deposited thin diamond films and even distrusted data from their own labs Now however they ve finally learned better, and Americans have joined Soviet and Japanese scientists in mak ing superhard diamond films

The secret is in picking the right mixture of gases to use in the deposition Dia mond is pure carbon but you can make crystalline diamond films only from a mix ture of 99 percent hydrogen and 1 percent methane a molecule containing four hydrogen atoms and one carbon atom We don't know exactly what s happening on the surface says Russell F Messier of Pennsylvania State University s Materials Research Laboratory It is clear however, that the result is diamond

No one is sure exactly what diamond films can do but they have high hopes Because diamond is so hard and chemically inert a thin coating could extend cutting tool lifetimes Diamond can also carry excess heat away from electronic components improving their operation And as a semiconductor diamond itself might be useful in electronics

First however, scientists need to learn more about making diamond films Soviet and Japanese researchers have a head start, but the Strategic Defense Initiative is putting money into U S diamond-making research and Penn State is organizing a Diamond and Related Materials Research Consor tium —Jeff Hecht

*"The new and bold can also be crappy*
*—White House staffer, 1975*

*The scientist has no corner on wisdom or morality'*
*—David Krech*

*"Every start upon an untrodden path is a venture which only in unusual circumstances looks sensible and likely to be successful*
*—Albert Schweitzer*

ARTICLE

# THE NATIONAL GUARDS

BY DONALD GOLDBERG

*If you liked* 1984, *you're gonna love what the military has planned*

The mountains bend as the fjord and the sea beyond stretch out before the viewer's eyes. First over the water, then a sharp left turn, then a bank to the right between the peaks, and the secret naval base unfolds upon the screen.

The scene is of a Soviet military installation on the Kola Peninsula in the icy Barents Sea, a place usually off-limits to the gaze of the Western world. It was captured by a small French satellite called SPOT Image orbiting at an altitude of 517 miles above the hidden Russian outpost. On each of several passes—made over a two-week period last fall—the satellite's high-resolution lens took its pictures at a different angle. The images were then blended into a three-dimensional, computer-generated video. Buildings, docks, vessels, and details of the Arctic landscape are all clearly visible.

Half a world away and thousands of feet under the sea, sparkling-clear images are being made of the ocean floor. Using the latest bathymetric technology and state-of-the-art systems known as Seam Beam and Hydrochart, researchers are for the first time assembling detailed underwater maps of the continental shelves and the depths of the world's oceans. These scenes of the sea are as sophisticated as the photographs taken from the satellite.

From the three-dimensional images taken far above the earth to the

PAINTING BY
STEPHEN DURKE

charts of the bottom of the oceans these photographic systems have three things in common They both rely on the latest technology to create accurate pictures never dreamed of even 25 years ago, they are being made widely available by commercial, nongovernmental enterprises and the Pentagon is trying desperately to keep them from the general public

In 1985 the Navy classified the underwater charts making them available only to approved researchers whose needs are evaluated on a case-by-case basis Under a 1984 law the military has been given a say in what cameras can be licensed to be used on American satellites, and officials have already announced they plan to limit the quality and resolution of photos made available The National Security Agency (NSA)—the secret arm of the Pentagon in charge of gathering electronic intelligence as well as protecting sensitive U S communications—has defeated a move to keep it away from civilian and commercial computers and databases

That attitude has outraged those concerned with the military's increasing efforts to keep information not only from the public but from industry experts, scientists and even other government officials as well "That's like classifying a road map for fear of invasion," says Paul Wolff, assistant administrator for the National Oceanic and Atmospheric Administration of the attempted restrictions

These attempts to keep unclassified data out of the hands of scientists, researchers, the news media and the public at large are part of an alarming trend that has seen the military take an ever-increasing role in controlling the flow of information and communications through American society, a role traditionally—and almost exclusively—left to civilians Under the approving gaze of the Reagan administration Department of Defense (DoD) officials have quietly implemented a number of policies decisions, and orders that give the military unprecedented control over both the content and public use of data and communications For example

- The Pentagon has created a new category of "sensitive" but unclassified information that allows it to keep from public access huge quantities of data that were once widely accessible
- Detense Department officials have attempted to rewrite key laws that spell out when the president can and cannot appropriate private communications facilities
- The Pentagon has installed a system that enables it to seize control of the nation's entire communications network—the phone system, data transmissions, and satellite transmissions of all kinds—in the event of what it deems a "national emergency" As yet there is no single universally agreed-upon definition of what constitutes "such a state" Usually such an emergency is restricted to times of natural disaster, war, or when national security is specifically threatened Now the military has attempted to redefine *emergency*

The point man in the Pentagon's onslaught on communications is Assistant Defense Secretary Donald C Latham, a former NSA deputy chief Latham now heads up an interagency committee in charge of writing and implementing many of the policies that have put the military in charge of the flow of civilian information and communication He is also the architect of National Security Decision Directive 145 (NSDD 145), signed by Defense Secretary Caspar Weinberger in 1984, which sets out the national policy on telecommunications and computer systems security

First NSDD 145 set up a steering group of top-level administration officials Their job is to recommend ways to protect information that is unclassified but has been designated sensitive Such information is held not only by government agencies but by private companies as well And last October the steering group issued a memorandum that defined sensitive information and

*"In his oversize yet Spartan Pentagon office, Latham cuts anything but an intimidating figure Articulate and friendly, he could pass for a network anchorman or a television game show host"*

gave federal agencies broad new powers to keep it from the public

According to Latham, this new category includes such data as all medical records on government databases—from the files of the National Cancer Institute to information on every veteran who has ever applied for medical aid from the Veterans Administration—and all the information on corporate and personal taxpayers in the Internal Revenue Service's computers Even agricultural statistics, he argues can be used by a foreign power against the United States

In his oversize yet Spartan Pentagon office, Latham cuts anything but an intimidating figure Articulate and friendly, he could pass for a network anchorman or a television game show host When asked how the government's new definition of sensitive information will be used, he defends the necessity for it and tries to put to rest concerns about a new restrictiveness

"The debate that somehow the DoD and NSA are going to monitor or get into private databases isn't the case at all," Latham insists "The definition is just a guideline just an advisory It does not give the DoD the right to go into private records"

Yet the Defense Department invoked the NSDD 145 guidelines when it told the information industry it intends to restrict the sale of data that are now unclassified and publicly available from privately owned computer systems The excuse it offered was that these data often include technical information that might be valuable to a foreign adversary like the Soviet Union

Mead Data Central—which runs some of the nation's largest computer data bases such as Lexis and Nexis, and has nearly 200,000 users—says it has already been approached by a team of agents from the Air Force and officials from the CIA and the FBI who asked for the names of subscribers and inquired what Mead officials might do if information restrictions were imposed In response to government pressure, Mead Data Central in effect censored itself It purged all unclassified government-supplied technical data from its system and completely dropped the National Technical Information System from its database rather than risk a confrontation

Representative Jack Brooks, a Texas Democrat who chairs the House Government Operations Committee is an outspoken critic of the NSA's role in restricting civilian information He notes that in 1985 the NSA—under the authority granted by NSDD 145—investigated a computer program that was widely used in both local and federal elections in 1984 The computer system was used to count more than one third of all the votes cast in the United States While probing the system's vulnerability to outside manipulation, the NSA obtained a detailed knowledge of that computer program "In my view," Brooks says "this is an unprecedented and ill-advised expansion of the military's influence in our society"

There are other NSA critics "The computer systems used by counties to collect and process votes have nothing to do with national security, and I'm really concerned about the NSA's involvement," says Democratic congressman Dan Glickman of Kansas, chairman of the House science and technology subcommittee concerned with computer security

Also under NSDD 145 the Pentagon has issued an order, virtually unknown to all but a few industry executives, that affects commercial communications satellites The policy was made official by Defense Secretary Weinberger in June of 1985 and requires that all commercial satellite operators that carry such unclassified government data traffic as routine Pentagon supply information and payroll data (and that compete for lucrative government contracts) install costly protective systems on all satellites launched after 1990 The policy does not directly affect the data over satellite channels, but it does make the NSA privy to vital information about the essential signals needed to operate a satellite With this information it could take control of any satellite it chooses

Latham insists this, too, is a voluntary policy and that only companies that wish to install protection will have their systems evaluated by the NSA. He also says industry officials are wholly behind the move and argues that the protective systems are necessary. With just a few thousand dollars' worth of equipment, a disgruntled employee could interfere with a satellite's control signals and disable or even wipe out a hundred-million-dollar satellite carrying government information.

At best, his comments are misleading. First, the policy is not voluntary. The NSA can cut off lucrative government contracts to companies that do not comply with the plan. The Pentagon alone spent more than a billion dollars leasing commercial satellite channels last year, that's a powerful incentive for business to cooperate.

Second, the industry's support is anything but total. According to the minutes of one closed-door meeting between NSA officials—along with representatives of other federal agencies—and executives from AT&T, Comsat, GTE Sprint, and MCI, the executives neither supported the move nor believed it was necessary. The NSA defended the policy by arguing that a satellite could be held for ransom if the command and control links weren't protected. But experts at the meeting were skeptical.

"Why is the threat limited to accessing the satellite rather than destroying it with lasers or high-powered signals?" one industry executive wanted to know.

Most of the officials present objected to the high cost of protecting the satellites. According to a 1983 study made at the request of the Pentagon, the protection demanded by the NSA could add as much as $3 million to the price of a satellite and $1 million more to annual operating costs. Costs like these, they argue, could cripple a company competing against less expensive communications networks.

Americans get much of their information through forms of electronic communications, from the telephone, television and radio, and information printed in many newspapers. Banks send important financial data, businesses their spreadsheets, and stockbrokers their investment portfolios, all over the same channels, from satellite signals to computer hookups carried on long-distance telephone lines. To make sure that the federal government helped promote and protect the efficient use of this advancing technology, Congress passed the massive Communications Act of 1934. It outlined the role and laws of the communications structure in the United States.

The powers of the president are set out in Section 606 of that law. Basically, it states that he has the authority to take control of any communications facilities that he believes "essential to the national defense." In the language of the trade, this is known as a 606 emergency.

There have been a number of attempts, in recent years, by Defense Department officials to redefine what qualifies as a 606 emergency and make it easier for the military to take over national communications.

In 1981, the Senate considered amendments to the 1934 act that would allow the president, on Defense Department recommendation, to require any communications company to provide services, facilities, or equipment "to promote the national defense and security or the emergency preparedness of the nation," even in peacetime and without a declared state of emergency. The general language had been drafted by Defense Department officials. (The bill failed to pass the House for unrelated reasons.)

"I think it is quite clear that they have snuck in there some powers that are dangerous for us as a company and for the public at large," said MCI vice president Kenneth Cox before the Senate vote.

Since President Reagan took office, the Pentagon has stepped up its efforts to rewrite the definition of national emergency and give the military expanded powers in the United States. "The declaration of emergency has always been vague," says one former administration official who left the government in 1982 after ten years in top policy posts. "Different presidents have invoked it differently. This administration would declare a convenient emergency." In other words, what is a nuisance to one administration might qualify as a burgeoning crisis to another. For example, the Reagan administration might decide that a series of protests on or near military bases constituted a national emergency.

> *"The declaration of an emergency has always been vague. Different presidents have invoked it differently. This administration would invoke a convenient emergency."*

Should the Pentagon ever be given the green light, its base for taking over the nation's communications system would be a nondescript yellow brick building within the maze of high-rises, government buildings, and apartment complexes that make up the Washington suburb of Arlington, Virginia. Headquartered in a dusty and aging structure surrounded by a barbed wire fence is an obscure branch of the military known as the Defense Communications Agency (DCA). It does not have the spit and polish of the National Security Agency or the dozens of other government facilities that make up the nation's capital. But its lack of shine belies its critical mission: to make sure all of America's far-flung military units can communicate with one another. It is in certain ways the nerve center of our nation's defense system.

On the second floor of the DCA's four-story headquarters is a new addition called the National Coordinating Center (NCC). Operated by the Pentagon, it is virtually unknown outside of a handful of industry and government officials. The NCC is staffed around the clock by representatives of a dozen of the nation's largest commercial communications companies—the so-called "common carriers"—including AT&T, MCI, GTE, Comsat, and ITT. Also on hand are officials from the State Department, the CIA, the Federal Aviation Administration, and a number of other federal agencies. During a 606 emergency, the Pentagon can order the companies that make up the National Coordinating Center to turn over their satellite, fiberoptic, and land-line facilities to the government.

On a long corridor in the front of the building is a series of offices, each outfitted with a private phone, a telex machine, and a combination safe. It's known as "logo row" because each office is occupied by an employee from one of the companies that staff the NCC and because their corporate logos hang on the wall outside. Each employee is on permanent standby, ready to activate his company's system should the Pentagon require it.

The National Coordinating Center's mission is as grand as its title is obscure: to make available to the Defense Department all the facilities of the civilian communications network in this country—the phone lines, the long-distance satellite hookups, the data transmission lines—in times of national emergency. If war breaks out and communications to a key military base are cut, the Pentagon wants to make sure that an alternate link can be set up as fast as possible. Company employees assigned to the center are on call 24 hours a day; they wear beepers outside the office and when on vacation they must be replaced by qualified colleagues.

The center formally opened on New Year's Day, 1984, the same day Ma Bell's monopoly over the telephone network of the entire United States was finally broken. The timing was no coincidence. Pentagon officials had argued for years, along with AT&T, against the divestiture of Ma Bell, on grounds of national security. Defense Secretary Weinberger personally urged the attorney general to block the lawsuit that resulted in the breakup, as had his predecessor, Harold Brown. The reason was that rather than construct its own communications network, the Pentagon had come to rely extensively on the phone company. After the breakup the dependence continued. The Pentagon still used commercial companies to carry more than 90 percent of its communications within the continental United States.

The 1984 divestiture put an end to AT&T's

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PAINTING BY RENE MAGRITTE

ARTICLE

*Scientists charting the undulating rhythms of superstrings discuss life in the higher*

# DIMENSIONS

BY GURNEY WILLIAMS III

To us it's a hypercube, but to the creature it's home. Quadra has plenty of room for a fascinating collection of 3-D things all tucked away in a drawer: a fortune in bullion that takes no more of her space than a page of gold leaf, 3-D cars stacked like baseball cards, whole green gardens piled carelessly like pressed flowers long forgotten. The things of our world are junk mail to Quadra because, as she recognizes with disdain, she lives in the fourth dimension, an indisputably higher plane.

How could we even *expect* to understand? We can't drink from her brandy snifter with its bulbous rim or drive her car on her cylindrical pavements. Just try to comprehend one simple architectural detail: the corners of Quadra's bedroom. *Four* lines radiate from each corner, not the three of our truncated tract houses. *And all of the four lines are at right angles to the others.* How could we stand in such a corner without another couple of legs? She can watch us, but Quadra tells herself, we cannot see her—not with our limited 3-D eyes.

In a sense, though, she's wrong. Some mathematicians are already exploring her world and getting closer to understanding it than ever before. One of the pioneers on her trail is Professor Thomas Banchoff at Brown University, a mathematician who has long charted the arcane geometries of Quadra's domain. He's made a home movie of her hypercube, hanging and twisting in space so that we can imagine spidering into every cranny of her house.

Today many people are following Banchoff in a fervent quest for the fourth dimension and beyond. The most immediate benefits of all this work are strictly practical. Several of Banchoff's students work for movie studios using computer graphics to simulate 3-D space on a 2-D screen. Information experts plot strategy in higher dimensions to find ways to push more information through computer modems or radio links. "You're not gonna believe how

many dimensions it takes to get information back from the outer planets says Edward C Posner, chief telecommunications and data acquisition technologist at the Jet Propulsion Laboratory (JPL) To pull in pictures from planets far from the sun NASA uses about 145,000 dimensions he says Each dimension represents a different part of the complex picture from space

But the biggest payoff of all in extra-dimensional exploration may be a deeper knowledge of the nature of no less than *all* matter and life The connection is what physicists call superstring theory the idea that everything—including us and other creatures seen and unseen—results from the movements of tiny strings snaking around in nine dimensions

The notion of extra dimensions has captivated more than a few Al Brown this year Banchoff has 93 students in a class devoted to the higher dimensions On a recent evening as a visiting lecturer at the State University of New York at Stony Brook he attracted a capacity crowd of more than 100 faculty, students and children who came on a cold night to see computer-generated films of rotating four-dimensional structures One of these shapes could be Quadra's home

Could he conjure a 4-D creature? 'A visitation? I can arrange for that' he said pulling a balloon from a pocket He simply blew up the balloon That's approximately what we'd see if Quadra tossed a four-dimensional beach ball through our three dimensions The fourth dimension would simply be invisible to our 3-D eyes

If you find the 4-D beach ball perplexing don't despair It's actually easy to get a grasp on extra dimensions if you just consider that some creatures have more complicated addresses than others In a two-dimensional plane it takes just latitude and longitude to find a house In a homey 3-D system you need three numbers to locate things the extra coordinate tells you the height above the plane or the distance along the third line extending from the corner of your room In a four-dimensional box—the hypercube—there are 16 corners each point sending its four edges toward other corners each edge forming a right angle with the ones next to it A 2-D picture of the hypercube looks like a small box hung by threads within a larger box Average 3-D creatures can't perceive its subtleties But computers have no such problem Even a micro can handle the fact that each corner of a 16 cornered bungalow is located by four coordinates

Richard C Jeffrey a professor of philosophy at Princeton University with a specialty in science, says that addresses become knottier as you pass into other realms For instance, if there are nine spatial dimensions as some physicists think that means that theoretically it takes nine numbers to locate things The high-dimension addresses physicists are interested in don't appear to have much impact on our workaday lives But according to Jeffrey the question is 'Are there actual things for which these extra bits of the address really are important? Are there things we can't locate without all the numbers? The answer, of course is yes They're in the same world that we are we simply can't find them because we don't know the address Maybe some of the things are *alive*

The fascination with life in other dimensions began more than 100 years ago when Edwin A Abbott an English clergyman and educator, wrote *Flatland* Its characters lived on a plane—a tabletop—and looked like geometrical shapes The hero was a square living in a pentagon Women were just lines—Abbott lived at the height of the Victorian Age A ball thrusting through the plane—appearing first as a dot then a growing and receding circle—could have passed for God

A German scholar Theodor Franz Eduard Kaluza made a foray into a higher dimension in 1919 He wrote to Albert Einstein, suggesting that the master add another dimension to the four he'd already proposed—three in space one in time A *fifth* spatial dimension Kaluza declared, would help to unify the known forces of nature Einstein hesitated then blessed the idea Kaluza's paper was published in 1921

*Yndrd's transparent, pear-shaped body has a simple intestinal system, a pipe closed at the bottom. After he eats, he has to throw up waste products, using a spittoon.*

Within a few years the theory was given an eerie twist by Swedish physicist Oskar Klein He suggested that the extra dimension was somehow wrapped up into a tight curl So if a 4-D creature set out on a race in the extra dimension, she would travel less than the width of an atomic nucleus before she returned to the starting line

The Kaluza–Klein theories didn't catch on and were relegated to physics attic for generations But within the last few years physicists working on superstring theory have begun to think Kaluza and Klein were right—except that the total number of dimensions is nine

You really have to go slumming in the lower dimensions though to understand life in the ninth dimension, a realm that physicists call nine space Start your tour with a low-life dimension—one space You're on a line and you perceive nothing except the two points on either side of you Since gravity and electromagnetism require at least two dimensions these forces don't exist There's no television no sunsets no point to the points Living in one space is no life at all

Escape to the second dimension Alexander Keewatin Dewdney a theoretical computer scientist and writer says life in Flatland can offer a lot more than the Reverend Mr Abbott imagined—more in some ways than the 3-D cornucopia we live in He sketched some of the advantages in *The Planiverse* (Poseidon Press) a story of contact with an alien on the planar planet of Arde The buglike creature is a flat character named Yndrd who stumbles into a computer program written by earthly students and takes the programmers on a tabletop odyssey of his planet

Dewdney had to play two-dimensional Darwin to figure out how Yndrd would have evolved to survive on the plane In some ways the creature is elegantly endowed He's got four arms—two on each side to permit one to grip a tool like a pencil while the other holds the writing tablet Yndrd's pear-shaped body transparent to us but impossible for him to see in its entirety has a simple intestinal system a single pipe closed at the bottom (After he eats he has to throw up waste products using a kind of spittoon ) He can't understand how humans can endure a 'food channel' running through their bodies 'Why do you not then fall into two pieces?' he asks

Yndrd in fact, can't see much advantage to 3-D at all In 2-D he points out ropes can't get tangled because nothing can cross anything else For the same reason Arde has neither hurricanes nor tornadoes since air currents can't cross each other winds blow only east or only west When it rains it takes only a line held over head to keep your head dry

But Dewdney realized as he wrote that none of these simple blessings would be worth giving up one of our dimensions "Imagine,' he says, 'that you can look only east or west and to change from one side to the other you have to crane your head right around over the top It would be like living between two walls As you meet someone you have to walk over him or lie down and let him walk over you because nobody can go around anything else What an exile it would be!'

Yndrd finally escapes this confinement with the help of an austere guru named Drabk who apparently leads him away toward a brighter spiritual existence Although the key to Yndrd's salvation isn't described in the book Dewdney says Drabk's beliefs are akin to Sufism a system of Moslem mysticism whose adherents learn to desire and possess nothing 'Good-bye Earth friends.' Yndrd says in a reprise of many a movie as he heads toward dimensions higher than our own

These days it doesn't take a guru to launch a 2-D creature into the third dimension You can use a computer and a hard disk Rebecca Allen, an independent

CONTINUED ON PAGE 104

FICTION

# THE EVENING AND THE MORNING AND THE NIGHT

BY OCTAVIA E. BUTLER

When I was fifteen and trying to show my independence by getting careless with my diet, my parents took me to a Duryea-Goode disease ward. They wanted me to see, they said, where I was headed if I wasn't careful. In fact, it was where I was headed, no matter what. It was only a matter of when, now or later. My parents were putting in their vote for later.

I won't describe the ward. It's enough to say that when they brought me home, I cut my wrists. I did a thorough job of it, old Roman style, in a bathtub of warm water. Almost made it. My father dislocated his shoulder breaking down the bathroom door. He and I never forgave each other for that day.

The disease got him almost three years later—just before I went off to college. It was sudden. It doesn't happen that way often. Most people notice themselves beginning to drift—or their relatives notice—and they make arrangements with their chosen institution. People who are noticed and who resist going in can be locked up for a week's observation. I don't doubt that that observation period breaks up a few families. Sending someone away for what turns out to be a false alarm. Well, it isn't the sort of thing the victim is likely to forgive or forget. On the other hand, not sending someone away in time—missing the signs or having a person go off suddenly without signs—is inevitably dangerous for the victim. I've never heard of it going as badly though as it did in my family. People normally injure only themselves when their time comes—unless someone is stupid enough to try to handle them without the necessary drugs or restraints.

My father killed my mother, then killed himself. I wasn't home when it happened. I had stayed at school later than

PAINTING BY ETIENNE SANDORFI

usual rehearsing graduation exercises By the time I got home there were cops everywhere There was an ambulance and two attendants were wheeling someone out on a stretcher—someone covered More than covered Almost bagged

The cops wouldn't let me in I didn't find out until later exactly what had happened I wish I'd never found out Dad had killed Mom then skinned her completely At least that's how I hope it happened I mean I hope he killed her first He broke some of her ribs damaged her heart Digging

Then he began tearing at himself through skin and bone digging He had managed to reach his own heart before he died It was an especially bad example of the kind of thing that makes people afraid of us It gets some of us into trouble for picking at a pimple or even for daydreaming It has inspired restrictive laws created problems with jobs housing schools The Duryea-Gode Disease Foundation has spent millions telling the world that people like my father don't exist

A long time later when I had gotten myself together as best I could I went to college—to the University of Southern California—on a Dilg scholarship Dilg is the retreat you try to send your out-of-control DGD relatives to It's run by controlled DGDs like me like my parents while they lived God knows how any controlled DGD stands it Anyway the place has a waiting list miles long My parents put me on it after my suicide attempt but chances were I'd be dead by the time my name came up

I can't say why I went to college—except that I had been going to school all my life and I didn't know what else to do I didn't go with any particular hope Hell I knew what I was in for eventually I was just marking time Whatever I did was just marking time If people were willing to pay me to go to school and mark time why not do it?

The weird part was I worked hard got top grades If you work hard enough at something that doesn't matter you can forget for a while about the things that do

Sometimes I thought about trying suicide again How was it I'd had the courage when I was fifteen but didn't have it now? Two DGD parents—both religious both as opposed to abortion as they were to suicide So they had trusted God and the promises of modern medicine and had a child But how could I look at what had happened to them and trust anything?

I majored in biology Non-DGDs say something about our disease makes us good at the sciences—genetics molecular biology biochemistry That something was terror Terror and a kind of driving hopelessness Some of us went bad and became destructive before we had to—yes we did produce more than our share of criminals And some of us went good—spectacularly—and made scientific and medical history These last kept the doors at least partly open for the rest of us They made discoveries in genetics found cures for a couple of rare diseases made advances in the fight against other diseases that weren't so rare—including ironically some forms of cancer But they'd found nothing to help themselves There had been nothing since the latest improvements in the diet and those came just before I was born They like the original diet gave more DGDs the courage to have children They were supposed to do for DGDs what insulin had done for diabetics—give us a normal or nearly normal life span Maybe they had worked for someone somewhere They hadn't worked for anyone I knew

Biology School was a pain in the usual ways I didn't eat in public anymore didn't like the way people stared at my biscuits—cleverly dubbed dog biscuits in every school I'd ever attended You'd think university students would be more creative I didn't like the way people edged away from me when they caught sight of my emblem I'd begun wearing it on a chain around my neck and putting it down inside my blouse

*"She tried to run through my father as though he weren't there She slammed into him She bounced off, fell, began tearing at herself She bit her own arm and swallowed the flesh."*

but people managed to notice it anyway People who don't eat in public who drink nothing more interesting than water who smoke nothing at all—people like that are suspicious Or rather they make others suspicious Sooner or later one of those others finding my fingers and wrists bare would fake an interest in my chain That would be that I couldn't hide the emblem in my purse If anything happened to me medical people had to see it in time to avoid giving me the medications they might use on a normal person It isn't just ordinary food we have to avoid but about a quarter of a *Physicians' Desk Reference* of widely used drugs Every now and then there are news stories about people who stopped carrying their emblems—probably trying to pass as normal Then they have an accident By the time anyone realizes there is anything wrong it's too late So I wore my emblem And one way or another people got a look at it or got the word from someone who had "She *is*!" Yeah

At the beginning of my third year four other DGDs and I decided to rent a house together We'd all had enough of being lepers twenty-four hours a day There was an English major He wanted to be a writer and tell our story from the inside—which had only been done thirty or forty times before There was a special education major who hoped the handicapped would accept her more readily than the able-bodied a premed who planned to go into research and a chemistry major who didn't really know what she wanted to do

Two men and three women All we had in common was our disease plus a weird combination of stubborn intensity about whatever we happened to be doing and hopeless cynicism about everything else Healthy people say no one can concentrate like a DGD Healthy people have all the time in the world for stupid generalizations and short attention spans

We did our work came up for air now and then ate our biscuits and attended classes Our only problem was housecleaning We worked out a schedule of who would clean what when who would deal with the yard whatever We all agreed on it then except for me everyone seemed to forget about it I found myself going around reminding people to vacuum clean the bathroom mow the lawn I figured they'd all hate me in no time but I wasn't going to be their maid and I wasn't going to live in filth Nobody complained No body even seemed annoyed They just came up out of their academic daze cleaned mopped mowed and went back to it I got into the habit of running around in the evening reminding people It didn't bother me if it didn't bother them

"How'd you get to be housemother?" a visiting DGD asked

I shrugged "Who cares? The house works It did It worked so well that this new guy wanted to move in He was a friend of one of the others and another premed Not bad looking

"So do I get in or don't I?" he asked

"As far as I'm concerned you do" I said I did what his friend should have done—introduced him around, then after he left talked to the others to make sure nobody had any real objections He seemed to fit right in He forgot to clean the toilet or mow the lawn just like the others His name was Alan Chi I thought Chi was a Chinese name and I wondered But he told me his father was Nigerian and that in Ibo the word meant a kind of guardian angel or personal god He said his own personal god hadn't been looking out for him very well to let him be born to two DGD parents Him too

I don't think it was much more than that similarity that drew us together at first Sure I liked the way he looked but I was used to liking someone's looks and having him run like hell when he found out what I was It took me a while to get used to the fact that Alan wasn't going anywhere

I told him about my visit to the DGD ward when I was fifteen—and my suicide attempt afterward I had never told anyone else I was surprised at how relieved it made me feel to tell him And somehow his reaction didn't surprise me

"Why didn't you try again?" he asked. We were alone in the living room.

"At first, because of my parents," I said. "My father in particular. I couldn't do that to him again."

"And after him?"

"Fear. Inertia."

He nodded. "When I do it, there'll be no half measures. No being rescued, no waking up in a hospital later."

"You mean to do it?"

The day I realize I've started to drift. Thank God we get some warning."

"Not necessarily."

"Yes, we do. I've done a lot of reading. Even talked to a couple of doctors. Don't believe the rumors non-DGDs invent."

I looked away, stared into the scarred, empty fireplace. I told him exactly how my father had died—something else I'd never voluntarily told anyone.

He sighed. "Jesus!"

We looked at each other.

"What are you going to do?" he asked.

"I don't know."

He extended a dark, square hand, and I took it and moved closer to him. He was a dark, square man—my height, half again my weight, and none of it fat. He was so bitter sometimes, he scared me.

"My mother started to drift when I was three," he said. "My father only lasted a few months longer. I heard he died a couple of years after he went into the hospital. If the two of them had had any sense, they would have had me aborted the minute my mother realized she was pregnant. But she wanted a kid, no matter what. And she was Catholic." He shook his head. "Hell, they should pass a law to sterilize the lot of us."

"They?" I said.

"You want kids?"

"No, but—"

"More like us to wind up chewing their fingers off in some DGD ward."

"I don't want kids, but I don't want someone else telling me I can't have any."

He stared at me until I began to feel stupid and defensive. I moved away from him.

"Do you want someone else telling you what to do with your body?" I asked.

"No need," he said. "I had that taken care of as soon as I was old enough."

This left me staring. I'd thought about sterilization. What DGD hasn't? But I didn't know anyone else our age who had actually gone through with it. That would be like killing part of yourself—even though it wasn't a part you intended to use. Killing part of yourself when so much of you was already dead.

"The damned disease could be wiped out in one generation," he said, "but people are still animals when it comes to breeding. Still following mindless urges, like dogs and cats."

My impulse was to get up and go away, leave him to wallow in his bitterness and depression alone. But I stayed. He seemed to want to live even less than I did. I wondered how he'd made it this far.

"Are you looking forward to doing research?" I probed. "Do you believe you'll be able to—"

"No."

I blinked. The word was as cold and dead a sound as I'd ever heard.

"I don't believe in anything," he said.

I took him to bed. He was the only other double DGD I had ever met, and if nobody did anything for him, he wouldn't last much longer. I couldn't just let him slip away. For a while, maybe we could be each other's reasons for staying alive.

He was a good student—for the same reason I was. And he seemed to shed some of his bitterness as time passed. Being around him helped me understand why, against all sanity, two DGDs would lock in on each other and start talking about marriage. Who else would have us?

We probably wouldn't last very long, anyway. These days, most DGDs make it to forty, at least. But then, most of them don't have two DGD parents. As bright as Alan was, he might not get into medical school because of his double inheritance. No one would tell him his bad genes were keeping him out, of course, but we both knew what his chances were. Better to train doctors who were likely to live long enough to put their training to use.

Alan's mother had been sent to Dilg. He hadn't seen her or been able to get any information about her from his grandparents while he was at home. By the time he left for college, he'd stopped asking questions. Maybe it was hearing about my parents that made him start again. I was with him when he called Dilg. Until that moment, he hadn't even known whether his mother was still alive. Surprisingly, she was.

"Dilg must be good," I said when he hung up. "People don't usually—I mean—"

"Yeah, I know," he said. "People don't usually live long once they're out of control. Dilg is different." We had gone to my room, where he turned a chair backward and sat down. "Dilg is what the others ought to be, if you can believe the literature."

"Dilg is a giant DGD ward," I said. "It's richer—probably better at sucking in the donations—and it's run by people who can expect to become patients eventually. Apart from that, what's different?"

"I've read about it," he said. "So should you. They've got some new treatment. They don't just shut people away to die the way the others do."

"What else is there to do with them?" *With us.*

"I don't know. It sounded like they have some kind of—sheltered workshop. They've got patients doing things."

"A new drug to control the self-destructiveness?"

"I don't think so. We would have heard about that."

"What else could it be?"

"I'm going up to find out. Will you come with me?"

"You're going up to see your mother."




CONTINUED ON PAGE 108

*An extraordinary day in the life of Josephine K*

# RUDE AWAKENING

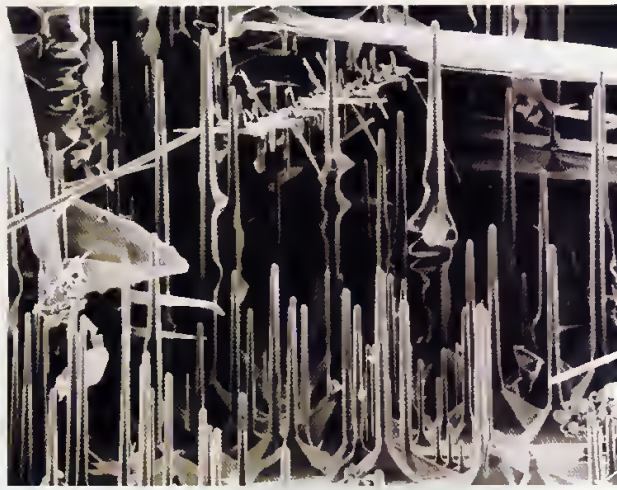
BY THOMAS M DISCH

When Josephine K, cousin of the ill-fated Gregor Samsa, awoke the morning after his funeral, she discovered that she had been afflicted with the same malady that had transformed Gregor into a gigantic insect. But unlike her spineless cousin, Josephine refused to cave in. She went straight to her vanity and put on makeup. Something severe would highlight her mandibles the best. Then, as she did every day, she went into the twins'

bedroom and looked in the crib. But their charming double comforter was empty. They'd already been taken for their daily pram ride in Prague's pretty Unheimlich Park. Well, then, she must have her breakfast. Upon opening the K. family's electrical refrigeration cabinet, however, she found it malfunctioning. Already the Jaffa grapefruits she'd bought were developing a nasty mold.

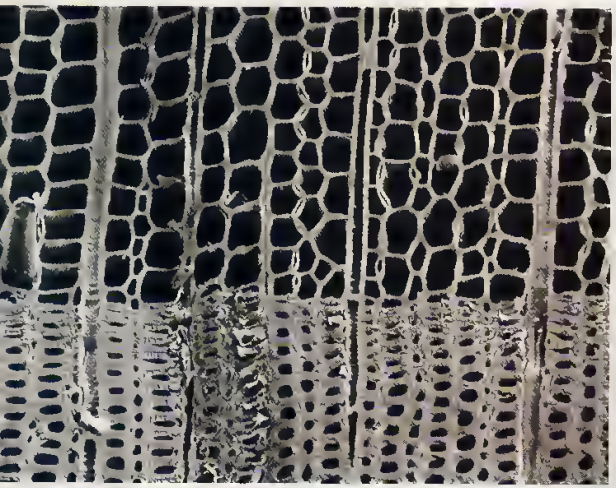
Josephine remained undaunted. *Work,* she thought, remembering her father's words. *makes free!* And so she

*Photomicrographs: a tapeworm (left); a ruby (below); a moth's eye (bottom); an ant (page 64)*



opened her sewing box and took out the unfinished macramé log hanger based on a pattern in *Modern Hausfrau* magazine. But today her fingers were all thumbs. "Darn it!" she ejaculated, burbling slime from her mandibles. For the needles had become inextricably tangled in the yarn. Finally she just decided to return to bed. She slipped into the bulky sweater she'd knit for her cousin and at once fell into a deep deep sleep. And when she awoke she was as human as she'd ever been. ∞

*Clockwise from right: the mouth of a fly, the surface of a leaf, and a cross section of wood*



ARTICLE

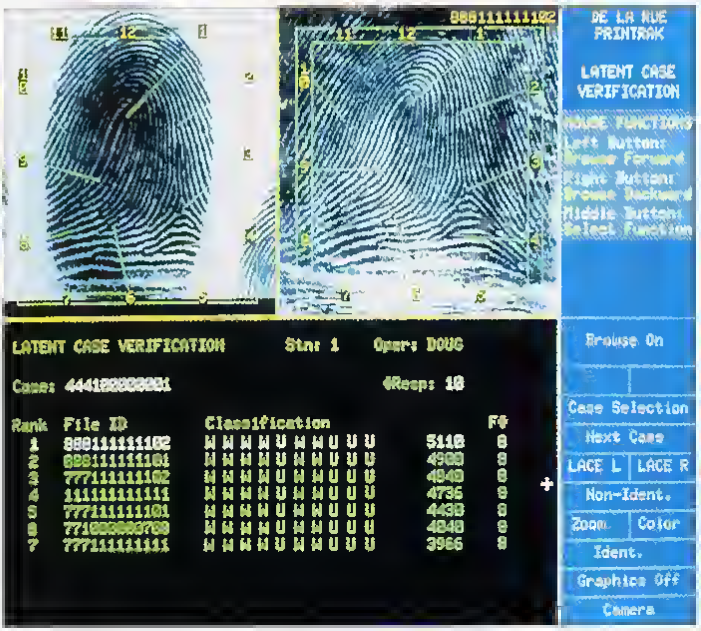
# GETTING AWAY WITH MURDER

BY ERIK LARSON

*With laser scanners and detailed genetic fingerprints, forensic scientists may finally have the edge on crime*

PAINTING BY ERNST FUCHS

*"Ideally, investigators arriving at a murder scene should immediately fume the body and check it closely with a portable laser"*




William M Bass III has a poor sense of smell which may help explain why he can do the things he does Once he was lowered headfirst into a vandalized coffin to see how much of the original occupant remained inside He wasn't especially thrilled by this but he wasn't particularly repulsed either It was as he puts it part of the job

Bass who heads the University of Tennessee's anthropology department is one of the country's leading forensic scientists As a badge-carrying consultant to the Tennessee Bureau of Investigation he has helped identify the skeletal remains of some 300 people He also spends much of his time trying to solve one of the most crucial problems in murder investigations—establishing how long a victim's been dead Once a detective knows this he or she can begin asking the victim's friends and colleagues the standard where were you on the night of the murder questions But setting the time is a lot harder than TV makes it look Quincy kind of ruined it for us says Jerry Thomas Francisco the state's chief medical examiner He was so damned good it's hard to measure up

*Above Computerized fingerprint identification systems may revolutionize crime detection*

Medical examiners can do well within the first three days after death using rigor mortis change in body temperature and other indicators to estimate the time elapsed since death After that investigators rely on gut feelings and experience and they begin calling in the physical anthropologists like William Bass

In woods adjacent to a parking lot at the university's hospital Bass has built an enclosure fenced with barbed wire called the Anthropology Research Facility—ARF for short, BARF with Bass's initial for fun or simply the decay facility There Bass and his students set out fresh unembalmed bodies (six at the moment) and then monitor how quickly the bodies decompose

There are damn few facts in this field says Bass One of the reasons no one's done this is there are too many variables you can't control Climate dogs bugs injuries and individual physiology—fat people decay more quickly than thin ones—can all affect how quickly the body decays Another problem is finding graduate students who can handle the work You need somebody who's not revolted by dead bodies he says

One such student is Robert Mann Bass's graduate assistant known here as Maggot Man By charting the day-by-day advance of insects and collecting and measuring specimens of maggots and flies Mann has come up with a startlingly precise fact about death The millimeter length of the largest maggot plus two will tell you how many days a victim has been dead

What they're doing is state-of-the-art says James Taylor director of New York's Metropolitan Forensic Anthropology Team They're the only real authorities

Bass knows this sort of work won't rid the world of murder but he and scores of other forensic scientists hope they can make it much harder to get away with

Murder is a humbling scientific problem For one thing there's a lot of it There were an average of 52 homicides a day in 1985 And murder is not something you can reproduce in a laboratory It confronts scientists with endless variation—killers do their work in kitchens bedrooms alleys along pipeline roads on lonely interstates Bodies and evidence get distorted by rain, heat dogs bugs clumsy investigators and nature's own chemical tricks Certain soil chemicals for example can change the blood of a buried victim from one type to another Murder moreover ain't what it used to be Most murders were once the smoking gun variety the ones where ma shoots pa or vice versa or two brothers fight and one stabs the other says Jerry Landsman Sr a detective lieutenant in the Baltimore Police Department's homicide unit But more and more we're getting drug-related murders and in a lot of these it's what we recover at the scene that either clears the case or leaves it open

Every year at the annual meeting of the American Academy of Forensic Sciences scores of cops coroners and forensic researchers get together to talk murder and mayhem At the academy's annual Bite Mark Breakfast meetinggoers swap tips on how to match distinctive tooth marks left on victims At the most recent meeting in February, scientific papers bore such scholarly titles as 'Who Bit the Baby?' 'Flesh and the Forensic Anthropologist' and 'The Girl in the Trash Dump A Forensic Dental Identification'

Technologies emerging from this kind of research are already helping researchers battle the bad guys Police in Orange County California now bring portable lasers to the scenes of major crimes to help find and highlight fingerprints Humagen Inc in Charlottesville Virginia, sells kits that use monoclonal antibodies (bioengineered cells that are designed to hunt

down and identify specified cells in or from the body) to detect the presence of human semen and to tell when blood is human or animal. The FBI is currently trying to devise a computer system to automatically compare the markings left on cartridge cases after a gun has been fired, and allow rapid comparisons with cartridges from old and unsolved crimes.

Future cops will hunt for buried bodies using proton magnetometers: devices that sense subtle changes in the earth's magnetic field, used now by archaeologists to look for ancient burial sites. They'll use lasers to develop fingerprints on the skin of murder victims, and DNA identification tests to match the blood of a killer with blood found at the crime scene. 'Someday,' says Larry Ragle of the sheriff's crime laboratory in Orange County, California, a lab known for its advanced use of forensic technology, 'you'll be able to put a drop of blood or sperm from a semen sample into a device, and it'll decode it and give you the range of characteristics of the donor: hair color, eye color, maybe even facial characteristics. You'll have an image like the kind our police artists do now.'

They never did this stuff on *Kojak*.

What cops like most is evidence that puts a subject at the scene of a crime in a way that lawyers can't contest. Fingerprints can do that—no forensic breakthrough since has had the impact of that first realization that everybody's prints are different. But now forensic scientists talk about a revolution of even greater significance. DNA mapping of blood, semen, and tissue, which produces a genetic identification as individual as a fingerprint. In fact, Alex Jeffreys, the British scientist who pioneered the technique, has already dubbed the process DNA-fingerprinting.

In the United States the leader in forensic DNA analysis is Lifecodes Corporation, in Elmsford, New York, a small concern that gets most of its revenue from clinical genetics assays and paternity testing. At Lifecodes, even the bathrooms are marked in genetic code—XX for women, XY for men. One day last January, three New York City homicide detectives made the drive to Elmsford, a short trip up the Saw Mill River Parkway from Manhattan, to drop off a piece of carpet padding heavily soaked with blood. Their visit was something of a landmark, one of the earliest uses of a technique that could one day tie a single individual to a particular crime absolutely, irrefutably, from just a single drop of blood or semen—and that can work on old as well as recent stains. The detectives' sample was six years old.

Through a series of complex steps now standard in labs that do genetic analyses, the DNA from a blood sample is purified and then chemically sliced into a kind of genetic confetti. After going through a process called electrophoresis, these bits of DNA wind up spread out—in order of their size—along the length of a sheet of special absorbent paper. For a given individual, this pattern will always be the same.

Next, technicians apply one of several DNA probes—radioactively labeled bits of DNA that seek out specific, complementary pieces of DNA in the sample and bind to them in a genetic handshake. Consider one such probe, called simply P.1. It looks for a particular fragment of DNA that has been cut loose from chromosome 14. When P.1 finds it, it sticks to it and then, in effect, waves a radioactive flag. When the sheet of paper containing the DNA pattern is then sealed in a cassette with a piece of X-ray film, the radioactivity exposes the film and leaves an image of a couple of small black bands—the DNA fragments.

The distance from the bottom of the film indicates the size of the fragments that the probe has found. Genetic researchers have compiled probability tables that tell how often these different sizes appear in the population. When fragments from two samples are the same size, the fragments match—the probability tables then determine the odds of such a match occurring by chance. By using other probes on the same samples and combining the results, Lifecodes can sharply limit those odds.

In one recent homicide case, for example, Robert C. Shaler, director of forensic services at Lifecodes, combined the results of conventional blood analyses with the results of a DNA probe done by Lifecodes. The case involved the 1985 murder of a social worker, found dead in her New York City apartment. Some of the blood at the scene didn't match her blood type. Nearly a year later, a burglar fell to his death. Police, on a hunch, asked Shaler—then with the medical examiner's office—to try matching the man's blood to the unidentified blood in the apartment. Shaler ran a series of blood-protein tests that showed the two blood samples had the same characteristics, but that one person out of every 100 also had that kind of blood. Lifecodes then did its tests. It too found a match and calculated that one person out of 15,000 would have that same DNA pattern. By combining the results, Lifecodes and Shaler showed that only one in 1.5 million people had the same blood.

'So out of New York City, you're looking at maybe between five and ten people who would have blood like that,' Shaler says. Nevertheless, the case remains open.

Now Lifecodes is experimenting with a new and far more complex probe that cuts to the soul of individuality. Instead of just a few black bands, this probe, pioneered by Britain's Jeffreys, yields dozens of them in a more complete genetic picture. But researchers have yet to learn how to analyze so many bands and to develop the probability tables that will let the bands tell their stories. Shaler also wants to heighten the sensitivity of his existing probes so they'll work with far smaller samples of DNA—ideally, to make the probes sensitive enough to work on almost any body cell that has a nucleus, including those in bone marrow and hair roots.

There may then come a day when crooks aren't just fingerprinted, but are routinely typed by their DNA patterns, which could be digitized and stored in central data banks along with other criminal records. Shaler doesn't think that will happen for some time—and wonders whether American culture, with its concern for safeguarding privacy, would ever permit that kind of routine analysis. Clearly, however, detailed DNA 'prints' could revolutionize the investigation of murder and rape.

'Then we'll be looking at the actual sequence of the individual,' says Shaler. 'Instead of saying that the blood sample occurs in only one out of a million people, we should be able to say with certainty this is that person's blood.'

For now, though, fingerprints are still about the most effective weapon against killers—provided detectives can find them. Latent prints—the prints found at the scene of the crime—often don't show up on certain kinds of surfaces, like leather wallets, oily weapons, and dead bodies. The prints investigators do find are typically only fragments—half a thumb here, a bit of pinkie there. In most parts of the country there isn't much cops can do with these except hope a suspect gets found through other methods and that the fragments can be matched to the prints taken when he's booked. This may explain why no TV cop series features a print expert as its hero.

But lasers and computers are turning the ID experts into the Flash Gordons of crime.

It was a laser that helped convict Victor King Malone, a Michigan man of first degree murder last year. On January 29, 1985, security guards at a Southfield, Michigan, mall found the body of a twenty-year-old prostitute who'd been beaten, sodomized, and strangled, then wrapped in sheets and electrical wire and stuffed into a plastic garbage bag. Fingerprint experts carefully examined the bag, the wire, and the sheets but found nothing. On February 7, police brought the bag to the Ontario Provincial Police Crime Lab in Toronto for a much closer laser inspection. It worked.

A forensic analyst there spotted a single print on the garbage bag. Southfield police compared this print with prints taken from Malone, who'd been arrested in Detroit for two other prostitute killings. The print matched the pinkie of his left hand. There would have been no other way to link him to that murder, says Allen M. Wolf, who prosecuted the case and is now an assistant U.S. attorney in Detroit. (Malone is cur-

rently appealing his conviction )

Lasers can't find all latent prints but they can locate many that other methods overlook At the same time they can highlight prints too faint for use in identification Lasers work by causing certain materials in fingerprints to fluoresce A fingerprint is a complex collection of ingredients 98 to 99 percent water the rest, a mix of inorganic and organic compounds including salts vitamins lipids and amino acids

The technique is magical At the FBI's Quantico Virginia, forensic research center Clarence Phillips an instructor stands beside a large Spectra Physics laser its cooling and pressure systems whining away A thick green glowing fiberoptic cable carries the laser's beam to a device that broadens it and casts it downward as a shimmery blue-green spotlight about the diameter of a honeydew melon

Phillips sticks a plastic coffee cup into the light and turns it slowly There is nothing to see, just luminous green plastic But put on a pair of orange lensed goggles (which filter out light that can mask the fluorescence), and the cup turns a deep rusty red Now when Phillips rotates the cup a fingerprint appears clean and clear like dust on black enamel

Lasers may at last allow police to develop fingerprints on the bodies of victims

"I would always try to use the laser on a child," says Paul W Maliska director of the forensic services group of Laser Photonics Inc , in Orlando Florida "A child's skin is structurally best suited to developing prints " Next best is a woman's skin because women have smaller tighter pores than do men What's crucial, Maliska says is to stabilize the prints on the body as quickly as possible using the fumes of Krazy Glue or Super Glue common tools now for latent-print experts (The fumes form a polymer with the materials in the prints fixing them but also serving as a base for dyes that can further highlight the natural fluorescence ) Ideally he says, investigators arriving at a murder scene should immediately fume the body and check it closely with a portable laser Any prints that were found he says would be especially damning "A male suspect would have a real hard time explaining why his fingerprints turned up on the body of a dead nude woman" Maliska says

Computers have made it especially worthwhile to search for those prints Most major cities now have automated print-search systems that let police match even small fragments of fingerprints found at crime scenes with prints already in their computers Cities are just beginning to link their systems together the first steps toward what could become a national network that would let police conduct nationwide manhunts in just a few minutes

Future cops may even be able to conduct national searches right from the crime scene or from their patrol cars during routine highway stops says Dick Cappello manager of research and development for De La Rue Printrak Inc in Anaheim California, one of the two largest marketers of automated fingerprint systems

He envisions a small remote print search terminal that could fit in a car During an arrest the suspect would place his or her

CONTINUED ON PAGE 134

# IT WAS THE PERFECT CRIME...

BY MARION LONG

How will high-tech detection and forensic science change criminal behavior? Will murder be harder to get away with in the next century? We asked some specialists in the art of murder to speculate about the future of this darkest of crimes

P D JAMES, *mystery writer and judge in the magistrate's court in London*

Quite frankly I don't think breakthroughs in forensic science will make much difference in ordinary domestic murders, which are rather sad, sordid, pathetic little affairs where people in unbearable domestic situations, or what have you, lose patience and seize a carving knife . These people are not going to pay any regard to what the police have available And I think the same is true for a sex criminal or any criminal who is under a dreadful compulsion He is unlikely to think *Well, I must be careful I don't leave any body fluids behind*

What this kind of work is most important for, in my view is as proof in court It is such invaluable proof if someone is pleading not guilty to have the prosecution able to say, 'Here is the exact match of your blood ' or 'Here is the identical bit of carpet from your floor' or whatever

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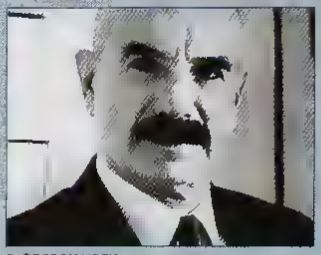
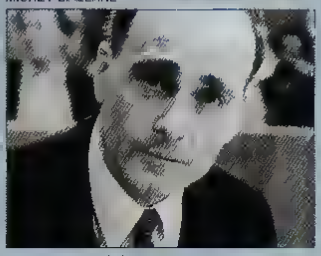


G GORDON LIDDY

HARLAN ELLISON

P.D. JAMES

MICKEY SPILLANE



VINCENT BUGLIOSI

*Subterranean skyscrapers, floating tunnels, cities constructed by remote control are but a few macrosolutions to megaproblems from the man whose motto is, "We know it works—let's build it!"*

# INTERVIEW

# FRANK DAVIDSON

Nausea, not necessity, is sometimes the mother of invention. Had Frank Davidson not shared a pitching ferry full of prostrate passengers three decades ago and nearly lost his own toddler, who was almost swept overboard, there might not be an English Channel tunnel in the works today. As a typical 90-minute Calais-to-Dover crossing stretched into a nine-hour ordeal, the young international-law specialist realized that alternative channel transportation was an idea whose time had come.

Today Davidson is a trim and hearty sixty-eight, and the world has finally come around to his way of thinking. On February 12, 1986, British prime minister Margaret Thatcher and France's president François Mitterrand signed a Channel Tunnel Treaty permitting construction of the twin electric-railway tunnel first proposed by Davidson's International Channel Tunnel Study in 1957.

The Channel Tunnel is but one of the ambitious technological schemes to which Davidson has devoted his professional life. In

PHOTOGRAPH BY KIM STEELE

1967 he coined the term *macroengineering* in an article for the British journal *Futures*. Today he defines it as "the study, preparation, and management of the largest engineering projects that can be built at any stage of humankind's evolution." The Alaskan pipeline, the Empire State Building, and Comsat are all part of an engineering tradition tracing back to the dawn of civilization. "The human," he maintains, "is an engineering animal. The first skyscrapers were attempted in the Middle East in prehistoric times—the Tower of Babel and the ruins of the ancient Mesopotamian ziggurats are their legacy."

A founder of The American Society for Macro-Engineering, which held its first major international conference in March 1986, Davidson has headed MIT's macroengineering research group since its inception in 1970. Similar macroengineering institutions now flourish in Canada, Britain, Spain, and Japan. Lacking engineering training himself—"I'm a perfect example of the lack of professional training I decry"—Davidson nonetheless has become a pivotal middleman in promoting specific macroengineering projects. George Bugliarello, president of the Polytechnic Institute of New York, says, "Frank, by his charm and his contacts, brought the political and economic communities together in recognizing macroengineering."

Davidson's insider status has been earned by "taking lunches" with the highly placed. His father was active in New York Democratic politics and introduced Frank in his early twenties to FDR. Davidson met other luminaries on the way up at Harvard College and Harvard Law School, and as assistant counsel to the U.S. embassy in Paris. He has served on dozens of government panels, industry boards, and university committees, advising on nuclear power plant location, high-speed ground transportation, mountain research, and venture capital funding. And while his contacts may have been cultivated, his charm is not. Says Bugliarello, "Frank is what Reagan pretends to be—a thoroughly nice person. But where Reagan has a vicious core, Frank is nice throughout."

Davidson's most popular work, *Macro: A Clear Vision of How Science and Technology Will Shape Our Future*, published in 1983 (William Morrow), is a chatty review of macroprojects past, present, and future. His more technical articles on macroengineering policies and practices have appeared in *Foreign Affairs*, *Technology in Society*, and *Technology Review*.

Macroengineering, and tunnel building in particular, are in Davidson's blood. His father, New York City's commissioner of water supply, was responsible for building the longest true tunnel on Earth—the 80-mile conduit that carries water from the Delaware Water Gap to New York's reservoirs. Today Davidson is still pushing his father's unrealized plans for a World War II memorial in New York: a public spa in Manhattan. (The design was based on an idea of a German engineer who wanted a memorial for German soldiers in the event of a German victory, and was later revised by Percy Corbett, architect of New York's Radio City Music Hall. It would feature actual or chemically reproduced samples of water from all the world's famous spas, says Davidson. There would be a swimming pool bigger than the Roman baths, with artificial clouds and ultraviolet sunlight.) A bent toward public service and conservation—reinforced by his postgraduate farm work and service in the Depression-era Civilian Conservation Corps (CCC)—figures in Davidson's big dreams. He envisions expanding the original CCC to include all youth, perhaps, to work on some of his macroprojects.

Davidson has circled the globe several times to oversee such macroprojects as the pipeline at Prudhoe Bay in Alaska, the Seikan Tunnel in Japan, or the waterfalls of Nepal. He missed out on the tour of China's Grand Canal organized by Manabu Nakagawa, founder of the Japan Institute for Macroengineering. But he did join his colleagues to sail down the Canal des Deux Mers in France last summer.

> *"A Channel tunnel may have been discussed in Julius Caesar's time. Caesar's chief engineer was a tunnel specialist and well qualified to dig a Channel tunnel."*

For a man of busy itineraries, lofty accomplishments, and prestigious friendships, Davidson cuts a surprisingly modest figure. says interviewer Don Lessem. Speaking in soft, hesitant tones and peering over reading glasses, Davidson appears more the absentminded professor than the international lawyer, financier, and high-tech macroengineer.

***Omni:*** Which is your reality—the unassuming life-style or the grandiose dream?

**Davidson:** In the movie *Fitzcarraldo*, an Amazonian tribe is hauling a ship over a mountain for this grand dreamer, Fitzcarraldo. These natives worry about a tribe downriver that believes the only reality consists of dreams. If "dreams" include imagination, plans, and designs, perhaps that tribe has a point. You cannot build even a sidewalk unless you first imagine it. I sit in this room talking to you, but the room wouldn't exist unless someone had imagined it, designed it, and had it built by an engineering process. Which is the reality, the space itself or what was in the minds of its creators? Aren't both, after all, part of the same process?

Actually, I'm no Fitzcarraldo. I don't tilt at windmills. My dreams aren't thinking big just for the sake of thinking big. They are sound applications of existing or achievable technology to appropriate problems. Big isn't always beautiful, but you can't think small when you're talking about water-supply problems or cleaning up toxic wastes. Even E. F. Schumacher [father of the "small is beautiful" philosophy], who worked for England's largest organization, The Coal Board, agreed with me on that. We need macrosolutions, big dreams, if you want to call them that. This would be a very sad world if we became stuck in the patterns of existing systems and institutions.

***Omni:*** Weren't macroprojects of the past, from the Pyramids to Howard Hughes's *Spruce Goose*, often the grandiose dreams of a few powerful individuals?

**Davidson:** Sometimes. When you're talking about macroengineering, you're talking about power. Power is really just the ability to get things done. Those in power are usually more capable than their public images lead one to expect. Many policy choices spring much more from personal experiences, like my disastrous Channel crossing, than systems analysts will admit. But I'd contrast exercises of personal whim—the Taj Mahal or the château of Vaux le Vicomte, the prototype for Versailles—with macroprojects that build infrastructure in the public interest: the Roman roads and aqueducts, the Suez and Panama canals, the Tennessee Valley Authority's rural electrical grid.

There are still people who build whatever the hell they want, and we do have the tendency to build anything we can build. Nelson Rockefeller's personal monument of a state office building in Albany comes to mind. But by and large, macroengineering means straight military projects, like the Stealth bomber, the Great Wall of China, and the Maginot Line in the past, or public utilities like the gas pipelines. Those aren't personal monuments.

***Omni:*** Many modern macroprojects still seem ill considered.

**Davidson:** You have to look at each case. The *Titanic* was a debit, but all big ships don't fall apart. We shouldn't have knee-jerk resistance to all macroengineering projects because of some celebrated failures. Besides, we learn from those failures. I'd ride on the next space-shuttle flight. I'll bet it'll be a damn sight safer than taking a drive in your car.

There are always risks in technology. The Seikan Tunnel connecting the two major islands of Japan was constructed with the loss of more than thirty workmen's lives. This was tragic, but before the tunnel was built—shortly after World War II—about fourteen hundred people drowned in a ferryboat accident between the islands. Rather than dwell on the shuttle tragedy

I'd focus on our failure to be shocked by repetitive loss of life because of inappropriate habits. The American highway system costs us more than forty thousand lives a year, with maybe ten times as many people injured. When I think of the fail-safe systems that could be applied to heavily trafficked roads, I get very angry indeed.

Professor David Gordon Wilson of MIT developed a palletized automated guide system for the Department of Transportation. This simple system could move cars and freight at seven or more times the current road carrying capacity. You drive your car onto a platform along a moving track, say as you enter the Callahan Tunnel here in Boston. The moving belt carries you along the congested artery at steady speeds far greater than the stop and go of thousands of drivers going their own way. The belt deposits you back on the open highway, and off you drive. This is an example of the sort of significant everyday, practical improvements macrotechnology can provide.

*Omni*: Don't delays and inaction surrounding macroprojects like the Channel tunnel frustrate you?

**Davidson**: No. You've got to be patient in this business. I go with the motto of the Young family in England: "Be right and persist." I was lucky to be in on discussions when the Channel tunnel subject came up in the Fifties. But this is an old project. The French and British first started digging a Channel tunnel in 1881. Actually, it may have been discussed in Julius Caesar's time. Caesar's chief engineer was a tunnel specialist and well qualified to dig a Channel tunnel. Some tunnels around Rome designed and built more than two thousand years ago are still serviceable. The Romans could have cut a tunnel through the chalk floor if they had had a means of testing the geology beforehand. Of course, they had no way to carry out core borings in advance of construction.

*Omni*: How is this now being done?

**Davidson**: We use drill rigs from offshore oil platforms that employ, for the first time, an electronic instrument called a sparkarray. Invented by Harold Edgerton of MIT, the sparkarray measures electrical impulses rebounding off the ocean floor to identify where various layers of the seafloor begin and end. The findings aren't too different from those of a British and French survey that sampled outcrops of the seafloor in 1881. The whole Channel floor is lower chalk, a lovely thing to bore through. It's soft, and it's impervious to water—the world's best material for tunneling. When we began digging, we even used the portion excavated on the British side in 1881. Not quite a mile long, that tunnel segment is still standing.

*Omni*: What other new technology will be used to dig the Channel Tunnel?

**Davidson**: We're considering not only building the two tunnels from the coasts toward the center but using one or two caissons implanted in the Channel to dig both toward the coasts and in between. Caissons simultaneously. This would be slightly more expensive, but the savings in interest charges would be dramatic. Economist Lester Thurow noted. There are three main considerations for the tunnel construction industry. The first is speed. The second is speed. The third is speed.

*Omni*: Has this submerged caisson system already been developed?

**Davidson**: It's been designed in detail by the renowned submarine engineer J. Vincent Harrington. My company, Technical Studies, Inc., has the right to use the patent for Channel Tunnel purposes. It's pointless to excavate rapidly unless all facets of the construction program, including approach roads and terminals, are also speeded up.

*Omni*: Would the success of a Channel tunnel encourage the building of other macroengineered projects?

**Davidson**: No doubt about it. The Channel Tunnel has given enormous impetus to a dozen similar projects that have been in the gestation chamber for years, if not decades and centuries. There is now a detailed study under way for a tunnel or a combination of bridges and tunnels between Japan and South Korea. A Danish company has looked closely at the possibilities of a bridge or tunnel connection across the Great Belt of Denmark—from Zealand, near Copenhagen, to the Jutland Peninsula, north of Schleswig-Holstein. This would link the whole of Denmark. It's about thirteen miles altogether, and I think we'll see some action soon. I'm particularly interested in a Gibraltar Tunnel. It would be economically beneficial to both Morocco and Spain and would have a very positive effect on the politics of the region. The problem here is that the Strait of Gibraltar is very deep—more than nine hundred feet. If you bored a tunnel or laid an immersed tube in a trench across the strait, the great depths would require approach tunnels so lengthy that the cost would be far beyond foreseeable revenues. But a technical solution that could save these countries half a century of agony does exist. I propose a floating tunnel, one placed deeply enough for ships to sail over, yet not so deeply that the approach tunnels would present unassumable costs. Anchored to the bottom by cables, the tunnel would be made of buoyant plastic. The main problem would be corrosion and stress on the cables.

> *"Stockebrand demonstrated supersonic tube flight by sending a Ping-Pong ball through an eight-hundred-and-fifty-foot pipe at eleven hundred miles per hour."*

Such a system could be profitably applied to building a floating tunnel that spans the Strait of Messina between Italy and Sicily. Most bridge engineers believe new materials will enable us to build single-span bridges two miles wide—even though the largest span that across the Hamber River in England, is less than a mile. But you can't have bridge piers impeding traffic over a two-mile plus waterway like Messina. You could have a floating tunnel, though. It sounds ambitious, but it's not like going to the moon.

*Omni*: What's become of the Kra Canal in Thailand, that most ambitious of international waterway projects?

**Davidson**: That canal would reduce by perhaps seven hundred miles the sea voyage between the Middle East and Japan. The idea was first proposed by Ferdinand de Lesseps, builder of the Suez Canal. Japan and other nations trading with the Middle East are very interested, although the Isthmus of Kra features a granite ridge that previously would have been too expensive to blast through. Ernest Frankel, professor of ocean engineering at MIT and senior maritime adviser to the World Bank, has developed a system for linking portable plastic sections to make the walls of the canal without substantial excavation at the site. Prefabricated wall sections, made elsewhere would be placed on either side of a future canal by special temporary railway. Japanese and American engineers are studying such a plan for a new Panama canal, which we'll need by 2000.

*Omni*: How about plans to revolutionize ship transport?

**Davidson**: We could build roadways for hauling ships, much as the ancient Greeks did across the Isthmus of Corinth. We could dispense with canals entirely by putting ships on railroad tracks, as proposed by *Scientific American* one hundred years ago, or move them overland on large Hovercraft-like platforms. The ships could ride on a cushion of water or air. In Belgium they've developed a huge new ship elevator. At the Isthmus of Kra such an elevator could lift the ship to the top of the cliffs on a pallet. Maybe we'll just update *Fitzcarraldo*. Put the pallet on a large Hovercraft with skirts to keep the air or water underneath, and move the ship by land.

*Omni*: What new technology is needed to build man-made islands?

**Davidson**: None. The Aztecs built small landfills and causeways. Some of the world's most impressive artificial islands were built twenty years ago off the Maryland coast for the Chesapeake Bay Bridge-Tunnel system. These four man-made islands of sand and rock, in waters thirty to forty-five feet deep, are supported by tres-

tles of prestressed concrete. A similar system was used to create more than three square miles of gravel-filled islands in Osaka Harbor. It includes a superfanker port and several office buildings and high-rise buildings. Also in Japan, Mitsui Engineering based the Harbor Airport island concept partly on the early work of Buckminster Fuller. A generation ago, engineers thought you could sink triangular cofferdams [watertight enclosures] of prestressed concrete into the seas, pump out the water within, and bring in dirt fill. Now Professor Terai, formerly of MIT, the senior adviser to the Nippon Telephone and Telegraph Company, has devised a special system for earthquake-prone regions like the wafers off Tokyo Bay. In his plan the megastructure is supported on columns with adjustable sleeves around them. Depending on the changing pressures communicated to computer controls, each column could vary its height appropriately for the stress. Small boats and large could travel under the structure and supply the city, and there would be minimal interference with sea life from the columns. Ten miles outside Tokyo, this multistory sea city for a million people would have an airport and golf course on the roof!

Island building, too, may be the answer to overpopulation problems. Today Cambodian refugees live precariously in United Nations relief camps in Thailand. Why not follow the Dutch model of reclaiming land from the sea and build permanent homes for refugee populations on new islands?

And we needn't build just along the coasts. Building atop seamounts, undersea mountains that peak close to the surface, is feasible in many places. More than forty of these have been identified in the Pacific alone. The mounts could serve as construction bases for landlocked countries, like Bolivia or Switzerland, attracted to the idea of having seaports. Countries with a maritime tradition like Holland's could extend their sovereignty.

At some point in the twenty-first century I expect different nations will establish islands of their own in space. You may well be flying up to Mars for your honeymoon and on the way pass an island in the sky with an enormous Dutch flag.

***Omni:*** What new transportation uses exist for tunnels under land?

**Davidson:** Underground transport of automotive traffic is absolutely practical and logical. The first subway was built in London about one hundred years ago, and virtually every subway system since that time—whether in Moscow, Tokyo or Montreal—has been modeled on it. People haven't noticed that since the first subways were built, the automobile was invented. The easiest way to incorporate the car into underground transport is to imitate the surface railway by having motor traffic riding piggyback on subway carriers. It's been done in the Simplon and the St. Gotthard tunnels in Switzerland for more than half a century. Moving trucks this way would reduce street congestion and pollution.

***Omni:*** What about high-speed underground transport?

**Davidson:** It makes much more sense than Reagan's ideas for ultrasonic air transportation. Dr. Robert Salter of the RAND Corporation, an engineer-scientist responsible for a number of major aerospace programs, became convinced in the Seventies that a supersonic subway was technically realizable. His concept is simplicity itself. Take an electronically driven, magnetically levitated train and run it in a vacuum tunnel. Without friction the speeds attainable are incredible. The Boston and Moscow subways might be linked within one worldwide network.

Salter estimates it is physically possible to send such a train from Boston to San Francisco in about twenty-one minutes. We invited him to the MIT Faculty Club for lunch, and by dessert he had agreed to slow down the train to make it an hour ride cross-country. Accelerating to and decelerating from peak speeds of sixteen thousand miles per hour would subject the rider to unsafe and uncomfortable g forces.

***Omni:*** When might we see such a train?

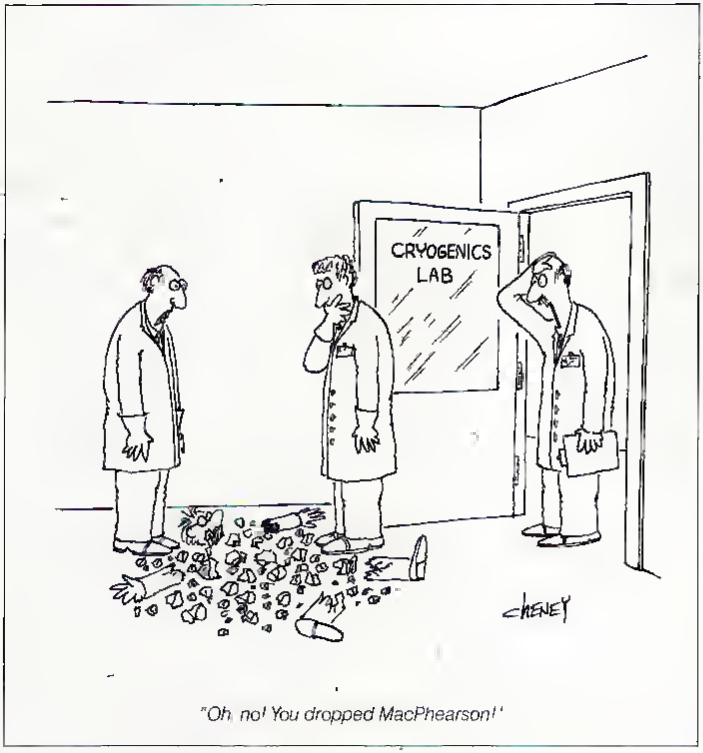
**Davidson:** Problems with the braking system must be overcome, but the technology for creating magnetically levitated [maglev] trains within vacuum chambers already exists. I've ridden on the only operational maglev train—a single car connecting the Birmingham [England] airport with a nearby railroad station. The ride over a guideway to the railway station takes just over ninety seconds and is very smooth. Years ago the Japanese tested a maglev from an MIT model that moved at speeds of three hundred twenty-one miles per hour. Many companies are working hard on maglev. They haven't nailed down a route yet, but one from Reno, Nevada, to Los Angeles is possible.

***Omni:*** Has anyone demonstraled that a maglev in a vacuum tube is possible?

**Davidson:** We have at MIT. Engineering firms told me a working model of supersonic tube travel would cost hundreds of thousands of dollars. Then a friend steered me to Thomas Stockebrand, an engineer with Digital Equipment Corporation. When I described to him what I had in mind, he said, "Sure, I can build it, but it'll cost you eight hundred dollars." Months later, on April 25, 1985, in the presence of leaders of the engineering profession from many nations, Stockebrand demonstrated supersonic tube flight on the MIT athletic field. He sent a Ping-Pong ball through an eight-hundred-fifty-foot length of two-inch-diameter plastic pipe at better than eleven hundred miles per hour.

***Omni:*** But wouldn't the tunnel digging for a supersonic subterranean transportation system be prohibitively expensive?

**Davidson:** Certainly now, but not in a century. With something like the automated Subterrene that John Rowley developed al




*"Oh, no! You dropped MacPhearson!"*



CONTINUED ON PAGE 124

## EXPLORATIONS

CONTINUED FROM PAGE 26

word that counts rather than the first

Modern cryptanalysts owe all that they know about Beale and his exploits to a pamphlet that Ward published in 1885. Every titillating detail about Beale—that he was tall and swarthy, that savage animals accosted him—comes from Ward. There is no independent confirmation, no corroborating correspondence, no journals, no wills, no references to the treasure whatsoever. If Ward was a prankster, however, he was a damn good one, having pulled off one of the longest-running hoaxes—not to mention one of the most expensive. "These games have cost, in terms of man-hours and computer time, much more than the tens of millions the treasure is supposed to be worth," Hammer says.

Hammer himself ran extensive statistical tests on the distribution of the numbers in the undeciphered Beale papers and concluded, in a prizewinning paper, that the numbers are not random but definitely conceal a message. Most cryptanalysts accept this conclusion, but the mere fact that there is a message Hammer concedes doesn't mean that the whole thing isn't a hoax. Who's to say that the message isn't something like "You're the biggest sucker in the universe, dodo brain?" But as long as there's a chance that the treasure's really out there, Hammer and the others aren't about to give up.

### HERE'S YOUR CHANCE

Decode the numbers (below) that lead to the buried treasure — and buy yourself a shovel. The loot is yours if you can find it. The attorney general of the state of Virginia passed a ruling in the 1960's giving ownership of the treasure to whoever uncovers it, no matter whose land it's on.


For more information on the code or about membership in the Beale Cypher Association, send $1 to the BCA at Box 236, Warrington, PA 18976.

FICTION

# ON GOLDEN SEAS

BY ARTHUR C. CLARKE

*Executive agenda: gone fishing to reduce the national debt*

PAINTING BY AKIRA YOKOYAMA

Contrary to the opinion of many so-called experts, it is now quite certain that President Kennedy's controversial Budget Defense Initiative was entirely her own idea and her famous "Cross of Gold" speech was as big a surprise to the OMB and the secretary of the Treasury as to everyone else. Presidential Science Adviser Dr George Keystone (Cops to his friends) was the first to hear about it.

Ms Kennedy, a great reader of historical fiction—past or future—had chanced upon an obscure novel about the fifth Centennial, which mentioned that seawater contains appreciable quantities of gold. With feminine intuition (so her enemies later charged) the President instantly saw the solution to one of her administration's most pressing problems.

She was the latest of a long line of chief executives who had been appalled by the remorselessly increasing budget deficit, and two recent items of news had exacerbated her concern. The first was the announcement that by the year 2010 every citizen of the United States would be born a million dollars in debt. The other was the well-publicized report that the hardest currency in the free world was now the New York subway token.

"George," said the President, "is it true that there's gold in seawater? If so, can we get it out?"

Dr Keystone promised an answer within the hour. Although he had never quite lived down the fact that his master's thesis had been on the somewhat bizarre sex life of the lesser Patagonian trivit (which, as had been said countless times, should be of interest only to another Patagonian trivit), he was now widely respected both in Washington and academe. This was no mean feat, made possible by the fact that he was the fastest byte slinger in the East. After accessing the global data banks for less than twenty minutes, he had obtained all the information the President needed.

She was surprised—and a little mortified—to discover that her idea was not original. As long ago as 1925 the great German scientist Fritz Haber had attempted to pay Germany's enormous war reparations by extracting gold from seawater. The project had failed, but—as Dr Keystone pointed out—chemical technology had improved by several orders of magnitude since Haber's time. Yes—if the United States could go to the moon, it could certainly extract gold from the sea.

The President's announcement that she had established the Budget Defense Initiative Organization (BDIO) immediately triggered an enormous volume of praise and criticism.

Despite numerous injunctions from the estate of Ian Fleming, the media instantly rechristened the President's science adviser Dr. Goldfinger, and Shirley Bassey emerged from retirement with a new version of her most famous song.

Reactions to the BDI fell into three main categories, which divided the scientific community into fiercely warring groups. First there were the enthusiasts, who were certain that it was a wonderful idea. Then there were the skeptics, who argued that it was technically impossible—or at least so difficult that it would not be cost-effective. Finally, there were those who believed that it was indeed possible—but would be a bad idea.

Perhaps the best known of the enthusiasts was the famed Nevermore Laboratory's Dr. Raven, driving force behind Project EXCELSIOR. Although details were highly classified, it was known that the technology involved the use of hydrogen bombs to evaporate vast quantities of ocean, leaving behind all mineral (including gold) content for later processing.

Needless to say, many were highly critical of the project, but Dr. Raven was able to defend it from behind his smoke screen of secrecy. To those who complained, "Won't the gold be radioactive?" he answered cheerfully, "So what? That will make it harder to steal! And anyway, it will all be buried in bank vaults, so it doesn't matter."

> *"Isaacson set to sea on a vast floating platform looking as if an aircraft carrier had tried to make love to an oil refinery. Keystone left to go looking for the greater Patagonian trivit."*

But perhaps his most telling argument was that one by-product of EXCELSIOR would be several megatons of instant boiled fish, to feed the starving multitudes of the Third World.

Another surprising advocate of the BDI was the mayor of New York. On hearing that the estimated total weight of the oceans' gold was at least five *billion* tons, the controversial Fidel Bloch proclaimed, "At last our great city will have its streets paved with gold!" His numerous critics suggested that he start with the sidewalks, so that hapless New Yorkers no longer disappeared into unplumbed depths.

The most telling criticisms came from the Union of Concerned Economists, which pointed out that the BDI might have many disastrous by-products. Unless carefully controlled, the injection of vast quantities of gold would have incalculable effects upon the world's monetary system. Something approaching panic had already affected the international jewelry trade when sales of wedding rings had slumped to zero immediately after the President's speech.

The most vocal protests, however, had come from Moscow. To the accusation that BDI was a subtle capitalist plot, the secretary of the Treasury had retorted that the USSR already had most of the world's gold in its vaults, so its objections were purely hypocritical. The logic of this reply was still being unraveled when the President added to the confusion. She startled everyone by announcing that when the BDI technology was developed, the United States would gladly share it with the Soviet Union. Nobody believed her.

By this time there was hardly any professional organization that had not become involved in BDI, either pro or con. (Or in some cases, both.) The international lawyers pointed out a problem that the President had overlooked. Who actually owned the oceans' gold? Presumably every country could claim the contents of the seawater out to the two-hundred-mile limit of the Economic Zone—but because ocean currents were continuously stirring this vast volume of liquid, the gold wouldn't stay in one place.

A single extraction plant at *any* spot in the world's oceans, could eventually get it all—irrespective of national claims! What did the United States propose to do about that? Only faint noises of embarrassment emerged from the White House.

One person who was not embarrassed by this criticism—or any other—was the able and ubiquitous director of the BDIO, General Isaacson had made his formidable and well-deserved reputation as a Pentagon troubleshooter; perhaps his most celebrated achievement was the breaking up of the sinister Mafia-controlled ring that had attempted to corner one of the most lucrative advertising outlets in the United States—the countless billions of sheets of armed-services toilet tissue.

It was the general who harangued the media and arranged demonstrations of the still-emerging BDI technology. His presentation of gold—well, gold-plated—tie clips to visiting journalists and TV reporters was a widely acclaimed stroke of genius. Not until after they had published their fulsome reports did the media representatives belatedly realize that the crafty general had never said in as many words that the gold had actually come from the sea.

By then, of course, it was too late to issue any qualifications.

At the present moment—four years after the President's speech and only a year into her second term—it is still impossible to predict the BDI's future. General Isaacson has set to sea on a vast floating platform looking, as *Newsweek* magazine put it, as if an aircraft carrier had tried to make love to an oil refinery. Dr Keystone, claiming that his work was well and truly done, has resigned to go looking for the *greater* Patagonian trivit. And, most ominously, U.S. reconnaissance satellites have revealed that the USSR is building perfectly enormous pipes at strategic points all along its coastline. ∞

*How science has succeeded in capturing that fleeting moment between human thought and action*

# WINDOWS ON THE MIND

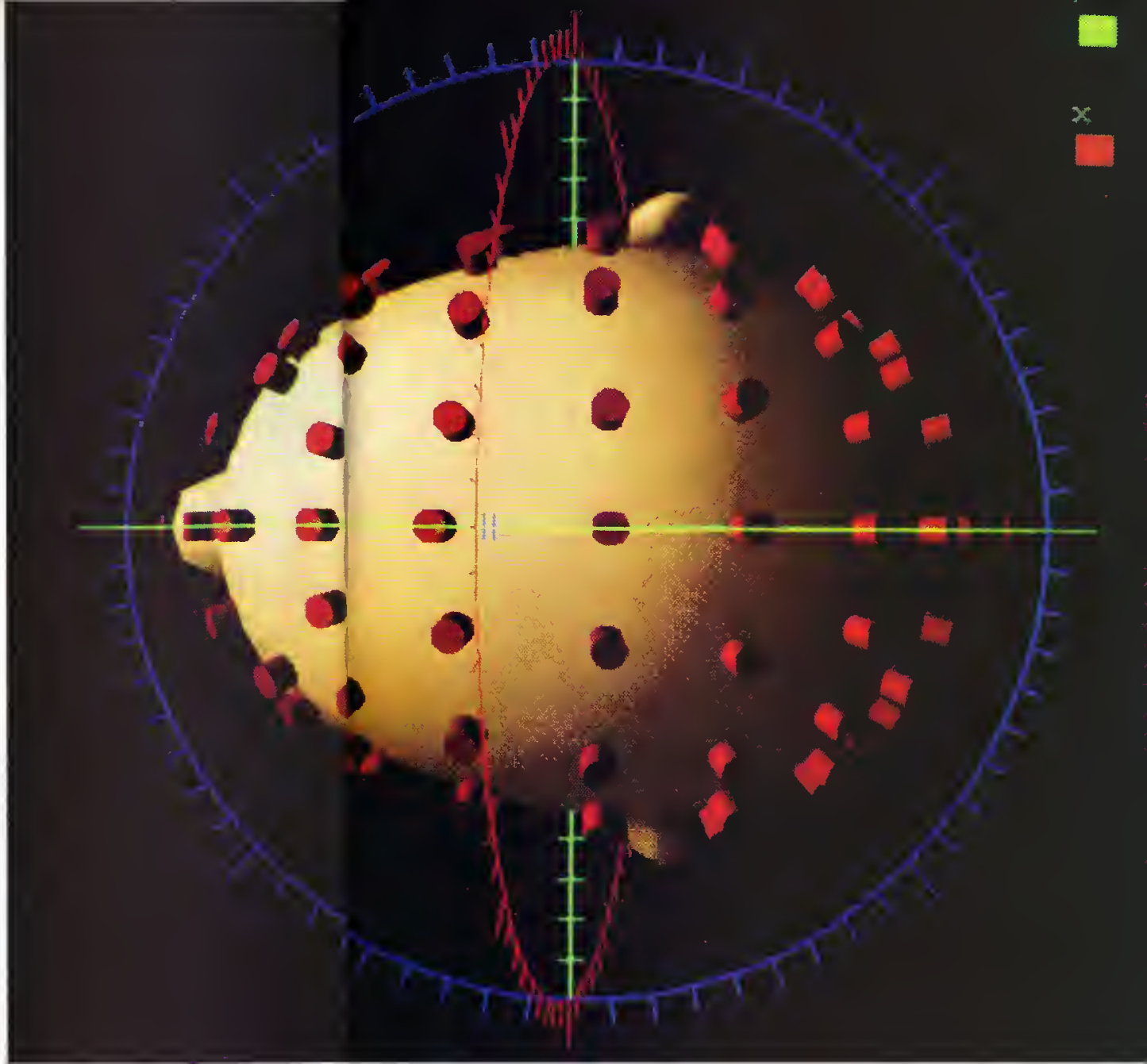
BY ELEANOR SMITH

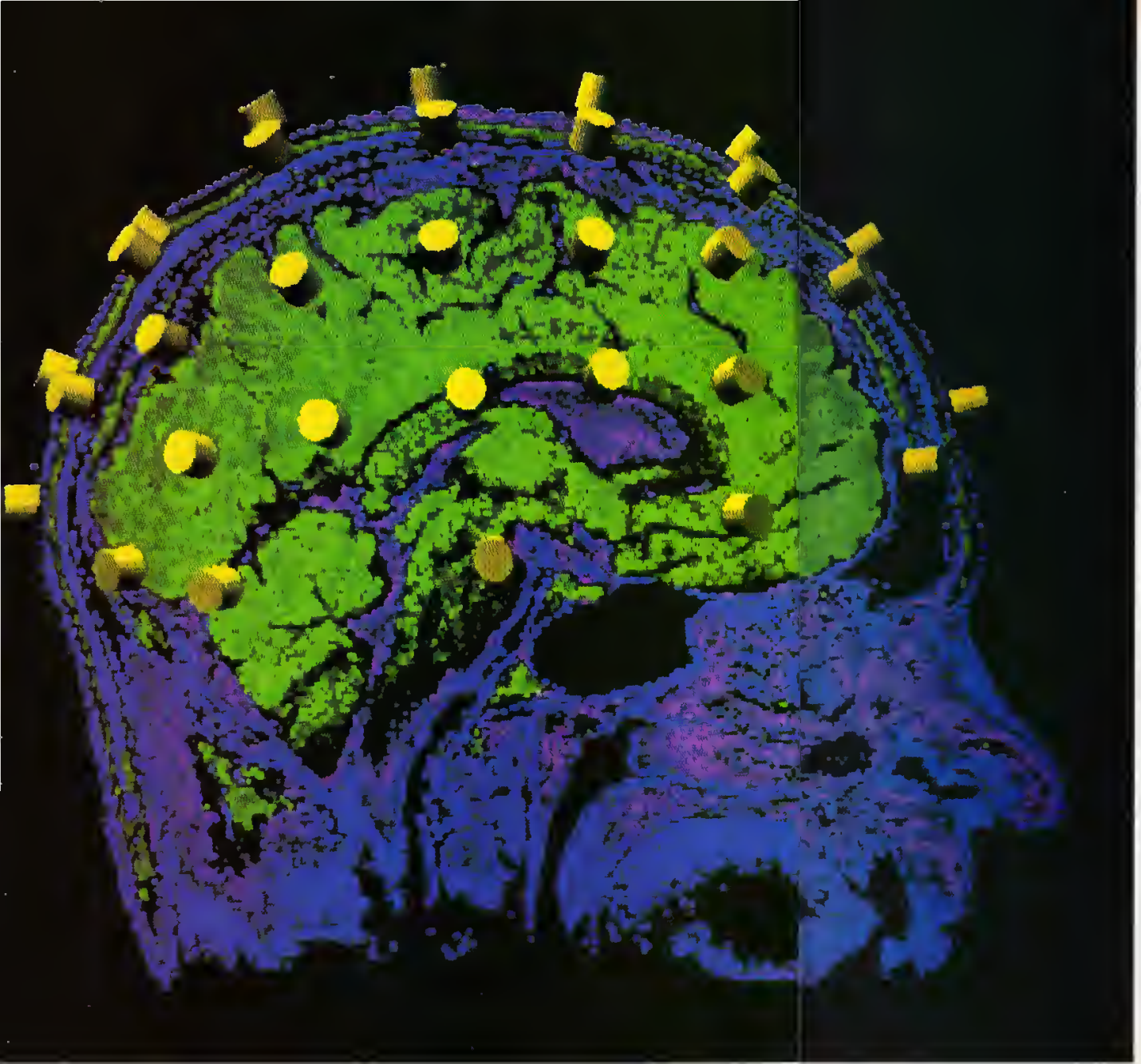
As part of his diagnostic ritual a neurologist of the future might have a patient suspected of having brain damage sit in a chair, put on a helmet and play a video game. As the patient played the doctor would study a screen and watch by means of a computerized head scan, how the patient's brain handled the sensory onslaught of video play.

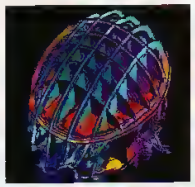
In seconds he'd have before him the ultimate brain X ray: one revealing how the delicate neuronal circuitry of the brain processes information and controls the body. Finally, the innermost workings of this sublime organ would be accessible to medical science.

This X-ray machine, says neuroscientist and computer scientist Alan Gevins, is about seven to ten years away from being built, but it has its beginnings in a unique experiment shown in the photos on these pages.

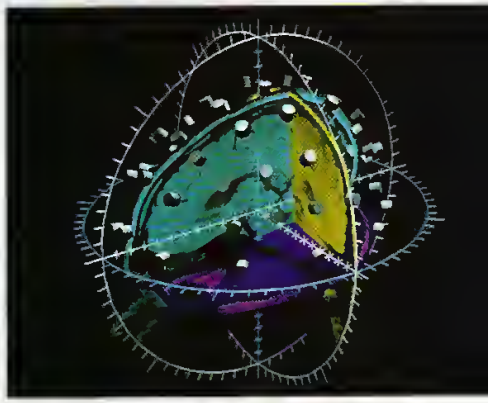
Over the past few years Gevins and his colleagues at EEG Systems Laboratory (EEGSL) have marshaled a dazzling combination of biomedical engineering, neuroscience and computer graphics to study a few microseconds of intense

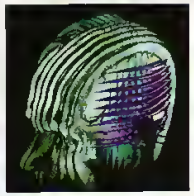






*The laboratory's ambitious experiment took four and a half years, cost some $2 million, and involved about 1 trillion separate computer operations*



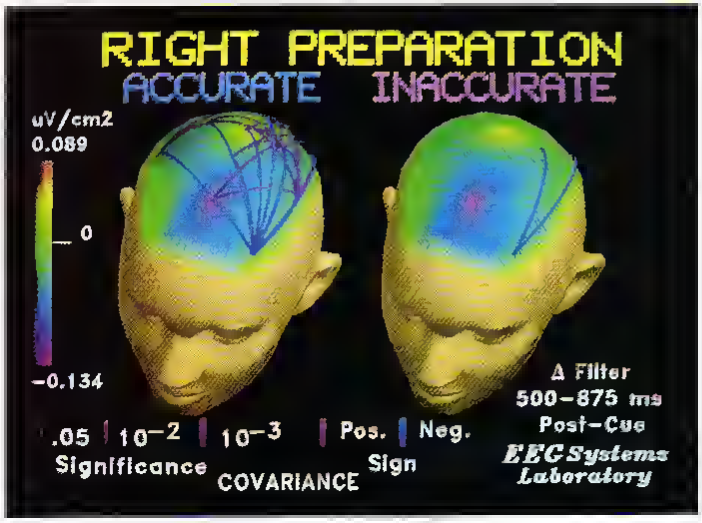


brain activity They wanted to study how different areas of the brain interact with one another and how the brain as a whole prepares itself to act

The study started in 1982 and the EEGSL team spent the first year screening research candidates and running them through tests The next three and a half years were spent analyzing the huge amount of data produced by the tests Prior to game play, EEGSL's team first mapped the outside of each man's brain by running a sensor-equipped robotic arm over his skull The system fed coordinates into a computer, which made a 3-D image of the head (photos on opening pages)

Then the team took cross-sectional pictures of each person's brain (large photo at left center photo above) from three different angles with a 3-D scanner called a magnetic resonance imaging system (MRI) A computer stacked together the MRI image slices (top and above right) and combined them into a 3-D image model of the brain (above left)

*"The new scanner could be used to diagnose the early onset of such degenerative diseases as Alzheimer's and Parkinson's"*




Gevins asked seven young men to play a video game. As each man watched his individual screen, Gevins and his team watched the brain waves of each player.

Each player donned a cloth cap embedded with up to 64 electrodes. During game play his brain waves were relayed to a computer and recorded.

The challenge was a simple video game called Finger Pressure Test. A number between 1 and 9 (representing 100 to 900 grams) flashes on the screen. Subjects were asked to push the button using precisely the amount of pressure called for. Already screened for their abilities to concentrate, the players on average were accurate in six out of every ten tries.

To find out why some attempts were accurate and others were not, the EEGSL team scanned the recorded brain waves with a pattern recognition program developed by electrical engineer Nelson Morgan. This edited out brain signals not involved in playing the video game.

The researchers discovered that a distinct pattern of waves called preparation sets appeared just before the brain sent its reaction signals to the body. During this dynamic process the brain constantly tuned and retuned itself as it anticipated changes in its environment. After a while the EEGSL team could tell how the game player would respond milliseconds *before* he responded. They could spot brain patterns associated with accurate and inaccurate game moves.

Earlier this year the experiment was announced in the prestigious journal *Science* signaling the beginning of a new era in brain studies. These initial results sprang from an expensive, time-consuming effort. The experiment took four and a half years, cost $2 million, and required 1 trillion computer operations. The staff handpicked to do this consisted of four computer scientists (including Douglas Greer, whose mathematical program produced the photos shown here), one electrical engineer, one neuropsychologist, one neurophysiologist, and Gevins.

The experiment showed that the brain prepares for action by linking together specialized areas. "We create a model of external reality and of ourselves," Gevins says. "And every few hundred milliseconds we probe the environment for those things that match or do not match our models."

For the present, his work is purely experimental. In both the near and distant future, however, Gevins says, his research has several possible applications. The technology could be used to develop a brain scanner to measure and photograph the brain as it processes information.

Doctors would find this invaluable for assessing brain damage in their patients. If someone has a stroke and his brain begins to rewire itself, Gevins says, "the scanner would be able to show which areas of the brain are compensating for the damaged areas. That would help the doctor direct rehabilitative therapy." The new scanner—which Gevins says could be built in seven to ten years—could also be used to diagnose the early onset of such common degenerative brain diseases as Alzheimer's and Parkinson's.

Eventually, Gevins says, we may be able to use this knowledge of the brain to increase our mental abilities. The experimental findings of the game player study suggest that during the inaccurate plays there is some sort of attention lapse. The game player loses his concentration.

With this information, he says, it would be possible to build a brain scanner to help healthy individuals focus more of their brain power. Someday people will be able to use his equipment to do attention-enhancing exercises. The equipment could become a kind of mental Nautilus machine to help develop mental capabilities.

It would work like this: Using principles of biofeedback, individuals put on an electrode-lined cap connected to an EEGSL machine and, by doing some concentration exercises, learn how to regulate and improve their attention span.

Gevins says his research also has implications for what and how children are taught in school. "Before teaching technical material, educators might do well to emphasize exercises that strengthen attention skills—the ability to really focus on something, to retain information for a long time, to become attentive very quickly. Many of our errors are, in a sense, predetermined by our failure to concentrate properly during the split second we see or hear something."

Finally, EEGSL's insights into how the brain performs could aid researchers trying to produce machines possessing human intelligence. Many artificial-intelligence researchers now work on so-called neural-net computers, which use a biological model of the brain as their blueprint. They hope to create electronic analogs of individual brain neurons that work cooperatively. Almost all of these neural-network computers use in their models a relatively small number of neurons—fewer than a million. EEGSL's work suggests that they should think in more complex terms, using whole neuronal populations—hundreds of millions of neurons.

Gevins hopes to construct a computer that can duplicate some of the complex networking in the brain. For the present, he and his staff continue to sift through the electronic static from the active brain in their search for a few more insights into the mystery of human consciousness.

*Above: The photo shows the more complex brain activity preceding an accurate response compared with a simpler, inaccurate response.*

*The book's most shocking claim is that men and women are being used to create a race of human–E.T. hybrids*

# ANTI-MATTER

## UFO UPDATE

On the night of June 30, 1983, a large circular spot appeared on a grassy patch of ground outside Indianapolis. Sometime later the story goes, local resident Kathie Davis (not her real name) underwent hypnosis, dredging up memories of a UFO landing. Davis later met UFO researcher Budd Hopkins, who helped her unearth a nightmarish series of events. These revelations are the subject of what may be the ultimate UFO book: Hopkins's *Intruders: The Incredible Visitations at Copley Woods*, which is scheduled to be published this month by Random House. The book's most shocking claim is that large numbers of men and women throughout the country—and probably the world—are being abducted and used to create a race of human–E.T. hybrids. Kidnapped men, Hopkins suggests, "donate" semen via instruments or intercourse with not quite human females. Women experience terrifying invasive forms of artificial insemination and strange pregnancies that end suddenly. The women are impregnated during their first abduction, says Hopkins, and "lose" the child during a second abduction. Many of these women, Hopkins adds, meet the children who were taken away from them when they are abducted yet again.

Davis, for instance, says she met her "daughter" during an abduction experience in October 1983, when the girl was just about four. Davis claims she immediately knew the child but, to her immense sorrow—the E.T.s led the girl away, explaining that on Earth Davis would be unable to care for her or even to keep her alive.

If you think that this sounds like so much *National Enquirer* material, Hopkins doesn't blame you. Nobody wants to believe this, including the participants, he says. Who the hell wants this to be true?

Is it true? Hopkins, a respected abstract artist whose interest in UFOs was sparked by his own sighting some years ago, believes so. "These aren't just druggy kids or marginal individuals but substantial citizens," Hopkins says of the abductees in his book, who include a Minnesota farmer, a well-known writer and a psychologist. Most impressive to Hopkins is the way his subjects' accounts dovetail in terms of the aliens' appearance, behavior and technology.

UCLA psychopharmacologist Ronald Siegel, an internationally known authority on altered states of consciousness, however, says the abduction phenomenon can be explained by hallucinations related to stress, darkness and isolation. Such situations can create images that are strikingly vivid and cause those who see them to respond as if they were real. He suspects the abduction reports are alike because they arise from a common subjective state of consciousness in which archetypal images emerge.

Whether the experiences are real or not, Hopkins says his primary concern is the well-being of the abductees. "In my work," he says, "I'm focusing on individuals who are suffering, who have lived with this all their lives and had no one who could help them. There are a lot of them out there. We have to realize we have an enormous human problem even before we think of it in cosmic terms." —*JEROME CLARK*

Though the archaeopteryx could barely fly it was a truly wondrous bird A crow size creature with reptilian features It is said to have flourished around 160 million years ago Many claim it is the oldest bird known

Astronomers Sir Fred Hoyle and Chandra Wickramasinghe both of the University College of Cardiff in Wales don't agree however For a couple of years now the professors have been attacking the species—and the fossil that supposedly proves it once existed—as a hoax Their latest onslaught *Archaeopteryx The Primordial Bird A Case of Fossil Forgery* The feathers that appear in photographs of the fossil Hoyle and Wickramasinghe assert were actually *pasted* on a fossil of *Compsognathus* a 20-inch long dinosaur Hoyle says the paste is so blatant that in one picture it resembles a blob of chewing gum Hoyle concedes that one could look at the photos and miss the forgery, but he says it is the most barefaced tricks that are the hardest to spot

According to the astronomers the forgery can be traced to the 1861 discovery of the fossil in a Bavarian quarry The find was made by a local medical officer who publicized his feathered reptile but refused to let visiting paleontologists sketch it or even inspect it closely

Finally Richard Owen the director of the British Museum gave his stamp of approval to the fossil by purchasing it for a huge fee

Owen was driven Hoyle and Wickramasinghe say, by a hatred of Darwin (left) He may have bought what he knew to be a fake in order to trap the evolutionist into claiming that it supported the theory that birds evolved from reptiles Wickramasinghe says But Darwin was too astute to be hooked

The British Museum vehemently disputes these allegations A team there has found that nearly invisible hairline cracks on the fossil slab correspond almost perfectly with those on its opposite face They say it would have been impossible for forgers to duplicate those cracks

But Hoyle and Wickramasinghe stand firm By 1861 they assert fossil forgery was profitable enough to be a well-honed art

—Ivor Smullen

*'The illusion that I suspect her of treachery must be maintained '*

*—Frank Herbert*

## SLEEPLESSNESS

Leslie Gamble says he spent 12 years without a wink of sleep. Now he's writing a book about the experience, plans for TV and radio appearances are in the works.

It all started when Gamble, an agricultural scientist, was hit by a truck at London's Heathrow Airport back in 1970. After the accident, he claims, he lost fragments of memory—and stayed permanently awake.

No longer able to function in his career, Gamble says he devised methods for

passing the night. He walked dark country roads, did the crosswords (which he'd formerly hated), and even made phone calls to empty offices, counting the rings.

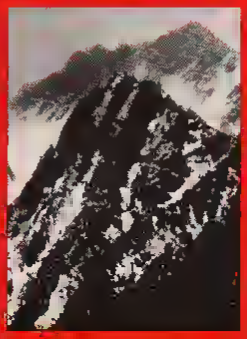
After seven years of litigation, Gamble, now sixty-eight, was awarded £12,000. The perpetual sleeplessness, he says, wore off about a year ago, when he took a half-hour nap. Since then, he says, "I've gradually built up to three and a half hours a night."

But is all this for real? The answer is no, according to psychiatrist and sleep expert Ian Oswald, who studied Gamble's case back in 1980. In that year, Gamble spent some time at the Royal Edinburgh Hospital's sleep laboratory. Oswald found that Gamble fell asleep at six in the morning, only to be awakened by his wife two and a half hours later. "When we suggested that he underestimated his sleep," Oswald says, "the couple left angrily. In my opinion, Gamble may have always been a short sleeper and simply cashed in on it. Dramatic statements about lack of sleep are unreliable, and I have no hesitation in saying that Gamble is a publicity-seeking charlatan and trickster, with his wife as collaborator."

Gamble, meanwhile, says he's recently weaned himself off sleeping pills and tranquilizers. He is now campaigning against dependence on such drugs, "even by insomniacs."—Ivor Smullen

## BLUE MOUNTAINS

In 1935 an expedition of physiologists climbed high into the Andes, where they found a group of miners living at 17,500 feet. For decades this was considered the highest altitude capable of sustaining human life over the long term. But when mountaineer/physiologist John West of the University of California at San Diego's School of Medicine visited the same area, near Aucanquilcha, Chile, last year, he made a startling discovery: a handful of blue men living at nearly 20,000 feet, an altitude that is life-threatening even to hearty mountain climbers after a few weeks.



Scientists have studied other blue people, in the Ozarks, who are pastel colored due to genetic abnormalities, and West points out there are diseases that can cause a bluish discoloration of the skin. But what makes these blue men so odd is that their coloration seems to result from an adaptation to the air at that altitude, which has less than half the oxygen found at sea level.

To deal with the deficit, the miners apparently produce large amounts of hemoglobin, the oxygen-carrying pigment in blood cells. "The hemoglobin is poorly oxygenated," West explains, "and it shows through their skin, giving it a bluish color. I suspect these men increase the depth and rate of their breathing," he adds. "And because they were born and bred at five thousand to twelve thousand feet, that may have given them a head start in adapting. But there's a lot we don't yet understand."

Sukhamay Lahiri, a University of Pennsylvania physiologist, has also observed the blue men of the Andes. He points out that Tibetan priests, who spend time at similar altitudes in the Himalayas, also have a bluish tint. "But what's startling about the Andes men," he says, "is that they are living and doing heavy labor at these altitudes."—Sherry Baker

# ANTI MATTER

## BRAZILIAN LIGHTS

Last May 19 reporters waited at the airport in São Jose dos Campos, Brazil Their assignment to interview Colonel Osires Silva the newly appointed head of the state owned oil company But when Silva arrived in his executive plane the journalists found themselves with an unexpected story Instead of talking about his new position Silva excitedly proclaimed that he and his civilian pilot had just seen a UFO Trained as an aeronautical engineer Silva noted that the strange light resembled a dancing point in the sky' and traveled faster than 900 miles per hour

What s more Silva wasn t alone According to physicist Willy Smith who investigated the incident for UNICAT a UFO data bank radar per sonnel spotted UFOs on their screens as well

It was the radar reports that put the Brazilian Defense Center on alert six jets were ultimately sent out after the alleged craft The pilots were unable to get close enough to estimate the size and shape of the UFOs Smith says But they described the objects as intensely glowing red lights that sometimes changed to white One pilot turned around after chasing a light Smith says only to have other pilots tell him UFOs were on his tail

The UFOs disappeared from sight after three hours Smith reports And the next day the Brazilian Air Force sanctioned a press conference where eyewitnesses

discussed what they had seen An official investigation was conducted Smith adds but the Brazilian government never released the findings

Whether or not the Brazilians can explain their UFOs *American* aerospace expert James Oberg suggests a possible explanation We know from our experience in the Fifties he says that radar that is less than state-of-the-art can make such prosaic things as atmospheric conditions and birds seem like UFOs

Smith disagrees I don t know what they were but the objects were not planes And if someone can come up with a natural phenomenon that could last three hours and elude jet pilots on a search-and destroy mission I d certainly like to hear what it could be Sherry Baker

*Outer space is no place for a person of breeding'*
*Lady Violet Bonham Carter*

*'The universe or nothing*
*H G Wells*

## ANTIGRAVITY MACHINE

A little company in Tulsa is getting rich selling antigravity machines They re not admitting it of course they may not even know The machines are disguised as air purifiers But Dr Patrick Flanagan knows what they really are The quirky Arizona inventor holds the patent on them

Sixty years ago Flanagan explains a physicist named T Townsend Brown built a gravitator a condenser with alternating plates of aluminum foil and an insulator When he set it on a balance and connected high voltage DC wires to each end it got lighter seemed worth checking

Flanagan repeated the experiments and says he confirmed all Brown s claims Not only did the gravitator really get lighter he says he discovered that it produced a *negative* field

Flanagan searched the scientific literature for reports of a similar effect and came up empty handed He still can t explain it he says but he found a use for it

I tried putting some decaying meat near the device he reports An hour later the odor was gone The meat dehydrated with no sign of decomposition Ultimately I found that it was an excellent air purifier

That was confirmed by tests at Hillcrest Medical Center in Tulsa I was amazed at its ability to clear particulate matter from the air declares epidemiologist Douglas Hubner who performed the study We used to have a lounge where long term patients were allowed to smoke The air was always heavy We installed the unit we were testing and a few hours later the smoke was completely gone

We also tested its effect on bacteria in the air he adds It seemed to reduce the bacteria counts but they were so low normally that it was not significant

Flanagan claims other successes as well His device can he says clean mercury from the air in a dentist s office and convert toxic carbon monoxide into carbon dioxide That s very strange he concedes In New Jersey they ve been testing to see if it can remove radon gas from contaminated houses It s very exciting

Whether it fights radon or not Flanagan s mysterious antigravity air purifier already a success Sierra Environmental Systems reports that in the last year it has sold about 500 of the devices at $500 to $1 500 each Owen Davies

CONTINUED FROM PAGE 54

computer artist from Los Angeles is leading the way. After apprenticeships at the Architecture Machine Group of MIT and the Computer Graphics Laboratory at the New York Institute of Technology, she has become a high priestess of talking heads.

Allen's most recent project was giving life to plain 2-D photographs of a German music group called Kraftwerk. The quartet of musicians sometimes works with a set of mannequins—twins of each of the performers—who appear to play instruments. Allen began by using a 35mm camera to photograph each mannequin's head from seven different viewpoints. Then she and her assistant, Steve DiPaolo, digitized each of the photos and entered the data into a VAX 11/780 computer. "The real trick is making them move," she says. In the computer each of the heads is simply a set of about 1,200 points stored on a 360-megabyte hard disk. To bestow life, Allen instructs the computer to calculate how each point might be affected by changes in perspective. How would a point on the tip of the nose look if you were viewing the head from above? How would the mouth look if the face were viewed from the side? After all the points from all seven photos have been encoded, Allen can use her knowledge of perspective to make a computer image that appears to move in 3-D.

The talking heads, Allen says, draw intense interest in military circles. "We often had CIA types come through the lab asking, for instance, if it were possible to make the faces on the screen speak another language, like, say, Russian." I couldn't help thinking, *Man, these guys are serious!*

But Allen sees a *higher* calling for herself. Five years ago she created a simple computer-generated saint for choreographer Twyla Tharp to use in a 90-minute dance video. Her Saint Catherine could gesture, walk, turn, leap, and teach dance to humans. It was perfectly natural—even traditional, Allen says—to construct a 3-D character out of 2-D shapes. She worked just the way an artist paints portraits from flat dabs of color—except that her palette was a computer, and the portrait a supernatural conglomeration of 3-D paint.

"Often in religion, societies build artificial persons," Allen says. "Since computers often seem godlike, it makes sense to portray the saint as a computer-generated character." Banchoff himself is hoping to use computers to convert some of his four-dimensional figures into holograms—solid-looking images that spectators eventually will be able to view from all perspectives, like pieces of high-dimensional art.

But Banchoff notes, when computers do finally open a route for human passage from 3-D to 4-D and beyond, it won't be saints we're likely to find. "In the preface to the second edition of *Flatland*," he says, "Abbott wrote, 'One touch of nature makes all worlds akin.' Meaning *not* that we're all wonderful but that we're all pretty base." no matter how many dimensions we're born with. "Each dimension has its own prejudices," Banchoff says. "One might imagine that the 4-D creature, for example, looks down on our confusion, convinced it's much smarter than we are."

Though Quadra's no saint, smarter she might be. That's one conclusion to be drawn from work by Neil Sloane, a mathematician at AT&T's Bell Laboratories in New Jersey and an expert on the quirks found in higher dimensions.

Sloane gets some of his best ideas by tooling around in his Bell Labs cubicle with an odd collection of pennies and balls. He can show, for example, that in a stack of oranges in a three-dimensional supermarket, one orange can be in contact with as many as 12 other oranges. So if nerve cells were round, one of our brain cells could theoretically be in immediate contact with 12 other cells, leading to a rich interchange of sensations and inspirations tossed back and forth across the synapses.

But in a four-dimensional market, Sloane has been able to prove, the orange could theoretically be in touch with at least 24 other oranges. That means a 4-D creature's brain could be much more complex than ours, with a more efficient network of interconnections among cells.

Lucky for Quadra, Dewdney says. "The four-dimensional world would require a vastly more complicated visual system than ours," so it would take greater intellect to find a bus stop—or to be a brain surgeon. "But who knows whether it's easier or harder to operate on a complex brain if you have a complex brain yourself?"

But Sloane hasn't stopped at the fourth dimension. He has already learned that in the produce stores of the eighth dimension, grocers could pack a maximum of 240 oranges next to a single orange. And he's currently playing around with even more extraordinary stacks in 72 dimensions, where unimaginably smart purveyors of hyperfruit might be able to get the number up to 6,218,175,600.

"At least I hope it's possible," says Sloane, because of the implications for communications in our 3-D world. Information from deep space, for example, arrives on Earth in the form of fragments of code, to be interpreted by computer. Like pieces of a cosmic jigsaw, the snippets are assembled into multicolored pictures of distant moons and planets. One danger is that 'code words' used to carry the details of photographs from space will be confused with one another, jumbling the view.

The solution depends on help from higher dimensions. It works like this: Rather than listen to the entire stream of signals from space, NASA's computers follow the more efficient strategy of collecting regular samples of the signal, something like a public opinion pollster. Like separate polls,

*"You have broken the law of gravity. How do you plead?"*

each of these samplings yields distinctive results. In a great electronic leap, the computer then treats each separate result as the coordinate—a little piece of the address—of a point in a multidimensional space. It can thus pack many pieces of information into a small territory, like oranges in the 4-D deli. The more dimensions, the better and more elaborate the space pictures become.

JPL's Edward Posner says that as the *Voyager* probe approaches its distant target—Neptune—it has used more dimensions to communicate with Earth. "We were up to about seventy dimensions at Jupiter and Saturn," he says, "and then we switched to one hundred forty-five thousand dimensions—not only because we were farther away but because we wanted to get more pictures per hour."

The biggest breakthrough in all of extradimensional exploration, though, may come not from applied physicists but from the theoreticians. Much of the work has taken place at Princeton University, home to the "superstring quartet" of researchers. These scientists, hoping to explain all the forces of nature in one elegant theory, suggest that everything arises from the wormlike wiggling of nine dimensions' worth of strings. Since the publication of their string theory in 1984 and 1985, two of the quartet—Emil Martinec and Ryan Rohm—have moved to other universities. David J. Gross and Jeffrey A. Harvey still have offices around the corner from each other, each overlooking a serene courtyard in the middle of a bucolic campus.

The tranquility is deceiving. In the summer of 1984 the Princeton physicists were astonished to learn during luncheon conversation of a breakthrough by two other researchers, John Schwarz and Michael Green at the Aspen Center for Physics. Green and Schwarz had been able, after more than a decade of work, to solve some persistent problems in their string theory. Edward Witten, another member of the Princeton physics department, hurried to ask for a copy of the Schwarz–Green paper to be delivered by Federal Express. The Princeton physicists devoured it. It was impressive, but the Princeton scientists began an immediate search for a string theory of their own.

Every day over the next few months followed the same pattern. The scientists kept coming up with possible formulas to account for the strings they tested each one out, hoping to find that it, and it alone, could explain the extradimensional worms. "We'd kill one idea in an hour and kill the next in two hours," Harvey explains. "Should the theory be in ten dimensions? No, maybe it should be in eighteen dimensions. But *that* didn't work. And then one day we were in David Gross's office trying to kill off a particular version. Emil had written down on the board a particular choice of dimensions for the string. By lunchtime we hadn't found out what was wrong with it. By the afternoon we were starting to get a little suspicious, and within a day or two we were pretty sure we were on to something."

The Princeton version of superstring theory, now widely popular, resonated with the ideas Kaluza and Klein had dreamed up three generations earlier. All living creatures and all matter exist in nine spatial dimensions and one time dimension. Six of the spatial dimensions are impenetrable even to our strongest instruments.

Where are the extra dimensions? We're living in them. Imagine pointing your eyes toward a straw on the other side of the room. It appears to be a two-dimensional line. But if you look at it closely, you can see the third dimension and watch the progress of a bug circling the outside of the straw. The six extra dimensions of superstring theory are analogous to loops around the straw, although each of the tiny loops extends into spaces we can't see.

Physicists aren't hopeful that we'll soon penetrate the endless, hidden undulations of the strings. In the deep recesses of existence suggested by the theory, Gross explains, if you go in any direction—and there are six—you come back to the starting point after a short distance, something like ten to the minus thirty-third centimeters. Our most powerful machines today can't look at anything smaller than ten to the minus sixteen centimeters.

To explore the circuits of strings would take a billion billion times more energy than we've been able to create even in the biggest accelerators, Gross says. Harvey adds that to move around in those extra dimensions, you'd have to yoke yourself to stellar power. "You'd have to get yourself squeezed into some black hole and shot out God knows where," he says. "I'm not sure it would be worth it."

Physicists have only just begun to dream about Quadra's world and the realm of nine space beyond. Having opened a theoretical door to other dimensions, they now face more conundrums about life and creation than ever before. All of these are now legitimate scientific questions for the string quartet and all physicists: Why do we appear to live in just three dimensions if there are really nine? Does the movement of strings in the extra dimensions generate particles heavier than anything we've ever detected before? How can we find them? What's at the core of all life? Why, if there are nine spatial dimensions, have we relegated just one lone dimension to time?

Quadra, for one, would like to know. Her computers, like the brains of all the creatures, are thick with tightly packed hyperchips. Lately she's put them to work to create four-dimensional scenes of fifth-dimension creatures. The next step will be to turn the creatures into hyperholograms—5-D statues. She knows that they think themselves superior to her, but every time she looks at the screen with her six eyes, she finds it easy to shrug off their haughtiness and to laugh at what must be God's joke in building all the hyperworld out of writhing little worms. DO

## BODY

CONTINUED FROM PAGE 32

burn evenly—are being redesigned to help kill cancer cells.

Research shows that the microspheres, when manufactured with magnetic particles and coated with the appropriate antibodies, will bond to cancer cells. Then these microspheres could be put through a magnetic field, separating the cancer cells from the healthy ones. This new treatment has been tried in England to cleanse cancer cells from the bone marrow of 40 patients with neuroblastoma, a rare and often fatal form of cancer. The results of the study have not as yet been determined.

NASA—in conjunction with the National Institute on Aging, the Veterans Administration (VA), the Administration on Aging, and the National Institute for Disability and Rehabilitation Research—is also working on a portable wandering prevention system, to keep more than 1 million victims of Alzheimer's disease from straying into dangerous situations. Using the tracking and communication devices found on the space shuttle (as well as other NASA technology), researchers hope to develop a sensor to attach to patients. Says Mercia Decker, health science specialist at the VA central office in Washington, DC: "It would be wonderful if rather than using chemical or physical restraints on Alzheimer's patients, which limits their exercise, we had a portable system that would alert the caretaker when the patients stray."

The possibilities for biomedical devices recycled from aerospace technology seem endless. Indeed, says Ray Whitten, at the Office of Technology Utilization in Washington, DC, it seems safe to conclude that the technology that has made it from "Mission Control to the marketplace is already benefiting thousands of people at home, and the number that will benefit in the future will be in the millions." DO

### CREDITS

**Page 12 from left,** William Coupon; Etienne Sandorfi (top), Zeiss/German GEO (bottom); René Magritte, EEG Systems Laboratory (top); Doug Hansen, **page 22,** Geoffrey Chandler; **page 25,** Gerhard Gschwendler; **page 28,** Deborah Healy; **page 32,** Keim/NASA; **page 36 left,** Movie Still Archives; **page 36 right,** Barry D. Hill; **page 37 left,** Denise Watt; **page 37 right,** Tom Evans/Photo Researchers, Inc.; **page 38 left,** Susan Taylor; **page 38 right,** Jeff Rotman/Peter Arnold; **page 39 left,** Dade W. Thornton/Photo Researchers, Inc.; **page 39 right,** Georg Gerster/Photo Researchers, Inc.; **page 40 left,** Novosti/Soviola; **page 40 right,** Adolf Schaller/Photo Researchers, Inc.; **page 41 left,** Monique Manceau/Photo Researchers, Inc.; **page 41 right,** Dr. Freiburger/Peter Arnold; **page 42,** Joe Munroe/Photo Researchers, Inc.; **page 52,** *The Blank Signature,* René Magritte, National Gallery of Art, Collection of Mr. and Mrs. Paul Mellon; **pages 64–69,** courtesy of Carl Zeiss/Oberkochen, West Germany; **page 74,** De La Rue Printrak, Inc.; **page 78 top left,** Robert J. Schoenhut; **page 78 bottom left,** Peter Cahroo; **page 78 center,** Thomas Victor, *Time;* **page 78 top right,** Yvonne Hemsey/Gamma-Liaison; **page 78 bottom right,** Showtime; **pages 78–85,** Akira Yokayama/JCA; **pages 92–95,** EEG Systems Laboratory, San Francisco; **page 96,** Tim White; **page 100 top,** No. 319836 (photo by Robert E. Logan), courtesy Department of Library Services, American Museum of Natural History; **page 100 bottom,** Culver Pictures, Inc.; **page 101 top,** Joel Levinson; **page 101 center,** C. B. Harding; **page 101 bottom,** Dan Morrill; **page 102,** Don Dixon; **page 127,** Paul Ambrose; **page 128 top,** Andy Westnik/M/M&R; **page 128 bottom left,** Michael Dalo; **page 128 bottom right** Michael Dalo; **page 129 top,** GE RCA; **page 129 bottom,** Cryodynamics Inc.; **pages 136–137,** Scot Morris

# THE EVENING

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He took a ragged breath. "Yeah. Will you come with me?"

I went to one of my windows and stared out at the weeds. We let them thrive in the backyard. In the front we mowed them, along with the few patches of grass.

"I told you my DGD ward experience."

"You're not fifteen now. And Dilg isn't some zoo of a ward."

"It's got to be, no matter what they tell the public. And I'm not sure I can stand it."

He got up, came to stand next to me. "Will you try?"

I didn't say anything. I focused on our reflections in the window glass—the two of us together. It looked right, felt right. He put his arm around me, and I leaned back against him. Our being together had been as good for me as it seemed to have been for him. It had given me something to go on besides inertia and fear. I knew I would go with him. It felt like the right thing to do.

"I can't say how I'll act when we get there," I said.

"I can't say how I'll act, either," he admitted. "Especially — when I see her."

He made the appointment for the next Saturday afternoon. You make appointments to go to Dilg unless you're a government inspector of some kind. That is the custom, and Dilg gets away with it.

We left L.A. in the rain early Saturday morning. Rain followed us off and on up the coast as far as Santa Barbara. Dilg was hidden away in the hills not far from San Jose. We could have reached it faster by driving up I-5, but neither of us were in the mood for all that bleakness. As it was, we arrived at one PM. to be met by two armed gate guards. One of these phoned the main building and verified our appointment. Then the other took the wheel from Alan.

"Sorry," he said. "But no one is permitted inside without an escort. We'll meet your guide at the garage."

None of this surprised me. Dilg is a place where not only the patients but much of the staff has DGD. A maximum security prison wouldn't have been as potentially dangerous. On the other hand, I'd never heard of anyone getting chewed up here. Hospitals and rest homes had accidents. Dilg didn't. It was beautiful—an old estate. One that didn't make sense in these days of high taxes. It had been owned by the Dilg family. Oil, chemicals, pharmaceuticals. Ironically, they had even owned part of the late, unlamented Hedeon Laboratories. They'd had a briefly profitable interest in Hedeonco, the magic bullet, the cure for a large percentage of the world's cancer and a number of serious viral diseases—and the cause of Duryea-Gode disease. If one of your parents was treated with Hedeonco and you were conceived after the treatments, you had DGD. If you had kids, you passed it on to them. Not everyone was equally affected. They didn't all commit suicide or murder, but they all mutilated themselves to some degree if they could. And they all drifted—went off into a world of their own and stopped responding to their surroundings.

Anyway, the only Dilg son of his generation had had his life saved by Hedeonco. Then he had watched four of his children die before Doctors Kenneth Duryea and Jan Gode came up with a decent understanding of the problem and a partial solution, the diet. They gave Richard Dilg a way of keeping his next two children alive. He gave the big, cumbersome estate over to the care of DGD patients.

So the main building was an elaborate old mansion. There were other, newer buildings, more like guesthouses than institutional buildings. And there were wooded hills all around. Nice country. Green. The ocean wasn't far away. There was an old garage and a small parking lot. Waiting in the lot was a tall old woman. Our guard pulled up near her, let us out, then parked the car in the half-empty garage.

"Hello," the woman said, extending her hand. "I'm Beatrice Alcantara." The hand was cool and dry and startlingly strong. I thought the woman was DGD, but her age threw me. She appeared to be about sixty, and I had never seen a DGD that old. I wasn't sure why I thought she was DGD. If she was, she must have been an experimental model—one of the first to survive.

"Is it Doctor or Ms.?" Alan asked.

"It's Beatrice," she said. "I am a doctor, but we don't use titles much here."

I glanced at Alan, was surprised to see him smiling at her. He tended to go a long time between smiles. I looked at Beatrice and couldn't see anything to smile about. As we introduced ourselves, I realized I didn't like her. I couldn't see any reason for that either, but my feelings were my feelings. I didn't like her.

"I assume neither of you have been here before," she said, smiling down at us. She was at least six feet tall, and straight.

We shook our heads. "Let's go in the front way, then. I want to prepare you for what we do here. I don't want you to believe you've come to a hospital."

I frowned at her, wondering what else there was to believe. Dilg was called a retreat, but what difference did names make?

The house close up looked like one of the old-style public buildings—massive, baroque, front with a single, domed tower reaching three stories above the three-story house. Wings of the house stretched for some distance to the right and left of the tower, then cornered and stretched back twice as far. The front doors were huge—one set of wrought iron and one of heavy wood. Neither appeared to be locked. Beatrice pulled open the iron door, pushed the wooden one, and gestured us in.

Inside, the house was an art museum—huge, high-ceilinged, tile-floored. There

"Kimmie is twelve now and has a mind of her own."

were marble columns and niches in which sculpture stood or paintings hung. There was other sculpture displayed around the rooms. At one end of the rooms there was a broad staircase leading up to a gallery that went around the rooms. There more art was displayed. "All this was made here," Beatrice said. "Some of it is even sold from here. Most goes to galleries in the Bay Area or down around L.A. Our only problem is turning out too much of it."

"You mean the patients do this?" I asked.

The old woman nodded. "This and much more. Our people work instead of tearing at themselves or staring into space. One of them invented the p.v. locks that protect this place. Though I almost wish he hadn't. It's gotten us more government attention than we like."

"What kind of locks?" I asked.

"Sorry. Palmprint-voiceprint. The first and the best. We have the patent." She looked at Alan. "Would you like to see what your mother does?"

"Wait a minute," he said. "You're telling us out-of-control DGDs create art and invent things?"

"And that lock," I said. "I've never heard of anything like that. I didn't even see a lock."

"The lock is new," she said. "There have been a few news stories about it. It's not the kind of thing most people would buy for their homes. Too expensive. So it's of limited interest. People tend to look at what's done at DIlg in the way they look at the efforts of idiots savants. Interesting, incomprehensible, but not really important. Those likely to be interested in the lock and able to afford it know about it." She took a deep breath, faced Alan again. "Oh, yes. DGDs create things. At least they do here."

"Out-of-control DGDs—"

"Yes."

"I expected to find them weaving baskets or something—at best. I know what DGD wards are like."

"So do I," she said. "I know what they're like in hospitals, and I know what it's like here." She waved a hand toward an abstract painting that looked like a photo I had once seen of the Orion Nebula. Darkness broken by a great cloud of light and color. "Here we can help them channel their energies. They can create something beautiful, useful, even something worthless. But they create. They don't destroy."

"Why?" Alan demanded. "It can't be some drug. We would have heard."

"It's not a drug."

"Then what is it? Why haven't other hospitals—?"

"Alan," she said. "Wait."

He stood frowning at her.

"Do you want to see your mother?"

"Of course I want to see her!"

"Good. Come with me. Things will sort themselves out."

She led us to a corridor past offices where people talked to one another, waved to Beatrice, worked with computers. They could have been anywhere. I wondered how many of them were controlled DGDs. I also wondered what kind of game the old woman was playing with her secrets. We passed through rooms so beautiful and perfectly kept it was obvious they were rarely used. Then at a broad, heavy door, she stopped us.

"Look at anything you like as we go on," she said. "But don't touch anything or anyone. And remember that some of the people you'll see injured themselves before they came to us. They still bear the scars of those injuries. Some of those scars may be difficult to look at, but you'll be in no danger. Keep that in mind. No one here will harm you." She pushed the door open and gestured us in.

Scars didn't bother me much. Disability didn't bother me. It was the act of self-mutilation that scared me. It was someone attacking her own arm as though it were a wild animal. It was someone who had torn at himself and been restrained or drugged off and on for so long that he barely had a recognizable human feature left, but he was still trying with what he did have to dig into his own flesh. Those are a couple of the things I saw at the DGD ward when I was fifteen. Even then I could have stood it better if I hadn't felt I was looking into a kind of temporal mirror.

*"We passed through more rooms. People painted, sculpted in wood, stone, even composed and played music. Almost no one noticed us. They weren't ignoring us. They didn't know we existed."*

I wasn't aware of walking through that doorway. I wouldn't have thought I could do it. The old woman said something, though, and I found myself on the other side of the door with the door closing behind me. I turned to stare at her.

She put her hand on my arm. "It's all right," she said quietly. "That door looks like a wall to a great many people."

I backed away from her, out of her reach, repelled by her touch. Shaking hands had been enough, for God's sake.

Something in her seemed to come to attention as she watched me. It made her even straighter. Deliberately, but for no apparent reason, she stepped toward Alan, touched him the way people do sometimes when they brush past—a kind of tactile "Excuse me." In that wide, empty corridor it was totally unnecessary. For some reason she wanted to touch him and wanted me to see. What did she think she was doing? Flirting at her age? I glared at her, found myself suppressing an irrational urge to shove her away from him. The violence of the urge amazed me.

Beatrice smiled and turned away. "This way," she said. Alan put his arm around me and tried to lead me after her.

"Wait a minute," I said, not moving.

Beatrice glanced around.

"What just happened?" I asked. I was ready for her to lie—to say nothing happened, pretend not to know what I was talking about.

"Are you planning to study medicine?" she asked.

"What? What does that have to do—?"

"Study medicine. You may be able to do a great deal of good." She strode away, taking long steps so that we had to hurry to keep up. She led us through a room in which some people worked at computer terminals and others with pencils and paper. It would have been an ordinary scene except that some people had half their faces ruined or had only one hand or leg or had other obvious scars. But they were all in control now. They were working. They were intent but not intent on self-destruction. Not one was digging into or tearing away flesh. When we had passed through this room and into a small, ornate sitting room, Alan grasped Beatrice's arm.

"What is it?" he demanded. "What do you do for them?"

She patted his hand, setting my teeth on edge. "I will tell you," she said. "I want you to know. But I want you to see your mother first." To my surprise, he nodded, let it go at that.

"Sit a moment," she said to us.

We sat in comfortable, matching upholstered chairs. Alan looking reasonably relaxed. What was it about the old lady that relaxed him but put me on edge? Maybe she reminded him of his grandmother or something. She didn't remind me of anyone. And what was that nonsense about studying medicine?

"I wanted you to pass through at least one workroom before we talked about your mother—and about the two of you." She turned to face me. "You've had a bad experience at a hospital or a rest home?"

I looked away from her, not wanting to think about it. Hadn't the people in that mock office been enough of a reminder? Horror film office. Nightmare office.

"It's all right," she said. "You don't have to go into detail. Just outline it for me."

I obeyed, slowly, against my will, all the while wondering why I was doing it.

She nodded, unsurprised. "Harsh, loving people, your parents. Are they alive?"

"No."

"Were they both DGD?"

"Yes, but—yes."

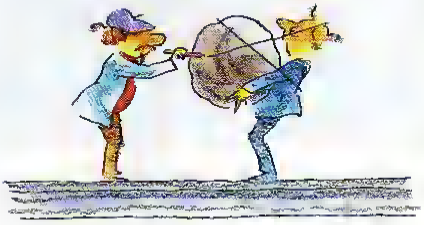
"Of course. Aside from the obvious ugliness of your hospital experience and its implications for the future, what impressed you about the people in the ward?"

I didn't know what to answer. What did

# The Artist







she want? Why did she want anything from me? She should have been concerned with Alan and his mother.

'Did you see people unrestrained?'

'Yes.' I whispered. 'One woman. I don't know how it happened that she was free. She ran up to us and slammed into my father without moving him. He was a big man. She bounced off, fell, and began tearing at herself. She bit her own arm and swallowed the flesh she'd bitten away. She tore at the wound she'd made with the nails of her other hand. She... I screamed at her to stop.' I hugged myself, remembering the young woman, bloody, cannibalizing herself as she lay at our feet, digging into her own flesh. Digging. 'They try so hard, fight so hard to get out.'

'Out of what?' Alan demanded.

I looked at him, hardly seeing him.

"Lynn," he said gently. "Out of what?"

I shook my head. 'Their restraints, their disease, the ward, their bodies.'

He glanced at Beatrice, then spoke to me again. 'Did the girl talk?"

'No. She screamed.'

He turned away from me uncomfortably. 'Is this important?' he asked Beatrice.

'Very,' she said.

"Well... can we talk about it after I see my mother?"

Then and now. She spoke to me. "Did the girl stop what she was doing when you told her to?"

The nurses had her a moment later. It didn't matter.

It mattered. Did she stop?

'Yes.'

'According to the literature, they rarely respond to anyone,' Alan said.

'True.' Beatrice gave him a sad smile. 'Your mother will probably respond to you, though.'

'Is she?' He glanced back at the nightmare office. "Is she as controlled as those people?"

'Yes, though she hasn't always been. Your mother works with clay now. She loves shapes and textures and—'

'She's blind,' Alan said, voicing the suspicion as though it were fact. Beatrice's words had sent my thoughts in the same direction. Beatrice hesitated. "Yes," she said finally. 'And for... the usual reason I had intended to prepare you slowly.'

"I've done a lot of reading."

I hadn't done much reading, but I knew what the usual reason was. The woman had gouged, ripped, or otherwise destroyed her eyes. She would be badly scarred. I got up, went over to sit on the arm of Alan's chair. I rested my hand on his shoulder, and he reached up and held it there.

'Can we see her now?' he asked.

Beatrice got up. 'This way,' she said.

We passed through more workrooms. People painted, assembled machinery, sculpted in wood, stone, even composed and played music. Almost no one noticed us. The patients were true to their disease in that respect. They weren't ignoring us. They clearly didn't know we existed. Only the few controlled-DGD guards gave themselves away by waving or speaking to Beatrice. I watched a woman work quickly, knowledgeably, with a power saw. She obviously understood the perimeters of her body was not so dissociated as to perceive herself as trapped in something she needed to dig her way out of. What had Dilg done for these people that other hospitals did not do? And how could Dilg withhold its treatment from the others?

"Over there we make our own diet foods," Beatrice said, pointing through a window toward one of the guesthouses. "We permit more variety and make fewer mistakes than the commercial preparers. No ordinary person can concentrate on work the way our people can."

I turned to face her. 'What are you saying? That the bigots are right? That we have some special gift?'

'Yes,' she said. 'It's hardly a bad characteristic, is it?'

'It's what people say whenever one of us does well at something. It's their way of denying us credit for our work.'

'Yes. But people occasionally come to the right conclusions for the wrong reasons.' I shrugged, not interested in arguing with her about it.

"Alan?" she said. He looked at her.

"Your mother is in the next room."

He swallowed, nodded. We both followed her into the room.

Naomi Chi was a small woman, hair still dark, fingers long and thin, graceful as they shaped the clay. Her face was a ruin. Not only her eyes but most of her nose and one ear were gone. What was left was badly scarred. "Her parents were poor," Beatrice said. "I don't know how much they told you, Alan, but they went through all the money they had, trying to keep her at a decent place. Her mother felt so guilty, you know. She was the one who had cancer and took the drug. Eventually they had to put Naomi in one of those state approved custodial care places. You know the kind. For a while, it was all the government would pay for. Places like that... well, sometimes if patients were really troublesome—especially the ones who kept breaking free—they'd put them in a bare room and let them finish themselves. The only things those places took good care of were the maggots, the cockroaches, and the rats."

I shuddered. "I've heard there are still places like that."

"There are," Beatrice said. "kept open by greed and indifference." She looked at Alan. "Your mother survived for three months in one of those places. I took her from it myself. Later, I was instrumental in having that particular place closed."

"You took her?" I asked.

"Dilg didn't exist then, but I was working with a group of controlled DGDs in L.A. Naomi's parents heard about us and asked us to take her. A lot of people didn't trust us then. Only a few of us were medically trained. All of us were young, idealistic, and ignorant. We began in an old frame house with a leaky roof. Naomi's parents were grabbing at straws. So were we. And by pure luck, we grabbed a good one. We were able to prove ourselves to the Dilg family and take over these quarters."

"Prove what?" I asked.

She turned to look at Alan and his mother. Alan was staring at Naomi's ruined face, at the ropy, discolored scar tissue. Naomi was shaping the image of an old woman and two children. The gaunt, lined face of the old woman was remarkably vivid—detailed in a way that seemed impossible for a blind sculptress.

Naomi seemed unaware of us. Her total attention remained on her work. Alan forgot about what Beatrice had told us and reached out to touch the scarred face.

Beatrice let it happen. Naomi did not seem to notice. "If I get her attention for you," Beatrice said, "we'll be breaking her routine. We'll have to stay with her until she gets back into it without hurting herself. About half an hour."

"You can get her attention?" he asked.

"Yes."

"Can she?..." Alan swallowed. "I've never heard of anything like this. Can she talk?"

"Yes. She may not choose to. Though. And if she does, she'll do it very slowly."

"Do it. Get her attention."

"She'll want to touch you."

"That's all right. Do it."

Beatrice took Naomi's hands and held them still, away from the wet clay. For several seconds Naomi tugged at her captive hands, as though unable to understand why they did not move as she wished.

Beatrice stepped closer and spoke quietly. "Stop, Naomi." And Naomi was still, blind face turned toward Beatrice in an attitude of attentive waiting. Totally focused waiting.

"Company, Naomi."

After a few seconds, Naomi made a wordless sound.

Beatrice gestured Alan to her side, gave Naomi one of his hands. It didn't bother me this time when she touched him. I was too interested in what was happening. Naomi examined Alan's hand minutely, then followed the arm up to the shoulder, the neck, the face. Holding his face between her hands, she made a sound. It may have been a word, but I couldn't understand it. All I could think of was the danger of those hands. I thought of my father's hands.

"His name is Alan Chi, Naomi. He's your son." Several seconds passed.

"Son?" she said. This time the word was quite distinct, though her lips had split in many places, and had healed badly. "Son?" she repeated anxiously. "Here?"

"He's all right, Naomi. He's come to visit."

"Mother?" he said.

She reexamined his face. He had been three when she started to drift. It didn't seem possible that she could find anything in his face that she would remember. I wondered whether she remembered she had a son.

"Alan?" she said. She found his tears and paused at them. She touched her own face where there should have been an eye, then she reached back toward his eyes. An instant before I would have grabbed her hand, Beatrice did it.

"No!" Beatrice said firmly.

The hand fell limply to Naomi's side. Her face turned toward Beatrice like an antique weather vane swinging around. Beatrice stroked her hair, and Naomi said something I almost understood. Beatrice looked at Alan, who was frowning and wiping away tears.

"Hug your son," Beatrice said softly.

Naomi turned, groping, and Alan seized her in a tight, long hug. Her arms went around him slowly. She spoke words blurred by her ruined mouth but just understandable.

"Parents?" she said. "Did my parents care for you?" Alan looked at her, clearly not understanding.

"She wants to know whether her parents took care of you," I said.

He glanced at me doubtfully, then looked at Beatrice.

"Yes" Beatrice said. "She just wants to know that they cared for you."

"They did," he said. "They kept their promise to you, Mother."

Several seconds passed. Naomi made sounds that even Alan took to be weeping, and he tried to comfort her.

"Who else is here?" she said finally.

This time Alan looked at me. I repeated what she had said.

"Her name is Lynn Mortimer," he said. "I'm—" He paused awkwardly. "She and I are going to be married."

After a time she moved back from him and said my name. My first impulse was to go to her. I wasn't afraid or repelled by her now, but for no reason I could explain. I looked at Beatrice.

"Go," she said. "But you and I will have to talk later."

I went to Naomi. Took her hand.

"Bea?" she said.

"I'm Lynn." I said softly.

She drew a quick breath. "No," she said. "No, you're—"

"I'm Lynn. Do you want Bea? She's here."

She said nothing. She put her hand to my face, explored it slowly. I let her do it, confident that I could stop her if she turned violent. But first one hand, then both, went over me very gently.

"You'll marry my son?" she said finally.

"Yes."

"Good. You'll keep him safe."

As much as possible, we'll keep each other safe." Yes," I said.

"Good. No one will close him away from himself. No one will tie him or cage him." Her hand wandered to her own face again, nails biting in slightly.

"No," I said softly, catching the hand. "I want you to be safe, too."

The mouth moved. I think it smiled. "Son?" she said.

He understood her, took her hand.

"Clay," she said. Lynn and Alan in clay. "Bea?"

"Of course," Beatrice said. "Do you have an impression?"

"No!" It was the fastest that Naomi had answered anything. Then, almost childlike, she whispered, "Yes."

Beatrice laughed. "Touch them again if you like, Naomi. They don't mind."

We didn't. Alan closed his eyes, trusting her gentleness in a way I could not. I had no trouble accepting her touch, even so near my eyes, but I did not delude myself about her. Her gentleness could turn in an instant. Naomi's fingers twitched near Alan's eyes, and I spoke up at once, out of fear for him.

"Just touch him, Naomi. Only touch."

She froze, made an interrogative sound.

"She's all right," Alan said.

"I know," I said, not believing it. He would be all right, though, as long as someone watched her very carefully, nipped any dangerous impulses in the bud.

"Son!" she said, happily possessive. When she let him go, she demanded clay, wouldn't touch her old woman sculpture again. Beatrice got new clay for her, leaving us to soothe her and ease her impatience. Alan began to recognize signs of impending destructive behavior. Twice he caught her hands and said no. She struggled against him until I spoke to her. As Beatrice returned, it happened again, and Beatrice said, "No, Naomi." Obediently Naomi let her hands fall to her sides.

"What is it?" Alan demanded later when we had left Naomi safely, totally focused on her new work—clay sculptures of us. "Does she only listen to women or something?"

Beatrice took us back to the sitting room, sat us both down, but did not sit down herself. She went to a window and stared out. "Naomi only obeys certain women," she said. "And she's sometimes slow to obey. She's worse than most—probably because of the damage she managed to do to herself before I got her." Beatrice faced us, stood biting her lip and frowning. "I haven't had to give this particular speech for a while," she said. "Most DGDs have the sense not to marry each other and produce children. I hope you two aren't planning to have any—in spite of our need." She took a deep breath. "It's a pheromone. A scent. And it's sex-linked. Men who inherit the disease from their fathers have no trace of the scent. They also tend to have an easier time with the disease. But they're useless to us as staff here. Men who inherit from their mothers have as much of the scent as men get. They can be useful here because the DGDs can at least be made to notice them. The same for women who inherit from their mothers but not their fathers. It's only when two irresponsible DGDs get together and produce girl children like me or Lynn that you get someone who can really do some good in a place like this." She looked at me. "We are very rare commodities, you and I. When you finish school you'll have a very well paid job waiting for you."

"Here?" I asked.

"For training, perhaps. Beyond that, I don't know. You'll probably help start a retreat in some other part of the country. Others are badly needed." She smiled humorlessly. "People like us don't get along well together. You must realize that I don't like you any more than you like me."

*"She examined Alan's hand minutely, then followed the arm up to the neck, the face. Holding his face between her hands, she made a sound. All I could think of was the danger."*

I swallowed, saw her through a kind of haze for a moment. Hated her mindlessly—just for a moment.

"Sit back," she said. "Relax your body. It helps."

I obeyed, not really wanting to obey her but unable to think of anything else to do. Unable to think at all. "We seem," she said, "to be very territorial. Dilg is a haven for me when I'm the only one of my kind here. When I'm not, it's a prison."

"All it looks like to me is an unbelievable amount of work," Alan said.

She nodded. "Almost too much." She smiled to herself. "I was one of the first double DGDs to be born. When I was old enough to understand, I thought I didn't have much time. First I tried to kill myself. Failing that, I tried to cram all the living I could into the small amount of time I assumed I had. When I got into this project, I worked as hard as I could to get it into shape before I started to drift. By now I wouldn't know what to do with myself if I weren't working."

"Why haven't you—drifted?" I asked.

"I don't know. There aren't enough of our kind to know what's normal for us."

"Drifting is normal for every DGD sooner or later."

"Later, then."

"Why hasn't the scent been synthesized?" Alan asked. "Why are there still concentration-camp rest homes and hospital wards?"

"There have been people trying to synthesize it since I proved what I could do with it. No one has succeeded so far. All we've been able to do is keep our eyes open for people like Lynn." She looked at me. "Dilg scholarship, right?"

"Yeah. Offered out of the blue."

"My people do a good job keeping track. You would have been contacted just before you graduated or if you dropped out."

"Is it possible," Alan said, staring at me, "that she's already doing it? Already using the scent to—influence people?"

"You?" Beatrice asked.

"All of us. A group of DGDs. We all live together. We're all controlled—of course, but—" Beatrice smiled. "It's probably the quietest house full of kids that anyone's ever seen."

I looked at Alan, and he looked away. "I'm not doing anything to them," I said. "I remind them of work they've already promised to do. That's all."

"You put them at ease," Beatrice said. "You're there. You—well, you leave your scent around the house. You speak to them individually. Without knowing why, they no doubt find that very comforting. Don't you, Alan?"

"I don't know," he said. "I suppose I must have. From my first visit to the house, I knew I wanted to move in. And when I first saw Lynn, I—" He shook his head. "Funny. I thought all that was my idea."

"Will you work with us, Alan?"

Me? You want Lynn."

"I want you both. You have no idea how many people take one look at one workroom here and turn and run. You may be the kind of young people who ought to eventually take charge of a place like Dilg."

"Whether we want to or not, eh?" he said.

Frightened. I tried to take his hand, but he moved it away. "Alan, this works," I said. "It's only a stopgap. I know. Genetic engineering will probably give us the final answers, but for God's sake, this is something we can do now!"

"It's something *you* can do. Play queen bee in a retreat full of workers. I've never had any ambition to be a drone."

"A physician isn't likely to be a drone," Beatrice said.

"Would you marry one of your patients?" he demanded. "That's what Lynn would be doing if she married me—whether I become a doctor or not."

She looked away from him, stared across the room. "My husband is here," she said softly. "He's been a patient here for almost a decade. What better place for him when his time came?"

"Shit!" Alan muttered. He glanced at me. "Let's get out of here!" He got up and strode across the room to the door, pulled at it, then realized it was locked. He turned to face Beatrice, his body language demanding she let him out. She went to him, took him by the shoulder, and turned him to face the door. "Try it once more," she said quietly. "You can't break it. Try."

Surprisingly, some of the hostility seemed to go out of him. "This is one of those p v locks?" he asked.

"Yes."

I set my teeth and looked away. Let her work. She knew how to use this thing, she and I both had. And for the moment, she was on my side.

I heard him make some effort with the door. The door didn't even rattle. Beatrice took his hand from it, and with her own hand flat against what appeared to be a large brass knob, she pushed the door open.

"The man who created that lock is nobody in particular," she said. "He doesn't have an unusually high I.Q., didn't even finish college. But sometime in his life he read a science fiction story in which palmprint locks were a given. He went that story one better by creating one that responded to voice or palm. It took him years, but we were able to give him those years. The people of Dilg are problem solvers, Alan. Think of the problems you could solve!"

He looked as though he were beginning to think, beginning to understand. "I don't see how biological research can be done that way," he said. "Not with everyone acting on his own, not even aware of other researchers and their work."

"It *is* being done," she said, "and not in isolation. Our retreat in Colorado specializes in it and has—just barely—enough trained, controlled DGDs to see that no one really works in isolation. Our patients can still read and write—those who haven't damaged themselves too badly. They can take each other's work into account if reports are made available to them. And they can read material that comes in from the outside. They're working, Alan. The disease hasn't stopped them; *won't* stop them." He stared at her, seemed to be caught by her intensity—or her scent. He spoke as though his words were a strain, as though they hurt his throat. "I won't be a puppet. I won't be controlled—by a goddamn smell!"

"Alan—"

"I won't be what my mother is. I'd rather be dead!"

"There's no reason for you to become what your mother is."

He drew back in obvious disbelief. "Your mother is brain-damaged—thanks to the three months she spent in that custodial-care toilet. She had no speech at all when I met her. She's improved more than you can imagine. None of that has to happen to you. Work with us, and we'll see that none of it happens to you."

*"She found his tears and paused. She touched her face where there should have been an eye, then reached back toward his eyes. Before I would have grabbed her, Beatrice did."*

He hesitated, seemed less sure of himself. Even that much flexibility in him was surprising. "I'll be under your control or Lynn's," he said.

She shook her head. "Not even your mother is under my control. She's aware of me. She's able to take direction from me. She trusts me the way any blind person would trust her guide."

"There's more to it than that."

"Not here. Not at any of our retreats."

"I don't believe you."

"Then you don't understand how much individuality our people retain. They know they need help, but they have minds of their own. If you want to see the abuse of power you're worried about, go to a DGD ward."

"You're better than that, I admit. Hell is probably better than that. But—"

"But you don't trust us."

He shrugged. "You do, you know." She smiled. "You don't want to, but you do. That's what worries you, and it leaves you with work to do. Look into what I've said. See for yourself. We offer DGDs a chance to live and do whatever they decide is important to them. What do you have, what can you realistically hope for, that's better than that?"

Silence. "I don't know what to think," he said finally.

"Go home," she said. "Decide what to think. It's the most important decision you'll ever make."

He looked at me. I went to him, not sure how he'd react, not sure he'd want me no matter what he decided.

"What are you going to do?" he asked.

The question startled me. "You have a choice," I said. "I don't. If she's right, how could I not wind up running a retreat?"

"Do you want to?"

I swallowed. I hadn't really faced that question yet. Did I want to spend my life in something that was basically a retired DGD ward? "No!"

"But you will."

"Yes." I thought for a moment, hunted for the right words. "You'd do it."

"What?"

"If the pheromone were something only men had, you would do it."

That silence again. After a time he took my hand, and we followed Beatrice out to the car. Before I could get in with him and our guard-escort, she caught my arm. I jerked away reflexively. By the time I caught myself, I had swung around as though I meant to hit her. Hell, I did mean to hit her, but I stopped myself in time. "Sorry," I said with no attempt at sincerity.

She held out a card until I took it. "My private number," she said. "Before seven or after nine, usually. You and I will communicate best by phone."

I resisted the impulse to throw the card away. God, she brought out the child in me.

Inside the car, Alan said something to the guard. I couldn't hear what it was, but the sound of his voice reminded me of him arguing with her—her logic and her scent. She had all but won him for me, and I couldn't manage even token gratitude. I spoke to her low-voiced.

"He never really had a chance, did he?"

She looked surprised. "That's up to you. You can keep him or drive him away. I assure you, you *can* drive him away."

"How?"

"By imagining that he doesn't have a chance." She smiled faintly. "Phone me from your territory. We have a great deal to say to each other, and I'd rather we didn't say it as enemies."

She had lived with meeting people like me for decades. She had good control. I, on the other hand, was at the end of my control. All I could do was scramble into the car and floor my own phantom accelerator as the guard drove us to the gate. I couldn't look back at her. Until we were well away from the house, until we'd left the guard at the gate and gone off the property, I couldn't make myself look back. For long, irrational minutes, I was convinced that somehow if I turned, I would see myself standing there, gray and old, growing small in the distance, vanishing.

# INTERVIEW

CONTINUED FROM PAGE 86

Los Alamos National Laboratory. It may not be too difficult or expensive. This is a tunneling machine with a tungsten head. It heats whatever is in front of it so much that the material melts and allows the penetrating machine to move forward. As the material cools, it forms a glassy shell of a thickness and strength adequate to serve as the outer lining for a tunnel. You could start two robot Subterrenes—one from each coast—and have them meet up in Kansas. Better yet, use multiple headings.

*Omni*: Does our reluctance to consider even the most modest improvements in underground transportation spring from irrational fears of being belowground?

Davidson: Well, General de Gaulle said he refused to ride the Paris metro because he thought it was subhuman. But if we are to protect the surface landscape we must put more infrastructure underground. It may be worthwhile to have the opposite of the skyscraper—the *groundscraper*. The University of Minnesota Engineering Department has—I won't say put up—put down a building several stories under ground level. The entire space is illuminated by mirror-reflected sunlight. It's wild. Imagine a structure that's half groundscraper and half skyscraper! Pessimists could live underground, and optimists aboveground.

I suppose I'd be in one of Frank Lloyd Wright's mile-high towers. We'll eventually see these mile-high towers as solutions to urban crowding. I had previously thought buildings that high would consist almost entirely of elevators. But French engineer Gabriel Bouladon has solved the elevator problem with a system combining the continuous floor of an escalator with the preselected exits of an elevator. As you mount the escalatorlike step, walls rise up in a U shape around you. Each step becomes an enclosed, two-passenger box; each box is piled on top of the one below in a continuously rotating belt. The shafts and waiting areas required for this system are minuscule compared with those needed for elevators. At least ten times the traffic volume could be accommodated. The man responsible for the design of Manhattan's World Trade Center told me that he'd have recommended Bouladon's system for the Twin Towers had there been time to build a prototype.

*Omni*: Could Antoine Khawand's "house building" machine revolutionize construction in the twenty-first century?

Davidson: It certainly could. As a graduate student at MIT, Khawand built a prototype machine to which you could add various attachments to perform different operations in building a house. The machine consisted of a steel girder with instrumentation inside, slung between two tractors. His machine had robot pincher arms and specialized in automatically laying tiles, either vertically or horizontally. It laid them with absolute precision and so rapidly your eye could hardly follow its movements.

Because the machine's mobility is spectacular, the applications are mind-boggling. You could build houses and then move them to their site, or build them on the location by remote control. And you could send out a battery of machines to build a town. Beyond the greatly increased speed of construction, this would enhance both quality and cost control. Imagine sitting in your office in Harvard Square, issuing commands to a computer, and presto—twenty specialized machines rumble across the Sahel desert to build a resort town, along with its ancillary reservoir! Perfecting the machine would take many millions of dollars, but we already know the prototype works. The implications for training of personnel, the trade union situation, and the trade-off of high-tech for low-tech employees in the building trades are knotty issues. But it works! So let's try it.

*Omni*: Is it easier to get macroprojects built in a totalitarian society where the public is less involved?

Davidson: No. In Russia there has been heated public debate over whether to reverse their northward-flowing rivers to irrigate the south. When the project was slated to be part of the next five-year plan, prominent writers, historians, and engineers petitioned the government and protested in newspapers and magazines about the environmental and cultural damage the project might do. Gorbachev himself never took a position, but last spring the Party Congress tabled the project indefinitely.

*Omni*: Won't it be decades—perhaps even centuries—before society is ready for these macrochanges?

Davidson: You have to be patient, and as the joke goes, I'm confident about predicting anything but the future. The writers of science fiction have more accurately forecast developments in the long-term future than so-called scientists attempting to forecast. Robideau, a French caricaturist, suggested one hundred years ago in a fictional tale, "The Twentieth Century." The construction of an additional continent in the Pacific. He illustrated this notion with convincing scenes of gigantic cranes delivering fill to caissons sunk in the sea. And Jules Verne predicted submarines and a transatlantic supersonic subway from Liverpool to Boston. A lot of science fiction is really engineering fiction. The difference between it and concept engineering is not so great.

*Omni*: What's tops on your personal list of future macroprojects?

Davidson: My cross-country sportsway idea. And now it's become embodied in a new and somewhat powerful coalition of trails organizations called the American Trails Network, so there's a realistic prospect that eventually we'll be able to hike, bike, ride a horse, or even cross-country ski, roller-skate, or (in parts) paddle right across or up and down our country. Every-

where I go, the idea of at least a modest right-of-way across the US gets enormous support The sportsway would be a landscaped swath maybe two hundred yards wide Of course we would still need our old friends—bridges and tunnels—in some places This coalition of conservationists, fitness enthusiasts and industry could provide a landscaped trail on the surface with readily accessible conduits underneath Various utilities might well be interested for the right-of-way it would provide them for coal-slurry pipelines, oil and gas pipelines, electrical and communications lines belowground This is not some ivory-tower option

And we've got an idea at MIT that's hot as a firecracker—irrigating the Sahel desert with water perhaps from the Amazon Last November a number of engineers under the chairmanship of Sir Robert G A Jackson, former under secretary general of the United Nations, met at Rensselaer Polytechnic Institute to consider the technical aspects of water supply Wild as it sounds financially and politically one suggested solution was to transport part of the Amazon River as it debouches into the South Atlantic to the Sahel via huge plastic tubes An aqueduct one hundred fifty feet in diameter, made of rubber or rubberlike plastic could be held in place on the sea bottom by a cement ballast to overcome the buoyancy of the seawater

Joe Debanne formerly of MIT pioneered this idea a decade ago Algeria he said, could buy the Rhine River from France and shunt it across the Mediterranean in a big plastic pipe His scheme is viable in many parts of the world—ducting the Congo northward, the Tigris to Kuwait, or the Indus northwestward to the Pakistani and Iranian coasts

The Sahel plan is now a concept not a precise plan But we had better consider it We're used to spending billions on sending CARE packages so that little Suzie won't conk out But there are a lot more Suzies in the future If we want to look after them we'd better build infrastructure We're approaching a point where we need to think about a world water supply We already have something of a world food-supply system because of shipping It is subject to ad hoc arrangements and crisis management but if Russia has a shortage we send a heck of a lot of grain We could have a deliberate and conscious world water-supply system In terms of the twenty-first century this is going to be one of the big topics Today we have world communications and transportation tomorrow we'll have a world energy grid and water grid World resource problems cannot be solved without thinking in macroengineering terms

*Omni*: Would you say you dream in macroengineering terms?

**Davidson**: At night? No, my dreams are quite mundane But my daydreams are macro Remember Fitzcarraldo—those dreams may be reality

# STAR TECH

## ACCESSING THE FUTURE

### ADOPT-A-WHALE

In recent years Americans in a mood to expand their families have been offered opportunities to adopt everything from Ecuadorian urchins to sugar-maple saplings. Not to be outdone the folks at College of the Atlantic in Bar Harbor, Maine are now offering what may be the biggest adoption bonanza of all time: a chance to adopt an 80-foot-long finback whale.

Prospective 'parents' do not have to worry about expanding their swimming pool to accommodate the new kid. Instead, for $25 interested parties get an 8x12-inch color photo of their whale (the animals come already equipped with names like Scarlip O'Hara, El Tigre and James Bond), a brief biography and a packet of educational material on finbacks in general. "I gave one to my father-in-law this Christmas," says Beverly Agler of College of the Atlantic's Allied Whale Organization, "and he loved it. He went around telling everyone he'd gotten the biggest Christmas present ever."

—Bill Lawren

*Access:* Write Allied Whale, College of the Atlantic, Bar Harbor, ME 04609.

### CAVITYLESS CANDY

Chewy, chewy Tootsie Rolls last a long time, but so do the cavities they cause. Now dental researchers are coming up with sweets that won't cause cavities.

According to Scott Harper, associate director of the Oral Health Research Center at Fairleigh Dickinson University (FDU) in New Jersey, research is progressing quickly on certain calcium compounds—calciums lactate, propionate, acetate and levulinate—that, when added to sweets, inhibit sugar-fed bacteria from producing the acid that eats away at tooth enamel. In studies on rats fed a sucrose and cornstarch diet, FDU researchers found a reduction of up to 100 percent in cavities on the smooth surfaces of teeth, and between 30 and 40 percent on the rough surfaces. Calcium compounds also bathe the enamel in the very substance it is made of—calcium—and just as extra salt won't dissolve in a glass of salt-saturated water, calcium in enamel won't dissolve in calcium-laden saliva.

Researchers, both in academe and with candy manufacturers (who are understandably tight-lipped about it all), still need to work on further human studies and on the slightly "off-flavor" taste that calcium lends to sweets, but most are confident that someday soon consumers will see cavity-fighting candy—what Harper calls "the greatest thing since sugarless gum."

—Gregg Levoy

*Access:* Optimally, such products could be available within a few years. The regulatory process is tricky. The FDA considers cavities a periodontal disease, and any additive to treat them would be reviewed as a drug, not a food additive.

### CHEROKEE SPIRITUAL SEX

A man working to relieve his performance anxiety practices the "fire breath," trying to pull his breath up from the base of the spine. He experiences an orgasm lasting 45 minutes.

It's all part of a Quodoushka seminar, a workshop in Native American spiritual sexuality. The lessons of Quodoushka, held in secret by the Sacred Council of the Elders for generations, are being revealed to non-Indians for the first time by Cherokee medicine man and psychologist Harley Swiftdeer.

Swiftdeer believes that the beauty and power of sexuality stem from the conscious use of sexual energies for higher purposes. The Los Angeles-based shaman teaches that there are five levels of orgasm, each with its own sensations, and demonstrates how to attain orgasm with the breath alone.

Another surprise Quodoushka holds that there are distinct types of male and female genitalia and that they are aroused by different manipulations and positions, and can determine the quality of compatibility between partners.

—Connie Zweig and Dick Richards

*Access:* Swiftdeer and a group of apprentices offer three-day residential workshops around the country. For information write Liz Chandra, Quodoushka Training Seminars, Box 11702, Marina del Rey, CA 90292, or call (213) 306-2168.

## URINE HOT LINE

You say you've recently indulged in a little controlled substance, and you're worried about that upcoming urinalysis at your job? Well for two bucks plus toll charges San Diego's Question Authority has some help for you a hot line that gives cogent clues as to how to beat the urine test

A brief tape-recorded message tells you how long various drugs stay in the system and how to disguise the telltale traces in your urine—even while the doctor is watching

Question Authority's W Evan Sloane calls it 'the first political use of hot-line technology' Since its inauguration late last year he says, the line has had callers from all over the country—"typically" he reports "young couples in their mid-thirties who don't want to lose their jobs just because they smoke a little marijuana'

—Bill Lawren

*Access* Dial (619) 976-TEST

## SONIC PAINKILLER

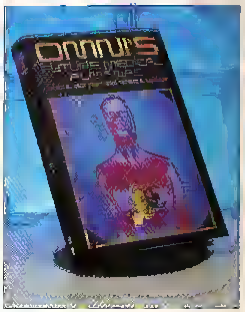
It's bigger than a bread box but it's smaller than a microwave oven and it could be one of the bigger breakthroughs of modern medicine in controlling arthritic pain The prototype called Sonotron looks like an ordinary electronic box with a couple of meters and knobs There's a wire leading to a gunlike gadget—sort of a modified hair dryer But when its button is pressed, a strange purple spark appears and there's a high squealing sound

The Sonotron was something of an accident according to its inventor Dr Alfonso Di Mino, the sixty-six-year-old head of ADM Tronics a New Jersey company whose main business is making chemicals Di Mino (shown above with his device) had been thinking of ways to manipulate and lower the ohm value of resistors After a marathon two weeks in his basement he came up with a device that combines low frequency audio and radio waves One day after suffering from a long standing bout of arthritis in his right hand he turned the device on the pain reasoning that he had nothing to lose The pain suddenly stopped and it hasn't returned He was stunned Next, he treated his son Andre's peritendinitic thumb No pain A horse that was to be put down because of a seriously bowed tendon was also saved with Sonotron treatments

"We don't know how it works," admits Andre Di Mino "and thank God we don't have to worry about why it works We only have to prove it's safe for FDA approval The device has undergone successful tests on laboratory rats with induced arthritis Tests on humans with osteoarthritis in the hands and knees are presently under way—Doug Garr

*Access* ADM Tronics, 153 Ludlow Avenue Northvale NJ 07647

## THE ULTIMATE MEDICAL GUIDE




How many times have you asked your doctor about a medical breakthrough you read about in *Omni* (or anywhere else) only to find that he or she has never heard of it? Or perhaps you were told the treatment (or drug operation or test) was not available in your area

*Omni's Future Medical Almanac* (McGraw-Hill) seeks to remedy this problem It tells you how to take advantage of medical treatments on the cutting edge bionic body parts electric pain control selecting the sex of your baby treatments that increase sexual desire,

even brain grafting

The *Almanac* covers futuristic developments in 14 leading medical fields bioelectricity bionics laser medicine nutrition, gene therapy pain relief sexuality and so on What's more each chapter contains an access guide with names addresses, and phone numbers of doctors clinics hospitals and other institutions that offer the treatments described The *Almanac* is dedicated to the proposition that the patient should be armed with sufficient information to take control of his or her own health care

*Access* In bookstores, or send $17 95 (check or money order) to McGraw-Hill Book Company, Department MH, General Books Division Third Floor 11 West 19 Street, New York NY 10011

## OZONE-FRIENDLY REFRIGERATOR

A New Jersey manufacturer of Space Age refrigeration equipment has borrowed from nineteenth-century technology to make a small refrigerator (motor shown at right) that runs on inert helium or nitrogen instead of Freon and uses 50 percent less energy than conventional refrigerators do

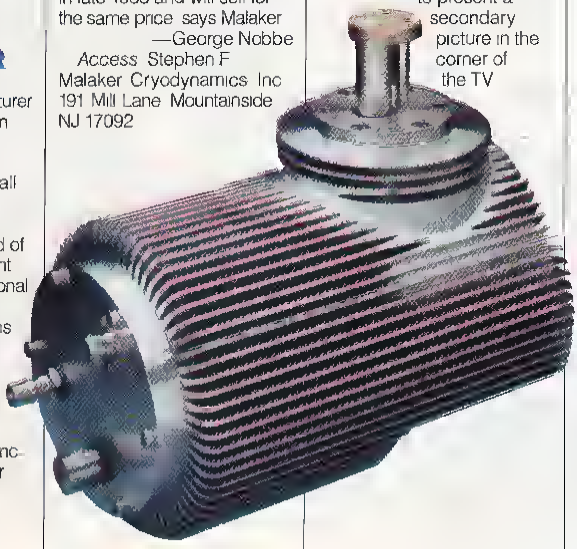
The chlorofluorocarbons produced by most home refrigerators are blamed for depleting the earth's protective ozone layer Not so with the equipment made by Cryodynamics, Inc- claims Stephen F Malaker the company president

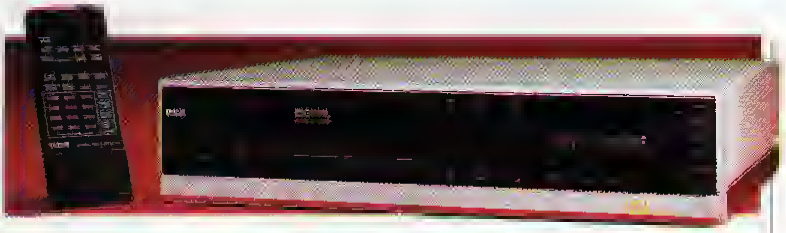
His refrigerator has a capacity of 5 3 to 7 cubic feet, compared with the 18 to 21 cubic feet of the average American refrigerator today

We're working with the Chinese government to make nine million of them a year by 1990 They'd be perfect there Chinese apartments are very small, says Malaker whose machines will sell for about $200—a princely sum considering the average worker in Shanghai makes only about $27 a week The Cryodynamics models could hit the American market in late 1988 and will sell for the same price says Malaker

—George Nobbe

*Access* Stephen F Malaker Cryodynamics Inc 191 Mill Lane Mountainside NJ 17092





## PICTURE-IN-PICTURE FEATURE FOR VCR'S

Now there are VCRs that let you screen a cassette and look in on a broadcast or cable show that may be on at the same time Equipped with special digital circuitry which is also showing up in TV sets these VCRs can display two separate programs simultaneously on the same TV screen

Called picture-in-picture the feature makes it possible to present a secondary picture in the corner of the TV screen By remote control, a viewer can switch the secondary picture to become the main image on the screen with the original primary picture then becoming the picture within a picture The viewer can also move the smaller picture to any corner of the screen

The digital circuitry makes it possible for VCRs to perform additional feats of electronic magic On some new models a viewer can instantly freeze the VCR's picture whether the source is a cassette or a broadcast or cable channel With many of these models, colorful electronic effects are available for altering the video image so the folks at home can play video artist

The picture quality is also improving through the use of digital circuitry VCRs can now offer noise-free pictures during such special functions as search stop action frame advance, and slow motion And digital circuitry is being used in some models for overall image improvement during normal playback —Marjorie Costello

*Access* The features described are available from a growing number of VCR brands (RCA's model VMT 400 is pictured above) Some models may not offer all of these digital enhancements

# NATIONAL GUARDS

CONTINUED FROM PAGE 50

monopoly over the nation's telephone service and increased the Pentagon's obsession with having its own nerve center. Now the brass had to contend with several competing companies to acquire phone lines, and communications was more than a matter of running a line from one telephone to another. Satellites, microwave towers, fiberoptics, and other technological breakthroughs never dreamed of by Alexander Graham Bell were in extensive use and not just for phone conversations. Digital data streams for computers flowed on the same networks.

These facts were not lost on the Defense Department or the White House. According to documents obtained by *Omni*, beginning on December 14, 1982, a number of secret meetings were held between high-level administration officials and executives of the commercial communications companies whose employees would later staff the National Coordinating Center. The meetings, which continued over the next three years, were held at the White House, the State Department, the Strategic Air Command (SAC) headquarters at Offutt Air Force Base in Nebraska, and at the North American Aerospace Defense Command (NORAD) in Colorado Springs.

The industry officials attending constituted the National Security Telecommunications Advisory Committee—called NSTAC (pronounced *N* stack)—set up by President Reagan to address those same problems that worried the Pentagon. It was at these secret meetings, according to the minutes, that the idea of a communications watch center for national emergencies—the NCC—was born. Along with it came a whole set of plans that would allow the military to take over commercial communications assets—everything from ground stations and satellite dishes to fiberoptic cables—across the country.

At a 1983 Federal Communications Commission meeting, a ranking Defense Department official offered the following explanation for the founding of the National Coordinating Center: "We are looking at trying to make communications endurable for a protracted conflict." The phrase *protracted conflict* is a military euphemism for nuclear war.

But could the NCC survive even the first volley in such a conflict?

Not likely. It's located within a mile of the Pentagon itself, an obvious early target of a Soviet nuclear barrage (or a conventional strike, for that matter). And the Kremlin undoubtedly knows its location and importance, and presumably has included it on its priority target list. In sum, according to one Pentagon official, "The NCC itself is not viewed as a survivable facility."

Furthermore, the NCC's "Implementation Plan," obtained by *Omni*, lists four phases of emergencies and how the center should respond to each. The first, Phase 0, is Peacetime, for which there would be little to do outside of a handful of routine tasks and exercises. Phase 1 is Pre Attack, in which alternate NCC sites are alerted. Phase 2 is Post Attack, in which other NCC locations are instructed to take over the center's functions. Phase 3 is known as Last Ditch, and in this phase whatever facility survives becomes the de facto NCC.

So far there is no alternate National Coordinating Center to which NCC officials could retreat to survive an attack. According to NCC deputy director William Belford, no physical sites have yet been chosen for a substitute NCC, and even whether the NCC itself will survive a nuclear attack is still under study.

Of what use is a communications center that is not expected to outlast even the first shots of a war and has no backup?

The answer appears to be that because of the Pentagon's concerns about the AT&T divestiture and the disruptive effects it might have on national security, the NCC was to serve as the military's peacetime communications center.

> *"The NCC's mission is as grand as its title is obscure: to make available to the Defense Department all the facilities of the civilian communications network in times of emergency."*

The center is a powerful and unprecedented tool to assume control over the nation's vast communications and information network. For years the Pentagon has been studying how to take over the common carriers' facilities. That research was prepared by NSTAC at the DoD's request and is contained in a series of internal Pentagon documents obtained by *Omni*. Collectively this series is known as the Satellite Survivability Report. Completed in 1984, it is the only detailed analysis to date of the vulnerabilities of the commercial satellite network. It was begun as a way of examining how to protect the network of communications facilities from attack and how to keep it intact for the DoD.

A major part of the report also contains an analysis of how to make commercial satellites "interoperable" with Defense Department systems. While the report notes that current technical differences such as varying frequencies make it difficult for the Pentagon to use commercial satellites, it recommends ways to resolve those problems. Much of the report is a veritable blueprint for the government on how to take over satellites in orbit above the United States. This information, plus NSDD 145's demand that satellite operators tell the NSA how their satellites are controlled, guarantees the military ample knowledge about operating commercial satellites.

The Pentagon now has an unprecedented access to the civilian communications network, commercial databases, computer networks, electronic links, telephone lines. All it needs is the legal authority to use them. Then it could totally dominate the flow of all information in the United States. As one high-ranking White House communications official put it: "Whoever controls communications controls the country." His remark was made after our State Department could not communicate directly with our embassy in Manila during the anti-Marcos revolution last year. To get through, the State Department had to relay all its messages through the Philippine government.

Government officials have offered all kinds of scenarios to justify the National Coordinating Center, the Satellite Survivability Report, new domains of authority for the Pentagon and the NSA, and the creation of top-level government steering groups to think of even more policies for the military. Most can be reduced to the rationale that inspired NSDD 145: that our enemies (presumably the Soviets) have to be prevented from getting too much information from unclassified sources. And the only way to do that is to step in and take control of those sources.

Remarkably, the communications industry as a whole has not been concerned about the overall scope of the Pentagon's threat to its freedom of operation. Most protests have been to individual government actions. For example, a media coalition that includes the Radio-Television News Directors Association, the American Society of Newspaper Editors, and the Turner Broadcasting System has been lobbying that before the government can restrict the use of satellites, it must demonstrate why such restrictions protect against a "threat to distinct and compelling national security and foreign policy interests." But the whole policy of restrictiveness has not been examined. That may change sometime this year, when the Office of Technology Assessment issues a report on how the Pentagon's policy will affect communications in the United States. In the meantime, the military keeps trying to encroach on national communications.

While it may seem unlikely that the Pentagon will ever get total control of our information and communications systems, the truth is that it can happen all too easily. The official mechanisms are already in place, and few barriers remain to guarantee that what we hear, see, and read will come to us courtesy of our being members of a free and open society and not courtesy of the Pentagon. ☐

# MURDER

CONTINUED FROM PAGE 78

fingers on a scanner, which would transmit the prints to a print-search network. The arresting officer could request searches of any database in the country, in minutes.

With portable laser scanners and video-transmitting equipment, even latent prints could be searched directly from the crime scene, says Maliska. "A bulletin on the suspect would be put out right from the crime scene," he adds.

Computers will also help future cops solve the most difficult of cases—those involving a victim who has lain dead a long time. The classic body in the woods, for instance, or the corpse that, as coroners put it, has "wintered over"—the victim dies before the first snows of winter and isn't found again until the spring thaw.

Douglas W. Owsley, a physical anthropologist at Louisiana State University, is experimenting with using a sophisticated graphics computer to identify skeletons by matching the skulls with photographs of missing people. He got interested in the technique when he set out last year to solve a mystery brought to him by Ted Wax of Gonzales, Louisiana. From veiled family talk and other clues, Wax had grown convinced that his late grandfather, Captain John Calhoun Brown, was really Wild Bill Longley, one of the baddest bad guys of the old West—and that Longley's hanging in 1878 had been rigged to give him a chance to go straight.

Longley, by his own count, had gunned down 32 people, the first when he was fifteen years old. Captain Brown, on the other hand, was a Louisiana timber baron, a pillar of civic trust—a good guy. Wax brought Owsley a photograph of the young Longley and several photographs of the much older Captain Brown. Using the Longley shot and one of the latter photographs, Owsley measured various facial features whose physical dimensions should not have changed over time, like the distance between the inner corners of the eyes. He then had the computer force one photograph to fit the other. To test the computer's ability to distinguish between faces, Owsley took photographs of other young males, himself included, and tried matching those to Captain Brown's. A cluster-analysis program scored the matches.

Only Wild Bill fit. "If it's not him," says Owsley, "it's someone who has the same cranial morphology in a lot of details."

Graphics computers may eventually allow investigators to reconstruct faces on skulls, doing in minutes what forensic sculptors now need days to finish, says Lewis Sadler, a medical illustrator and associate professor at the University of Texas Health Science Center in Dallas. Now he does a manual version of the technique. He begins by placing markers on the skull at 60 different points, each marker showing how deep the tissue should be at that point, as established by ultrasound studies done in Germany. He photographs the skull, making sure the 60 points are visible, and then does a sophisticated version of connect-the-dots—a drawing of the face that went with that skull. The sketch can then be reproduced in missing-persons flyers or law enforcement bulletins.

To test the accuracy of his technique, Sadler visited the Smithsonian Institution's anatomy collection and tried it out on a skull. He compared the finished product with the death mask, a cast that had been made of the person's face soon after death. The fit was good. A computer, he says, could speed the process, allowing far quicker calculation of the 60 osteometric points. With airbrushing programs an artist would then reproduce the face possibly even in three dimensions. "It's a matter of working with a lot more points, or anatomical information," he says. But certainly that's what computers are good at—crunching numbers."

*"Phillips holds a paper cup to the laser light and turns it slowly. There is nothing to see. Look through a pair of colored glasses, though, and fingerprints appear."*

It is cold in Knoxville, Tennessee—a good thing, because the cold suppresses the stench of decay. Snow that fell the night before lies in patches, sharply white against the deep copper soil. Maggot expert Robert Mann walks up the short and now muddy road to ARF Bass's decay facility.

Within the enclosure there is a small shed, with chain link fencing over the top and sides. The bodies of two dead men, both under opaque plastic tarps, lie inside on a concrete base. One—a robust man, judging by the mass under the plastic—shot himself in the head with a .357 magnum about a month before. A large sign on the gate to this smaller enclosure identifies it as a university facility and includes Bass's office and home telephone numbers, just in case someone stumbles by and happens to wonder about the bodies.

Mann continues on to a low, red bluff where another body, once a black woman, lies under a wire cotton, a wood-frame rectangle covered with wire mesh to allow insects and weather in but to keep out the larger carnivores, like dogs and vultures. Mann had earlier removed the woman's head because it had decayed to the bone already and he wanted to protect the skull from rodents to preserve it for inclusion in a data bank of skeletal measurements.

Mann slips on a pair of surgical gloves, then squats beside the body and looks it over, concentrating, offering a casual narrative of what happens after death.

"You can see the mold has formed on her; she's going from this orange mold to a blackened state," he says, pointing. Although most of her skin has been bleached to a Caucasian white, the sides of her legs blaze with Halloween colors, orange against black. Mann shifts her left leg and points to the ground underneath. "If it was warm out, there would have been maggots all along here," he says. He keeps record books filled with day-by-day observations of maggot growth and the body's decay. He repositions the leg, then gestures toward the ground above the shoulders. "Where the head was, there's a hair mass. See, if this were on a hillside and we found scattered bones up and down the slope, we'd go back and look for this hair mass—because it'd be there, and that would tell us where the body first lay."

Another body, of a man in his mid-fifties who died of a heart attack, lies in a shallow, open grave. Two more bodies are buried nearby to gauge the effects of burial and to monitor changes in the surface soil for clues that could help police locate buried homicide victims. One study done by Bass's students found that plant growth accelerated rapidly over shallow graves, a finding they later put to practical use by locating a body buried in a field. His researchers have also found that the temperatures of buried bodies increase markedly relative to the soil around them, and that soil settling after a burial will leave a noticeable depression. They've noted which insects arrive first (blowflies) and which leave last (dermestid beetles), and that bodies with open wounds decay far more quickly than those without.

The bodies here are artifacts of past human lives, stripped of anything that can trigger grief or sadness—basic materials for basic research. The anonymity helps. "I'm glad I don't know the people I have to work on," says Mann as he drives back along the Tennessee River toward Bass's office. "I'm glad I don't know the things that were going through their minds before they died, the things that surrounded their deaths. It would be so much you'd really have a hard time handling it."

Instead, he finds the going easy except maybe on the hottest days of summer, when the odors here grow so thick and sweet it's almost suffocating. "I enjoy this because I've got a real strong conviction. There are people out there murdering people and gettin away with it. I feel that every step should be taken to try to figure out when this person died, how he died, and who he is. Because one little bit of evidence could be something very important that's overlooked. Somebody's gettin off, and it burns me up."

# PERFECT CRIME

CONTINUED FROM PAGE 76

Such advances will be significant to crime and thriller writers. They have certainly changed my life. Back in the so-called Golden Age of the Thirties, writers knew little about forensic science and all sorts of extraordinary things were put into books. In most mysteries, for example, the town doctor would usually do the postmortem on the murder victim, and within a few hours he would tell the detectives very exciting things about exactly how the victim died. Nowadays we know it would take a fully equipped forensic science laboratory at least a week to reveal as much. But nobody worried about that sort of thing because the public did not know much about forensic science. But today people know a great deal about how policemen and coroners work, and they expect a great deal of accuracy. So if one is a serious crime writer, one has to do a great deal of research.

MICKEY SPILLANE, *crime novelist*

Nothing's going to change for the criminal with all this technological nonsense. Are you kidding, honey? Hope springs eternal even in the criminal breast. Criminals think they can get away with it. Most start early, don't have enough sense to know they are going to get caught, and are usually found out by their own stupidity.

Technology has improved throughout this century. Have you noticed any lessening of crime? Do you know how most crimes are solved? Through the use of informants, that's how. It's usually a matter of sheer legwork on the part of cops. Computers and such can aid you in certain areas. If you are talking about industrial crime, where you're dealing with numbers—like running down serial numbers or finding where phone cheats operate, things that can be numerically established on a computer—then the computer is an aid in solving a crime.

The only thing I write about is murder. Now, when you're dealing with a murderer, you're not dealing with a guy who is thinking about lasers. I know what I'm talking about here. And I'm not going to learn about technology, learn about any techniques. Look, you've got bad guys, and you've got good guys. Somebody does something, and you run 'em to earth.

VINCENT BUGLIOSI, *prosecuting attorney in the Manson murders*

People do not generally appreciate the extremes to which a criminal will go to beat the criminal-identification process. Perhaps they'll carry around vials of other people's blood and spill it at the scene of the crime. Then someone else will have his DNA analyzed. As for laser fingerprints, I'm not sure. The reality is that now it's extraordinarily difficult for law enforcement to pick up readable, identifiable fingerprints that can be matched up with the defendant's. Do you know how often they get usable prints? Only about three percent of the time. And I don't think that even with lasers to assist the police, the percentage is going to climb that much higher.

Now, let's say you've got a situation in which the prosecutor has the results of one of those DNA–fingerprinting tests or something like it. Even then, things aren't hopeless for the criminal—not by a long shot.

What the defense will try to do when faced with this is to try and attack—and if possible destroy—the credentials or the credibility of the expert witness. And they'll attack the *ability* of this particular witness to administer or interpret the scientific test. Even though the test itself is an extremely precise instrument, that doesn't mean the witness on that stand is necessarily an infallible operator.

Also, the defense attorney will put down science. He will attempt to appeal to the jury on a one-to-one basis, as though they were talking over the backyard fence, and he'll say things like, "All this highfalutin stuff is all well and good, but we don't have to have these people coming in here with their half-dozen doctorate degrees and telling us anything. Let's just apply our own common sense."

You'd be surprised how effective this is.

HARLAN ELLISON, *science fiction writer*

Crime detection will never keep up with criminals. In the future it may be necessary to outwit the telepathic cop, the policeman with special training, the one who can read your mind. But even assuming a world with telepathy operating for the police force, the criminals will still be able to flummox them. There's a story in which the basic question is, In a world of telepathy, where *any* cop can read your mind, how does a murderer commit a successful murder? In this case, the guy who is going to commit the murder devises a mnemonic—a recited formula—that he uses to confound the cops. He runs this through his mind constantly. On a subliminal level he's thinking about what he wants to think about, but on a more conscious level, he's got this goddamn rhyme running all the time that confounds the hell out of the experts. That story is a wonderful template, I think. It seems possible to me that crooks may become much more savvy about various mind control and hypnotic techniques.

G. GORDON LIDDY, *Watergate burglar*

The criminals are *already* getting around these forensic and technological developments. As usual, they are way ahead of most of the rest of us. They hire—and will continue to hire in greater numbers—scientific and technological and medical experts. They have some of the best in the world working for them.

The problem is not the technology but the fact that we have and will have ever stronger rules against using it effectively. There are no rules on the other side. They use it as they choose. DQ

*Joggling—the whole-body workout, more on Competition #43, and rules to write by*

# GAMES

By Scot Morris

Juggling appears to be relatively easy because most people think a juggler throws with one hand and catches with the other, but in fact both hands work symmetrically. Learning to juggle is like solving a puzzle—finding what you can do within the mathematical constraints imposed by gravity.

After I first wrote about juggling for a Games column (August 1981) I attended the International Jugglers Association (IJA) convention and discovered a new sport that consists of juggling while jogging. It's called naturally, joggling. It's more often a run than a jog, however. The current world records are:

- *Mile.* Kirk Swenson, 1986, 4 minutes, 43.8 seconds.
- *Five-kilometer run.* Kirk Swenson, 1986, 16 minutes, 55 seconds.
- *100 meter dash.* Owen Morse, 12.34 seconds.

These are good times even without juggling. According to top jugglers, joggling reduces their running speed only about 5 percent. Swenson's best running mile, for example, is only 15 seconds faster.

Joggling is surprisingly easy to learn. Juggling is already a left–right, left–right activity, so anyone who can do a three-ball cascade can joggle. And unlike juggling, the tendency to throw the balls out from the body is naturally conducive to joggling.

## AEROBIC JOGGLING

In early January 1986 I was using three official rubber balls designed by Brian Dube, the premier manufacturer of juggling equipment. The soft shells were filled with plastic pellets producing a beanbaglike effect. When a ball drops it comes to a dead stop instead of bouncing off in front of other runners.

I knew I was getting a good lower-body workout by running and good eye–hand coordination by juggling. *But if the balls were heavier,* I thought, *I'd also get an upper body, and probably aerobic, workout.* So I went to a gun shop and bought some lead musket balls. Opening the rubber balls, I replaced most of the plastic pellets with the lead shot, then resealed them. The former four ounce balls now each weighed a hefty 1.3 pounds.

The first time I tried them my arms ached after 50 throws. But I was able to gradually increase my endurance and was soon able to joggle for a whole stretch of beach. With continued use of the heavier balls, my biceps became stronger and my upper torso began filling out.

*A brand new experience. Joggling the author's weighty balls works the upper body and the heart.*

Neither Dube nor *Juggler's World* editor Bill Giduz nor *Guinness Book of World Records* editor and former IJA president Gene Jones had ever heard of juggling as an upper-body exercise. So I approached professional ice-skating juggler Albert Lucas, who has been hailed as the best juggler in history.

Lucas, twenty-six, is the only person to juggle his age for three straight years, three balls at age three, and five at age five. He now holds 11 world records, including a seven-ball juggle that lasted 2 minutes and 3.48 seconds and a five-club juggle of 37 minutes and 10 seconds. Although his single joggling record—a 100-meter dash in 12.67 minutes—was recently broken by Owen Morse, Lucas hopes to break that record again.

He had set his sights on joggling the Los Angeles Marathon, but wondered whether his legs *and* arms could hold out for 26.2 miles. During a six-month performance engagement in Japan, he began his marathon training by running at night after his shows. And by using a set of my heavy joggling balls, he found he increased his endurance.

## THE JOGGLED MARATHON

When Lucas applied for permission to joggle in the 1987 Los Angeles Marathon, the Marathon Committee wanted to be sure that dropped balls wouldn't present a hazard to other runners. So Dube and I designed a bounceless joggling ball that met the committee's safety standards. Lucas then gained entry, provided he start at the back of the pack. To guarantee that Lucas's finishing time would be recognized by the *Guinness Book of World Records,* the compendium's

*Juggling + Jogging = Joggling*

editor Gene Jones, was flown to California to verify the achievement. Rules were formulated that would set the standards for future joggling races. If Lucas dropped a ball, he had to pick it up and return to where the ball first hit the ground, then resume the race from behind that point. At water stations he had to come to a complete stop, hold the balls in one hand, take his drink, and start juggling again before he could resume running. Other marathoners would run alongside him to ensure there were no infractions of these rules.

On March 1, Lucas joined Rod Dixon, Nancy Ditz, Art Boileau, and 15,000 other runners for the third-largest marathon in the world (only the New York and London marathons have more entrants). He carried three lightweight balls, and on the sleeve of his red T-shirt he wore the logo of his equipment sponsor, Exerballs.

After just four hours, four minutes, and 35 seconds, Lucas finished his first marathon. He did the whole thing passing perhaps 7,000 others along the way, without a single drop. It was the fastest joggling marathon and the first no-drop marathon. If it hadn't been for the water stops, he might also have broken the record for continuously juggling three balls.

## PROVING A POINT

My heavy juggling balls may be the first upper-body and aerobic exercise equipment since the jump rope. And, like curls with free weights, they work the wrist as well as the lower and upper arm and shoulder muscles, but they do it aerobically because of the constant arm pumping.

I wanted some academic backing for such claims, but Peter Francis, professor of biomechanics at San Diego State University, told me the benefits of the exercise were self-evident. "You could take before and after measurements of bicep strength, chest size, oxygen consumption, or endurance, and you'd probably find that all those things improve," he said. "As a research study, that isn't terribly interesting. It tells you that when you exercise a muscle, it gets stronger, but we already know that."

To determine the overall cardiovascular benefits, however, exercise physiologist Jim White of the University of California–San Diego agreed to gather heart-rate data on a joggler in action. During a warm-up on a treadmill, Lucas's heart rate was 132 beats per minute. When he began joggling a set of one-pound balls, that rate increased to 146. When the balls were taken away, it went back to 132. When he was given a set of lead-filled, two-pound balls, his rate went up to 154.

White then measured my heart rate while I was standing still and juggling three tennis balls, each weighing about two ounces. The rate: 102 beats per minute. When I juggled one-pound balls, it increased to 117, and with two-pound balls, 131.

## THE SHAMELESS PLUG

Having dubbed my heavy juggling balls Exerballs, I decided to take this silly idea to market.

And while I hope they will be available in stores some day, for now they can be ordered by mail from Brian Dube, Inc., 25 Park Place, New York, NY 10007. Each set includes instructions for juggling the three-ball cascade (the left–right, left–right pattern used in joggling). The vinyl balls are about 2.8 inches in diameter and are filled with varying ratios of plastic, steel, and lead, depending on weight. The basic set of three one-pound balls costs $19; the one-and-a-half-pound set, $24; and the two-pound set, $27. Add $6 per set for shipping and handling.

## WRITER'S RULES

Readers of this column often send in original material they hope to see us publish. Here are *my* guidelines for good writing for those potential *Omni* contributors:

- Subject and verb always has to agree.
- Do not use a foreign term when there is an adequate English *quid pro quo*.
- It behooves the writer to avoid archaic expressions.
- Do not use hyperbole; not one writer in a million can use it effectively.
- Avoid cliches like the plague.
- Mixed metaphors are a pain in the neck and should be thrown out the window.
- Placing a comma between subject and predicate is not correct.
- Parenthetical words however must be enclosed in commas.
- Consult a dictionary frequently to avoid mispelling.
- Don't be redundant.
- Don't repeat yourself or say what you have said before.
- Remember to never split an infinitive.
- The passive voice should not be used.
- Use the apostrophe in it's proper place and omit it when its not needed.
- Don't use no double negatives.
- Proofread carefully to see if you have any words out.
- Hopefully, you will use words correctly, irregardless of how others use them.
- Never use a long word when a diminutive one will do.
- Avoid colloquial stuff.
- No sentence tragments.
- Remember to finish what

## COMPETITION #43

In case you wanted to know. Send your entries for Creative Contraptions (April 1987) postmarked by June 1, 1987, to *Omni* Competition #43, 1965 Broadway, New York, NY 10023-5965.

# LAST WORD

By Mitch Coleman and Dave Jaffe

*Scientists at a remote listening station received TV signals from outer space. "If you think our TV is bad, take a look at what they're watching," said one researcher*

For years we've known that television signals from Earth were leaking into space, ready to be intercepted by other intelligent civilizations. But some experts have suggested the reverse is also true. Television broadcasts from other civilizations could be heading our way.

For that reason, a few scientists here on Earth have been using powerful television antennas to scan the heavens for broadcast signals that would confirm the existence of intelligent, televised life elsewhere in the cosmos.

Recently scientists at a remote listening station in Arizona received signals that gave Earthlings their first look at television from outer space. After logging a month's worth of viewing, one researcher turned his notes over to reporters with the warning, "If you think our TV is bad, take a look at what *they're* watching." His book showed the following:

**Science Forum.** "Oxygen: The Silent Killer." A group of methane-breathing environmentalists participate in a lively panel discussion — until someone opens a window.

**Cooking With Bleznik.** Bleznik, a sentient vegetable and TV chef *extraordinaire* of Traloc IV, gives tips on frugal cooking using inexpensive cuts of meat, soup stock, and bits of himself.

**Celebrity Slam-Dunk Competition.** Some of the galaxy's stars test their skills against the hapless Dunks of Gamma III.

**This Old Starship.** Tyo shows how drilling a hole in the wall to hang a picture can kill everyone on the ship.

**The Baltonian Sportsman.** The crew of the *Stalker* return from a remote planet with their latest alien captures, a Judgecrater and a Jimmyhotla, whom they attempt to mate.

**Dodecahedron of Fortune.** Contestants on Dirvac II spin a multidimensional shape to win new life forms pointed to by the mute but lovely, green-skinned Xxanna White.

**Yogaga.** Classes in meditative positions showing how to reduce stress in the arms, shoulders, upper back, lower back, front upper arms, mid-rear quasi-back shoulder gills, brachiated knuckle flaps, and hind lower shoulderlike foreback.

**The Cosby Show.** They get it there, too.

**I Love Loo-Z.** Loo-Z and Rick-E plan simultaneous surprise parties, and both hide their gifts in the matter/antimatter descrambler! Rick-E is furious.

**National Geogalactic Special.** "The Gentle Giants of Gorn." The gentle, helpless Gornian monolith creatures are examined and slowly tipped over.

**60 Nanoseconds.** A very, very, very quick look at something fuzzy.

**20 Billion Years in Review.** A half hour magazine show that examines everything that has happened since the dawn of time. Also, a look at nuclear-winter fashions.

**Can You Eat This?** Contestants from all over the galaxy compete to see who can eat the most members of the studio audience.

**Anaerobics.** The microscopic precision-ski team of Medea II performs anaerobic exercises, then turns into vinegar.

**Nature's Incredible Mimics.** The rock lizards of Trelgath: Are they lizards mimicking rocks, or . . . just rocks?

**All My Spores.** The Bo'liks split up and become thousands of little Bo'liks. Tandar regains the sight in 823 of his eyes.

**Foul-ups, Bleeps, and Megaton Mistakes.** A show on how hilarious goofs and practical jokes led to the end of civilization as we know it on Xanthor.

**Worlds at War** (documentary series). Tonight's episode focuses on the warlike banana-shaped inhabitants of Bronos and their doomed alliance with the Chimpanzians.

**Creature Feature** (movie). *I Married a Lifeless Lump of Protoplasm.* Incredibly dense Xaxian woman marries title Lump.

**Good Morning, Schlbchfmndr** (a kind of talk show). On today's show the asexual hosts have as guests the living crystal creatures of Lesk, which they interview in a quiet voice, and experts who debate the question "The speed of light — should it be reduced to 55,000 miles per second?"

**Here Come the Szazbeks!** The hilarious antics of the Szazbeks. The Szazbeks picnic is ruined when Sherith forgets the ammonia dip.

**Pictures in the Sky.** Astronomers in the Centauri cluster take the viewers on a tour of their most famous constellations, including The Guy With One Enormous Foot, The Straight Line, and The Big Bucket of Dots. ∞

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*The photogenic Mitch Coleman (above) and his elusive writing partner, Dave Jaffe, are two earthbound writers who live in Chicago.*

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