OMNI

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THE NEW SCIENCE OF IMAGINATION

WHEN ROBOTS RULE THE WORLD

A MARTIAN CHRONICLE: ALDRIN'S DREAMSHIP

HOW TO MAKE YOUR OWN SUPERCONDUCTORS

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VOL 10 NO 2 NOVEMBER 1987

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Peer through the eyes into the depths of the soul, the source of the spiritual energy abounding within each of us. Enter this fanciful labyrinth and begin a trancelike journey with the gods of imagination. Artist Doo-Hyun Moon created our cover

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FIRST WORD

By Gaylord Nelson

If people destroy something replaceable made by mankind, they are called vandals. If they destroy something irreplaceable made by God, they are called developers.

Near the top of the world, stretching 125 miles along the Arctic Ocean in the northeast corner of Alaska, is a unique piece of America. This is the narrow coastal plain of the Arctic National Wildlife Refuge, an area rich in wildlife.

For polar bears the coastal plain provides a refuge for rearing young. Millions of swans, snow geese, northern pintail, and various other waterfowl spend their summers here. There are grizzly bears, wolverines, and musk-oxen, the rare and shaggy survivors of the Ice Age. But the best-known species here is the plain's porcupine caribou. Each spring for thousands of years they have been migrating from wintering grounds in Canada to calve on the Alaskan plain. The sight of these 180,000 caribou marching across the refuge is one of the most stunning in the world of wildlife.

But if the U.S. Interior Department has its way, the coastal plain soon will become home to oil derricks, pipelines, airfields, and pumping stations. Interior Secretary Donald P. Hodel is pressing Congress to approve a bill that would allow his agency to lease the plain to oil companies. The secretary claims that national security is at stake. We must move immediately, he insists, to protect ourselves from all kinds of dire consequences.

Such claims, of course, are pure nonsense. Only a long-range energy conservation plan, combined with the development of alternative liquid fuels and enhanced recovery of existing oil deposits, can solve our energy problems. Unfortunately, the administration has no long-range plan and apparently no interest in developing one.

Colonizing the coastal plain with oil derricks makes no more sense than damming the Grand Canyon to produce hydropower. Such natural treasures are the planet's rarest commodities, and if the coastal plain is compromised, we will never again see a comparable Arctic area representing tens of thousands of years of nature's intricate works unaffected by human activity. The U.S. Fish and Wildlife Service describes the Arctic refuge as "the last unspoiled area of its kind in the entire Northern Hemisphere."

"Wilderness is an anchor to windward," former U.S. senator Clinton P. Anderson wrote a quarter century ago. "Knowing it is there, we can also know that we are still a rich nation, tending our resources as we should—not a people in despair, searching every last nook and cranny of our land for a board of lumber, a barrel of oil, a blade of grass, or a tank of water." Already more than 95 percent of all Alaskan acreage considered promising by the oil and gas industry has been made available for development. Of the 1,125 miles of the Arctic coastline, only the 125 miles within the refuge have not been opened to leasing.

Secretary Hodel is fond of saying that we can produce oil and, at the same time, protect the integrity of the coastal plain. But if the plain is fully developed, several thousand people will live and work there. Huge amounts of gravel will be mined for the drill pads. Miles of road will be laid for heavy equipment. Millions of gallons of toxic water and drilling muds will be stored in fragile ponds that may eventually wash away into bird and fish habitats.

All of this will have serious environmental consequences that cannot be predicted. The suggestion, however, that these activities can go on for 25 years without major and permanent damage would be challenged by every ecologist I know of in this country. Indeed, Hodel's own Interior Department reported: "The existence of oil facilities and activities would eliminate the opportunity for further scientific study of an undisturbed ecosystem." The department's report also states that oil and gas development would cause a 40 percent decline in the caribou population and a 50 percent decline in the musk-oxen population.

If the oil industry beats the one-in-five odds and strikes oil, the Interior Department predicts a median find of 3.2 billion barrels of oil, which would amount to just two percent of our daily oil consumption over the life of the field. This would delay by only a few months the inevitable shift from oil to other forms of energy. Sadly, though the need to plan for a transition became clear to us during the oil shocks of the Seventies, we are doing even less today than we did then to prepare for such a shift. We have a national energy policy firmly rooted in the Fifties.

The battle over the fate of the coastal plain, which is expected to be the hottest environmental issue of the late Eighties, is now being fought on Capitol Hill. U.S. representative Morris Udall, a Democrat from Arizona, has introduced a bill that would prevent development of the coastal plain by designating it a wilderness. U.S. representative Don Young, a Republican from Alaska, has introduced a contrasting bill that would open the area to oil and gas developers.

Several years ago essayist Joseph Wood Krutch made a telling observation pertinent to the current debate: "If people destroy something replaceable made by mankind, they are called vandals; if they destroy something irreplaceable made by God, they are called developers."

The question Congress and the American people must answer is: Do we want to save this remarkable treasure in its perfectly natural condition for its intrinsic, aesthetic, scientific, and philosophical values, or do we want to compromise it for the temporary benefit of a few months' supply of oil?

Gaylord Nelson, a U.S. senator for 18 years and the founder of Earth Day, is now counselor for The Wilderness Society.

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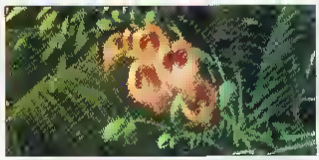
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PATENTLY ABSURD


LITTLE DROP OF HORRORS


BRAUN

Imagine working on a factory assembly line where objects *float* by instead of riding on a conveyor belt. Can you picture overcoming gridlock by shifting your car *above* the others? For that matter who needs a car? Just place a small gizmo in your shoes and move along magnetic fields from which you push off and keep going. These are just a few future scenarios using the technological marvel of superconductors. If you can conjure up other possibilities, send us your ideas, and you could win $500 in this month's Superconstruction contest.

Beginning on page 72, *Bruce Schechter* tells you "How to Make Your Own Superconductors." The chemicals and other ingredients and equipment you'll need are fairly easy to obtain from high-school and college laboratories or such sources as electrical supply houses and the *Edmund Scientific Catalog*. Before you start mixing and baking, however, be sure to have a science teacher or some other professional by your side; any experiment of this nature is potentially dangerous. Once you know the recipe and understand how and why superconductors work, you can let your creativity run rampant. We don't need to see the results. Just submit your ideas, in 200 words or less, for the most creative future superconductor invention you can think of, whether serious or just fun. The entries will be judged by our panel of experts, including IBM research scientist Paul Grant and science teacher David Pribyl, who directed his Gilroy, California, students in creating their own superconductors.

Superconductors may eventually alter such technologies as transportation on Earth, but former astronaut Buzz Aldrin hopes to propel us toward Mars in his pyramid-shaped cycler spacecraft. In "The Martian Metro" (page 52), *Frank Braun* and *Owen Davies* explain Aldrin's plans for the spacecraft that will board and discharge passengers at space station stops between Earth and the red planet. Endorsed by the National Commission on Space, Aldrin's unique vehicle will hitch rides on the gravity fields of the moon and Mars. According to Aldrin's calculations, the first spaceport for such a trip could be installed as early as 1995, with the cycler becoming fully operational by the year 2014.

While researchers may be looking at Space Age technology to spearhead us into the twenty-first century, psychologists are delving into the cultures of primitive peoples like the !Kung of southern Africa. As a result of their investigations, a number of new therapeutic techniques have sprung up in the West, according to *Richard Katz* in "Make Believers" (page 126). Using trance states similar to those induced by tribal healers, Jungian analyst Mary Watkins, for example, submits her clients to "waking dreams." In such therapy, patients imagine conversations with "characters" who compose their personalities. Psychologists moreover are also learning to treat psychotic patients by entering their fantasy worlds with them and helping them find a way out. A clinical psychologist at the University of Alaska in Fairbanks, Katz has spent the last 20 years observing tribal healers around the world. His study of !Kung practices is the subject of the book *Boiling Energy* (Harvard University Press).

When traditional medicine has failed, patients seeking a cure have often been susceptible to quackery. As *Nina Guccione* points out in the pictorial "Patently Absurd" (page 100), whether you suffered from headaches, rheumatism or hair loss, somebody was sure to have a bogus remedy. And in "Little Drop of Horrors" (page 84), *Henry Wouk* enters the microscopic worlds of mosquito larvae and other pond denizens.

This month's fiction features "Diner" (page 92), *Neal Barrett, Jr.*'s first story to appear in *Omni*. His novel *Through Darkest America* was recently published by Congdon and Weed. *Lewis Shiner* ("Rebels," page 64) is the author of *Frontera* (Bain Books) and, more recently, *Deserted Cities of the Heart* (Bantam, 1988). And Dan Simmons' ("E Ticket to Namland," page 108) won the 1986 World Fantasy Award for his novel *Song of Kali*.

Omni fiction made an impressive showing at the recent World Science Fiction Convention. We congratulate Hugo award winners *Greg Bear* honored for his short story "Tangents" (January 1986) and *Roger Zelazny* for his novelette *Permafrost* (April 1986).

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NOVEMBER

LETTERS

COMMUNICATIONS

Burden of Dreams

I agree with Yevgeny Yevtushenko [First Word, August 1987]. Wouldn't it be wonderful if our world leaders believed in international brotherhood? Let's rid the world of nuclear weapons and then reduce our stockpile of conventional weapons. We could even eliminate war if the superpowers refused to supply military aid to smaller countries. With all the money saved, we will solve the problems of hunger, suffering, disease—and travel to Mars and beyond—together.

Bob Fischella
Tucson, AZ

Yevtushenko pleads for a world where all political views are accepted. I don't want to live in such a world. Is peace worth ignoring political regimes that practice genocide, racial discrimination or slavery?

L. K. Darrow
Grants Pass, OR

After reading Yevtushenko's article, I recalled how my friends and I, then Soviet teenagers, used to laugh at the "lackey poet" and court jester Yevtushenko. He may be able to fool some naive Westerners, but he can't fool people who lived in the Soviet Union.

When he talks about the tragedies of the twentieth century, why doesn't he mention the Gulag Archipelago? Instead, he criticizes the "evils" of Western civilization. I'll take American TV advertising and puerile media evangelists over the dreary, all-pervasive Soviet Marxist TV propaganda anytime.

The great Russian poet Iosif Brodsky is banished, Sotzhenitsyn is exiled, the best Soviet science-fiction writers such as Arkady and Boris Strugatsky are banned. But Yevtushenko still pushes his dubious brotherhood. The new *glasnost* covers a vicious monster.

Paul Stonehill
Los Angeles

Inventing The Future

I agree with Stewart Brand. Science fiction does influence science ["Mothers of Invention," Forum, August 1987]. Isaac Asimov, for example, is a scientist and writer who builds imaginary worlds with some basis in fact. As a writer, I hope my ideas, no matter how crackpot, will stimulate someone in the hard sciences to say, "That just might work."

C. D. Moulton
Hudson, FL

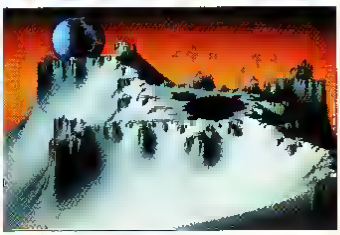
Why does *Omni* have such a hang-up about MIT? You treat that place as if it were the only scientific and technological research center on Earth. Have you ever heard of Rice, The University of Texas or Rensselaer Polytechnic Institute?

Alfonso G. Chan
Fort Worth

Fractured

To set the record straight and satisfy those so concerned with making sure credit is given where it is due, here's some additional information about the pictorial "Fractal Fairy Tales" (October 1987). The image below, as well as several others, was from the book *The Beauty of Fractals* by H.-O. Peitgen and P. H. Richter (Springer-Verlag, New York, 1986). The pictures were produced by a group of mathematicians and physicists at the University of Bremen and the University of California, Santa Cruz, that included the book's coauthors, as well as D. Saupe and H. Juergens.

Homer Smith of Art Matrix, Box 880, Ithaca, NY 14851, sells fractal photographs, postcards, and videos and provided us with pictures. Scott Burns, Julian Palmore, and Harold Benzinger of the University of Illinois at Urbana-Champaign also contributed.



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ACID TEST

FORUM

Can LSD assist artistic development? It can, according to Los Angeles psychiatrist and University of California medical school professor Oscar Janiger. In this time of prohibition against all experiments with the drug, Janiger recently made public the results of the largest study of LSD and creativity ever conducted. Under wraps for 25 years, the study was conducted prior to the 1962 ban on the drug by the Food and Drug Administration.

The research on LSD and the creative process was part of a larger study of the drug's effects that included Cary Grant, Jack Nicholson, James Coburn, Andre Previn, Aldous Huxley, Anais Nin, Adele Davis, and 800 others—truck drivers, prostitutes, college professors, and space-program scientists.

According to Janiger, the larger study's purpose was simply to "map the terrain" of LSD, then a mysterious new drug. The creativity study was begun at the suggestion of an artist who, after painting under LSD, likened the experience to four years of art school.

The creativity study's design was simple enough. Each artist went to Janiger's home. Before being given two micrograms of LSD per kilogram of body weight, the artist was asked to paint a Hopi kachina doll provided by Janiger. After ingesting the drug, the subject was again asked to paint the doll. Later, the painter was asked to write or dictate a detailed account of the experience and to comment on its meaning. Janiger sent a comprehensive questionnaire to each participant at intervals of a month and a year later.

The contrast between the "before" and "after" works is striking. The before renderings of the colorful kachina doll were often realistic, predictable, and drawn to scale. But the LSD-inspired renderings were invariably abstract, symbolic, brighter, more emotional, more adventuresome, and tended to use all available space on the canvas.

Janiger or an assistant stayed with the subject at all times during the eight-hour experience. An intense, somber man of sixty-eight, Janiger became fascinated with LSD's effects on the artist's inner process. Totally consumed in their tasks, the artists rarely spoke. Instead, they would continually look at the object and then go back to the canvas and continue painting. Almost never going back to resketch, they'd move on confidently, as if they were laying tile.

Does the painter subconsciously call up buried influences? Having observed dozens of painters under LSD, Janiger believes the spontaneity induced by the drug precludes studied imitation. It moves too fast, he says. Instead, Janiger speculates that carried within the brain are the inherent germs of the so-called schools of art. They are reflections of some internal configurations of the human brain. "In other words, maybe the way our apparatus is designed in our heads is not totally open-ended, but there are clusters of constellations of perception. LSD becomes a means of opening the possibilities, a connecting rod to specific schools of art in the sense that they expose to the mind what is already there."

According to their statements, the artists were uniformly positive about the drug's effects on their work. Wrote Frank Murdock in 1958: "The LSD helped tremendously to relieve inhibitions I had had in my artwork. It taught me the value of the impressionistic approach to my art. This impressionistic area of thinking now enters into my work, whether it be realistic or abstract. So many taboos are self-imposed by the artist because of prejudices and jealousy. LSD helped release me from these bonds."

Painter Tom Van Sant said in 1959: "All self-consciousness, value, and judgment disappeared. I was capable of attention only in the area of my brush, and it seemed impossible to attend to the composing of an area larger than two or three square inches. After a while, the brushes seemed too small, so Van Sant switched to a three-inch house-painting brush. Color and form vibrated and moved with the music being played, and waves of joy and excitement flooded through me."

In an exhibit titled "The Enchanted Loom—LSD and Creativity," Janiger displayed the before and after paintings for the first time last year and invited the artists to comment on their work. Twenty-five of the original 60 artists were located. Three general impressions stood out. They were all very taken by seeing their work again; most of them expressed how often they had thought about the experience over the years; and the experiment had influenced their work from that point on.

Almost to a person, says Janiger, they said that if it wasn't the most important experience in their artistic development, it was one of the most important. Only three of the returnees said they had taken the drug again.

According to Janiger, LSD does not produce a tangible alteration in the way a painter paints; it does not turn a poor painter into a good painter or a good painter into a great one. Instead, it alters the way the artist appraises the world. "It allows an artist stuck at a certain level of perception to plunge into areas where access was restricted by the confines of his perceptions."

From childhood on we are given a prescribed set of ways to look at the world, yet the very essence of the artist's activity is to break loose of the tyranny of form. LSD offers the artist an additional tool to use to explore the greater depth of what he or she is looking for, says Janiger.

And what about others who want to enhance their creative potential? Janiger stresses "artistic training" as being necessary to reap any benefit from the drug. Without that training you're just a kid in Haight-Ashbury who is elevating novelty into an art form. Novelty is not art.

Even for the artist, Janiger does not feel LSD always uncovers new, useful information. "You can break out of jail, and the jail can be built in the middle of the desert or the jungle," he notes.

In a drug-riddled era, it hardly seems the right time for renewed interest in LSD. But Janiger, who advocates the controlled study of the drug, sees hopeful signs. When he sponsored a symposium at UCLA recently, the auditorium was packed. —Robert B. Tucker

TIME TRAVEL

MIND

By Bill Lawren

The travelers lie on the floor of a darkened suburban living room some of them covered with blankets to ward off the journey's chill. Their bodies form a wheel with their heads nearly touching at the hub. The room becomes quiet and a massive graying man with a full beard and friendly eyes begins to speak. "This is an invitation into the future," he says, "a future you will create. We will be traveling to the year 2137. If you find anything in that future that doesn't please you, then change it."

The man's measured Arkansas drawl—soft and soothing—pulls the travelers along an imaginary forest path into a sunlit clearing. Deep in a trance, they join hands and arrange themselves on a large obelisk. The obelisk lifts off and begins to speed through time, eventually landing in the year 2137. The passengers dismount and move through a crystal spire into a timeless, suspended state. With soft music playing in the background, the travelers create their own futures—personal utopias in which they unravel their life problems.

This future drama is the creation of Joe Hart, a professor and career counselor at the University of Arkansas in Little Rock. Hart, who stands six feet four inches and weighs more than 300 pounds, calls what he does sociometry, explaining the term as "the study of interpersonal vibrations." He uses future travel as a therapeutic tool to help people plan their lives or solve their problems by visualizing the outcomes. "The idea," he says, "is to help individuals develop confidence by building their own futures."

Hart stumbled onto the technique in the mid-Seventies, when he was leading psychodrama sessions in which he used role playing to give participants insights into their problems. After these types of sessions, only a few people divulge their feelings and talk about what has just happened to them. I wanted more people to share their experiences, so I started using future projection at the end of sessions to get closure," Hart recalls.

It worked. People became less inhibited, more expressive. But Hart wasn't satisfied. "By placing them twenty years in the future," he says, "I was getting a lot of stuff out of *Star Wars* or science fiction. Or people couldn't get past their own deaths." Inspired by Christopher Priest's *The Perfect Lover*, a science fiction novel in which people project themselves far into the future, Hart decided to take people into a time so distant that neither science fiction nor the death of their egos would stand in the way of creativity.

For the last ten years, members of Hart's extensive network of "time tourists"—hundreds of clients ranging from a religious group in Ames, Iowa, to the no-nonsense American Psychiatric Association—have reported a variety of experiences that rival the best science fiction in richness, imagination, and pure lyricism. One businessman traveled to a distant planet, a perfectly transparent world with cities of shining crystal. A social worker was swept across a green landscape by a flying porpoise, who could plunge her deep into the ocean or carry her to the rim of the sun. One couple found themselves in a world made entirely of music, through which they moved by "launching" notes from a music staff and riding them like chariots.

Traveler without luggage. No frills trip.

While each person's experience is unique, Hart finds certain themes that keep recurring. "In the futures that people create, the distinction between inside and outside is often blurred," Hart explains. "Buildings flow into parks and open spaces, which are then incorporated in other buildings. The means of transportation is vague and inexplicit; traveling just seems to happen. Communication between people is much less verbal than what we're used to, but much more precise. People seem to operate on some kind of unspoken understanding."

No matter how intriguing the architecture and imagery of these futures, Hart is more interested in their therapeutic value. When travelers reach 2137, they walk through a "museum" and see their own lives on exhibit. Hart, at the helm, instructs them to take apart and then rebuild their life exhibits. Then they enter a "palace" where they can gratify all their wishes. "The experience of accomplishing goals in the future and understanding what steps were taken to achieve those goals helps end defeatist cycles," Hart says.

He has a bulging file of success stories. According to Hart, people have turned their lives around. A government employee developed the confidence to win a long-sought promotion; a manager resolved a difficult business problem; terminal cancer patients developed new networks of understanding friends who helped them face death. "I used to feel like a board with a bunch of buttons on it," says JoAnn Cavanaugh, a Dallas woman whose hundreds of future trips during the past seven years qualify her as Hart's most veteran traveler. "Anybody could push those buttons, and I would fight, weep, or go to pieces," she says. "Now there are no more buttons on the board."

Hart says there is no average profile of a future traveler. But not everyone should ride the imaginary carpet. "The best results occur with people who have an open belief system," Hart says. "And if participants believe they're going to get

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ARTIFICIAL INTELLIGENCE

By Grant Fjermedal

Carl Hewitt scares the hell out of me, but perhaps he is right. Use intelligent computers to help govern us and robotic police to help keep us in line. Hewitt, an associate professor of electrical engineering and computer science at the Massachusetts Institute of Technology (MIT), sees the future of humanity in the quickly developing field of parallel computers, the massively powerful machines that will process information in a fashion similar to the human brain's. Hewitt also believes that the coming of such high-powered marvels will allow the human race to sidestep the threat of nuclear war by equally sharing control with machines.

In fact, he is already at work designing ways of making computer systems more reliable, a step that will lay the foundation for such sharing. Hewitt's idea is to make computers more like the U.S. Congress—that is, give them the capability to not only process a vast amount of knowledge but also evaluate and debate it before coming to a decision about what to do. Eventually such a sophisticated electronic organization would be capable of analyzing world conflicts and choosing appropriate actions. It would do so in a way, says Hewitt, that's "not left to human whim and emotion, with nationalistic states threatening each other."

Of course, Hewitt's solution depends on whether countries would be willing to share power with computers and be policed by robots. One can already see the bumper stickers: WHEN GUNS ARE OUTLAWED, ONLY ROBOTS WILL HAVE GUNS! Governments will undoubtedly balk when it comes to handing over control.

But Hewitt thinks the resistance will ebb under certain circumstances. "People could become very scared and very threatened," he explains, "by small nuclear wars popping off here and there—like between India and Pakistan or between Israel and the Arabs."

Then, Hewitt believes, the countries of the world will consider implementing institutional controls to prevent future use of nuclear weapons. "In the current political climate," Hewitt says, "it doesn't seem possible. But as artificial intelligence makes advances and as the threat of nuclear war becomes more concrete, the climate of opinion is going to change."

Hewitt recognizes that his solution to the threat of nuclear war represents a technological fix to an essentially social problem. He agrees that ideally we should disarm and learn to live in peace, rather than sharing our destinies with machines. But, he says, "history is not on the side of long-term understanding."

And while weapons technology has advanced tremendously during the twentieth century, political systems have not. Consequently, Hewitt believes, we have a dangerous imbalance between our weapons capabilities and our political capacity to handle that weaponry.

George Williams, a professor emeritus of divinity at Harvard, believes Hewitt may be right in his assessment of the situation. "In the back of my thoughts about computers taking over is my fear that we are not capable—as human beings—of taking care of ourselves," Williams explains. "We are just going mad. I don't think we can remain humane very much longer. I think computers could take the rattle out of life. I just don't see how we can keep going on the way we are."

A peace plan that may save us from WW III

But then there's another chilling factor to consider. Could we lose control over the system we create to protect us? One of the young computer whizzes who has considered such a disaster is MIT graduate student Phil Agre. "It strikes me that the first generation of intelligent programs is going to be psychotic just because it's so hard to build a self-organizing entity that doesn't fall apart," he says. "And falling apart is what's going on when a person starts hallucinating."

He sees psychotic behavior developing in a computer program in much the same way it develops in a human, as a result of "inappropriate care in very early childhood. That is," he says, "when the basic inner parts of the mind don't develop properly because of the child's attempts to compensate for an inadequate environment. The same developmental problems," he notes, "could easily arise with advanced computer systems."

But even if we can give our computers and robots a happy childhood, it is conceivable that through the sheer acquisition of knowledge they might embark on completely unexpected paths. For one thing, an intelligent machine truly concerned with protecting the environment might decide that the earth would be better off with fewer humans, perhaps even with no humans. Agre is well aware of such scenarios.

"We will soon be in the place of the people who were developing atomic power and deciding whether to do it and whether history would hate them," Agre says. "I hope that it makes a difference that we are somewhat more politically aware than the scientists working at Los Alamos and the people who were doing nuclear physics back in the Thirties. But still, he says sadly, "I have this bad fantasy that if I really do my job properly, I will be reviled at my death."

HIGHER EDUCATION

SPACE

By Doug Stewart

This month officials in a modest office in Boston are accepting student applications for an institution unlike any this planet has seen. The school, called the International Space University (ISU), hopes to eventually become the first degree-granting university to orbit planet Earth.

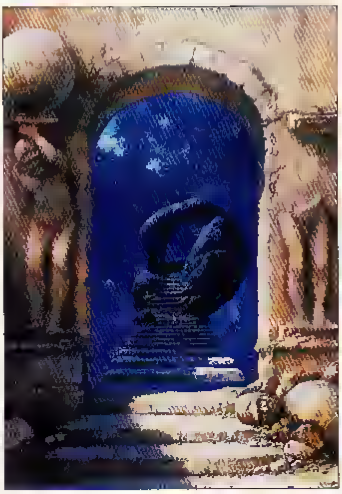
Presently ISU has a small faculty and it expects to have an equally modest-size student body of 100. For the rest of this century its classes will most likely be held in donated facilities on terra firma. But space activists see it as the first purely international training ground for the space citizens of the future.

The school's courses will be taught in a series of summer sessions held at different sites in the United States and abroad over the next five years. The first will begin on the campus of the Massachusetts Institute of Technology (MIT) in the summer of 1988, when students from the United States, Canada, Europe and—ISU founders hope—the Far East will take classes in a variety of areas such as space law, business and management and space engineering.

ISU is the brainchild of three people: Peter Diamandis, Todd Hawley and Bob Richards, all in their mid-twenties and each possessing a near obsession with space exploration and development. Diamandis is working on both a Ph.D. in aerospace engineering at MIT and an M.D. at Harvard under a NASA fellowship. Hawley set up the Space Generation Foundation, a space-activist group, and is now working on an M.A. in international space policy at George Washington University, and Richards, a Canadian, founded a Canadian branch of Students for the Exploration and Development of Space. He has a B.S. in systems engineering from the University of Toronto.

The three joined forces in 1986, in large part to lure people away from the usual tunnel-and-computer fields of research and get them to participate in a graduate program concentrating on space studies. Although there are space-studies programs at schools such as the University of Colorado and the University of North Dakota, according to Diamandis, the usual aerospace curriculum is "too much aero and not enough space." One of the goals of ISU, he says, is to train *space* doctors, *space* lawyers and *space* architects, not just engineers.

What also makes ISU unique among space-studies programs is its chief goal of bringing together researchers from different countries and different disciplines. Although the faculty will be largely American, the student body will be a careful mix of nationalities and backgrounds. Diamandis and the faculty are looking to the day when crews, like those that will staff the space station, will be international. The classes, he says, will be similarly mixed, providing an opportunity for "teaching U.S. students how the Japanese students think and vice versa, because they'll be interacting with each other." ISU will also seek out students with different academic backgrounds and interests. "A student comes to us and takes classes in a total of eight areas, from space law to space medicine," he explains. "At the least he or she learns some of the buzzwords and gets at least a basic understanding of what that area does."



The door to this college may be an airlock

The summer sessions will start in June 1988 and continue through 1992. MIT has already agreed to host the first session, and both Canada and the Soviet Union have expressed interest in hosting summer sessions in 1989 and 1990. The cost of the $1.3 million program will be borne by participating governments and corporations that sponsor the students, not by the students themselves. (As of this past summer, ISU already had received $170,000 in start-up funding—$50,000 of that granted by NASA.) By the turn of the century the ISU founders dream of having a university module attached to the space station.

Despite its small scale, the idea of an *international* space university has fired the imaginations of space bureaucrats and scholars from around the world. Many of them converged on the MIT campus last April for ISU's kickoff. Two former astronauts, a Soviet cosmonaut, delegations from China, India, Japan, Canada, and the European Space Agency, a former secretary of the Air Force, and two NASA administrators all attended. Also present were scientists, engineers, aerospace executives, and several hundred space buffs of assorted ages.

In attendance, courtesy of the videocassette recorder, was author and scientist Arthur C. Clarke. The first universities helped to bring mankind out of the Dark Ages and into the Renaissance," he reminded the conferees via videotape from his home in Sri Lanka. "The International Space University may very well become an essential cornerstone in leading humanity ahead in space and on Earth in the century to come." Clarke pointed out that people under the age of thirty are part of a space-bound generation, yet the majority are unaware of their celestial birthright.

During the three-day demonstration classes last April, attendees got a sampling of lectures. The faculty of the day included such notable space experts as Harvard astronomer George Field, MIT professor Philip Morrison, and George

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CHILD LIKES

EXPLORATIONS

By Dava Sobel

Born under the sign of the mushroom cloud, weaned on acid rain, and sent to school in the wake of Three Mile Island and *Skylab*'s fall to Earth, 154 sixth-graders in Minnesota have nevertheless fashioned an image of the future that is guardedly optimistic. It is a world they expect to create within their lifetimes.

"There is a perfect future I have in my mind. One characteristic is peace—not just a world without wars but peace in the home and everywhere you go."

The 154 eleven- and twelve-year-olds who made the predictions shown here in italics were volunteers in a research project devised by futurist Ruthanne Kurth-Schai, who believes that children's images of the future, like their ideas in general, are a major untapped resource. Kurth-Schai enlisted students from five schools in Minneapolis and St. Paul. She gave them the opportunity to work as futurists—to take part in a long-term group effort to sketch ideal future worlds—and unhesitatingly they jumped at the chance to contribute their ideas.

"We will discover that the universe is something inside something else."

At first, Kurth-Schai recalls, the students shared a passive, pessimistic attitude about the future. It would happen to them; they felt no matter what they did, and it would not be good.

"Finally, in the end, there will be a last battle. The missiles will be launched, and there will be nothing."

Asked to write an essay about the future, the children came up with only three ideas apiece. All 154 students mentioned nuclear war, and some aspect of high technology. But the third idea differed from one child to the next, and from this diversity the children eventually forged a common group view that was both positive and action-oriented.

"People will share what they have to make this a better world."

Kurth-Schai turned the youngsters' first anonymous essays into a series of statements about the future and returned to their classrooms to read the list aloud.

"In the future, the world will be destroyed by nuclear war." "In the future, young people will assume adult responsibility and have adult opportunities at a younger age." "In the future, people will be more intelligent." "In the future, people will live on the moon and other planets," and so on. Again anonymously, each child voted whether the predictions "probably will happen" or "probably won't happen" and whether the events would "make me happy" or "make me sad."

Here a subtle change came over the five groups of children. As they considered each idea, their own future thinking expanded to embrace ideas they liked. They were getting the benefit of a group discussion without having to risk expressing their hopes or fears to the group directly.

At the next meeting, Kurth-Schai showed colorful pie charts of the way the children had voted on the statements. Each class got a sense of its collective consciousness, and the individual children could see that others shared their hopes and fears.

"I think that most nature will be destroyed to make room for people to live on Earth, but I hope some will survive for us to love."

In subsequent rounds, as the children wrote more essays, drew pictures, voted on more statements, and got more feedback on the group stance, Kurth-Schai says, their views of the future became more and more creative. Free to change their opinions as the weeks went by, the youngsters held firm on the *desirability* of various future scenarios, but their assessments of *probability* kept evolving.

By the final essay, nuclear war was still threatening to them, but the children were concentrating their energies on a broad range of issues, including education, family life, the environment, world peace, freedom, equality, human compassion, and social welfare. Instead of three ideas in an essay, they generated eight or nine.

"Computers pour all you need to know in your brain in seconds. Kids will start to experiment with the kinds of things the world's smartest scientists are experimenting with now."

In their utopias, technology became an ally that would enable them to don a

CONTINUED ON PAGE 139

Look forward, angels, to jetpacks, computer-fed brains, and world peace.

PLANET STALKERS

STARS

By Jeff Hecht

There are 10 billion stars very much like our sun in our galaxy alone. It seems reasonable to assume then that ours is not the only sun with planets. But finding those other planets has not been easy since they orbit stars light-years away. At those distances a planet might appear to be on top of a suntike star making it as hard to see as a firefly on a distant searchlight.

This past summer however three Canadian astronomers announced that they had found a series of stars with possible planets. Bruce Campbell of the Dominion Astrophysical Observatory in Victoria along with Gordon Walker and Stephenson Yang of the University of British Columbia has studied 16 sunlike stars for the past six years. Of these the three scientists said seven gave every indication of having at least one large planet—one to ten times the mass of Jupiter—orbiting them.

They made the discovery using a common technique for planet searching. They looked for a telltale wobble in a star's movement which might indicate the gravitational tug of a planetary companion. Someone watching our sun from a distance of light-years for example might notice that the gravity of some large mass (Jupiter) pulls the sun a million miles out of its path every year.

Using a refined version of this technique the Canadian group looked for subtle shifts in 16 stars by making minuscule measurements of the speed with which they moved toward or away from Earth. Their measuring method was so sensitive it could detect speed changes as slight as 25 miles per hour.

The two stars most likely to have planets are Epsilon Eridani and Gamma Cephei. At ten light-years away Epsilon Eridani is one of the closest single sunlike stars. For that reason it has long been a favorite setting for science-fiction writers and was one of two stars astronomer Frank Drake picked in 1960 when he began looking for radio transmissions that might indicate extraterrestrial life. Campbell's measurements indicate it has a planet two to five times as massive as Jupiter with an orbit at least ten years in length.

The other candidate is Gamma Cephei. Although it looks about as bright as Epsilon Eridani it is actually brighter since it is about 50 light years away. Speed-shift studies indicate Campbell says that somewhere around Gamma Cephei is a planet with 1.7 times the mass of Jupiter orbiting it once every 2.7 years.

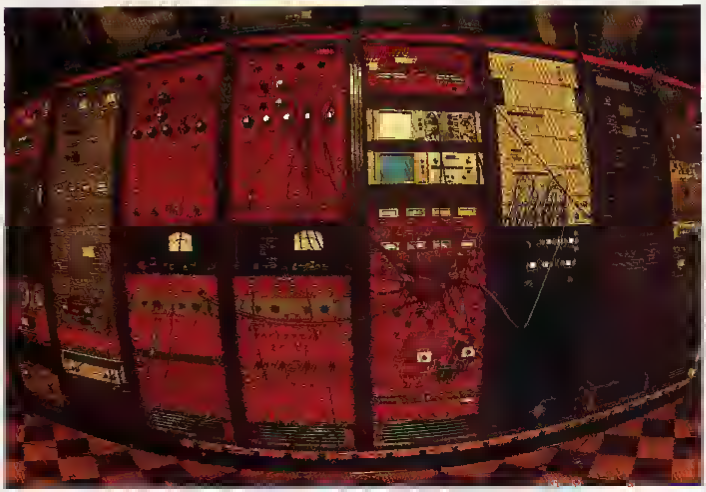
Initially astronomers were a little skeptical about the Canadians' announced discovery. Two years ago other scientists claimed they had found a planet they named VB8-B which on second glance turned out not to be there.

Since then astronomers have been extremely wary of any more discovery claims. They now agree however that the Canadians have discovered something perhaps planets or brown dwarfs.

For the moment a positive identification is impossible. First, Campbell says he and his colleagues don't know the exact sizes of the companions. Their detection methods allow them to make only rough estimates of the size range—one to ten times the mass of Jupiter—of the objects. Second he points out that he and his colleagues have been studying the stars for only about six years and have sketchy information about these objects. Our own Jupiter takes 12 Earth years to orbit the sun and it would take at least that long for a distant observer to learn basic data about it—like its exact mass its orbital period and the plane of its orbit. Similarly it could take decades of studying these stars to get more information about the mysterious planetlike bodies.

At the moment we don't have the technology to spot smaller planets on the scale of Earth that might harbor our kind of life. But by the Nineties astronomers will have at their disposal a device called the Astrometric Telescope Facility. Designed to be attached to a space station it could measure stellar motion much more accurately than is now possible with instruments on the ground.

Until then the discoveries by Campbell and his colleagues will keep planet searchers occupied and excited. And maybe somewhere out there waiting to be discovered is Earth Two.



Equipment used to search space. We may have found planet X. Can Y and Z be far behind?

THE BHOPAL SYNDROME

EARTH

By David Weir

Today life is back to normal in Bhopal. Unlike Hiroshima and Nagasaki the town did not suffer structural damage. So the appearance of normality has been easier to reconstitute, and it is now hard to imagine that the worst industrial disaster the world has ever known happened here. Very early on the morning of December 3, 1984, a violent chemical reaction occurred in a large storage tank at the Union Carbide factory. A yellowish-white fog, an aerosol of uncertain chemical composition, spread over the sleeping city of 800,000. (The exact chemical composition of the gas is a matter of continuing controversy. For purposes of simplicity, the killer gas is identified here as MIC.)

The mist hovered close to the ground—MIC is heavier than air—and blanketed the slums of Bhopal. Hundreds of thousands of residents were roused from their sleep, coughing and vomiting and wheezing. Many would soon be at least temporarily blinded. Most of those fortunate enough to have lived on upper floors or inside well-sealed buildings were spared. Those able to board a bicycle, moped, bullock cart, or bus did. But for most of the poor their feet were the only form of transport available. Many dropped along the way, gasping for breath, choking on their own vomit, and finally drowning in their own fluids. Families were separated; whole groups were wiped out at a time. Those strong enough to keep going ran 3, 6, up to 12 miles before they stopped. Most ran until they dropped.

By dawn the dead lay everywhere. Nobody counted as the bodies were heaped in piles and cremated according to Hindu tradition, or wrapped in shrouds and buried according to Moslem tradition. Posters with numbered pictures of some of the dead were put up so that relatives and friends could try to identify them. Many remained unidentified. Therefore only an estimate of the toll is left for historians—200,000 exposed, by most approximations, at least 2,500 dead and 17,000 permanently disabled. For many of the living, however, the horror had just begun. The tragic irony of Bhopal is that deaths and injuries were caused during the production of a pesticide not needed in India.

MIC is a particularly dangerous chemical. It is a little lighter than water but twice as heavy as air, meaning that when it escapes into the atmosphere, it remains close to the ground. It is highly inflammable and volatile, boiling at a temperature of 39.1° C (102.4° F). Most critically, MIC has the ability to react with many substances: water, acids, metals, and the small deposits of corrosive materials that accumulate in pipes, tanks, and valves. Those reactions are extremely vigorous and heat producing. Furthermore, given the presence of a catalyst, which could be a tiny bit of corrosion, MIC reacts with itself, quickly developing into a violent chain reaction.

The Union Carbide pesticide plant that sent poison gases pouring into the air over Bhopal was much closer to all of our lives than we realize. It was part of a worldwide food production system that affects nearly every person on Earth. The word for *pesticide* translates as "medicines for food" in many languages. Pesticides once were called wonder drugs in the United States as well. They stimulated crop yields undreamt of by our ancestor farmers and today, it is a common belief that we cannot grow food without them. A more accurate statement would be that we could grow all our food without pesticides.

Bhopal. Can it happen again?

During the past decade, as the agricultural pesticide markets in the developed countries approached saturation, the multinationals have turned more and more to exports, particularly to the booming markets of the Third World. In Africa, pesticide use was projected to have quintupled during the past ten years.

By moving into the Third World, the multinationals have encountered conditions quite unlike those at home. Malnutrition, illiteracy, poverty, and short life spans are the norm. Economic development, the priority of virtually every government in the world, lags far behind that of the United States, Europe, and Japan. By 1974, a decade before the Bhopal tragedy, Union Carbide was marketing its products in 125 countries, 75 of which had smaller economies than the corporation.

Of the thousands of industrial plants now in operation, few have been subjected to rigorous public scrutiny. During 1984, for example, Du Pont announced plans to build new pesticide plants in Indonesia and Thailand; Hoechst, in India, Pakistan, and Colombia; both Stauffer and Sandoz, in Brazil; and Monsanto, in Taiwan. Each year brings new announcements of similar plans by companies, big and small, throughout the world.

"In Dar es Salaam, Tanzania, I saw a formulation plant under contract to a multinational where the workers were completely unprotected," says Jan Huismans of the United Nations Environment Program. "The environment around the plant was exposed to dust and fumes, and the plant simply had no treatment facility for water discharge."

And in Egypt, a prominent scientist reported that a former dye company scheduled to start pesticide production in

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AUTHORS IN SEARCH OF A UNIVERSE

BOOKS

By Peter S. Beagle

In the Twenties and Thirties, H. P. Lovecraft extended to other horror/fantasy authors an unusual invitation: to write stories and novels based on *his* fictional cosmology. He offered them characters like the Old Ones and the Elder Gods, as well as the hostile, horrifying, and essentially alien universe he constructed for his emerging "Cthulhu Mythos." That included his haunted sunless town of Arkham, where everyone is the offspring of accursed matings between New Englanders and such creatures as giant frogs and squid.

Although few took him up on the invitation during his lifetime, young writers eventually began setting stories and novels in Lovecraft's overwritten, overwrought universe, inventing new gods, mysteries and half-human monsters to accompany his. In doing so, they were developing what is now known as a shared world.

A burgeoning phenomenon, today's shared worlds are specifically created by one or more writers, rather than by expanding on a previously developed world in someone else's work. The creators then recruit like-minded authors to contribute stories confined to the world's predetermined characteristics—its history, population, climate, flora and fauna, and geopolitical, cultural, racial and religious divisions.

Although royalty arrangements vary, writers are paid for each story they contribute. They also belong to a consortium, sharing in a book's profits and earning an additional percentage point every time another member uses one of their characters. Ownership of the shared world itself belongs to its creators, who act as the editors of the anthology.

The anthology's editors control the world as well as oversee the ongoing project. They guarantee that every story remains within the anthology's framework and they coordinate writers' ideas and referee difficulties among writers. Only when the project is completed does it go off to the publishing house's editor who tracks the process from manuscript to published text.

With some shared world anthologies—like *Wild Cards* (Bantam), where mutants are divided into such comic-booklike categories as "aces" and "jokers"—writers must obtain permission from a character's creator to use that character in another story. For others, like the sword-and-sorcery romance *Thieves' World* (Ace), writers can usually do anything except murder or mutilate a character.

As a major contributor to *Thieves' World* and other shared world anthologies, C. J. Cherryh's dictum is: "Thou shalt not create more trouble for a character than its creator can undo." And that is more delicate than you might think," Cherryh says. "As a writer, I have done some really rotten things to [cocontributor] Janet Morris's favorite characters, and she, in turn, has done terrible things to mine." Cherryh adds, however, that as an editor "I've had to tell writers that a character's owner won't permit assassination. And it can get touchy. It's a compromise can't be negotiated; the writer might have to rework the entire story."

Created a decade ago by Robert Lynn Asprin and Lynn Abbey, *Thieves' World* now comprises nine volumes of interrelated sword-and-sorcery romances. The first and most successful shared world anthology, it's set in Sanctuary, a city that might be Rome, Byzantium or any medieval crossroads with the usual seething warren of wizards, spies, mercenaries and wandering adventurers in which the genre abounds. And its gods, demigods and semidemigods continually possess and repossess their human avatars.

"It grew beyond anyone's expectations," Cherryh says. "The idea was simply to have fun. Writers like Poul Anderson, Marion Zimmer Bradley and Philip José Farmer all followed the same rules, playing with each other's characters. No one imagined it becoming a cottage industry. And certainly no one expected it to set a trend. Every shared world anthology on the market today, however, owes its existence to *Thieves' World*, including Cherryh's *Meroven* (Daw)."

"The success of *Thieves' World* proved that shared world anthologies would sell," says Minneapolis writer Will Shetterly, who with Emma Bull created *Liavek* (Ace), a shared world focused on luck and magic. "But the phenomenon is bigger than *Thieves' World* itself. Its precedent gave the rest of us a foot in the door, but after that, we were on our own."

Unlike *Thieves' World*'s grim and Wagnerian Sanctuary, most of Liavek's gods generally keep their distance, and the editors rarely lose sight of the fact that not all the residents are magicians, soldiers or spies. "When we embarked on the original *Liavek* anthology, we were very aware of *Thieves' World* and decided to go in another direction, toward a lighter, gentler fantasy style with absolutely no adventurer types, no mercenaries," Shetterly says. "Speaking very broadly, it *Thieves' World*'s general ancestor is Robert E. Howard [the creator of the Conan series, the cornerstone of modern sword-and-sorcery stories]. *Liavek*'s must be J. R. R. Tolkien."

"We owe a lot to both *Liavek* and *Thieves' World*," says author George R. R. Martin, editor of *Wild Cards*, the most recent entry among shared world antholo-

Shared invitations: Our world and welcome to it

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CONTINUUM

CALIFORNIA FEVER

I was traveling in Nigeria last year, researching a book, when I met a young woman in the city of Ibadan and asked her out to dinner. "I don't socialize with Americans," she said. "It's too dangerous." She was talking about AIDS. About the fact that West Africa at the time had few reported incidents of the disease while Americans were dying of it by the thousands.

Her remark caught me by surprise. Suddenly I was looking through the wrong end of a telescope at a world in which I, a white American, was dangerous to a black African. From her perspective—an opinion I would later hear repeated across the continent—AIDS is a First World disease, a product of affluence and decadence, a white man's plague infecting the globe.

The African view of AIDS may be as xenophobic as our own, but it bears thinking about. After stripping away the fear that surrounds the issue, one arrives at the following facts. AIDS was first identified as a syndrome—a group of symptoms that collectively characterize a disease—by Michael Gottlieb in Los Angeles in 1981. That a virus caused the disease was discovered in 1983 by Françoise Barré-Sinoussi, a researcher in Luc Montagnier's laboratory at the Pasteur Institute in Paris. According to common medical practice, syndromes, such as Parkinson's disease and Down's syndrome, are named after the people who discovered them. Viruses and viral illnesses are named after the locale in which they were first isolated, as with Colorado tick fever, St. Louis encephalitis, and Coxsackie and other viruses. What if protocol had been followed and acquired immune deficiency syndrome (AIDS), instead of receiving a name so vague as to be almost meaningless, were known instead as Gottlieb's syndrome, California fever, or the French disease?

Tracing the origin of a virus is crucial to understanding its mode of transmission. But the issue is also highly political. Because disease is guilt producing, the protective reflex is to regard one's body—and the body politic—as invaded from outside. (They don't call it Asian flu in Asia.) Scapegoating the foreigner is a way of avoiding the midnight fear that we actually deserve to die this horrible death, and many Africans suspect a political agenda behind the wave of AIDS researchers currently flooding the continent. "If you spent enough money, you could prove that AIDS came from anywhere in the world you wanted it to," a medical researcher told me. Numerous experts on this side of the Atlantic concurred with his view, including several senior professors in epidemiology at the Yale University School of Medicine. While the origin of AIDS remains obscure, what we do know about the disease is that it kills a lot of people in southern Uganda and New York City, where AIDS is the leading cause of death for men between the ages of twenty-five and forty-five.

Jonathan Mann, director of the World Health Organization's AIDS program, announced earlier this year that the disease had entered a new stage, one in which prejudice about race, class, and nationality was spreading as fast as the virus. "We are witnessing a rising wave of stigmatization against Westerners in Asia, against Africans in Europe, of homosexuals, of prostitutes, of hemophiliacs, of recipients of blood transfusions," he said. According to Mann, the epidemic is now in its third and most dangerous phase. The first stage ended when the silent workings of the disease were unmasked in 1981. In its second phase, AIDS emerged as a killer of major and potentially catastrophic proportions. In its latest manifestation, the disease has become politically and culturally dangerous.

Restricting travel and demanding blood tests for foreigners will not prevent the virus from spreading throughout the world, which is why the World Health Organization opposes these measures as costly diversions with no medical justification. Legislation to screen all travelers entering the United States will have no effect on an epidemic already widely disseminated throughout the population. In their rush to scapegoat foreigners, what U.S. politicians fail to realize is that the rest of the world views *Americans* as the most dangerous carriers of the disease.

AIDS in its third phase has become "a direct threat to free travel between countries and, more generally, to open international exchange and communication," says Mann. Xenophobia will not stop the disease, but it may stop the spread of ideas and approaches to curing the disease. As one nation after another throws up defensive walls constructed out of prejudice and exclusionary measures—measures with no practical effect on a virus that is already pandemic—the next casualty of AIDS may be our political and cultural freedom. —*THOMAS BASS*

Thomas Bass is writing a book on science in Africa, to be published next year by Houghton Mifflin.

CONTINUUM

When will the volcano beneath Yellowstone Lake erupt again? The last time ashes were spewed over everything west of the Mississippi

ERUPTION AT YELLOWSTONE?

William Locke a glacial geologist at Montana State University says that the molten magma of a large silicic volcano far beneath the placid surface of Yellowstone Lake is slowly bulging It has literally tilted the lake backward raising its southeastern shoreline and lowering its northwestern end

It has been 600 000 years since the national park's venerable volcano last erupted But when it did, it spewed a layer of ash inches thick over everything west of the Mississippi By contrast, Mount Saint Helens deposited just millimeters of ash over one corner of Washington State in 1980

Locke, who enlisted the support of the National Science Foundation and volunteers from Earthwatch, the Massachusetts research organization is collating measurements made last summer in an effort to determine how fast the caldera—the basin formed by the collapse of a volcano's cone—is expanding at Yellowstone Over the last 50 years there has been a three foot shift in the shorelines, Locke says and perhaps a 33-foot shift over the last 2 000 to 2,300 years

The problem is that volcanologists rarely see the full eruptive cycle of most volcanoes so they don't know what constitutes normal change If Locke's collated measurements show an increase in the *rate* of caldera expansion, he believes an eruption is probably on its way As Locke puts it,

What I'm trying to find out is what is normal for this particular volcano Is it just breathing or is the doming a precursor to eruption?'

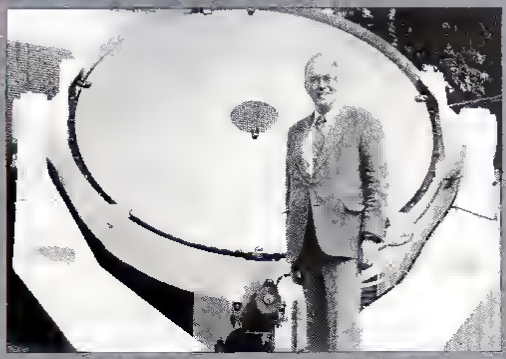
—George Nobbe

LASER TELESCOPES

Using a process akin to triangulation in surveying Charles Townes a Nobel laureate in physics, has linked two infrared telescopes capable of penetrating the clouds of dust and gas that shroud parts of the galactic center of the Milky Way He says together they will deliver up to 100 times more detail than conventional infrared telescopes

The infrared detection system called an interferometer uses a laser to generate infrared light at precisely determined wavelengths The laser light helps repeatedly measure the difference in arrival times between the signals picked up by each telescope Knowing the range of differences between these two times and also the distance between the two telescopes, astronomers can determine the size of the star

So accurate are the twin telescopes which have 80 inch flat mirrors, that their ability to distinguish details at vast distances is akin to being able to see a New Yorker's hand all the way from California His system will detect much that optical telescopes miss says Townes "This is a microscope on the sky' says the man who shared the 1964 Nobel prize with two Soviet scientists for work that led to the development of both lasers and masers



Nobel laureate Charles Townes poses with new telescope Using lasers to unravel puzzling signals from the center of the galaxy

The twin telescopes are mounted on their own flatbed trailer trucks (so they can easily be separated by various disfances) and they can be moved around the world to take advanfage of good viewing opportunities particularly from the Southern Hemisphere

The much-improved resolution of infrared signals gained by coupling the two separate telescopes, should shed lighf on the process of young-star formation allow tests ot the theory of relativity and explain the source of puzzling signals coming from the cenfer of the galaxy-which Townes and others believe is strong evidence of a black hole

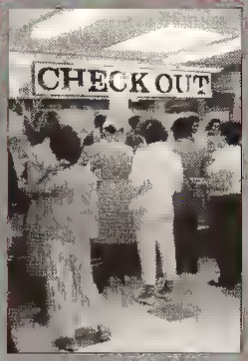
—George Nobbe

ELECTRONIC PRICES

If Telepanel, Inc of Toronto is correct in ten years every big supermarkef worth its coupons will have replaced its pricing clerks with an electronically confrolled shelf pricing system

That s no small achieve ment considering that a 50,000 square foof market sells as many as 40,000 individual products about 2,000 of which need weekly price changes Marking them by hand is expensive time-consuming, and no longer practical

At least nof to Telepanel s Chris Skillen vice president of sales and marketing His company has devised a sys tem that utilizes a liquid crystal display tag instead of the plastic tag you usually see at the edge of each shelf in front of each item The



In the future, supermarkets will become more electronic.

tag contains a memory chip receiver transmitter and battery interfaced with a computenzed scanner at the checkouf counfer

As a store s computer gets price changes from com pany headquarters all the market manager has to do is turn on the transmitter Low frequency radio waves will send the pricing information to each tag that has to be changed and to the automated scanner at the checkout counter In tests there has been 100 percent accuracy befween shelf and scanner

According fo Telepanel s Garth Aasen, insfallation at a typical supermarket (8 000 to 12,000 different products) will cost between $150 000 and $200 000 Skillen predicts the average markef could save enough in labor costs and earn enough through increased pricing and merchandising capability to pay for the system in 18 to 24 months

—George Nobbe

SOLAR POWER AND RHINOS

Scientists in Kenya have resorted to enclosing vast areas of private ranches and national parks with 5 000-volt solar-powered electnc fences in an effort to keep the country s rare black rhinoceroses in and the poachers out

The fences, some three to ten feet high have anywhere from four to ten hof wires carrying enough stored elec tricity to thwart the plodding animals whose gnstly horns are so highly prized in North Yemen (for dagger handles) and the Orienf (as a fever depressant) that they are worth some $9,000 on the hoot Twenty five poachers and 230 rhinos have been slain in recent months in what has escalated into a small war in Zimbabwe between paramilitary gov ernment forces and organized bands of hunters

Only about 3,800 black rhinos are in all of Africa today—500 in Kenya the rest in Zimbabwe and South Africa In 1970 there were an estimated 60,000 says David Weştern an ecologist and director of Wildlife Con servation International

He says solar power has been a boon in Africa, lowering fhe cost of fencing to about $2 250 per kilometer mostly around Tsavo and Nakuru national parks Western and Don Melnick of New York s Columbia University are collecting blood and tissue samples from wild and zoo rhinos They hope to determine how many subspecies of black rhino there are and whether they can be safely moved—from a genetic standpoinf—into smaller befter protected areas without nsking damag ing inbreeding and a weakened gene pool

We hope to relocate thirty into Nakuru and fifteen into Tsavo by the end of the year and fifty fo seventy more over the next two years,' says Western —George Nobbe

Black rhino Only 3 800 of the animals remain, and solar powered electric fences may help protect them from the poachers

CONTINUUM

POLLUTION AND THE POOL

Air pollution, it turns out can be reduced using the same stuff used to stabilize chlorine in swimming pools

Robert Perry of Sandia National Laboratory in Livermore California knew that much air pollution is caused by nitrogen oxides compounds formed during combustion in diesel engines He found tantalizing chemical clues indicating that nitrogen oxides could be removed from diesel exhaust by filtering it with a chemical called cyanuric acid But it took six weeks to order it through government channels and Perry knew that the substance was used as a water stabilizer in swimming pools 'So I just went down to the local swimming pool supply store and bought some," he says

When he tested cyanuric acid, he found that it indeed removed 99 percent of the nitrogen oxides from diesel exhausts He is working on a series of devices to be fitted over truck exhaust pipes and factory smokestacks so as to "wash" exhausts through cyanuric acid and thus remove nitrogen pollutants "I think this could have a major impact [on air pollution] Perry says Studies have shown that if you can eliminate the nitrogen oxides from diesel exhausts you could eliminate first degree smog alerts in Los Angeles '—Bill Lawren

The key to ending pollution may be in your pool

The flush toilet is the basis of Western civilization
—Alan Coult

Chalk one up for the philosopher After studying 266 species of rodents, a scientist verified Aristotle's original claim That a mother nurses two teats for each offspring in an average litter

ARISTOTLE WAS RIGHT

The Greek philosopher Aristotle has been subjected to much modern scoffing because of the wild inaccuracy of many of his armchair observations about animals But a contemporary scientist has just shown that at least one of Aristotle's uneducated guesses appears to have been right The number of teats on some mammalian mothers is in fact directly related to the number of kids in their litters

Avery Gilbert, a research biopsychologist at Philadelphia's Monell Chemical Senses Center took a statistical look at moms in over 266 species of rodents The average mother he found sported two teats for each offspring in an average litter This provided her with a safety margin in case litters were larger than average so that there would still be at least one teat per pup

But some species of tree squirrels Gilbert found give birth in such rapid succession that two litters are often nursing simultaneously placing younger smaller pups in competition for available teat space with their "Baby Huey" siblings

In some of those cases, though nature has been kind to the kids The younger pups have special incisors that allow them to clamp down and cling for dear life to a captured teat This says Gilbert gives the younger offspring something of an advantage in what he calls a 'natural conflict situation"

Aristotle was not available for comment —Bill Lawren

FAT MEN DON'T GET MURDERED

Everyone knows the cliche of the jolly fat man, the guy who carries too much weight to be anything but easygo ing Now a forensic scientist has just added some new flesh to the bones of that old image It seems according to Dr Kenneth E Warner of the State of New Mexico Office of the Medical Examiner that fat people are significantly less likely to die violent deaths than their thinner counterparts

Warner who spent 15 years as a nutritionist before going to medical school has long been interested in people with weight problems As a medical examiner in Miami he noticed that people who died violent deaths seemed to be predominantly thin When he moved to New Mexico he decided to test that impression Looking at the autopsy records of 726 people who died by suicide accidents, or murder he found that only 12 percent were overweight whereas in the population as a whole as many as 26 percent are on the heavy side

Warner who has since switched to the Alabama De partment of Forensic Sciences in Tuscaloosa, finds the evidence startling' but admits that he still can t quite explain it Sedentary lifestyles may be part of it he thinks "We don t see obese people skydiving or riding in hot air balloons ' On the other hand he says "the stereotype of the jolly fat man may be true It may be that they're just not going to do the kinds of things that ll get them killed in bars

—Bill Lawren

' When a man asks a woman out for dinner it isn't because he knows that on Friday night he ll want a steak '
—Wendy Wasserstein

There is nothing to express nothing with which to express no power to express no desire to express together with the obligation to express '
—Samuel Beckett

COMPUSKETCH

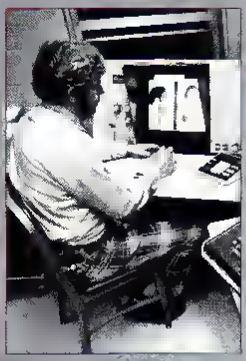
Remember Junior the wire-haired redhead who was Dick Tracy's consummate police artist? If a group of Silicon Valley entrepreneurs have their way, the Juniors of the future will be sharing their chores with an electronic artist named *Compusketch*

Developed by a team of computer engineers at Visatex Corporation in Campbell California, *Compusketch* is a $3 500 software program that uses witnesses descriptions to generate detailed composite sketches of possible bad guys A detective operator punches in the answers to such questions as What was the shape of the guy s face? or 'How brg was his nose? and *Compusketch* then sorts through its massive library of facial features (19 440 different eyes for example, and as many as 6 500 mus taches) to assemble the face that most closely matches the witnesses descriptions

According to Visatex s Don Sumner *Compusketch* has already found work at about a dozen different police departments—most of them like the one in Las Cruces New Mexico outfits too small to afford a flesh and-blood police artist But Sumner thinks that the advantages of *Compusketch* will soon become apparent to big-city cops as well "Large cities he says have thousands of crimes a month way beyond what one or two police artists can handle So a lot of minor cases don t get sketches With *Compusketch* he thinks even such petty crooks as burglars and street cons could end up with their portraits in a computerized rogues gallery

—Bill Lawren

Well, okay, some fat guys do meet violent ends (such as mafioso Carmine Galante, shown here) But most enjoy a jollier existence

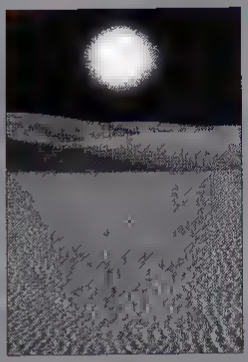


Now the police artist has been replaced by software

'Technological progress is like an axe in the hands of a pathological criminal "
—Albert Einstein

Anyone who sees and paints a sky green and pastures blue ought to be sterilized '
—Adolf Hitler

CONTINUUM



Two astronomers have solved the mystery of a double dawn

THE DAY THE SUN ROSE TWICE

China's ancient Bamboo Annals tell of a mystery: "In the spring of King I [that's right, just the letter *I*, pronounced 'aiee'] of the West ern Zhou dynasty, the day dawned twice at a place called Zheng." By solving that mystery, scientists have found how long days were nearly 3,000 years ago.

What happened? The sun was eclipsed just before it rose above the horizon, says Kevin D. Pang of the California Institute of Technology's Jet Propulsion Laboratory. People in Zheng saw the sky lighten before dawn, then turn dark as the moon passed in front of the sun. The end of the total eclipse was the second dawn.

Written on sticks of bamboo, the annals list events from about 2000 B.C. to 299 B.C., when they were buried with King Hsiang of the Wei Kingdom. In the tomb they survived a burning of books by Ch'in Shih Huang Ti, who built the Great Wall of China. Grave robbers later found the annals. Modern astronomers study them for records of ancient events.

The Bamboo Annals list earlier eclipses, but in the days before clocks, none were timed accurately. The daybreak eclipse at Zheng is an exception because modern astronomers can calculate the time of dawn.

Pang and Kevin K.C. Yau of Britain's University of Durham calculated that an eclipse on April 21, 899 B.C. matched the ancient account. If the day had stayed unchanged at 24 hours, the eclipse would have been seen at dawn in the *Middle East*, not in China. It was seen at dawn in China because days in 899 B.C. were about 0.043 second shorter than today. Over the million intervening days, that adds up to nearly six hours. That's enough to move the eclipse a quarter of the way around the earth, where the ancient Chinese saw it as a double dawn.

—Jeff Hecht

GIMPY SABER-TOOTHED TIGERS

Although most of us think of prehistoric America as a saber-toothed-tiger eat saber-toothed tiger world, surgeon Fred Heald has come up with some new ideas about that era after studying 9,000 to 38,000 year-old animal bones recovered from the La Brea tar pits. Heald found that saber-toothed cats frequently survived grave infections and bone-splintering injuries that crippled them. While these huge felines were clearly tough customers, Heald concludes they could never have lived with such severe handicaps unless other saber-toothed tigers helped them—by providing food and possibly protecting them from predators.

Heald spent five years examining and conducting a statistical study of 12,000 abnormal prehistoric bone specimens from the George C. Page Museum in Los Angeles. "It became apparent that the saber-toothed cat's life style could be read somewhat in the way it injured itself and the degenerative diseases it had," he notes.

"We found dislocated hips, rib fractures, and terrible draining wounds. One cat suffered a partial dislocation of the first vertebra below the skull—it was half out of joint and the animal's head was twisted a quarter turn to the right. There is no way it could have hunted." Heald concludes: To survive, it must have lived in a family group which left enough of each kill to maintain its life. Similar behavior has been observed among present-day lions.

Heald plans to study the bones of ancient giant wolves next to see if they too show signs of having survived disabling injuries thanks to the help of other wolves.

—Sherry Baker

If we wish to make a new world we have the material ready. The first one too was made out of chaos.

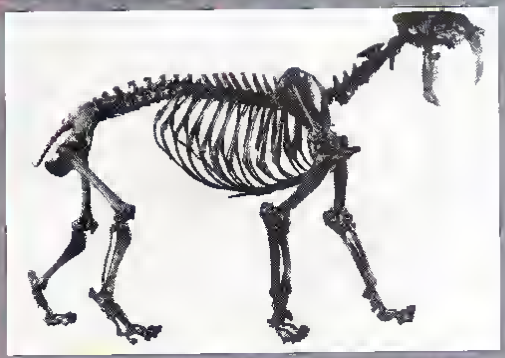
—Robert Quillen

"Research is to see what everybody else has seen, and to think what nobody else has thought."

—Albert Szent-Gyorgyi

It would be as useless to perceive how things 'actually look' as it would be to watch the random dots on untuned television screens.

—Marvin Minsky



This skeleton of a saber-toothed tiger led one researcher to a surprising conclusion. The vicious cats helped the handicapped.

Previous antisnoring devices couldn't differentiate between a snore and the sound of traffic. A new gizmo solves that problem.

ANTISNORE DEVICE

Man's eternal quest for a truly effective way to prevent snoring has led him over the centuries to any number of ingenious if often impracti cal, devices some merely useless some ridiculous others downright painful

One of the earliest was a chin strap that held the snorer's jaw shut Another triggered a piercing wail whenever the hapless sleeper lost control of his mandible Next was a device that violently shook his pillow at the faintest sound followed by a web of wires that broadcast antisnoring propaganda via an earplug

None of these Rube Goldberg cures proved popular either with the snorer or with his or her bedmate Too often the devices woke up the wrong person or incorrectly activated themselves because they couldn t tell the difference say between a snore and the sound of passing traffic

So it remained for one Anthony R Dowling, an Australian inventor from the Sydney suburb of Vaucluse to develop a compact self contained electronic mecha nism worn in the outer ear It will detect snoring via the vibrations it causes in the head and auditory canal then emit a buzzing sound that is inaudible to a sleeping partner Gradually this behavior modifier—complete with a combination microphone/speaker—will break a snorer s habit according to patent documents Dowling has filed —George Nobbe

"Computers can figure out all kinds of problems except the things in the world that just don t add up"

—James Magary

A two pound turkey and a fifty pound cranberry—that s Thanksgiving dinner at Three Mile Island

—Johnny Carson

SHEEP IN SHEEP'S CLOTHING

Using a variation on an old shepherd s trick, a University of California Davis animal science professor has developed a technique that speeds up the adoption of newborn lambs by sheep One day this surrogate motherhood could help boost the population of endangered animals in zoos and wildlife parks

The technique developed by Edward Price and his colleagues is being used successfully by sheep ranchers in the United States and several other countries It uses a stockinette which looks something like a turtle neck sweater and relies on odor to fool ewes (female sheep) into accepting orphaned lambs and those from large litters where there is not enough milk available

The old shepherd s trick requires taking the pelt from a ewe s dead lamb and placing it on an alien lamb to fool the ewe into accepting the orphan Now the stockinette is placed on the dead lamb and then fitted on the alien animal Prices technique also can be used to bond a second lamb to a ewe by using two stockinettes One is fitted on each lamb and then they are switched so both stockinettes carry the scent of the ewe s offspring

"The trick is to confuse the ewe so she doesn t know which is her lamb Then she ll accept both lambs explains Price

His technique is so effective that it reduces adoption time from the current five days to between 24 and 48 hours The technique also has been successfully tested several times with cattle and Price adds I suspect it would work with any mammal that relied on olfactory clues particularly ungulates" He believes it has potential applications with captive endangered species such as the African oryx

—Joel Schwarz

The key to saving a lamb s life s to dress him right

CONTINUUM

Rambo charges through the jungle for hours at a time but how can real soldiers cope with the heat? Blood doping may be the answer

DOPING RAMBO'S BLOOD

Watching Rambo charge for two hours through the steaming jungle you have to wonder how *anyone* could have such stamina But a super aerobically fit commando who can fight tirelessly in tropical heat may be more than a movie fantasy The Army Research Institute of Environmental Medicine in Natick Massachusetts is studying a blood infusion technique that not only improves maximum aerobic performance by 4 to 18 percent but also helps the body to adapt quickly to hot environments

Called blood doping the technique has been used illegally by track and field athletes for some years (the presence of doped blood cannot be detected) and its efficacy was first scientifically demonstrated in 1980 The procedure involves withdrawing blood freezing it for six to eight weeks and then injecting it back into the donor's body That artificially increases the number of oxygen carrying red blood cells in the body explains Michael Sawka a researcher at the institute What is new, however and somewhat puzzling to scientists is the recognition that blood doping increases thermoregulatory efficiency too

Sawka and colleagues learned that after 24 hours of being infused with two units of treated blood those research subjects acclimated to a hot environment showed the expected improvements in aerobic fitness but unacclimated individuals also showed a significant increase in their ability to perform in heat. The effects may last for several weeks according to Sawka

And the ultimate purpose of this research? When asked if the Army is considering using blood doping to help soldiers fight on a moment's notice in a tropical climate—say In Central America—Sawka answers 'It might be used in a special situation But I couldn't really comment on that specifically, one way or the other —Sherry Baker

FIDGETING BURNS CALORIES

For anyone who thinks fidgeting—tapping feet drumming fingers shredding paper napkins chewing pencils—is just nervous energy think again A recent National Institutes of Health (NIH) study has found that fidgeting—what they generously refer to as spontaneous physical activity—burns from 100 to 800 calories a day depending on a person's weight That is equivalent to anywhere from one to eight miles of jogging

Dr Eric Ravussin a researcher in the NIH's Clinical Diabetes and Nutrition Section in Phoenix discovered this while studying the efficacy of a new device called a respiration chamber which measures the amount of energy expended by the body in normal activity One hundred seventy-seven volunteers were each put into a 12 by 8 foot room (equipped with bed desk chair, sink toilet and TV) for up to a few days monitored by both wrist mounted and wall-mounted motion sensors and told to act normally (except no exercising) Their oxygen consumption was then measured to calculate the energy expended

But don't assume fidgeting is a substitute for exercise Ravussin cautions The study found no evidence that fidgeting leads to weight loss nor even that thin people fidget more than fat people You can still fidget and get fat' he says

He did extrapolate though that fidgeting is largely genetic in nature—fidgeters are born not made—and that fidgeting translates from body movements to general attitudes rather handily Those who are high fidgeters he says tend also to be more nervous and restless —Gregg Levoy

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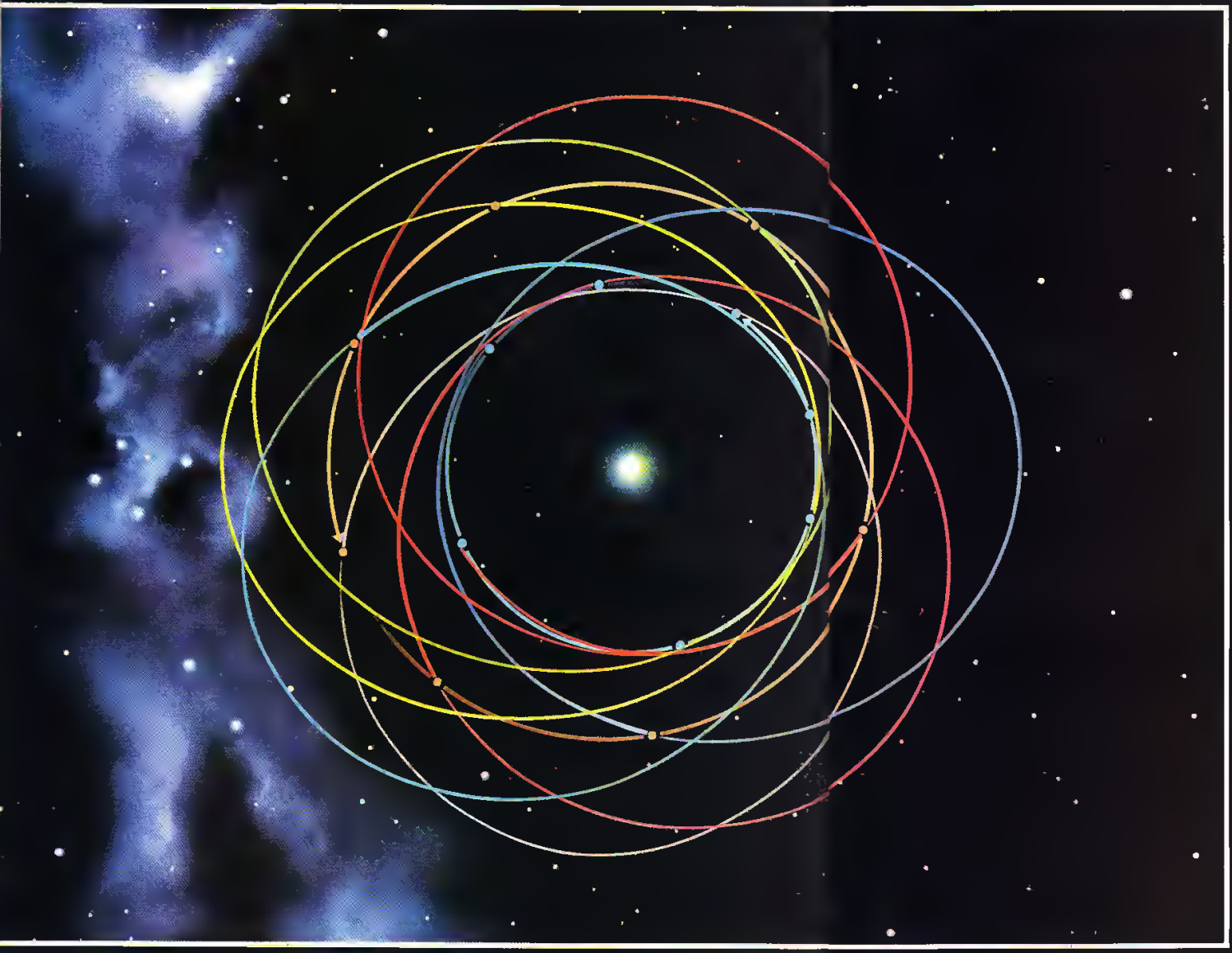
Even if you're on the right track you'll get run over if you just sit there'

—Will Rogers

What is the difference between religion and patriotism? When a dog howls at the moon that's religion When it barks at a stranger that's patriotism'

—Tuli Kupferberg



ARTICLE

Gliding endlessly in space, one astronaut's dream machine will be our link to the red planet

THE MARTIAN METRO

BY FRANK BRAUN AND OWEN DAVIES

Out of the deep black of space the ferry to Mars glides into view. Picture a trusswork girder joining two square-based pyramids at their points. Inside each pyramid are living quarters for up to 34 people—three times the number of occupants planned for the space station. As it soars through space at speeds averaging 14,000 miles per hour, the 735-foot-long structure spins around its midpoint to create an artificial gravity. Tethered weights govern its rotation; bound by Kevlar cables, they may spin at a distance up to 15,000 feet from the craft's body.

The craft is called the *Mars Cycler*. Once launched, it will sail endlessly between Earth and Mars, its half dozen permanent crewmen picking up passengers or sending them off in space taxis when it nears a cycleport space station near our moon or one of the moons of Mars.

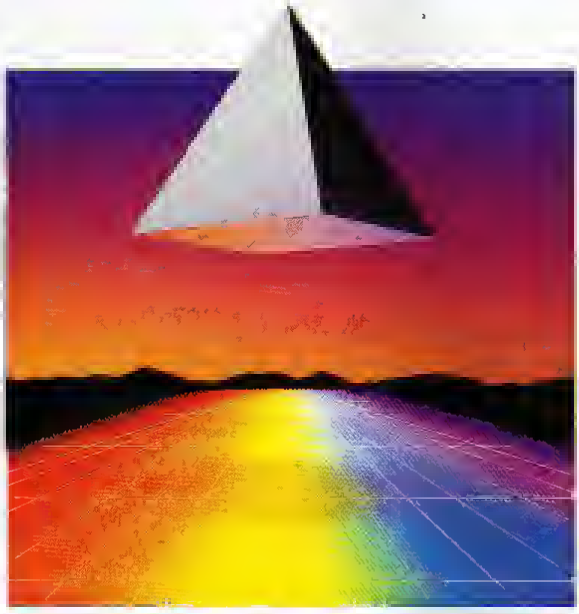
The cycler is the brainchild of Buzz Aldrin, the man who 18 years ago was part of the first crew to walk on the moon. Although he has left the astronaut corps, he continues to be fascinated with space travel, and today he is a man with a mission. The sandy-haired ex-astronaut wants to do nothing less than foment a revolution within the American space program. During the next 30 years he wants to see not only a colony on Mars but an interplanetary shuttle ferrying colonists and supplies from Earth to Mars and back on a regular schedule. The key to his vision is a fantastic spacecraft called the *Mars Cycler*.

Unlike traditional spaceships, the cycler has no giant rocket engines to boost itself from one planet to another. It's more like an unmanned probe, once

Left: An artist's rendering of the orbit of Earth (light blue circle) and Mars (orange circle). The other colored lines represent trajectories of the Mars Cycler between the two planets at different orbital points.

PAINTING BY HELMUT WIMMER

"Inside each square-based pyramid are living quarters for up to 34 people, three times the total number of occupants NASA has planned for the space station."



pushed into orbit it simply coasts using the gravity fields of the moon and the planets to bend its path toward its destination Unlike the space probes however its route curves back toward Earth to form an endless loop so that it can shuttle continuously between the planets The only power it needs is an occasional nudge from maneuvering thrusters to adjust its complex orbit

In Aldrin's scheme the cycler could be launched by 2014 and continue its journey for decades But that means finding some way around two serious obstacles The program would require more money than NASA has seen since the glory days of its race to the moon and it would mean scrapping the space agency's current plans for the next 20 years In particular the space station now scheduled for the Nineties would need to undergo drastic changes if it were to act as a way station for the cycler

Next to these problems the technological hurdles are relatively minor But several key components remain to be developed The cycler must be so automated that crew members can diagnose and repair any possible problems without the kind of help that shuttle crews now get from Earth Its life-support system must recycle food water and oxygen for years Various new space vehicles are needed including a heavy-lift launcher to carry the system up from Earth a large passenger vehicle to take the crew members into orbit and several smaller craft both manned and unmanned In addition the medical problems of long-term spaceflight have yet to be solved

Despite these obstacles Aldrin has no doubt that the goal more than justifies the price "Mars has to be the goal" he says "Even now we should be organizing our whole space program around that mission The space station we're now planning to build is a lot like a train station If wasn't the train stations that gave this country mobility it was the trains themselves

"With one-shot rockets we can go to the space station or even back to the moon" he adds "but we'll never have a transportation system that can support any kind of permanent development in space If we establish a base on Mars however we'll have to build efficient reliable transportation to support it That simplifies almost anything else we could want to do"

Aldrin has won some impressive support for this view including an endorsement from the National Commission on Space Though NASA's post-*Challenger* problems have delayed any hopes of pioneering on the high frontier and former astronaut Sally Ride has recently called for a go-slow approach to Mars the commission's 1986 report stands as the only official plan for the space program independent of the NASA establishment Its centerpiece is an American colony on Mars serviced by the cycler system that the former astronaut champions

With that nationwide exposure the cycler has become more prominent than its promoter Aldrin retains much of the obscurity often reserved for the *second* explorer of a new land

In part that is probably his own fault Aldrin speaks of himself with reluctance driven by the need to get on with his mission and punished by grim depression when the work is not getting done last enough But a few facts do emerge At twenty-two he was shooting down MiGs over Korea Ten years later he joined the astronaut corps equipped with one of the first Ph D's in astronautics granted by MIT The rendezvous techniques that now enable two spacecraft to meet in orbit came straight from his doctoral thesis After leaving the space program in the late Seventies Aldrin commanded the test pilot school at Edwards Air Force Base then left the service to start a new career as an aerospace consultant in California It was in that period that the idea for the *Mars Cycler* was born

Nobody had thought seriously about a Mars mission in years he recalls "There'd been a lot of work done on it in the Sixties but when NASA's budget fell apart they were scared of seeming too visionary, and Mars became a forbidden subject

About three years ago I was working on a way to support a moon colony Aldrin continues "Instead of using rockets to get there it seemed more efficient to go with a cycler orbiting between the earth and the moon with small transfer vehicles to get you on and off at either end of the trip Krafft Ehricke the late rocket pioneer had done some work on the concept of cyclers in the early Sixties and Walter Hollister a noted pioneer of orbital mechanics at MIT had done more a few years later Both studies looked promising I was trying to find the best orbit for the cycler"

It took some graduate students at the University of Colorado to break the long silence on Mars Under the name Case for Mars they organized scientific meetings in 1983 and '84 to revive the idea of starting an American colony on another planet Their call for scientific papers on the subject drew worldwide attention and instant enthusiasm

In 1984 Aldrin shifted his attention from lunar cyclers to Mars "One of the Case for Mars reports caught my eye" Aldrin says "It was a mission that called for a loose orbit around the earth and a swing by Mars to drop off supplies and rotate crews Then it would come back to a high Earth orbit After looking at the lunar cycler I couldn't see any reason to stop at Earth Why not just loop it around the planet and keep going?"

Its trajectory would be more like a satellite's than a rocket's The

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System shown: KEX-M700, CDX-M100 trunk mounted changer, JD-M100 6-disc magazine, wireless remote control.

Mars Cycler's orbit is a long ellipse interrupted by loops and sudden bends where the cycler passes the moon or a planet and uses its gravity to change course. The complex path begins near Earth and extends outward to the orbit of Mars, some 50 million miles away. Passengers could board the cycler when it neared Earth, ride it out to Mars, and get off at the other end. Or they could get on at Mars and ride it the other way back home.

Aldrin sees a permanent link to Mars as one guarantee that will give space development the continuing attention that NASA's program has never had. Without it, he fears, a Mars mission could meet the same fate as the Apollo program: it could be seen as a grand publicity stunt and leave us with little more than a handful of alien rocks and memories of lost glory.

Cyclers have other tempting advantages over ordinary rockets. There's no need to launch heavy engines, fuel tanks, and life-support equipment up from Earth's gravity every time you want to send a crew or supplies to Mars. A cycler's small, lightweight engines and life-support hardware are lifted only once, when the craft is placed in its orbit. Only crews and expendable supplies need go up for each trip. Thus shipping costs should drop several hundred dollars per pound—the exact amount varies with the source of the estimate—to around $10 per pound.

Early in 1985, after working on the *Mars Cycler* for six months or so, Aldrin dropped his freelance consulting to head the space-studies program at the University of North Dakota. At the same time, he joined Science Applications International Corporation (SAIC), a consulting firm that often handles research projects for NASA. There he found friendly competition. It turned out that Dr. John Niehoff, a long-time member of SAIC's staff, had also been working on a cyclic Mars transport.

Both men have spent years of their lives trying to solve what may be the hardest technical problem in setting up a Mars cycler: finding the right orbit for the craft. Orbital mechanics is a lot like a game of celestial billiards, but in billiards only the ball moves. In space, as the vehicle moves, so does its destination, and so do the "cushions" that can deflect its path, each in its own unique orbit. Getting them all lined up just right is as much art as science. Buzz Aldrin is widely held to be one of the most talented artists in the field.

Here are the factors to juggle for a trip to Mars. Earth is 93 million miles from the sun on average. Mars varies from 128 million miles to 154 million miles out. The distance from Earth to Mars can be as little as 35 million miles or as much as 340 million when they are on opposite sides of the sun. Earth circles the sun in 12 months. Because Mars is farther away and orbits more slowly, its year is about 22 Earth months long.

If Mars had a 24-month year, setting up the cycler would be easy. On one orbit you would leave Earth, visit Mars, and return home. On the next pass, one Earth year later, when you reached the orbit of Mars, the planet would be only halfway around its course, on the far side of the sun.

The cycler could make that run with only a skeleton crew to maintain the craft. On the third trip, 24 months after the first, Mars would return to its original position, and you would find the planet waiting for you when you arrived in its neighborhood. And so on. With two well-timed cyclers aimed at opposite sides of Mars' orbit around the sun, you could schedule trips to Mars and back once a year.

But that would work only if the orbit of Mars were exactly two Earth years long. 12 months doesn't go into 22 months evenly. (And it isn't really 22 months; it's 22 and a fraction.) So instead of reaching Mars every second lap, a cycler could conceivably orbit for decades between Martian rendezvous, missing its connections with its destinations. The trick is to find the best mix of course corrections and gravity swings around planets to give you the most frequent, regular arrivals at both Mars and Earth, while using the least fuel.

Both Aldrin and Niehoff have found ways to solve that complicated equation. Niehoff did it first, before Aldrin arrived at SAIC. But there is a growing consensus that Aldrin did it better.

Niehoff's solution is a grand scheme called the VISIT orbit. "It stands for Versatile Interplanetary Station for International Travel," he explains. "Or was it Versatile International Station for Interplanetary Travel? I named it that because on a program of this size we are very interested in international cooperation."

The VISIT orbits lie in almost the same plane as Mars' orbit around the sun. So a cycler would not have to use much fuel in making course corrections. It takes only 15 months to make one loop between Earth's and Mars' orbits. A cycler would pass by Mars only every second year, and Earth, once every five years. Thus if a cycler left Earth in, say, December 2001, it would reach Mars in March 2003 and return home eight months later. But it would not see Mars again until September 2020. You'd need at least three or four cyclers to maintain a regular transportation schedule, Aldrin guesses, six.

Aldrin's solution operates more like an escalator. In fact, space scientists refer to it as the up-and-down escalator. His orbits take two years to complete, and they angle away from Mars, gulping more fuel for course corrections than the VISIT orbits. Aldrin's plan also calls for symmetrical cyclers that can be set up to reach Mars in 150 days and take approximately 20 months to return to Earth—the up escalator—or to go from Mars to Earth in 150 days and take 20 months in the other direction—the down escalator. As is the case with any good escalator, the trips follow a regular schedule. Just one cycler could transfer people back and forth every 26 months or so. Two cyclers, one up and one down, would cut that time in half.

After looking closely at Aldrin's work, even Niehoff is starting to wonder whether the up-and-down escalator may be the way to go. "I was skeptical of it at first because of the energies required for course changes," he says. "It turns out that they are not as great as I had imagined, and the schedule is certainly attractive. Aldrin has put some very good work into this."

There are still other possibilities. We did look at what we call an interplanetary tour orbit," says Kerry Nock of the Jet Propulsion Laboratory in Pasadena, California, who led a recent study of cycler orbits for NASA. "You'd use the gravity assist of Venus to help maintain a regular schedule between Earth and Mars. That idea deserves more study if we decide to set up a major research program at Venus."

We also looked at sending people and supplies from Earth orbit to an orbit near Phobos [one of the Martian moons] and back using normal rockets in a minimum-energy trajectory," Nock adds. "It turns out, he says, that you can make one flight in each direction every two and one seventh years with rocket-powered spacecraft for about the same price as the cycler systems. That came as quite a surprise to us," he admits.

Throughout 1985 the National Commission on Space weighed possible futures for the NASA program. Aldrin shuttled from his home in suburban Los Angeles to the Jet Propulsion Laboratory, the Johnson Space Center in Houston, and NASA's Washington, DC, headquarters, lobbying wherever he might win support for the cycler concept. On many occasions he attended commission meetings and in January 1986 he flew to Washington to present his own testimony to the panel. So did Nock and several NASA scientists.

The group effort apparently worked. In May 1986, after a long delay in the wake of the *Challenger* tragedy, the commission released its final report, formally endorsing a manned mission to the red planet, construction of a Martian colony, and a cycler system to support it.

The report painted a picture of stately structures leisurely gliding through space toward their Martian destination. "Like ocean liners, the cycling spaceships will contain all the necessities for extended journeys," the commission stated. "They will be sufficiently spacious to provide passengers with comfortable quarters for long voyages through space and would include

CATCHING THE SHUTTLE TO MARS

It will probably be one of the most complicated itineraries man has ever attempted. A trip to the red planet on the *Mars Cycler* will involve a series of transfers that would daunt the most experienced frequent flyer. The six-leg Mars-bound trip goes from Earth to a spaceport in Earth orbit. From there you continue to a lunar spaceport and finally to something called an L-1 spaceport, where you will wait for the *Mars Cycler* to swing by. Once the cycler reaches Mars, the traveler disembarks for the local Mars port, and from there he makes the last leg of the trip down to the planet. Here is how a typical trip might go.

The journey begins at JFK International Aerospaceport, the aerospaceplane's base in the Northeast. Resembling the space shuttle of the Eighties but larger, the scramjet-powered vehicle can fly passengers to low Earth orbit in less than one hour.

When the plane reaches 180,000 feet, its auxiliary rockets cut in, and the ship aims for the Earth spaceport, 300 miles out. The port is a large rectangle of metal trusses. From here you will catch the next orbital transfer vehicle (OTV) to the lunar spaceport.

The lunar spaceport will give you an idea of what you can expect to be looking at for the next five months. Weighing some 40,000 pounds, it is an ungainly structure that resembles half of the *Mars Cycler*. It consists of one 400-foot-long latticework beam. Attached to it are giant cylindrical structures, quarters for 17, repair shops, and a fuel dock for the OTVs.

From the tip of the beam stretches a 300-mile strand of Kevlar cable one fifth of an inch thick. This ends in a counterweight that balances the mass of the spaceport so that the whole structure can be spun to provide artificial gravity.

The OTV that takes you to the lunar port is a strange affair. It resembles an enormous, shallow bowl, with a cluster of spheres ringed around a squat cylinder nestled in the center. The cylinder is the crew compartment, the spheres are fuel tanks, and the dish forms the base of the craft, which shields the crew from solar flares.

The lunar spaceport is in constant motion, gliding in a long, elliptical orbit. When necessary it can swoop close to the moon to meet Earth-bound transfer vehicles or fly far into space to meet ships approaching from Earth. When your OTV arrives, it will dock by clamping itself to the cable extending out from the port structure and pulling itself slowly toward the core of the port like a spider reeling in its web.

Once you've arrived at the lunar spaceport, you'll have 24 hours to relax in its small cabins. You will no doubt spend much of that time watching the busy commerce that flows around the station as new crew members come with research equipment, and cargo craft ferry manufacturing hardware down to the moon.

The next day it's back into another OTV for a trip out to the lunar cycleport at L-1. Roughly 35,000 miles from the moon on a direct line between Earth and its satellite, L-1 is a Lagrange point, where the pull of the earth and the moon cancel each other out. A space station could remain in that location indefinitely without using much fuel to hold its position.

You will have 48 hours to explore the spaceport (but it's so small, you'll probably do it in 15 minutes). The station itself is identical to the lunar spaceport but with none of the bustle found near the moon. In your freshly refueled OTV you will then head out to the mammoth structure.

The cycler looks like two spaceports joined, with a pyramid at either end. One pyramid holds quarters for 34 people; the other carries fuel supplies, workshops, and a place to store and refuel your OTV. Near the midpoint several cylinders project at right angles from the main beam. One is a docking chamber; the others are research labs. The cycler's spin can be stopped to ease docking and to provide for microgravity studies. As it approaches Earth, the cycler spins around its center to provide one g of artificial gravity, but that will be reduced gradually during the 150-day journey to 0.34 g—Mars' gravity.

Once the cycler nears its destination you'll take a transfer vehicle from the cycler to the Mars cycleport. As before, the OTV will pull its way along the Kevlar tethers to the cycleport, some 500 miles from the planet.

It's busier there than at L-1, with OTVs going down to Mars and tankers shuttling back and forth from the fuel factory on Phobos, a Martian moon. But you don't have much chance to watch. There is one last ride, on a Mars lander. Resembling an OTV, its ceramic base glows with the heat as it enters the Martian atmosphere. Then the Martian base comes into view as the legs from the landing pod extend and settle on the dusty surface. Your six-month trip is over. You are on Mars.—Owen Davies

substantial research facilities. They will have food production and recycling, water and air reuse, and an 'artificial biosphere' closed-ecology support."

The cycler itself would be only one stage in the long journey to Mars. In both Aldrin's plan and the commission's report, the trip is a dazzling and imaginative catalog of space stations and specialized rockets, none of which exist outside some design studies prepared by Eagle Engineering, a Houston-based research firm founded by former NASA personnel.

You'd leave Earth on a passenger liner. It might be the aerospaceplane now on NASA's drawing boards and slated to enter service in the late Nineties. If so, you'd leave from, say, JFK Airport or Dallas–Fort Worth—almost anywhere with a long enough runway. Another possibility is that a special ferry into orbit might be needed. No one has given the matter much detailed thought as of yet.

Your first stop would be at the Earth spaceport in low orbit. It is a space station, but one that's considerably more complex than the one NASA now hopes to build. "You need hangars and fuel tanks and refueling equipment," Aldrin points out. "That isn't compatible with the superclean, zero-g research environment planned for the current space station. And it ought to have a way to move from place to place in orbit, as the current Soviet space station can."

(Aldrin notes that while the space station could not act as a spaceport, the spaceport could easily act as a space station and take over its research functions. "You'd just have to put the research projects on a separate platform far enough from the spaceport to eliminate the fuel vapors, vibrations, and the structure's gravity field," he says. "There is nothing difficult or expensive about it.")

At the Earth spaceport, you would board an orbital transfer vehicle for a journey to the lunar cyclaport, somewhere near the moon. (One variation on the plan calls for an intermediate cyclaport in geosynchronous orbit, 22,300 miles out from Earth.) The cyclaport would look much like the *Mars Cycler*, but it would carry only a single pyramid at one end of its trusswork beam with housing for 17 people. It probably will not orbit the moon itself but will hang in space at one of the Lagrange points, where the gravitational tugs of the earth and moon counterbalance each other, so that anything placed there will hang in space indefinitely.

So far, of the five possible Lagrange points, L–1 seems the best choice; it lies some 35,000 miles from the lunar surface, on a direct line toward Earth. Again, the details have yet to be worked out.

Board the *Mars Cycler*, and 150 days later you disembark for another cyclaport, making the transfer in tiny "space taxis" carried in a hangar onboard the cycler. And from there, at last, another shuttle takes you to the surface of Mars.

Aldrin points out that a good deal of aux-

iliary equipment is needed to make this system work. At the very least, it requires a cargo rocket for the Earth–spaceport–cyclaport run and a new generation of heavy-lift launchers to carry the whole works into space. Also needed: bases on our moon and the Martian moon Phobos. The moon base would smelt oxygen from the lunar rock, eliminating the cost of carrying it up from Earth. The Phobos base would manufacture propellant to resupply the cycler and cargo rockets at that end of its journey.

If all this is to be in operation before the year 2014, as Aldrin hopes, a few technical obstacles will have to be overcome—and quickly. "My strongest concern is that these long flights are going to be out of communication with Earth for long periods," comments Barney Roberts of the Advanced Projects Office at the Johnson Space Center. "We won't be able to monitor the spacecraft's operation from Earth and help the crew solve whatever problems they run into during a trip. Everything we now do in Houston will have to be automated and put into the ship. It's going to take time to learn how that can be done."

Another problem is life support aboard the spacecraft. "We've been conscientiously trying to learn how to recycle waste products and to provide food in space instead of having to carry enough supplies to last the whole trip," Roberts notes. "By comparison, an open system is simpler and lighter but requires more resupply trips. For those reasons a partly open system was originally supposed to be part of the space station project, but now a fully closed life support system is the accepted idea."

"Similarly, it doesn't make sense to run a Mars cycler without closed life support," he continues. "The trip is too long, and for that reason it would be advantageous to grow our own food."

Niehoff of Science Applications cites two other hurdles. "We've seen what long stays in orbit do to human muscle and bone," he says. "The Russians have had people in space for up to nine months, and some of them could hardly stand up when they got back. We have to learn how to maintain muscle tone and minimize the loss of bone calcium before we can send crews out on flights that will last for years. Spinning the ship to provide artificial gravity will do that, but unless it's an extremely large ship, you run the risk of giving everyone onboard severe motion sickness."

The other concern is high-energy radiation. "Niehoff says. "We don't see a lot of powerful cosmic rays on Earth, so we haven't studied how to protect against them. We don't know how much damage high-energy particles will do to the body. There's even a chance that they will do little damage in themselves but will interact with our shielding material to create a shower of particles that are less energetic but cause more biological damage. There is a lot of research to be done in this area."

Aldrin does not see these as overwhelming problems, however. The cycler would be completely cut off from Earth only when the sun passes directly between the cycler and Earth. At those times a relay satellite could be used to maintain communications. Experiments already in progress at NASA labs are addressing the life support problems that worry Roberts. And preliminary NASA studies have suggested that it may be possible to prevent the debilitating effects of zero g without simulating full Earth gravity. If so, motion sickness may not be a hazard.

The biggest obstacle confronting the *Mars Cycler* is NASA's schedule for the next decade. The only Mars mission now on the agency's docket is the *Mars Observer*, a low-budget orbiter meant to map the planet and analyze its minerals. The probe was to be launched in 1990 but is now on hold until the shuttle returns to service or an unmanned launcher becomes available.

NASA underscored its commitment to its schedule when Sally Ride's study panel on aerospace exploration released its findings last August. After reviewing possible space missions and consulting with NASA planners, Ride advised against a "headlong rush toward Mars." While endorsing the settlement of Mars as "the ultimate objective" of the space program, the report said a lunar base should be established first and all the technical problems of long-term spaceflight solved before we begin to think of expanding into the solar system. NASA does not plan to visit the moon again for at least 20 years.

Aldrin would like to rewrite that agenda completely. His first step would be to loft a "variable gravity research laboratory," a single-pyramid version of the cycler much like the cyclaports. For the *Mars Cycler* to begin service in 2014, the variable-g facility would have to be completed by 1992, the same year that NASA intends to *begin* work on the space station.

If Aldrin had his way, the remaining parts of the system would follow in close order: an LEO (low Earth orbit) spaceport in 1995, a cyclaport in geosynchronous orbit a year later, and one near the moon in 1998. We would return to the moon in 1999, 20 years ahead of NASA's current daydreams, and build a permanent manned base and oxygen factory there within two years. As all this takes place, Aldrin would have a series of robot probes visit Mars between 1997 and 2001 to learn more about the Martian environment and to help pick a landing site. Manned flybys would follow in 2003 and 2005, each flight dropping off half of the fuel factory to be erected on Phobos. The cycler would begin service to a community on Mars by the year 2014.

The National Commission on Space was much less ambitious in its version of the cycler plan. As the commission saw it, the variable g research station would not be completed until 2001, and the Earth spaceport would be delayed until 2007. The

lunar oxygen plant would go into production five years later. Cycleports would appear near the moon in 2016 and near Mars in 2022. There could be a small outpost on Mars by 2015, and the base would not be fully operational until at least 12 years later.

Few within NASA fault the technical feasibility of Aldrin's scheme. (The one scientist who had criticisms would not go on record against the cycler idea, arguing that at the very least it should be explored further.) The major hurdles it faces are primarily economic. Can we afford to do it? And is it cheaper than traveling by rocket? The answer to both questions appears to be a qualified yes. Like many grand schemes, its likelihood is shaped by more mundane developments. For nearly a decade, NASA's budget has been frozen at half its Apollo years peak, and funding for advanced planning and technology development is now only one tenth what it was. And that doesn't account for the de facto losses NASA can expect in building new shuttle boosters and a fourth orbiter with little added funding. Not even the announced retirement of the space program's arch-foe, Democratic senator William Proxmire of Wisconsin, has given space scientists hope that Congress will add appreciably more green to NASA's dark financial picture.

Just what it would cost to make a start on the *Mars Cycler* is not clear. It's an easy guess that a manned mission to Mars will not come cheaply, much less a whole cycler system. NASA officials are reluctant to name a price for any part of this package. "There's so much room for error on the engineering and cost that we don't feel comfortable with our estimate on any one piece of the system," hedges Johnson Space Center's Roberts. "When you work out a price for the whole program, a lot of these little errors cancel one another out, so we are more sure of that."

And the total? $160 000 000 087. It's probably safe to ignore that last $87 because the estimate is good only to plus or minus 20 percent. "Say between one hundred forty billion and one hundred eighty billion," Roberts concludes. "It comes to about ten billion dollars a year, including inflation. With inflation, that's only twice as much as the Apollo program."

Numbers like these, say the cycler proponents, can be misleading. The Apollo program cost $24 billion in 1967 dollars. In 1990 dollars, that translates into *at least $200 billion*. And we paid off the Apollo program in five years. The cycler program and payment for it would be spread out over 20 years. Roberts's estimate includes the first stage Mars base but not the variable-g research facility, the Earth station or the lunar cycleport. Figure a little less than $30 billion for the variable-g research facility and around $20 billion for each added cycler. So a four-cycler system could top $200 billion—to be paid for over a 20 year period. On a yearly basis it's less than what Apollo cost. But that could still be too big a bill, even for 20 years.

"There is just no way we can do this kind of mission as things stand," Roberts concedes. "Even with one percent growth we couldn't do a Mars mission in the next thirty years. There's no way we could ever do it if the budget stays flat, not in a hundred years. That may change."

The National Commission on Space has forecast two more years of economic drought in NASA's future but called for steady budget growth thereafter to $20 billion per year by the end of the century. If the gross national product grows steadily at 2.4 percent per year for the next 45 years—slightly better than it has done in the last 25—the space program would continue to soak up only half a percent of the nation's economy. That will require a commitment that cost-obsessed Washington has never been willing to make. Whether it will make that commitment is anyone's guess right now. For the near future, the likelihood of NASA's offering any financial support to the cycler idea appears bleak. At the Case for Mars conference held this past summer, James Fletcher, the head of NASA, gave general support to the *idea* of exploring Mars but stopped short of committing the agency to any one technology or timetable.

"I firmly believe we should go [to Mars]," he told the conference, "and I'm confident we will go. But the question is, When will we be ready?"

In the face of this ambivalence, Aldrin continues to lobby for his dream. He too made an appearance at the same conference to urge scientists to support a Mars mission and was joined in his efforts by fellow moon traveler and *Apollo 11* veteran Michael Collins. "America needs the space program," Aldrin told the scientists attending the conference, "because of the lift it gives men's souls."

Aldrin has another solution. Make the cycler an international project. "We could start with an international variable-gravity cycler," he says. "The habitat could be a derivative of *Skylab* with extra life support. I would like to see it launched by the Soviet Union into the same orbit as their *Mir* space station. A launch in 1992 could celebrate both Columbus and the seventy-fifth anniversary of the Soviet revolution."

In July 1985 Aldrin visited the Soviet Union to talk about a joint cycler program. "I didn't have much luck," he reports. "I spoke with Head Academician Roald Sagdeev, who is director of their Institute for Space Science. It was very frustrating. They just don't seem ready to talk about a large cooperative program. As things stand, a Russian will set foot on a Martian surface either Mars itself or one of its moons, before we go back to the moon."

If so, it will not be Aldrin's fault. Shortly after his trip to the Soviet Union, he went to Washington to give a report on his findings and to lobby yet again for a more ambitious space program. It is a habit that he intends to continue. ☒

EARTH

CONTINUED FROM PAGE 38

1985 did not have "enough safety measures for pesticides." The wastes will be discharged from a drain into the Mediterranean Sea, in the vicinity of a very crowded and highly populated area." He also identified a pesticide formulation plant near Cairo that had made many discharges into the Nile killing fish and causing conflicts with the surrounding "heavily populated areas." An official from the Ministry of Agriculture in Cairo confirmed that the plant represented a "potential Bhopal."

In Central America, pesticide manufacturing zones exist in the Dominican Republic and Guatemala. One investigator reported that most of Guatemala's pesticide plants "are practically in the middle of the city, and we have no safety measures."

Since the Bhopal pesticide disaster the world has been shaken by additional industrial accidents of major ecological significance. The worst occurred in the spring of 1986 in Chernobyl, USSR. A nuclear reactor exploded, spewing radioactivity into the atmosphere, which then carried it to every continent, contaminating food supplies all over the world.

Then came what Europeans call "ChernoBasel" or "Sandoz Bhopal" in the fall of 1986. A fire at a chemical warehouse owned by the multinational Sandoz, Inc. in Basel, Switzerland, led to the dumping of massive amounts of toxic substances, including 66,000 pounds of pesticides, into the Rhine River, one of the most important waterways in the world. Ciba-Geigy, a neighbor of Sandoz, also released a smaller load of toxic pesticides into the river during the same period.

"I think you're going to have to live with some of it [the risk]," Jackson Browning, a Union Carbide vice president, told a congressional committee. "Nobody wants a leak to occur. But to operate [the Institute, West Virginia] plant without any leaks at all for any length of time is just beyond our capabilities."

In the United States and overseas, the accidents continue, usually without fatalities, but often many people in surrounding communities are exposed to the chemicals. The long-term impact of pesticide poisoning on these victims' health is unknown. And the possibility of a worse accident remains ever present. "There is no question that Bhopal could happen in the United States," says Richard Boggs, a management consultant on employee safety and health issues. "You are dealing with such terribly dangerous chemicals that human failures or mechanical failures can be catastrophic. The potential is here, and it could happen maybe today, maybe fifty years from now." ☒

FICTION

Tearing down the walls of the scientific community is just the beginning for those afraid of the future

REBELS

BY LEWIS SHINER

Gunfire again. Before the project took over, back when this was a failing luxury hotel, Thomas's office had been the laundry room. He was in the back of the main building, a good half mile from the street, and the rifles sounded like firecrackers. It was the third time this week the *guardia* had opened up on demonstrators—nothing but warning shots so far, but the thought of it still made Thomas a little sick. Two days ago one of the kids, running away, had tried to climb the project fence and gotten hung up in the barbed wire on top.

His concentration was gone. He rolled away from the computer and picked up the letter again. It was on lined notebook paper and said, "Need to see you. Where are you hiding out? Love, Lindsey." The envelope had been addressed to him care of the Anthro Department at UT Austin, Please Forward. It had come in with the morning mail. He put it back in the envelope and put the

PAINTING BY DIEGO RIVERA

envelope in his shirt pocket. The shooting stopped, and now there was another noise, a roar that kept climbing and dropping in pitch. Heavy machinery.

Oh, Christ, Thomas thought. *A tank.*

His intercom hummed. "Wake up, Thomas," Sarah said. "The Sixties are over. Big Brother is here. They're coming in."

"What the hell are we supposed to do?"

"I don't know about you, but I'm going to lie down behind my desk and chant some mantras."

Sarah was overweight and pushing fifty. "That's really funny," Thomas said.

"I wasn't kidding. Look, don't do anything stupid, okay? It looks like the entire Mexican National Guard out there. They *will* kill you, okay?"

Thomas kicked the screen out of his window and crawled outside. Straight ahead was the crumbling orchestra pavilion, its wall of solar cells glistening in the afternoon sunlight. The smell of manure and damp earth drifted off the gardens in front of it. To his left, running for hundreds of yards back along the hillside, were experimental permiculture and agriculture plots, animal compounds, ponds, and stables. To his right were the front gates and the *guardia.*

Thomas watched the tank come over the fence. It had been a hell of a fence, eight feet high and topped with barbed wire, cutting them off from the hungry and the poor and the desperate. Now the poles snapped like toothpicks, and metal treads ground the chain links into the lawn.

The tank crawled past the ruins of the casino and parked up against the fountain. The casino had been the namesake of the Hotel Casino de la Selva back in the Twenties and Thirties, when it had been the social center of Cuernavaca. The project had put a geodesic dome over it, an aluminum framework and triangular insulating plastic pillows. Next to it the tank looked like a bloody-jawed tyrannosaur.

There looked to be about fifty soldiers. They would outnumber the project staff two to one. Thomas sprinted around the back of the main building, toward the swimming pool and the scattered guest cottages. The humidity glued his shirt to his back and bunched up his underwear between his legs. Beyond the dark, algal green of the swimming pool were the jai alai courts. The perpetually stoned botanists down here from Texas A&M had lost them to a new gene-spliced kudzu a year ago and been fighting to get them back ever since.

"Thomas!" It was one of the summer kids, out in the middle of the enormous pool on one of the ocean arks. He had his shirt open and was leaning off the boom. "What's happening?"

"We're busted," Thomas yelled. "Head for the fucking hills."

Between the pool and the back guest houses was a stretch of imported sand, with umbrellas and folding beach chairs. Weeds were slowly taking over, but the footing was still bad. Before Thomas could get across it he heard the slap of running feet on concrete and the unmistakable rattle that rifles make when they get lifted to the shoulder and cocked.

"¡Alto!"

Thomas stopped and slowly put up his arms. The soldiers took him into the mural room. Most of the others were already milling around in the middle of the floor, dwarfed by the fifty-foot ceilings and the allegorical figures on the walls. The project had been using it for their main dining room. The soldiers had pushed the tables and chairs off to one side so they could herd everyone together. Every so often the doors would open and another two or three people would straggle in from the back woods, soldiers behind them to shove them if they slowed down.

Thomas found Judy Shapiro, the project director. She and Bill Geisler were the center of attention, but they didn't have any answers either. Geisler was Shapiro's roommate and lover. He was also the only person on the project who didn't seem to know about her penchant for graduate students of either sex, the younger the better.

"To his right were the front gates and the guardia. He watched the tank come over the fence, the poles snapping like toothpicks, and metal treads grinding the chain links into the lawn."

They were both in their early thirties, almost ten years younger than Thomas, both veterans of the New Alchemy Institute on Cape Cod and the Lindisfarne Hamlet in Colorado. They were sunburned, earnest, and wore odd clothes. Geisler was project secretary, which meant he greased palms and got permits and generally tried to maintain Shapiro's supply lines to reality.

Thomas had his own title. He was project anthropologist. It didn't mean much, except that Margaret Mead used to hang out at New Alchemy, so Shapiro had wanted an anthropologist of her own. He was supposed to provide expertise on native shelters. In practice, when he wasn't doing the shitwork that was expected of them all, he had plenty of computer time to work on his own stuff. That being the application of Ilya Prigogine's dissipative structures to the Mayan collapse circa A.D. 900. He'd run out of funding at UT, the project had made him an offer, and now he'd been here two years, and there was a tank in the yard.

"I don't suppose *you* know anything?" Shapiro asked Thomas. He shook his head. "Stay close. We have to put up a united front."

Thomas wandered off, found a chair, and sat down. A *guardia* officer came in and stood for a while with his hands behind his back. He was bareheaded, and his uniform hung loosely off his shoulders. He looked about sixty. His hair was brown going to gray, a stigma of European blood. He was a captain, and Thomas suspected he wouldn't go much further. Indian ancestry was the thing these days.

Thomas had seen him out here before, asking questions, pounding his fist into his left hand. His name was Espinosa.

"This is everyone?" he asked Sarah, out of breath, came to stand next to Thomas's chair. Everybody else got more or less into a line facing Espinosa.

"I thought you were cowering behind your desk," Thomas said.

They dragged me out," she said. "The fascists."

Espinosa walked slowly down the line. He pointed to Shapiro and Geisler and, finally, to Thomas. "You three will stay here." His English was accented but clear enough. "The rest of you will go back to the United States, to your homes and families. You will be searched, and your belongings will be searched, but you will not be harmed. We will bring a bus to take you back to Mexico City, where you will take an airplane."

"Why you?" Sarah asked Thomas.

Seniority, I guess." Shapiro and Geisler had been here three years, since the beginning. Outside of Thomas and the clerical staff, like Sarah, everybody else was pretty recent. Thomas stood up, and Sarah put her arms around him. She was crying. "I don't want to go," she said. "There's going to be concrete everywhere and chlorine in the water. The food's going to taste wrong, and I'll get cancer."

"It's just temporary. Got to be. We'll get this straightened out and send for everybody again."

"God damn it, Thomas, don't patronize me. It's over. The world's not ready for us, and so they're going to destroy us."

'Sarah."

"G'bye, Thomas," she said, backing away. "Peace, love, and all that crap." She wiggled her fingers at him and then turned and let one of the soldiers lead her out.

It took half an hour to get the room cleared. Thomas was amazed to see how hard some of them fought to stay. Who was going to take care of the compost, who was going to check the pH in the fish tanks? What about aphids, what about nitrogen shortfalls?

One of the grad students, a thin girl from UCLA, tried to get loose. Espinosa signaled to one of his men, who slapped her hard across the face, jerked her arms behind her back, and marched her out.

But then, Thomas thought, *if they tried*

to drag me out, maybe I'd be fighting, too.

The place was seductive. He'd gotten comfortable with the idea of being out of the power grid, politically and ecologically.

Espinosa kept three soldiers behind with him. *They were just kids,* Thomas thought. The older ones would be fighting in the eastern jungles or the streets of Mexico City and Zihuatenejo.

"I want you to show me the weapons," Espinosa said.

Shapiro let out a theatrical sigh. "Is that all? The weapons business again? We haven't got any. How many times do we have to tell you?"

"It is known that you are supporting the rebels. We know this, you see. The rebels line up outside the gate. We don't look for the guns or the mortars. We look for the nerve gas. The virus."

"For God's sake," Shapiro said. "Those kids outside were protesters. They want us out of here as much as you do. In *spite* of the fact that your government asked us here in the first place."

"I am not playing with games here." Espinosa said. "The rebels must be stopped. They are fighting against legal, elected candidates. They are breaking the law."

It was a bad year for the Institutional Revolution. The PRI had been continuously in power now since 1946, and counting a few name changes they went all the way back to 1928. Parties didn't last that long by losing elections. Sometimes they just had to keep recounting the votes until they came out the way they were supposed to.

The PRI had tried that in Zihuatenejo and Taxco back in December, and people had started turning over cars and lighting matches. Half of Zihua had burned to the ground before the *guardia* shot enough people to quiet things down again.

"Okay, we hear you making all the right noises," Shapiro said. "What is it you want? *¿La mordida?*"

Thomas flinched. There was plenty of corruption in Mexico, but a certain style was expected. One didn't haggle over bribes in public.

"No, lady. I don't want you money. I want to see the things you have keep hidden from me. Everything, you understand?"

A couple dozen of the soldiers were searching the staff cottages. Thomas could hear drawers slamming and furniture being pushed around. They'd even dragged a couple of mattresses out onto the lawn and ripped them up with bayonets to make their position clear. Thomas felt sorry for Espinosa. What was the old man supposed to make of windmills that looked like toy rocket ships on top of miniature oil rigs? Five- and six-foot-high columnar fish tanks with giant water lilies floating on top? The glass walls and aquariums on the south sides of all the bungalows?

The worst was the solar wall: troughs of hyacinths inside a long, louvered greenhouse. It ran straight out from the main building to the fountain where the *guardia* had parked their tank. The project's sewage ran through troughs to get rid of the organics, then out to the fountain and a series of sand filters to clean and aerate it. But the greenhouse itself stank of shit.

Espinosa hesitated at the door, wrinkling his face.

"I'm with you," Thomas said. "But these folks don't seem to mind the smell of their own shit. All part of living in harmony with the planet."

"Fuck you," Thomas," Shapiro said.

"These people?" Espinosa said. "Are you not one of them?"

"That's something Thomas was never good at," Shapiro said. "Making up his mind. Committing himself."

"Could we maybe have a little less dissension in the ranks?" Geisler asked.

"I want to see inside," Espinosa said.

"What in hell for?" Shapiro asked.

"What better place to hide weapons?"

"Oh, Christ. Make yourself at home."

"You," Espinosa said, looking at Thomas. "You come with."

They went in. Thomas breathed through his mouth. He felt like he was getting shit on his tongue and gums. Espinosa made out that it didn't bother him, poking at the plants, bending over to check the undersides of the bracing under the troughs.

"There aren't any weapons," Thomas said.

"I want to believe you," Espinosa said. He rolled up one sleeve and felt around in the murky water. "Maybe I do believe you. But I don't trust you." There was a certain dry humor in the slant of his eyebrows. "You understand?"

"*Los requisitos.*" Formalities.

"*Claro que sí.*" Espinosa dried his arm thoroughly with a handkerchief and then dropped the handkerchief on the floor. It was like they had sealed some kind of bargain, though Thomas wasn't sure what it involved. They went back outside. A soldier came running up with a three-foot marijuana plant, dirt still crumbling off its roots. "*¡Mira capitán! ¡Marijuana!*"

"It's not ours," Shapiro said. "God damn it, I told everybody. No dope!"

Espinosa told the soldier in Spanish. "Go talk to the sergeant. See if he's found any drugs in the rooms." Then he looked at Shapiro. "You could go to jail for this, all of you. Smuggling the drugs and helping the rebels."

"I already told you—"

Geisler put a hand on her arm. "Judy, take it easy."

Espinosa wasn't bluffing. The plant was more than enough to get them into jail. And if their paperwork got lost and they spent months or years there, even died there, well, it had happened before.

Thomas's skin felt clammy. "Look," he said. "We're trying to cooperate. We didn't know about the marijuana." He was lying, of course, and so was Shapiro. The A&M

gang was famous for their killer hybrid pot If Espinosa tried to burn the plants he would stone all of Cuernavaca

"¡Sargento!" Espinosa shouted The sergeant came running back knees high British Army style Lock them up he said in English then repeated it in Spanish

The sergeant looked confused Where sir? he asked Espinosa in Spanish 'Everything is glass '

Think of something Espinosa said

The sergeant shut them in the kitchen One door led into the mural room and the rest of the main building and the other door led out by the pool Espinosa put guards on both of them It's time for supper anyway Thomas said He made himself an avocado sandwich and sat down at the long grease-soaked table

Shapiro ranted for ten or fifteen minutes about how none of this could be happening Finally she got hungry too and Thomas made some more sandwiches

Thomas hadn't worn a watch in over a year but he'd gotten pretty sensitive to the cycles of daylight Close to sunset the goats and chickens and parrots got restless and let out more than their usual amount of noise He made it to be about eight o clock when they heard the tank start up and drive away A few minutes later Espinosa came in He was slumping a bit looking his age

You can sleep in you same places tonight There will be guards at the door

You want something to eat? Thomas said We'll have to throw it out if you don't

Espinosa looked uncomfortable We meet here tomorrow morning Seven o' clock He turned and walked out again

None of the coftages had locks Thomas waited until dark to open his door and look out There were two guards neither over eighteen They started to raise their guns then saw the bottles in his hands He gave them each a beer and asked in Spanish if he could sit by the pool for a couple of minutes It was only a few yards away

If you try to run one of them apologized 'we'll have to shoot you

Claro " Thomas said

When they saw he just wanted to sit by the water they faded into the darkness and left him alone

The pool was gigantic the largest Thomas had ever seen It was the center of the project not just physically but metaphorically The project was a model of the world and the pool was its ocean It was stocked with mirror carp which made imitation tides when they thrashed their fails It had tilapia instead of whales to eat the algae and clean the water White amurs ate the bigger plants and the project ate the amurs and the tilapia Thomas was far enough into the metaphor that listening to the patter of the murky water against the tiles had become like listening to real waves It cleared his head relaxed him

Eventually he noticed an orange glow off to his right on the hotel side of the shallow end About the same time he smelled the smoke from the cigarette If had been so long since Thomas had actually seen anybody smoking tobacco that he was a little horrified"

I think Espinosa said at last "my men have not much discipline

They trusted me Thomas said Don't blame them for that

You are believers in trust you Northamericans True?

What do you mean?'

Tell me about you boats

You mean the ocean arks? The ark was anchored in the deep end Thomas could hear it scraping gently against the edges of the pool It was a hell of a design strong light simple made of balsa wood and epoxy It was twice as fast as the gasoline-powered boats it replaced silent needed no fuel or engine repairs

They use them on the south coast now true?

There's two of them in Zihuatenejo The people down there love them They're

"Espinosa dried his arm thoroughly with a handkerchief and then dropped the handkerchief on the floor. It was like they had sealed a bargain, though he wasn't sure what it involved."

catching twice the fish they used to

No Espinosa said The rebels have you boats now One is sunk The other they sail around in the bay It is a weapon now you see?

Stupid bastards Thomas thought They'd sunk a boat that could have fed hundreds for the rest of their lives For politics

You trust too much Espinosa said 'You trust the money and the tools and you think people are stupid that don't speak English as good as you

No Thomas said Maybe I used to think like that before I came here But people can change People can learn That's what this place is all about

I would like to believe you ' The orange light of the cigarette flew out over the pool and sizzled into the water Thomas heard a second splash as a carp struck at it But I don't trust you

Thomas went back to his room The guards who must have heard Espinosa complaining looked nervous as he shut them out He stuck a doorstop in the frame to wedge the door closed

He didn't want to think about Espinosa anymore He spread out Lindsey's letter on the bed next to him and tried to decipher it She had signed it Love —that had to count for something

What he wanted to believe was that she'd developed after all these years a physical passion for him that she could no longer deny None of the other men she'd had and God knew there had been enough of them had worked out Now Thomas would get his shot She was his brother's wife which had always been a problem Even though his brother was legally dead had disappeared from the Timberlawn Psychiatric Hospital in Dallas back in the late Seventies and hadn't been heard from since In those eight years Thomas had seen Lindsey maybe twice written to her a couple of times a year

But he hadn't forgotten her The first time he'd ever seen her was backstage after one of Eddie's concerts It would have been in the early Seventies sometime She was hanging all over Eddie She had on a thin white tank top and no bra leather jeans eyeliner all the way around her eyes boots with three inch heels and zippers A cigarette hung out of her mouth the smoke not as strong as her perfume Her hands rattled with too many rings and her hair was brittle from bleach

He was still used to thinking of Eddie as a little kid but seeing Lindsey changed all that Her image was primal A little kid wouldn't have been able to live up to her

It was bullshit of course Under the blatant sexual propaganda she was like anybody else She watched soap operas and read *Cosmo* and ate canned peach halves wrapped in a slice of Wonder Bread But Thomas had imprinted her as some kind of bush league sex goddess the way ducks imprint their mothers and his left-brain logic had no power over her

Thinking about her even now made his dick hard as a piece of lumber He pulled musty-smelling drapes over the fish tanks built into the south wall 'This could get ugly he told the fish You wouldn't want to see it He masturbated picturing Lindsey stretched out on her back arms reaching up for him breasts flattened a little toward the sides eyes a little crossed Kid stuff Then he drank a beer and took a shower and went to sleep

Espinosa met them in the kitchen for breakfast *huevos motulenos* This is good food he said Very rich '

Thanks Shapiro said 'since you sent our dishwashers home yesterday you can do your own dishes

Forget the dishes Espinosa said He looked at Thomas Today I want lo see what you do with the computer

Today Shapiro said is Thomas's day in the gardens There's nobody to trade out with him

Tomorrow maybe there *are* no gardens Today I look at the computer

Suit yourself ' Thomas said He put his dishes and Espinosa's in a sink full of water

CONTINUED ON PAGE 78

ARTICLE

HOW TO MAKE YOUR OWN SUPERCONDUCTORS

BY BRUCE SCHECHTER

"Let me show you what we are all so excited about," Kumar Patel, director of research at Bell Laboratories, said one warm day early in the spring of 1987. He smiled slyly, then plucked a dull, black disk about the size of a silver dollar from his pocket.

Patel placed the disk in a flat glass dish that was perched on a large cork. Next he reached for an ordinary thermos bottle with a cloud of condensation quietly pouring from its mouth. "This is just liquid nitrogen," he explained. "It's a very commonly used material; there's no big deal to it. Your doctor uses it to remove warts." Patel poured liquid nitrogen over the disk, and the substance (with a boiling point of -320° F, or 77° above absolute zero) bubbled in the warm office air.

After a few minutes, as the disk cooled, the boiling nitrogen quieted to a simmer. Patel then produced a small, powerful magnet—a silver cube a quarter of an inch on a side—and placed it in the air above the disk.

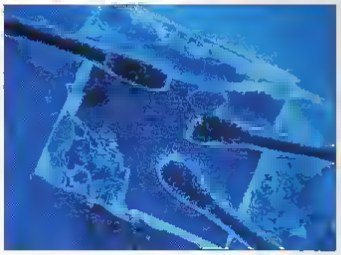
The black disk, chilled by the liquid nitrogen, had become a superconductor. And the small magnet just hung motionless in the space above it like a castle in the air.

By now even a casual peruser of newspapers and magazines has heard that scientists and engineers are excited by a breakthrough in a field with the immodest name of superconductivity. Ordinary electrical conductors exact a stiff energy toll on the electric current they carry, burning up a significant percentage of usable energy

"The new superconductors are so easy to make that even high-school students can whip them up in their labs. And they have"

in the form of heat. Superconductors, on the other hand, carry energy absolutely gratis. Because superconducting materials offer no resistance to moving electrons, they're the closest thing to a free lunch the universe has to offer. Casting about for a convenient analogy, journalists have compared the breakthrough to the invention of the transistor or the laser. Actually, it has the potential for being bigger than either of these. "The possibilities," says Praveen Chaudhari, vice president of the Science Research Division of IBM, "are indeed as awesome and wide reaching as the imagination can absorb, and they may affect the lives of all of us one day. In my twenty-one years as a scientist, I've never experienced anything as profound."

Most physicists agree. Without even thinking very hard, they have come up with dozens of practical applications. Superconducting power lines, for example, could save the large amount of electrical power that is now lost in the form of heat. Vastly powerful magnetic fields generated by superconductors could propel high-speed trains which would float atop the fields and travel between cities at 300 miles per hour. Superconductors could make computers faster and smaller, be the basis of better



medical scanners, and even drive more efficient household appliances. Once your eyes are trained, you will see applications for superconductivity anywhere. Wherever electricity is used or energy is wasted, superconductors could help. The twenty-first century commuter, for instance, might drive a superconducting car that levitates over a magnetic roadway. The highly complex superconducting computer that runs the car would be more powerful than the most advanced present-day computer and fit compactly into the dashboard. And as you gazed into the distance, your view would be unobstructed. The ugly, hulking power lines that once dominated the landscape would be replaced by compact superconducting solar collectors—devices that would be efficient and neat. Until just recently, of course, practical use of superconductors was elusive, to say the least.

The first superconductor was discovered in 1911 when Dutch physicist H. Kamerlingh Onnes cooled down a sample of mercury while measuring its electrical resistance. As expected, the resistance smoothly decreased with the falling temperature. Then, at about 4° above absolute zero, the mercury shed every last trace of its electrical resistance. As abruptly as water turning to ice, the normal mercury became a superconductor.

Over the next 50 years, scientists learned that almost any metal could become a superconductor. Superconducting compound materials—including niobium titanium, today used in medical scanners and atom smashers—were found as well. But no matter *what* the substance, it had to be cooled to nearly absolute zero before superconducting characteristics set in. And until the Fifties, *nobody* had any notion of just how these superconductors worked.

For more than half a century, superconductivity was one of the outstanding mysteries of physics. Then, in 1957, physicists John Bardeen, Leon Cooper, and John Schrieffer published a historic series of papers describing the phenomenon. The scientists, who won a Nobel prize for their work, in 1972, proceeded from an already well established observation that an electric current moving through an ordinary metal is essentially a stream of electrons flowing through a fixed crystal lattice. Electrical resistance arises when, from time to time, the electrons smash into the crystal lattice, losing energy. But in a superconductor, the scientists say, something very different happens. The electrons become attracted to one another and now, instead of traveling the lattice one by one, they travel in pairs. These electron pairs engage in an elaborate kind of dance. When one zigs, the other zags, and when one moves to the right, the other moves to the left. In other words, they become mirror images of each other, so that when the first electron bangs into an impurity, the second one ricochets, regaining the energy the first one lost. The net result is that the pair neither gains nor loses any energy as it travels through the crystal lattice of the metal. The metal thus has no electrical resistance and is called a superconductor.

But this new understanding brought scientists no closer to the goal of creating superconductors that functioned at temperatures higher than a few degrees above absolute zero. (Absolute zero is equivalent to approximately -273.15° C, the temperature at which every last bit of heat is removed.) To achieve these low temperatures, scientists had to use liquid helium and elaborate, bulky insulation. According to Patel, when you take cooling costs and other factors into account, using liquid ni-

Previous pages: Levitation achieved with a superconductor and two magnets. This page, top: A superconducting ceramic moving toward a magnet. Bottom: Electron microscope image of a high temperature superconductor.

trogen is about 1,000 times less expensive than using helium. So almost all of the wonderful applications of superconductors were used only where nothing else would do—as the magnets in giant atom smashers, for instance, and in the latest medical scanners. Technologists were teased and tantalized by the potential of superconductivity. They felt like starving men feasting on beautiful photographs of food.

Spurred by high-tech dreams, scientists have spent entire careers searching for materials that become superconductors at higher temperatures. The late Bernd Matthias, who divided his long career between Bell Labs and the University of California in San Diego, was the best known and most successful superconductor hunter. Guided by little more than intuition, Matthias and his co-workers discovered hundreds of superconductors, including the niobium compounds that form the basis of the current generation of practical superconducting devices. In their search for better superconductors, scientists left no plausible stone unturned and even had a go at some pretty implausible stones. On the belief that some biological molecules might be superconducting, for instance, one investigator bred bacteria in a strong magnetic field, hoping to grow superconducting bacteria. It was a crazy idea, but not quite crazy enough to work.

Room-temperature superconductors, of course, would be ideal. But superconductors that could be kept cool with the help of liquid nitrogen, which is cheaper than beer and can be kept overnight in a picnic cooler, would be a development of incalculable importance. After 75 years of research, however, nobody had even gotten close to nitrogen temperature. Most believed that nitrogen-temperature superconductors were simply impossible, that nature wasn't that obliging.

Nature, it turns out, has been not only obliging but magnanimous. Thanks to a stunning series of discoveries initiated by Alex Muller and Georg Bednorz of the IBM Zurich Research Center, scientists have found a class of materials that become superconductors at well above the temperature of liquid nitrogen. In fact, these materials, which become superconductors at 90° above absolute zero, are so easy to make that high-school students can whip them up in school labs. And they have.

Paul Grant, a research scientist at the IBM Almaden Research Center in San Jose, California, believes he has even come up with the first practical use of the new superconductors—science education. A few months after he and his colleagues had whipped up their first batch, he advised high school science teacher David Pribyl and his students from Gilroy, California (famous for its garlic), to have a go at making superconductors themselves. Grant feels that this must be some kind of record. "In less than six months a major discovery made the trip from the research laboratory to a high-school chemistry project," Grant says. "Next year science fairs will have hundreds of these experiments."

The new superconductors are made up of yttrium, barium, copper and oxygen—the chemical formula is $Y_1Ba_2Cu_3O_7$. The proportions of the yttrium, barium and copper have led scientists to call this material 123—a nice coincidence since making it is as easy as that.

To start, according to the recipe formulated by Grant, you will need some copper oxide, barium carbonate, and yttrium oxide. The first two are often found in high-school chemistry labs. All three can be obtained from almost any chemical supply house or, as Grant suggests, scrounged from a nearby university or junior college. The chemicals need not be all that pure—99.9 percent is fine. As the formula implies, the proportions of the three chemicals should be one part yttrium to two parts barium to three parts copper. According to Grant, 1.13 grams yttrium oxide, 3.95 grams barium carbonate, and 2.39 grams copper oxide will do just fine.

"The specter of a magnet hanging motionless in space should propel as many students into the sciences as the ominous beeping of Sputnik did a generation ago."

Grind the chemicals to a fine powder with a mortar and pestle, obtainable at any chemical warehouse. Next, bake the powders in a kiln at a temperature of between 900° and 950° C for 12 hours. Turn off the kiln and, without removing the mixture, allow it to cool. This should take five or six hours. The resulting material should be a fragile black mass. Grind it up again and place the powder in a disk-shaped die about a half inch in diameter. Place a metal anvil (a piston that just fits in the die) over the powder and compress it in a hydraulic press to 15,000 to 18,000 pounds. Such a hydraulic press is found in most high-school machine shops.

The resulting disk is not yet a superconductor because, although it contains the right proportions of yttrium, barium and copper, it does not contain enough oxygen. The disk must be baked again, this time in a gentle flow of oxygen, which can be pumped back into the kiln with the sort of tube found in any chemistry lab. (Adding oxygen isn't strictly necessary, but it makes for a better superconductor.) The students at Gilroy High used oxygen obtained from their school's machine shop. The material is again baked at 950° C, but it is crucial to cool it very slowly—eight hours at the minimum—to ensure it absorbs enough oxygen.

To make sure your project is successful you must be particularly careful about a few common pitfalls. Temperature is critical. While baking your material at 950° C is ideal, cooking it at 1,000° often means failure. You must make sure you cool your disk down *slowly* and measure your ingredients carefully. Above all, keep your lab bench clean. Contaminating one substance with another drastically lowers your chance of success. Please remember, recipes are rarely complete. The experienced chef knows this and fills in missing steps unconsciously. The same is true of laboratory recipes. The consequences of mistakes in the kitchen are only unpalatable; laboratory mistakes can be dangerous or even deadly. So have a professional, such as a science teacher, in the room while the work is being done.

But if all goes well, your disk will be a superconductor. To prove this you will need some liquid nitrogen (which can be obtained from a local college, dermatologist or welding supply house), an insulated cup, and a sliver of a samarium-cobalt magnet. The last is a powerful, lightweight magnet available from, among other sources, Edmund Scientific in Barrington, New Jersey.

Invert the insulated cup and place the disk of 123 on the slightly concave cup bottom. Handle the 123 with plastic tweezers because it crumbles when it absorbs moisture. Put a sliver of the magnet on top of the disk and pour on a little liquid nitrogen, just enough to almost submerge the disk. As it cools, the 123 disk becomes furred with ice. And then the magic. The disk becomes superconducting, and the magnet leaps into the air.

Already Arthur Ellis of the chemistry department of the University of Wisconsin-Madison plans to put together a levitation kit that includes a superconducting disk and magnet. And as far as Grant is concerned, the specter of a magnet hanging in space should propel as many students into science as the ominous beeping of *Sputnik* did a generation ago. There will be kids growing up as familiar with superconductivity," he says, "as the present generation is with lasers and computers. I don't want to oversell it, but it is to our benefit to have an electorate that is well educated in the science of the day."

Whether or not you go to the trouble of making your own superconductor, you can still enter *Omni*'s Superconstruction contest. We would like you to submit 200 words or less on the most creative future superconducting invention you can think of. Your entry may have worldwide implications or may simply be fun. A panel of judges will review all submissions, and the winner will receive $500. Please send entries to Superconstruction, *Omni*, 1965 Broadway, New York, NY 10023.

REBELS

CONTINUED FROM PAGE 70

They went to his office and Thomas turned on his PC. "You want to see my stuff or the project stuff?" He was networked to the project database and could call in any of the monitor programs.

"You," Espinosa said.

Thomas logged on and called up his mapping program. He was suddenly conscious of his open window of the screen lying out on the lawn where he'd kicked it. Espinosa didn't say anything about it, so neither did he. But the memory of the tank, the rifles, the men pawing through the cottages, was a physical presence in the room.

A graph scrolled down the CRT. It looked a little like a topographical map, the various regions shaded with dots, brackets, plus signs, asterisks, and rectangles.

"This is a trend surface analysis of Mayan sites," Thomas said in explanation. The words came out fast and harsh. "It's a kind of regression analysis, using the region as a response surface."

"Trend – surface – analysis," Espinosa said. He looked as if someone were explaining to him why his children were dead. Sad, frightened, unable to understand. Thomas suddenly saw the deliberate sadism in what he was doing, slapping Espinosa around with words and machines that were as alien as he could make them. He swiveled around in his chair.

"Look," he said. "I understand your position. You don't want to be here. The government's scared, you're scared, you're grabbing at straws. *Es decir, asi'rse a un bledo, ¿okey?*"

"Just talk English. I understand you."

"Maybe you're afraid of this place. Because you don't understand what's going on here. But there's no big mystery to it. I can show you how to use a computer this afternoon."

"My son, he uses the computers at the university city. We don't afraid of computers."

"Okay, fine. But what I'm saying is, this isn't what you're looking for. This is ancient history. This is about the Mayan collapse, a thousand years ago. It shows when the cities died out. We're still trying to figure out why it happened."

"Maybe they had rebels," Espinosa said.

"Maybe they did. It was in fact one of the models he was testing, and consistent with Prigogine's work."

"The dark areas, they are the most recent?"

"Kind of," Thomas said. "It's showing a lot of different things at once. Population, economy, what the land is like, government."

Espinosa was nodding. "My son is study the what you call it. Science of politics."

"Probably a real good idea," Thomas said.

One of the soldiers knocked on the open door and came in. "There is a woman," he said to Espinosa in Spanish. "A *gringa*, blond. Looking for him." He tilted his head toward Thomas.

"Lindsey," Thomas said, his throat closing up on him. "*Se llama* Lindsey."

The soldier looked at him. "*Si, verdad.*"

"*Okey*," Espinosa said. "Search her. But be careful with your hands, you understand me? And bring her to me."

Thomas got up, sat back down again. Espinosa was watching, and he seemed to relax a little for the first time. *It's the first weakness any of us have let him see*, Thomas thought. *We've been holed up here like some kind of pale foreign gods, doling out favors and expecting to be loved in return. No wonder they resent us.*

"She is you girlfriend?" Espinosa asked gently.

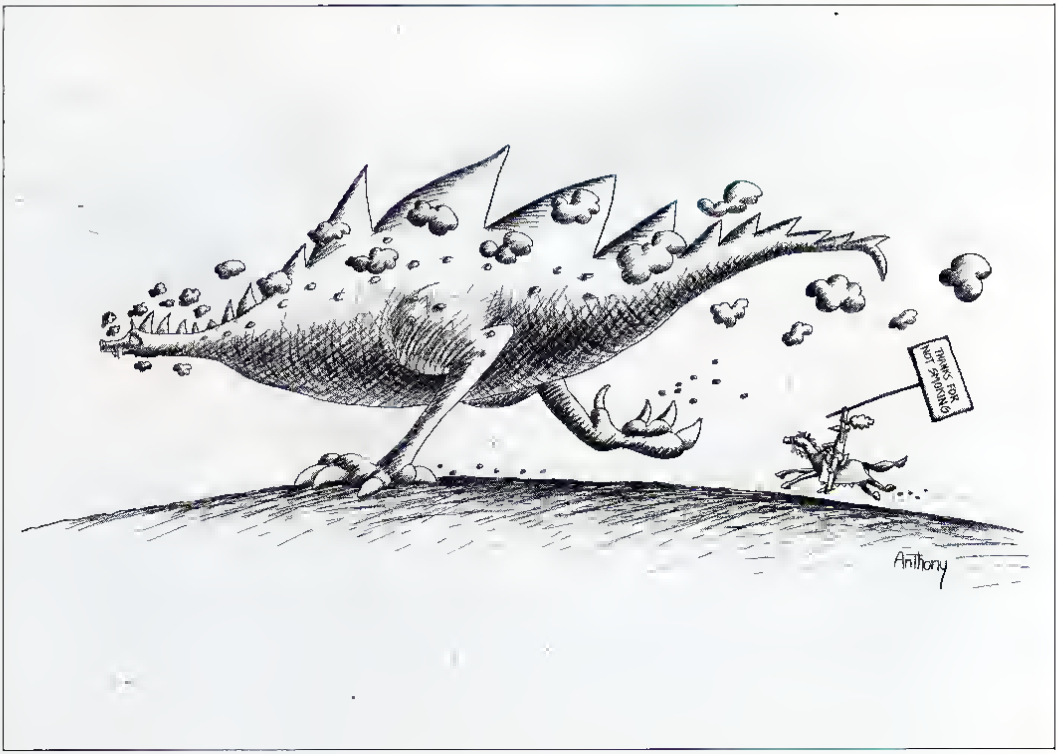
"No," Thomas said. "Just – she's just a friend."

"*Si, claro*," Espinosa said. "Of course." If was the way he might have smiled at his son, at the university in Mexico City.

The guard brought her in, and Thomas stood up again.

"Nothing, sir," the guard said in Spanish, and Espinosa nodded him away.

Her hair was darker, not quite brown, and some of the long strands had gone white.



She still wore eye makeup, but the eyes looked softer, set in a web of fine lines like the ones that had come up at the corners of her mouth. No other makeup except a little pale lipstick. Nothing to hide anymore. She wore a simple knit dress, navy blue, loose enough to fit local standards of modesty. Flat shoes, no jewelry.

Except her wedding ring.

"You look wonderful," Thomas said. "I can't believe how good you look."

"You, too." Lindsey said. She had trouble meeting his eyes. She held on to her bare upper arms, forearms crossed over her chest. Thomas saw she wasn't going to hug him. The rest of his fantasies crumbled and blew away like fairy dust.

Your whole life has been like this, he told himself. *You've been sitting around waiting for someone or some idea to come along and sweep you off your feet. How much longer are you going to wait?*

He offered her his chair, and she settled cautiously, tugging on the hem of her dress, fiddling with her purse. Finally she looked at Espinosa and then at Thomas. "What in God's name is going on here?"

Thomas shrugged. "Up until yesterday we were trying to save the world. New energy sources, new food supplies, new shelters, the whole bit. Now it looks like the world is not interested in being saved." He wanted a reaction from Espinosa, but he didn't get one.

Are you, like, under arrest or something?"

"I don't know. *Digame, Capitan Espinosa,* am I under arrest?"

"Not officially. Not right now."

"Can we talk?" Lindsey asked. "I mean, in private? It's ... it's a personal matter."

"Ah." Espinosa said. He put his hand around his chin and looked away. After a few seconds he said, "We go outside. You sit and talk, far enough away we don't hear you, but we can see everything."

So I don't give her any microfilm.

No film, no virus, no nerve gas. Thomas could no longer tell whether Espinosa was kidding or not.

"I have to show him a picture," Lindsey said. Is that okay?

"Show to me."

Lindsey passed him a three-by-five black-and-white print. Espinosa looked at it very hard for a few seconds, then turned it over a couple of times. He shrugged and handed it to Thomas.

It showed three Mayans in robes, laughing and smoking dark conical cigars. A fourth man, with equally long hair and the same kind of cotton robe, looked like he was trying to get out of the picture.

The fourth man was his brother Eddie.

They sat on folding chairs by the pool. Thomas shifted from side to side, listening to the sand crunch under the runners of the chair. "Do you want to talk about it or not?" Lindsey asked.

"Sure," Thomas said. "Where did you get the picture?"

"Some kid reporter took it. He's on assignment for *Rolling Stone* trying to get an interview with the rebels. He did a feature on the Lacondones while he was waiting. His editor knew Eddie in the Seventies and recognized him."

"So now what happens?"

"So now I go up there and look for him. What else?"

Thomas shrugged.

"For Christ's sake!" Lindsey said. "What the hell's wrong with you? If this *is* Eddie, then it means he's okay! He's alive! He's your *brother,* for Christ's sake! Don't you care?"

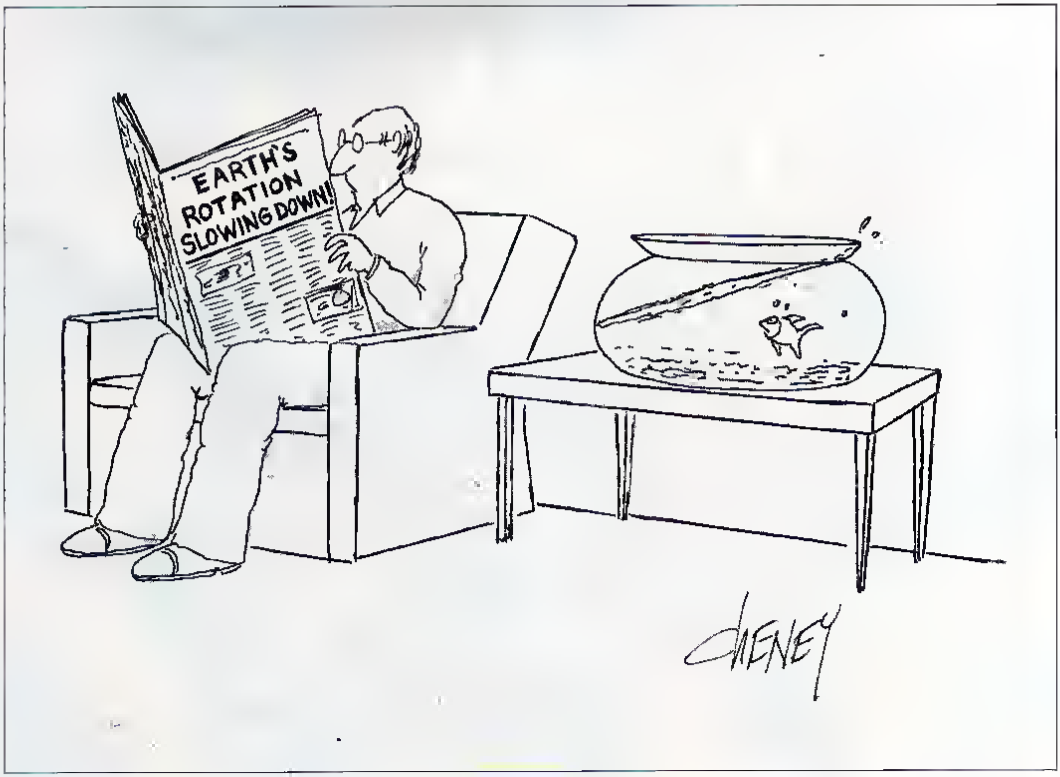
"I care." Thomas said. "Maybe I care more than you do. I care enough to leave him the fuck alone if he wants. Look, even if I could get away from here, even if we could talk Espinosa into letting me go, who says Eddie even *wants* to be found?"

"Maybe he has amnesia."

Amnesia. Shit. Maybe it's not Eddie at all, maybe it's his evil twin. You watch too much TV.

"What do you want me to do, just forget about him?"

"That's *exactly* what you should do. The entire country is coming down around our ears. Those mountains are full of rebels.



and the *guardia* is going nuts trying to find them. If you get caught up in that you're going to need somebody to rescue *you*."

"That's why I want you to come with me."

"You're chasing the past. Eddie chucked it all ten years ago. He cut his records and said what he had to say and got out. He's finished. He's retired. If he wants to play Indian for the rest of his life, he's entitled."

"What about you? Are you retired, too?"

Thomas remembered the look on Espinosa's face when he talked about his kid. For the first time, he saw through to something that he doubted Geisler and Shapiro had ever seen. Espinosa's kid: the son of a career military man in a Third World country, plugging away on his CRT. If that wasn't the future, he didn't know what was.

"I don't think so," he said. "I think maybe I'm just getting started. I've been standing around here for a couple of years with my thumb up my ass when there's real work to be done. Changing people's heads. People like Espinosa. Maybe stopping the next Chernobyl or Bhopal before we kill off the whole planet."

She shook her head. "You tell me I'm living in the past, and then you start up with all this Woodstock generation crap. You're not going to change anything hiding out down here."

"Who's hiding out?" Thomas said. "They're right up against the future every day here. They've got close to a thousand sensors all over the complex, feeding a central computer. They've got plans to retrofit entire cities with solar technology, to teach poor villages how to build boats like that one there—"

"Listen to you. You keep saying 'they.' I hear everything you're saying, but I don't buy it. I think you're kidding yourself. People aren't going to tear down all their beautiful ranch-style homes and start living in greenhouses. Things are just going to go on the way they always have."

Thomas looked down at his sneakers, tapping the sides together. "You know what they say about me here? They say I'm *sanpaku*. It's Japanese or something. It means I show too much white along the bottoms of my eyes. It's supposed to mean I'm out of balance or something. Well, maybe I am. I'm forty-one years old. I'm divorced, no kids, no house, no car, no pension. It's time for me to start believing in something."

"Thomas—"

"No," he said. "Maybe we can't change everything overnight. But we can get started. A little at a time. Retrofitting, rebuilding. When the ranch houses fall down, we can put up something better. Even just getting the information *out* there would be something." Finally he looked at her. "It's time for me to do this," he said. "It's what I want." They both got up. She put out her hand, and Thomas took her in his arms, just because he wanted to. He held her until she relaxed and put her arms around him, too. The smell of her hair was sweet, intoxicating, but when he tried to concentrate on it, it went away. It was like he was already trying to remember it. He was the first to let go.

"I'm at the Hotel Capitol," she said. "Calle Uruguay, near the Alameda. If you change your mind—"

"Not this time," Thomas said.

She stopped once by the far side of the pool and looked back. Thomas sat down and stared into the water, and finally she went away.

Espinosa sat in the chair next to him, the one where Lindsey had been sitting. "She want you to leave with her?"

"Yeah," Thomas said. "That's what she wanted."

"She is a very beautiful woman. Very handsome."

Thomas nodded. He picked up a thumb-size chunk of cement and tossed it at the nearest carp. The water killed its momentum. It drifted slowly past the nose of the fish, which had backed up two inches to watch it. *Fuck you, too,* Thomas thought.

"I could let you go," Espinosa said. "To go with her. You don't need to be here."

He means it. Thomas decided. No ulterior motives, no bullshit. It made him painfully self-conscious. "No," he said. "Thank you. But no. I want to stay here."

"It is so important to you? This work?"

"Yes," Thomas said. "This work."

"Do we get our people back?" Shapiro asked. They were in the mural room again. Espinosa had brought two of his men along, but their rifles were slung over their shoulders, out of the way.

"No," Espinosa said. "We are not responsible for so many Northamericans all in one place."

"Then what's the point? The three of us can't run this place by ourselves."

"The Republic will be you partner now. We bring in people to help you."

"Great," Geisler muttered. "We've just been nationalized."

"What people?" Shapiro asked. "The Army?"

"No. I think maybe my son like to work here. He can bring others from the university city to help him."

"Your *son*?" Shapiro said. "What kind of bullshit stunt—"

"Judy," Thomas said, "just shut up for once." He nodded to Espinosa. "I think that's really a good idea. I look forward to meeting your son. I think we'll all have a lot to learn from each other."

"Thomas," Shapiro said.

He held up one hand. "Not right now, okay? Maybe later." He walked over to the door. His footsteps were very loud on the parquet. "I think you guys can get along fine without me, and I've got a lot of work to do."

There were parrots in the trees behind the gardens. They had the intonations of speech, but none of the sense. Thomas found their cries somehow comforting as he knelt in the damp black earth and started pulling weeds. ☒

CONTINUED FROM PAGE 20

something out of the experience if they feel they deserve more, then the process works better." It's crucial, Hart notes, that people trust the other members of the group.

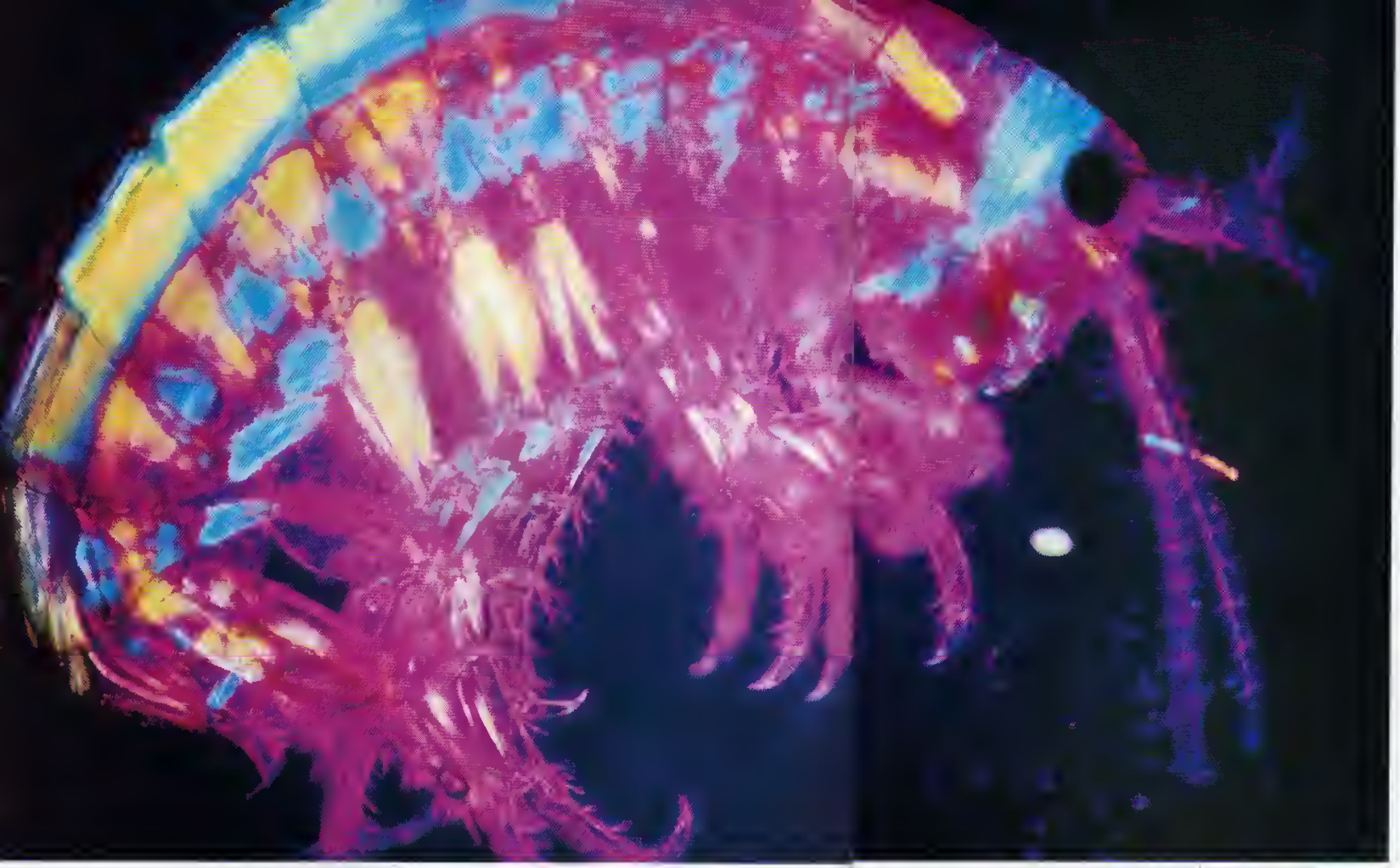
Henry Herrerra, professor of psychiatry and medicine at the University of Rochester School of Medicine and Dentistry, agrees. "There are common elements in all activities intended to change behavior or points of view," he says. "It's very important in all the healing professions that participants share the same worldview with the therapist and that they believe in the therapy and the therapist."

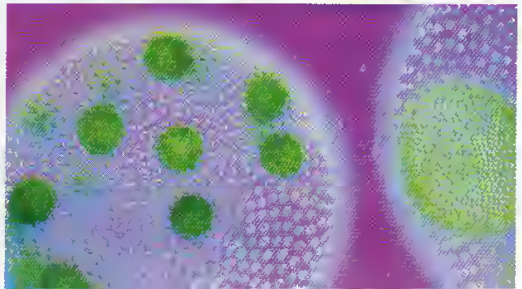
Herrerra, however, questions whether Hart's future-drama technique has been evaluated using methods of assessment such as the use of control groups to judge the effectiveness of the treatment. "I have no doubt that people derive psychological benefits from this experience," Herrerra says. "But I would want to know if the effects are uniform, how long the benefits last, and what the risks to participants are, if any." Too many New Age therapies are not rigorously evaluated today, Herrerra adds.

Hart charges $10 to $15 for an hour-and-a-half session. Some companies spend as much as $1,500 for a full weekend. He now plans to join forces with Raghu Nath, a University of Pittsburgh management professor, to build a series of high-technology centers. Advanced computer robotics and electronics companies would collaborate to push American technology to the edge of the avant-garde. As part of that effort, each center would contain one building devoted to what Hart calls "high-socio-technology": the application of sociometric techniques like future travel to help human relationships keep pace with rapidly developing high technologies.

"Ninety-five percent of the small high-tech companies that start up fold within a few years," says Nath. "After the initial phase, management stiffens up and acts without imagination." Nath thinks that future travel could help prevent American high-tech companies from stagnating. "Using this technique," he says, "would keep management fluid and move businesspeople from thinking only about everyday considerations into realms of pure creativity."

Increasingly, corporations are using self-realization techniques such as future travel as a management tool to promote creativity. "I find this phenomenon very curious," Herrerra comments. "We're supposed to be a highly developed technological and scientific culture, but more and more people are seeking some kind of symbolic, transcendental experience—a religious experience." Herrerra believes that this trend in big business forces us to ask questions about our need for values and meaning in contemporary society. "It's obvious that we are not capable of sustaining a purely technological culture," he says. ☒





LITTLE DROP OF HORRORS

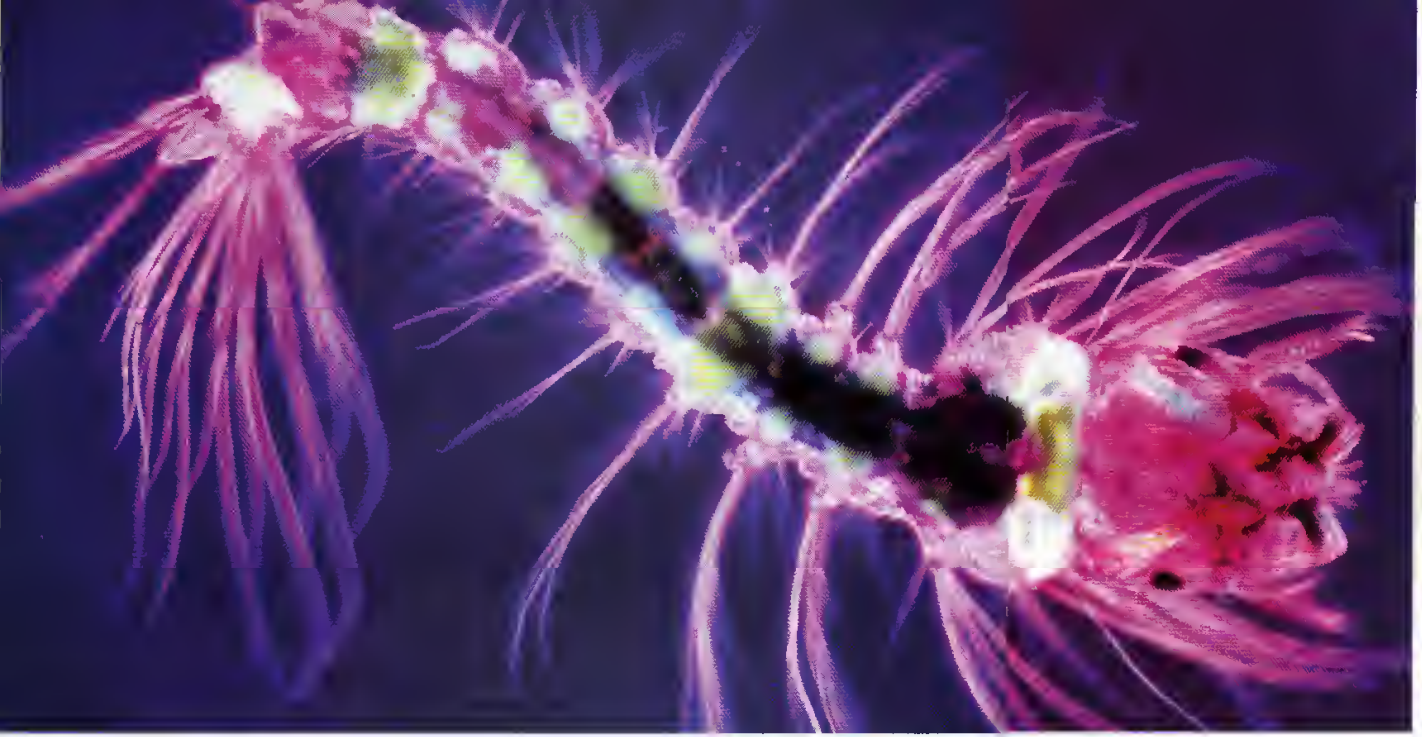
BY HENRY WOUK

These strange hairy beasties extraterrestrial flowers and elegant abstracts are trophies of the hunt The hunter is retired microbiologist Alex Rakosy He conducts his photo safaris in the unexotic lands of Illinois and Indiana in ponds less than an hour s drive from his home near Chicago

Over the last nine years he has tracked down and photographed hundreds of the exotic flora and fauna that can be found in a drop of fresh pond water Packing nothing more lethal than a fine-mesh plankton net, the scientist/photographer skims water samples from suburban ponds He then brings them back to his home laboratory where he sorts through his microscopic trophies and photographs them using a technique called optical staining

Chemical staining employed in conventional photomicrography highlights microorganisms with color dyes One problem The small creatures not only die from the staining process but their delicate structures are damaged as well

Rakosy has devised a way to get vivid color photos of living micro-creatures like the tiny freshwater shrimp (left) and the fragile colony of green algae (below) without obliterating them He photographs his captives in their drop-of-water habitats and adds various hues with a series of colored filters attached to his camera lens It doesn t intertere with the creatures' well-being at all he says of the process so you see the living organisms just as they appear in their natural habitats You also

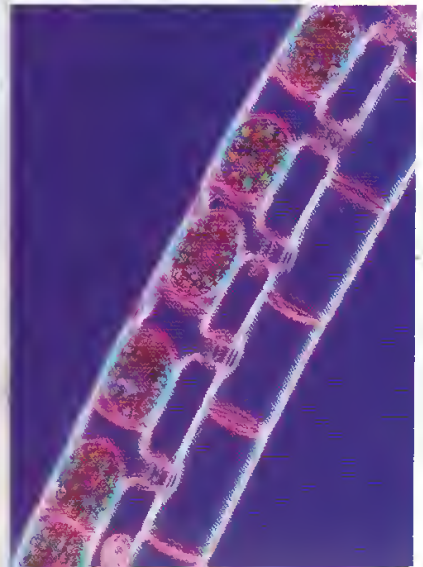


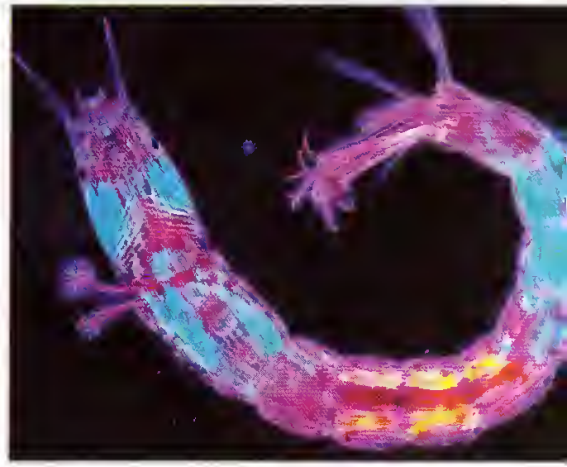
get to see parts of an organism that you would not get to see any other way like the fine hair structures on the body of the mosquito larva' (above)

Rakosy sets out on safaris in the early spring and travels to vernal ponds bodies of fresh water formed by the melting snows These pools are microcosms in the literal sense of the word Many of the same organisms found in suburban ponds can be found all over the world—in New Zealand Africa or the Malay Peninsula he points out "These creatures are the beginning of the food chain—true primordial life Without them there would be no higher forms of life

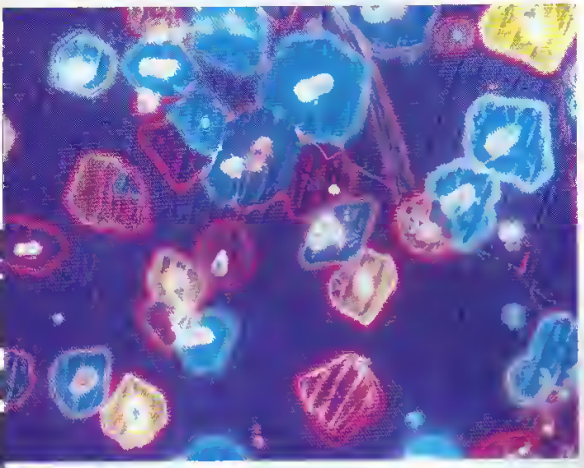
Every pond he has found has its own characteristic life forms and its own life span The environments in which these creatures dwell are as fragile as they are The average vernal pond Rakosy estimates lasts barely four months Thus what was a body of water teeming with life in

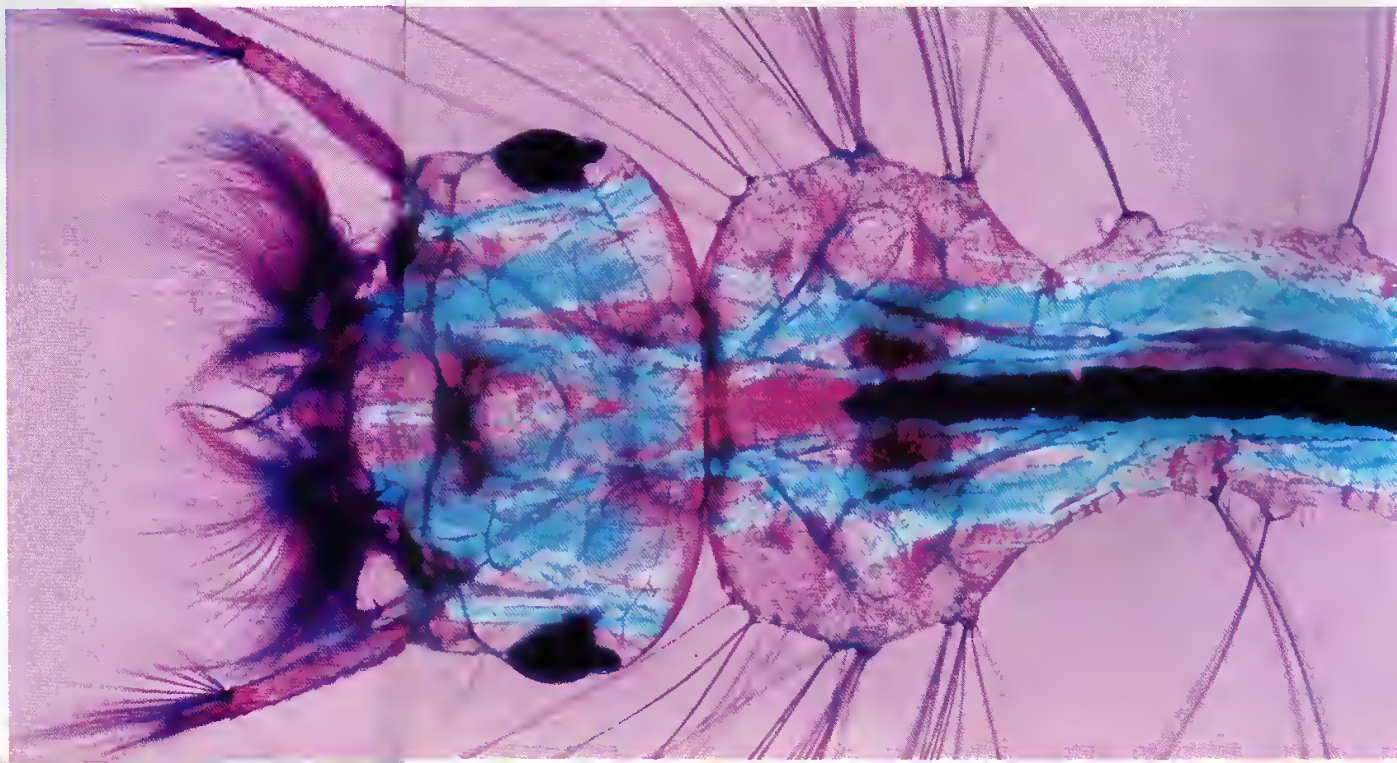
Rakosy's sensitive photo technique captures the delicate structure of the larva of an anopheles mosquito (above) green algae in the early stages of growth (above right), the larva of a midge (far right) and reproducing algae (right)





"Many of the same organisms found in suburban ponds can be found all over the world"





"The cycle of birth, life, and death in this little universe is, by our standards, all too brief."

March is a barren stretch of parched land in midsummer. The cycle of birth, life, and death in this universe is, by our standards, all too brief.

His explorations, which he describes as a kind of "wildlife photography under the microscope," have shown there are aesthetic as well as scientific dimensions to the world visible through his microscope. Over time he began noticing the recurrence of designs in nature, like the ragged pattern made by the crystals found under one insect's carapace (far left). The more of these he collected, the more a sense of déjà vu crept over him. Then one day he realized where he had seen these designs: on the canvases of abstract painters like Joan Miró, Wassily Kandinsky, and Paul Klee. Rakosy has now moved on from simply cataloging the creatures of this tiny universe to searching it for designs evocative of the masters. Even in a drop of water, art and life become one.

Tiny crystals on an insect's shell (far left), a small crustacean with two egg sacs (left), the flowerlike structure of a protozoa colony (below left), and the fragile culex mosquito larva (below) were all found in a drop of pond water

FICTION

DINER

Henry is planning an all-American Independence Day celebration, but everyone knows he can't deliver

BY NEAL BARRETT, JR

He woke sometime before dawn and brought the dream back with him out of sleep. The four little girls attended Catholic junior high in Corpus Christi. Their hand-painted guitars depicted tropical Cuban nights. They played the same chord again and again, a dull repetition like small wads of paper hitting a drum. The light was still smoky, the furniture unrevealed. He made his way carefully across the room. The screened-in porch enclosed the front side of the house facing the Gulf, allowing the breeze to flow in three directions. He could hear rolling surf, smell the sharp tang of iodine in the air. Yet something was clearly wrong. The water, the sand, the sky had disappeared, lost behind dark coagulation. With sudden understanding he saw the screen was clotted with bugs. Grasshoppers blotted out the morning. They were bouncing off the screen, swarming in drunken legions. He ran outside and down the stairs, knowing what he'd find. The garden was gone. A month before, he'd covered the small plot of ground with old window screens and bricks. The hoppers had collapsed the whole device. His pitiful stands of lettuce were cropped clean, razored on the ground as if he'd clipped them with a mower. Radishes, carrots, the whole bit. Eaten to the stalk. Then it occurred to him he was naked and under attack. Grasshopper socks knitted their

PAINTING BY RALPH GOINGS

way up to his knees. Something considered his crotch. He yelled and struck out blindly, intent on knocking hoppers silly. The fight was next to useless, and he retreated up the stairs.

Jenny woke while he was dressing.

"Something wrong? Did you yell just a minute ago?"

"Hoppers. They're all over the place."

"Oh, Mack."

"Little fuckers ate my salad bar."

"I'm sorry. It was doing so good."

"It isn't doing good now." He started looking for his hat.

"You want something to eat?"

"I'll grab something at Henry's."

She came to him, still unsteady from sleep, awkward and fetching at once. Minnie Mouse T-shirt ragged as a kite. A certain yielding coming against him.

"I got to go to work."

"Your loss, man."

"I dreamed of little Mexican girls."

"Good for you." She stepped back to gather her hair, her eyes somewhere else.

"Nothing happened. They played real bad guitar."

"So you say."

He made his way past the dunes and the ragged stands of sea grass, following the path over soft, dry sand to solid beach, the dark rows of houses on stilts off to his right. The Gulf rolling in, brown as mud, giving schools of mullet a ride. The hoppers had moved on, leaving dead and wounded behind. The sun came up behind dull, anemic clouds. Two skinny boys searched the ocean's morning debris. He found a pack of Agricultural Hero cigarettes in his pocket and cupped his hands against the wind. George Panagopoulos said there wasn't any tobacco in them at all. Said they made them out of half-dried shit and halt kelp and that the shit wasn't bad, but he couldn't abide the kelp. Where the sandy road angled into the beach, he cut back and crossed Highway 87, the asphalt cracked and covered with sand, the tough coastal grass crowding in. The highway trailed southwest for two miles, dropping off abruptly where the red-white-and-blue Galveston ferries used to run, the other end stretching northeast up the narrow strip of Bolivar Peninsula past Crystal Beach and Gilchrist, then off the peninsula to High Island and Sabine Pass.

Mack began to find Henry's posters north of the road. They were tacked on telephone poles and fences, on the door of the derelict Texaco station wherever Henry had wandered in this merchandising adventure. He gathered them in as he walked, snapping them off like paper towels. The sun began to bake, hot wind stinging up sand in tiny storms. The posters said:

FOURTH OF JULY PICNIC AT HENRY ORTEGAS DINER. ALL THE BARBECUE PORK YOU CAN EAT. EL DIOS BLESS AMERICA.

Henry had drawn the posters on the backs of green accounting forms salvaged from the Sand Palace Motor Home Inn. Even if he'd gotten Rose to help, it was a formidable undertaking.

No easy task to do individually rendered, slightly crazed, and plainly cokeeyed fathers of our country. Every George Washington wore a natty clip-on Second Inaugural tie and, for some reason, a sporty little Matamoros pimp mustache. Now and then, along the borders, an extra reader bonus: snappy American flags or red cherry bombs going *kapow*.

Mack walked on, picking posters. Squinting back east, he saw water flat as slate, vanishing farther out with tricks of the eye. Something jumped out there or something didn't.

Jase and Morgan were in the diner, and George Panagopoulos and Fleece. They were a collection of gimmie caps and patched-up tennis shoes, jeans stiff and sequined with the residue of fish. Mack took the third stool down. Fleece said it might

"Henry's standing over the stove behind the counter, poking something flat across the grill, concentrating intently because he's already seen the posters rolled up and stuffed in Mack's pocket."

get hotter. Mack agreed it could. Jase leaned down the counter.

"Hoppers get your garden, too?"

"Right down to bedrock is all," Mack said. "I had this tomato." Panagopoulos said this one little asshole tomato 'bout half as big as a plum. "I'm taking a piss and hear these hoppers coming and I'm down and out of the house like that. I'm down there in what, maybe ten, twenty seconds flat, and this tomato's a little bugger and a seed. You know? A little bugger hanging down, and that's all." He made a swipe at his nose, held up a finger, and looked startled and goggle-eyed.

Mack pretended to study the menu and ordered KC steak and fries and coffee and three eggs over easy, and all this time Henry's standing over the charcoal stove behind the counter, poking something flat across the grill, concentrating intently on this because he's already seen the posters rolled up and stuffed in Mack's pocket and he knows he'll have to look right at Mack sooner or later.

"Galveston's got trouble," Jase said. "Dutch rowed back from seeing that woman in Clute looks like a frog. Said nobody's seen Mendez for 'bout a week."

"Eddie's a good man for a Mex," Morgan said from down the counter. "He'll stand up for you, he thinks you're in the right."

Mack felt the others waiting. He wondered if he really wanted to get into this or let it go.

Fleece jumped in. "Saw Doc this morning, sneaking up the dunes 'bout daylight. Gotta know it those hoppers eat his dope."

Everyone laughed except Morgan. Mack was silently grateful.

"I seen that dope," Jase said. "What it is, there's maybe three tomato plants 'bout high as a baby's dick."

"I don't want to hear nothin' about tomatoes," said Panagopoulos.

"Don't make any difference what it is," Fleece said. "Man determined to get high, he going to do it."

Panagopoulos told Mack that Dutch's woman up in Clute heard someone had seen a flock of chickens. Right near Umbrella Point. Rhode Island Reds running loose out on the beach.

Mack said fine. There was always a good chicken rumor going around somewhere. That or someone saw a horse or a pack of dogs. Miss Aubrey Gain of Alvin swore on Jesus there was a pride of Siamese cats in Liberty County.

Mack wolfed down his food. He didn't look at his plate. If you didn't look close, you maybe couldn't figure what the hot peppers were covering up.

When he got up to go, he said, "Real tasty, Henry," and then, as if the thought had suddenly occurred, "All right if you and me talk for a minute?"

Henry followed him out. Mack saw the misery in his face. He tried on roles like hats. Humble peon. An extra in *Viva Zapata!* Wily tourist guide with gold teeth and connections. Nothing fit. He looked like Cesar Romero, and this was his cross. Nothing could rob him of dignity. No one would pity a man with such bearing.

Mack took out the roll of posters and gave them back. "You know better than that, Henry. It wasn't a real good idea."

"There is no harm in this, Mack. You cannot say that there is."

"Not me. I can't, no."

"Well, then."

"Come on. I got Huang Hua coming first thing tomorrow."

"Ah. Of course."

"Jesus, Henry."

"I am afraid that I forgot."

"Fine. Sure. Look, I appreciate the thought, and so does everyone else. This Chink, now, he hasn't got a real great sense of humor."

"I was thinking about a flag."

"What?"

"A flag. You could ask, you know? See what he says. It would not hurt to ask. A very small and insignificant flag in the window of the diner. Just for the one day, you understand?"

Mack looked down the road. "You didn't even listen. You didn't hear anything I said."

Just for the one day. The Fourth and nothing more."

"Get all the posters down, Henry. Do it before tonight."

"How did you like the George Washington? Henry asked. "I did all of those myself. Rose did the lettering, but I am totally responsible for the pictures."

The Washington was great.

"You think so?"

"The eyes kinda follow you around."

Yes." Henry showed his delight. "I tried for inner vision of the eyes."

"Well, you flat out got it."

Jase and Morgan came out. Jase picking up the rubber fishing boots he'd left at the door. Morgan looked moody and deranged. Mack considered knocking him senseless.

"Look." Mack told him. "I don't want you on my boat. Go with Panagopoulos. Tell him Fleece'll be going with me and Jase."

"Just fine with me," Morgan said.

"Good. It's fine with me, too."

Morgan wasn't through. "You take a nigger fishing on a day with a *r* in it, you goin' to draw sharks certain. I seen it happen."

"You tell that to Fleece," Mack said. "I'll stand out here and watch."

Morgan went in and talked to Panagopoulos. Jase waited for Fleece, leaning against the diner, asleep or maybe not. Mack lit an Agricultural Hero and considered the after-taste of breakfast. Thought of likely antics with Jenny's parts. Wondered how a univalve mollusk with the mental reserve of grass could dream up a wentletrap shell and then wear it. This and other things.

Life has compensations, but there's no way of knowing what they are.

Coming in was the time he liked the best. The water was dark and flat, getting ready for the night. The bow cut green and no sound at all but a jazzy little counterbeat, the crosswind snapping two fingers in the sails. The sun was down an hour, the sky settling into a shade inducing temporary wisdom. He missed beer and music. Resented the effort of sinking into a shitty evening mood without help.

Swinging in through the channel, Pelican Island off to port, he saw the clutter of Port Bolivar, the rusted-out buildings and the stumps of rotted docks, the shrimpers he used to run heeling drunkenly in the flats. South of that was the chain-link fence and the two-story corrugated building. The bright red letters on its side read SHINING WEALTH OF THE SEA JOYOUS COOPERATIVE 37 WELCOME HOME INDUSTRIOUS CATCHERS OF THE FISH.

This Chinese loony-tune message was clear a good nautical mile away; a catcher of the fish with a double cataract couldn't pretend it wasn't there.

Panagopoulos's big Irwin ketch was in. The other boats as well; the nets up and drying. Fleece brought the sloop in neatly, dropping the sails at precisely the right moment, a skill Mack appreciated all the more because Morgan was scarcely ever able to do it, either rushing in to shore full sail like a Viking bent on pillage or dropping off early and leaving them bobbing in the bay.

The Chinks greatly enjoyed this spectacle, the round eyes paddling the forty-three-foot Hinckley in to shore.

Mack and Jase secured the lines, and then Jase went forward to help Fleece while the Chinks came aboard to look at the catch. The guards stayed on the dock looking sullen and important, rifles slung carelessly over their shoulders. Fishing Supervisor Lu Ping peered into the big metal hold, clearly disappointed.

"Not much fish," he told Mack.

"Not much," Mack said.

"It's June," Fleece explained. "You got the bad easterlies in June. Yucatan Current kinda edges up north, hits the Amarillo Clap flat on. That goin' to fuck up your fishing real good."

"Oh, yes." Lu Ping made a note. Jase nodded solemn agreement.

Mack told Jase and Fleece to come to the house for supper. He walked past the chain-link fence and the big generator that kept the fish in the corrugated building cooler than anyone in Texas.

The routine was: the boats would come in and tack close to the long rock dike stretching out from the southeast side of the peninsula, out of sight of the Chinks, and the women and kids would wave and make a fuss and the men would toss them fish in canvas bags: flounder or pompano or redfish if they were running or maybe a rare sack of shrimp, keeping enough good fish onboard to keep the Chinese happy but mostly leaving catfish and shark and plenty of mullet in the hold, that and whatever other odd species came up in the nets. It didn't matter at all, since everything they caught was ground up, steamed, pressed, processed, and frozen into brick-size bundles before they shipped it.

Mack thought about cutting through the old part of the port, then remembered about Henry and went back. There were still plenty of posters on fence posts and abandoned bait stands and old houses, and he pulled down all he could find before dark.

They ate in front of the house, near the dunes, a good breeze coming in from the Gulf, strong enough to keep mosquitoes and gnats at bay, the wind drawing the driftwood fire nearly white. Henry brought a large pot of something dark and heady, announcing it was Acadia Parish shrimp creole, Chihuahua style, and nobody said it wasn't. Mack broiled flounder over a grill. Jase attacked guitar. Arnie Mace, Mack's uncle from Sandy Point, brought illegal rice wine. Not enough to count, but potent. Fleece drank half a mason jar and started to cry. He said he was thinking about birds. He began to call them off. Herons and

Now this time, watch!"

plovers and egrets. Gulls squawking cloud white thick behind the shrimpers. Jase said he remembered pink flamingos in the tidal flats down by the dike.

There was an old bastard in Sweeny you know him, Mack," George Panagopoulos said. "Swears he had the last cardinal bird in Texas. Kept it in a hamster cage long as he could stand it. Started dreaming about it and couldn't sleep, got up in the middle of the night and stir-fried it in a wok. Had a frazzle of red feathers on this hat for some time, but I can't say that's how he got 'em."

"That was Emmett Dodge," Mack said. "I always heard it was a jay."

"Now I'm near certain it was a cardinal." Panagopoulos looked thoughtfully into his wine. "A jay, now, if Emmett had had a jay, I doubt he could've kept the thing quiet. They make a awful lot of noise."

Mack helped Fleece throw up.

"Georgia won't talk to me," Fleece said miserably. "You the only friend I got."

"I expect you're right."

"You watch out for Morgan. He bad talkin' you ever chance he get."

"He wants to be pissant mayor, he can run. I sure don't care for the honor."

"He says your eyes beginnin' to slant."

"He said that?"

"Uh-huh."

"Well, fuck him." Fleece was unsteady but intact. Mack looked around for Henry and found him with Rose and Jenny. He liked to stand off somewhere and watch her. A good-looking woman was fine as gold, you caught her sitting by a fire.

He took Henry aside.

"I know what you are going to say," Henry said. "You are angry with me. I can sense these things."

"I'm not angry at all. Just get that stuff taken down before morning."

"I only do what I think is right, *mi compadre*. What is just. What is true." Henry tried for balance. "What I deeply feel in my heart. A voice cries out. It has to speak. This is the tragedy of my race. I feel a great sorrow for my people."

"Okay."

"I shall bow to your wishes, of course."

"Good. Just bow before Huang gets here in the morning."

"I will take them down. I will go and do it now."

"You don't have to do it now."

"I feel I am an intrusion."

"I feel like you've had enough to drink."

"Do you know what I am thinking? What I am thinking at this moment?"

"No, what?"

"I am thinking that I cannot remember tequila."

"Fleece has already done this," Mack said. "I don't want you doing it, too. One crying drunk is enough."

"Forgive me. I cannot help myself. Mack, I don't remember how it tastes. I remember the lime and the salt. I recall a certain warmth. *Nada*. Nothing more."

Tears touched the Cesar Romero eyes, trailed down the Gilbert Roland cheeks. *If Jase plays 'La Paloma,' I'll flat kill him,* thought Mack. He left to look for Rose.

Jenny told him to come out on the porch and look at the beach. Crickets crawled out of the dunes and made for the water. The sand was black, a bug tide going out to sea. The crickets marched into the water and floated back. In the dark they looked like the ropy strands of a spill.

"The ocean scares me at night," Jenny said.

"Not always. You like it sometimes."

He wanted to stop this but didn't know how to do it. She was working up to it a notch at a time.

"It's not you," she said.

"Fine. I'll write that down." He worked his hand up the T-shirt and touched the small of her back. She leaned in comfortably against him.

"Things are still bad, you get too far away from the coast. I don't want you just wandering around somewhere."

"I haven't really decided, Mack. I mean, it's not tomorrow or anything."

"I don't think you're going to find anyone, Jenny." He said it as gently as he could. "Folks are scattered all about."

She didn't answer. They stood a long time on the porch. The house already felt empty.

The chopper came in low out of the south, tilted slightly into the offshore breeze, rotors churning flat, snappy farts as it settled to 87 stirring sand. Soldiers hit the ground. They looked efficient. Counterrevolutionary acts would be dealt with swiftly. Fleece and Panagopoulos leaned against the diner trading butts. Henry came out for a look and ducked inside. The morning was oyster gray with a feeble nibbing of clouds. Major Huang waved at Mack. Then Chen came out of the chopper and started barking at the troops. Mack wasn't pleased. Huang was purely political—fat and happy and not looking for any trouble. Chen was maybe nineteen tops, a cocky little shit with new bars. Mack was glad he didn't speak English, which meant Jase wouldn't try to sell him a shark dick pickled in a jar or something worse.

The Chinese uniforms were gallbladder green to match the chopper. Chen and three troopers stayed behind. The troopers started tossing crates and boxes to the ground. One followed discreetly behind the major.

"Personal hellos," Huang Hua greeted Mack. "It is a precious day we are seeing."

Mack looked at the chopper. "Not many supplies this time."

"Not many fishes," Huang said.

It's going to be like this, is it? Mack followed him past the diner down the road to Shining Wealth Cooperative 37. He noticed little things. A real haircut. Starched khakis with creases. He wondered what Huang had eaten for breakfast.

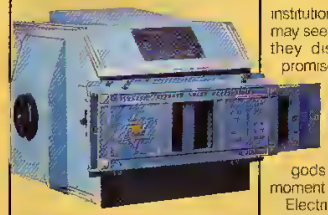
CONTINUED ON PAGE 136

Is this where I apply for sainthood?

PATENTLY ABSURD

BY NINA GUCCIONE

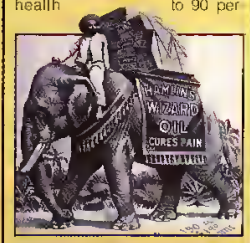
You don't feel well. You have very real, wormsome symptoms. Not one of the specialists you've seen can pinpoint the cause of your worsening condition. To aggravate matters, they ridicule or patronize you. Yet as long as you have elusive pains or sleepy spells, a balding head or small breasts, you will not be at a loss for sympathetic healers. Where conventional medicine fails, quackery hails!



The Museum of Medical Quackery, originally located in St. Louis, was furnished with items confiscated by the Food and Drug Administration (FDA). Relocated to the St. Louis Science Center (though not yet reopened), the collection was a showcase for bogus gadgetry similar to the pieces shown here, which were found in other private and institutional collections. The items may seem technically archaic, but they displayed ingenuity and promised hope for an age when all that ailed the patient was somehow connected to 'tired' blood or female troubles. Doctors were lesser gods then; faith was put in the moment's promise.

Electricity played a prominent, if not preposterous, role in the early 1900's medicinal arena. This relatively new wonder, if harnessed and administered properly, was life itself. The vast possibilities of applications were limited only by the inventor's imaginations.

Some of the medical machinery devised to electrify the body were known as faradic shockers or batteries. They were all similar in function and purpose to the device shown on the previous page. This penny-arcade machine was an unassuming device. A mild shock was administered while holding the fixed left handle and turning the right handle. It modestly claimed to cure headaches, rheumatism and nervousness, unlike some of its shameless competitors that not only purported to cure but also to diagnose the likes of cancer and tuberculosis—claiming to restore health to 90 per-



This page, above left: Dinshah Ghadiali's Spectrochrome claimed it used colored light to cure a variety of ills. Below, a violet ray generator recommended for everything from arthritis to poor circulation.

cent of patients whatever their disease and whether or not they even knew they had one!

For those suffering from lesser ills seeking perhaps to cure a mild bout of neuralgia while developing muscles the electric dumbbells were ideal For those whose only afflictions were mere laziness and flabby bodies (my ancestors) the Relax-a-cizor did the job—or at least was alleged to During this

'passive exercise' electrodes were attached to muscle groupings and slight electrical impulses were emitted causing muscles to contract and thereby achieve tone and firmness

Other contraptions included electric girdles electric brushes—one for the head one for the flesh electric slippers and even an electric bath With a morning jump start like that who needs caffeine? With a well equipped toiletry bag you could calm your nerves curb your dandruff and cure a few diseases before heading off to work Were these things so outlandish or were they the foresights to modern therapies?

In 1987 more than ever before electricity is sought for its reparative properties In today's medicine it is used to control bladders and straighten teeth to knit bones heat skin ulcers and diminish spastic motor problems

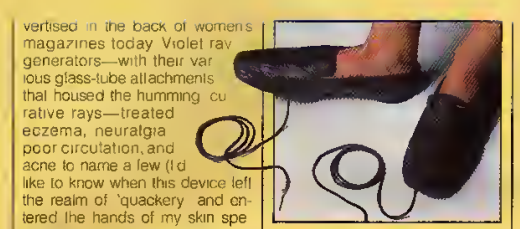
Other artifacts as imaginative as they were useless include a hair-loss treatment—a tight-fitting cap with a tube attached to the top

to splash warm water on the scalp (I imagine a shower works on the same principle and can guarantee the same results) There is a breast enlarger that looks suspiciously similar to those ad-

Left a faradic battery made by Otto Fleming of Philadelphia The user held the grips at left and current was increased by winding out the velvet covered cylinder to the right

vertised in the back of women's magazines today Violet ray generators—with their various glass-tube attachments that housed the humming curative rays—treated eczema, neuralgia poor circulation, and acne to name a few (I'd like to know when this device left the realm of 'quackery' and entered the hands of my skin specialist circa 1982 It even looked the same as the one shown on page 101)

One of the worst problems with quack gadgets more likely to now fall under the heading of alterna-

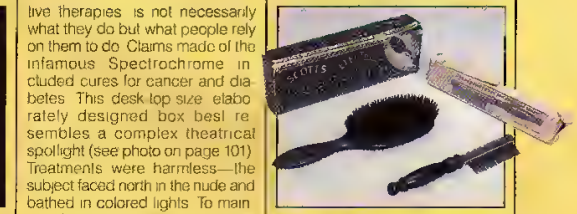


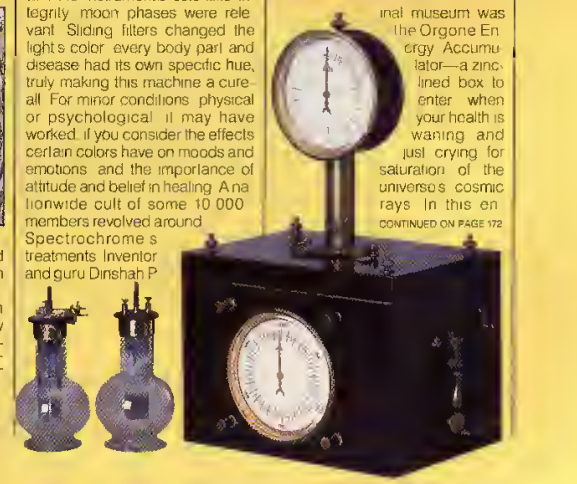
tive therapies is not necessarily what they do but what people rely on them to do Claims made of the infamous Spectrochrome included cures for cancer and diabetes This desk-top size elaborately designed box best resembles a complex theatrical spotlight (see photo on page 101) Treatments were harmless—the subject faced north in the nude and bathed in colored lights To maintain the instrument's scientific integrity moon phases were relevant Sliding filters changed the light's color every body part and disease had its own specific hue, truly making this machine a cure-all For minor conditions physical or psychological it may have worked If you consider the effects certain colors have on moods and emotions and the importance of attitude and belief in healing A nationwide cult of some 10 000 members revolved around Spectrochrome's treatments Inventor and guru Dinshah P Ghadiali was convicted of fraud in 1947 after a 47-day trial

Even the electric slippers—not recommended for wading Were they really off the mark? In certain circles reflexology is quite accepted The soles of your feet have points corresponding to your internal organs and stimulating these points of origin can diagnose and treat the organs

One of the highlights of the original museum was the Orgone Energy Accumulator—a zinc-lined box to enter when your health is waning and just crying for saturation of the universe's cosmic rays In this en

CONTINUED ON PAGE 172





Left an English-made galvanic faradic battery This page above left Psycograph used skull measurements to analyze personality Far right faradic shocker constructed in France

BOOKS

CONTINUED FROM PAGE 30

ogies We also owe something to H G Wells who said Change *one thing* and see what else occurs With *Wild Cards* were now attempting to go beyond the shared world idea into what we're calling the mosaic novel (In mosaic novels authors will be involved in creating more than just individual stories the entire book will be a group project with the writers banding together to develop the plot and coauthor everything from beginning to end taking much of the burden off the individual anthology editor)

Perhaps the most original and provocative of the shared world books *Wild Cards* presupposes that an extraterrestrial virus released on Earth in 1946 caused an epidemic of instant mutations Infected humans become aces—with such powers as flight shape shifting mind bending and tank-stopping strength—or huge jokers whose deformities range across a spectrum of horror from extra animal or human limbs to features that make the Elephant Man seem like a Calvin Klein model

Wild Cards's world of comic book superheroes is frankly based on a shared passion for early comic books and radio serials And as Shetterly points out shared world anthologies may actually have originated with DC Comics and its various writers and artists creating such books as *Batman Green Lantern* and *Hawkman*

Maybe people will decide that shared worlds are in the same category but for adults Shetterly says

Shetterly agrees with Martin and Cherryh that for authors who generally work in solitude the attraction—apart from profit—of creating a shared world is the interaction with other writers "You get instant feedback from your peers like an actor or a dancer Cherryh says "You're also forced to deal with characters and situations you have never confronted in your work before" Dealing with someone else's character according to Cherryh can aid professional development "It's like playing doubles You start adding details and filling in empty spaces she says

The shared world's allure however can also be its most besetting danger "Everyone depends on everyone else" Martin says "One person missing a deadline can jeopardize the whole project And when a writer's story veers from the book's objectives even when the story's brilliant everyone else has to adjust their stories and patch the continuity back together

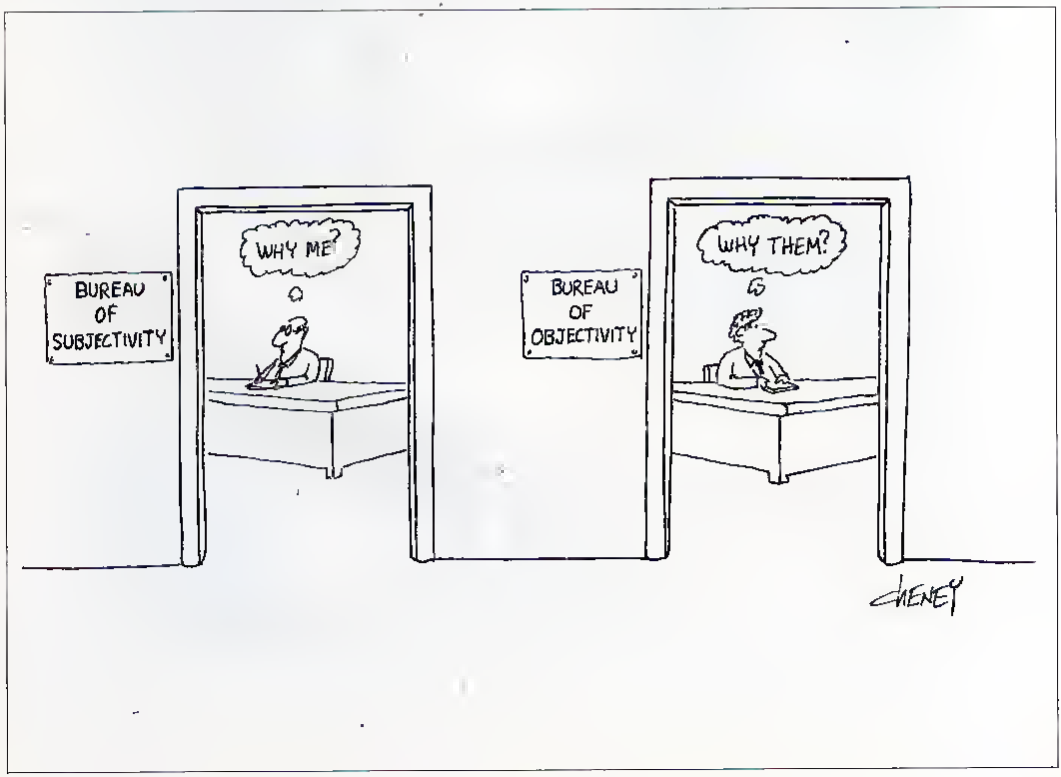
Continuity can be a major problem according to Cherryh and the editors must fit stories together like pieces of a puzzle They must also pay close attention to details "If you take your eyes off it for a moment even geography can wander It's even more difficult keeping a character consistent A con man can become too aggressive a tough up front woman starts sounding mealymouthed Many of us will continually check with each other to prevent a lot of trouble later" Cherryh says

Anthology editors of course prefer to work with writers who have similar artistic values—people with a sense of humor who can work quickly and think coherently "But they are exactly the individuals whose own visions will most often clash with the editors visions" Shetterly says "You inevitably end up fighting for consistency"

Nevertheless Cherryh comments that the oldest kind of storytelling is the singer in the marketplace spinning tales and making the listener beg for more Shared world writers she says are doing the same thing "on a kind of tag-team basis"

Eventually Shetterly thinks the number of anthologies flooding the market will subside with only the better ones surviving "They won't die out but there won't be as many Readers are becoming tired of them even disappointed" he says about many of the anthologies

As a literary form the shared world is still in a developmental stage "It's a completely new kind of literature Martin says Of course a lot of shared worlds will fail but others that we can't even imagine today will be flourishing tomorrow



FICTION

For most tourists in this Vietnamese amusement park, war is only a game

E-TICKET TO NAMLAND

BY DAN SIMMONS

The twenty-eight Huey gunships moved out in single file, each hovering a precise three meters above the tarmac, the sound of their rotors filling the world with a roar that could be felt in teeth and bones and testicles. Once above the tree line and gaining altitude, the helicopters separated into four staggered

PAINTING BY ROLAND CAT

V formations, and the noise diminished to the point where shouts could be heard.

"First time out?" cried the guide.

"What?" Justin Jeffries turned away from the open door where he had been watching the shadow of their helicopter slide across the surface of the mirrored rice paddies below. He leaned toward the guide until their combat helmets were almost touching.

"First time out?" repeated the guide. The man was small even for a Vietnamese. He wore a wide grin and the uniform and shoulder patch of the old First Air Cav Division. Jeffries was big even for an American. He was dressed in green shorts, a flowered Hawaiian shirt, Nike running sandals, an expensive Rolex comlog, and a U.S. Army helmet that had become obsolete the year he was born. Jeffries was draped with cameras: a compact Yashica SLR, a Polaroid Holistic-360, and a new Nikon Imager. Jeffries returned the guide's grin. "First time for us. We're here with my wife's father."

Heather leaned over to join the conversation. "Daddy was here during... you know... the war. They thought it might be good for him to take the Vet Tour." She nodded in the direction of a short, solid, gray-haired man leaning against the M-60 machine-gun mount near the door's safety webbing. He was the only person in the cabin not wearing a helmet. The back of his blue shirt was soaked with sweat.

"Yes, yes," smiled the guide and stepped back to plug his microphone jack into a bulkhead socket. His voice echoed tinnily in every helmet and from hidden speakers. "Ladies and gentlemen, please notice the tree line to your right."

There was a lurch as the passengers shifted their positions and craned for a view. Ten-year-old Sammee Jeffries and his eight-year-old sister, Elizabeth, shoved their way through the crowded space to stand next to where their grandfather sat by the open door. The barrel of Elizabeth's plastic M-16 accidentally struck the older man on his sunburned neck, but he did not turn or speak. Suddenly a series of flashes erupted from the tree line along one rice paddy. The passengers gasped audibly as a line of magnesium-bright tracer bullets rose up and lashed toward their ship, missing the rotors by only a few meters. Immediately one of the gunships at the rear of the V formation dove, curved back the way they had come in a centrifugally perfect arc, and raked the tree line with rocket and minigun fire. Meanwhile, at the guide's urging, Sammee stood on a low box, grasped the two-handed grip of the heavy M-60, swung it awkwardly to bear in the general direction of the now-distant tree line, and depressed the firing studs. The passengers instinctively clutched at their helmets to block their ears. Heavy cartridges, warm but not hot enough to burn anyone, clattered onto the metal deck.

An explosion split the tree line, sending phosphorous streamers fifty meters into the air and setting several tall palms ablaze. Bits of flaming debris splashed into the quiet rice paddy. The passengers laughed and applauded. Sammee grinned back at them and flexed his muscles. Elizabeth leaned against her grandfather and spoke loudly into his ear. "Isn't this *fun*, Grandpa?"

He turned to say something, but at that second the guide announced that their destination would be coming up on the left side of the ship, and Elizabeth was away, shoving her brother aside to get a better view, eager to see the village appear below out of the heat haze and smoke.

Later that evening five men sat around a table on the fifth-floor terrace of the Saigon Oberoi Sheraton. The air was warm and humid. Occasional gusts of laughter and splashing sounds came up from the pool on the fourth-floor terrace. It was well past nine, but the tropical twilight lingered.

"You were on the village mission tour this morning, weren't you?" asked Justin Jeffries of the young Oriental next to him.

"Yes. I was. Most interesting." The man sat in a relaxed manner, but something about his bearing, the precisely creased safari suit, the intensity of his gaze, suggested a military background.

"You're Nipponese, aren't you?" asked Justin. At the man's smile and nod, Justin went on. "Thought so. Here with the military mission?"

"No, merely on leave. R and R, I believe your people used to call it."

"Christ," said the overweight American who sat next to Justin's father-in-law. "You've been up north in the PRC fighting Chen's warlords, haven't you?"

"Just so," said the Nipponese and extended his hand to Justin. "Lieutenant Keigo Naguchi."

"Justin Jeffries, Kansas City." Justin's huge hand enclosed the lieutenant's and pumped twice. "This here is my father-in-law, Ralph Disantis."

"A pleasure," said the lieutenant.

"Pleased to meet you," said Disantis.

"I believe I saw you with your grandchildren at the village today," said Naguchi. "A boy and a girl?"

"The wall showed image after image of passengers in combat garb, tourists clutching at their helmets with one hand and hugging cameras, purses, and plastic M-16's to their chests."

Disantis nodded and sipped his beer. Justin gestured to the heavyset man next to his father-in-law. "And this is Mr.... ah... Sears, right?"

"Sayers," said the man. "Roger Sayers. Nice to make your acquaintance, Lieutenant. So how's it going up there? Your guys finally getting those little bastards out of the hill caves?"

"Most satisfactory," said Lieutenant Naguchi. "The situation should be stabilized before the next rainy season."

"Japanese brains and Vietnamese blood, huh?" laughed Sayers. He turned to the fifth man at the table, a silent Vietnamese in a white shirt and dark glasses, and added quickly, "No offense meant. Everybody knows that your basic Viet peasant makes the best foot soldier in the world. Showed us that forty years ago, eh, Mr.... ah...?"

"Minh," said the little man and shook hands around the table. "Nguyen Van Minh." Minh's hair was black, his face unlined, but his eyes and hands revealed that he was at least in his sixties, closer to Disantis's age than that of the others.

"I saw you on the plane from Denver," said Justin. "Visiting family here?"

"No," said Minh. "I have been an American citizen since 1976. This is my first trip back to Vietnam. I have no family here now." He turned toward Naguchi. "Lieutenant, I am surprised that you choose to spend your leave on an American's Veterans Tour."

Naguchi shrugged and sipped at his gin and tonic. "I find it a sharp contrast to modern methods. Up north I am more technician than warrior. Also, of course, learning more about the first of the helicopter wars is valuable to anyone who is interested in military history. You were a veteran of that war, Mr. Disantis?"

Justin's father-in-law nodded and took a long swallow of beer.

"I just missed it," said Sayers with real regret in his voice. "Too young for Vietnam. Too goddamn old for the Banana Wars."

Justin grunted. "You didn't miss much."

"Ah, you were involved in that period?" asked Naguchi.

"Sure," said Justin. "Everybody who came of age in the discount decade got in on the Banana Wars. The tour today could have been Tegucigalpa or Estanzuelas, just substitute coffee plantations for the rice paddies."

"I want to hear about that," said Sayers and waved a waiter over to the table. "Another round for everyone," he said. "From somewhere near the pool a steel drum band started up, unsuccessfully trying to mix American pop tunes, a Caribbean beat, and local musicians. The sound seemed sluggish in the wet, thick air. Tropical night had fallen, and even the stars appeared dimmed by the thickness of atmosphere. Naguchi looked up at a band of brighter stars moving toward the zenith and then glanced down at his comlog.

"Checking azimuth for your spottersat tonight?" asked Justin. "It's a hard habit to break. I still do it."

Disantis rose. "Sorry I can't stay for the next round, gentlemen. Going to sleep off some of this jet lag." He moved into the air-conditioned brightness of the hotel.

Before going to his own room, Disantis looked in on Heather and the children. His daughter was in bed already, but Sammee and Elizabeth were busy feeding data from their father's Nikon through the terminal and onto the wall screen. Disantis leaned against the door molding and watched.

"This is the LZ," Sammee said excitedly.

"What's an LZ?" asked Elizabeth.

"*Landing zone*," snapped Sammee. "Don't you remember *anything*?"

The wall showed image after image of dust rotors, the predatory shadows of Hueys coming in above Justin's camera position, the thin line of passengers in combat garb—men and women instinctively bent low despite obvious clearance from the rotors, tourists clutching at their helmets with one hand and hugging cameras, purses, and plastic M-16's to their chests with the other—groups moving away from the raised landing platform along rice paddy dikes.

"There's Grandpa!" cried Elizabeth. Disantis saw himself, aging, overweight, puffing heavily as he heaved himself down from the helicopter, disdaining the guide's outstretched hand. Sammee tapped at the terminal keys. The picture zoomed and enlarged until only Disantis's grainy face filled the screen. Sammee shifted through colors and widened his grandfather's face until it became a purple balloon ready to pop. "*Stop it*," whined Elizabeth.

"Crybaby," said Sammee, but some sixth sense made him glance over his shoulder to where Disantis stood. Sammee made no acknowledgment of his grandfather's presence but advanced the picture through a montage of new images.

Disantis blinked and watched the jerky newsreel proceed. The abandoned village of rough huts. The lines of tourist-troops along each side of the narrow road. Close-ups of huts being searched. Heather emerged from a low doorway, blinking in the sunlight, awkwardly lifting her toy M-16 and waving at the camera.

"This is the good part," breathed Sammee.

They had been returning to the LZ when figures along a distant dike had opened fire. At first the tourists milled around in confusion, but at the guides' urging they finally, laughingly, had taken cover on the grassy side of the dike. Justin remained standing to fake pictures.

Disantis watched as those images built themselves on the wall screen at a rate just slower than normal video. Data columns flashed by to the right. He saw himself drop to one knee on the dike and hold Elizabeth's hand. He remembered noting that the grass was artificial.

The tourists returned fire. Their M-16's flashed and recoiled, but no bullets were expended. The din was tremendous. On the screen a two-year-old near Justin had begun to cry. Eventually the guides helped a young tourist couple use a field radio to call in an air strike. The jets were there in less than a minute—three A-4D Skyhawks with antiquated U.S. naval markings bright and clear on the white wings. They screamed in under five hundred feet high. Justin's camera shook as the explosions sent long shadows across the dikes and made the tourists cringe and hug the earth from their vantage point six hundred meters away. Justin had managed to steady the camera even as the napalm continued to blossom upward.

"Watch," said Sammee. He froze the frame and then zoomed in. The image expanded. Tiny human forms, black silhouettes, became visible against the orange explosions. Sammee enlarged the image even further. Disantis could make out the silhouette of an outflung arm, a shirttail gusting, a conical peasant's hat flying off.

"How'd they do that, Grandpa?" asked Sammee without turning around.

Disantis nodded at the retreating waiter, removed the swizzle stick from his drink, and set the plastic saber into a row of seven others. Minh blinked and did the same with his.

Disantis shrugged. "Holos, maybe."

"Naw, not holos," said Sammee. He did not try to hide his condescension. "Too bright out there. Besides, you can see the pieces fly. Befcha they were animates."

Elizabeth rolled over from where she was sprawled. Her pajamas carried a picture of Wonder Duck on the front. "What'd Mr. Sayers mean on the way back, Grandpa?"

"When?"

"In the helicopter when he said, 'Well I guess we really showed Charlie today.' " Elizabeth took a breath. "Who's Charlie, Grandpa?"

"Stupid," said Sammee. "Charlie was the VC. The bad guys."

"How come you called him Charlie, Grandpa?" persisted Elizabeth. The frozen explosion on the wall screen cast an orange glow on her features.

"I don't remember," said Disantis. He paused with his hand on the door. "You two better get to bed before your father comes. Tomorrow's going to be a busy day."

Later, alone in his room, sitting in silence broken only by the hum of the air conditioner, Disantis realized that he could *not* remember why the Vietcong had been called Charlie. He wondered if he had ever known. He turned out the light and opened the sliding doors to the balcony. The humid air settled on him like a blanket as he stepped out.

Three floors below, Justin, Sayers, and the others still sat drinking. Their laughter floated up to Disantis and mixed with the rumble of thunder from a storm on the distant and darkened horizon.

On their way to a picnic the next day, Mr. Sayers tripped a claymore mine.

The guide had put them on a simulated patrol down a narrow jungle trail. Sayers was in the lead, paying little attention to the trail, talking to Reverend Dewitt, an airwaves minister from Dothan, Alabama. Justin and Heather were walking with the Newtons, a young couple from Hartford. Disantis was farther back in line, walking between Sammee and Elizabeth to keep them from quarreling.

Sayers stepped into a thin trip wire stretched across the trail; a section of dirt erupted a meter in front of him, and the claymore jumped three meters into the air before exploding in a white puff.

"Shit," said Sayers. "Excuse me, Reverend." The Vietnamese guide came forward with an apologetic smile and put a red KIA armband on Sayers. The Reverend Dewitt and Tom Newton each received a yellow WIA armband.

"Does this mean I don't get to go to the picnic?" asked Sayers.

The guide smiled and directed the others on how to prepare a medevac LZ in a nearby clearing. Lieutenant Naguchi and Minh cleared underbrush with machetes while Heather and Sue Newton helped spread marker panels of iridescent orange plastic. Sammee was allowed to pop the tab on a green smoke marker. The red-cross marked Huey came in with a blast of downdraft that flattened the tall grass and blew Disantis's white tennis hat off. Sayers, Dewitt, and Newton sat propped on their elbows and waved as their stretchers were loaded. The patrol resumed when the medevac copter was just a distant throbbing in the sky.

Justin took point. He moved carefully, frequently holding his hand up to halt the line behind him. There were two more trip wires and a stretch of trail salted with anti-personnel mines. The guide showed them all how to probe ahead with bayonets. For the last half kilometer they stayed in the grass on either side of the trail.

The picnic ground was on a hill overlooking the sea. Under a thatched pavilion sat three tables covered with sandwich makings, salads, assorted fruits, and coolers of beer. Sayers, Newton, and Dewitt were already there, helping two guides cook hamburgers and hot dogs over charcoal fires. "What kept you?" called Sayers with a deep laugh.

After a long lunch, several of the tourists went down to the beach to swim or sunbathe or take a nap. Sammee found a net

work of tunnels in the jungle near the picnic pavilion and several of the children gathered around as the guide showed them how to drop in CS gas and fragmentation grenades before actually searching the tunnels Then the children and a few of the younger adults wiggled in on their bellies to explore the complex Disantis could hear their excited shouts as he sat alone at one of the picnic tables drinking his beer and looking out to sea He could also hear the conversation of his daughter and Sue Newton as they sat on beach towels a few meters away We wanted to bring my daddy but he just refused to come said the Newton woman So Tommy says Well shoot as long as the government s paying part of it let s go ourselves So we did

We thought it d be good for my father said Heather I wasn t even born then but when he got back from the war way back in the Seventies he didn t even come home to Mother He went and lived in the woods of Oregon or Washington or somewhere for a couple of years

Really! said Sue Newton My daddy never did anything crazy like that

Oh he got better after a while said Heather He s been fine the last ten years or so But his therapy program said that it d be good for him to come on the Vet s Tour and Justin was able to get time off cause the dealership is doing so good

The talk turned to children Shortly after that it began to rain heavily and three Hueys and a lumbering Sikorsky picked them up to return them to the Sheraton The dozen or so people in Disantis s group sang Ninety nine Bottles of Beer on the Wall during the short flight back

There was nothing scheduled for the afternoon and after the storm passed several people decided to go shopping at one of the large malls between the hotel complex and the park Disantis caught an electric bus into downtown Saigon where he walked the streets until nightfall

The change of name to Ho Chi Minh City had never really taken and the metropolis had officially been renamed Saigon in the early Nineties The city bore little resemblance to the excited jumble of pedestrians motorbikes strip joints bars restaurants and cheap hotels Disantis remembered from forty years earlier The foreign money had all gone into the tourist enclaves near the park and the city itself reflected the gray era of the New Socialist Reality more than it did the feverish pulse of old Saigon Efficient faceless structures and steel and glass high rises sat on either side of busy boulevards Occasionally Disantis would see a decaying side street that reminded him of the cluttered stylishness of Tu Do Street in the late Sixties

Nguyen van Minh joined him as Disantis waited for a light to change on Thong Nhut Boulevard

Mr Disantis

Mr Minh

The short Vietnamese adjusted his

glasses as they strolled past the park where the Independence Palace had once stood. "You are enjoying the sights?" he asked. "Do you see much that is familiar?"

"No," said Disantis. "Do you?"

Minh paused and looked around him as if the idea had not pertained to him. "Not really, Mr. Disantis," he said at last. "Of course, I rarely visited Saigon. My village was in a different province. My unit was based near Da Nang."

"ARVN?" asked Disantis.

"Hac Bao," said Minh. "The Black Panthers of the First Division. You remember them, perhaps?"

Disantis shook his head.

"We were... I say without pride... the most feared fighting unit in all of South Vietnam... including the Americans. The Hac Bao had put fear into the hearts of the Communist insurgents for ten years before the fall."

Disantis stopped to buy a lemon ice from a street vendor. The lights were coming on all along the boulevard.

"You see the embassy there?" asked Minh, pointing to an antiquated six-story structure set back behind an ornate fence.

"That's the old U.S. Embassy?" asked Disantis, without much interest in his voice. "I would have thought that the building would've been torn down by now."

"Oh, no," said Minh. "It is a museum. It has been restored very much to its original appearance."

Disantis nodded and glanced at his comlog.

"I stood here," continued Minh, "right here... in April of 1975 and watched the helicopters take the last of the Americans off the roof of the embassy. It was only my third time in Saigon. I had just been released from four days in prison."

"Prison?" Disantis turned to look at Minh.

"Yes. I had been arrested by the government after members of my unit had commandeered the last Boeing 727 out of Da Nang to Saigon. We fought civilians—women and children—to get aboard that plane. I was a lieutenant. I was twenty-three years old."

"So you got out of Vietnam during the panic?"

"They released us from jail when the North Vietnamese were in the suburbs," said Minh. "I was not able to leave the country until several months later."

"Boat?" asked Disantis. The lemon ice was melting quickly in the warm air.

Minh nodded. "And you, Mr. Disantis, when did you leave Vietnam?"

Disantis tossed the paper wrapper into a trash can and licked his fingers. "I came here early in '69," he said.

"And when did you leave?" Minh asked again. Disantis lifted his head as if to sniff the night air. The evening was thick with the scent of tropical vegetation, mimosa blossoms, stagnant water, decay. When he looked at Minh there was a dark gleam in his blue eyes. He shook his head. "I never left," he said.

Justin, Sayers and Tom Newton came up to the guide as he sat alone at a table near the back of the hotel bar. The three Americans hesitated and looked at each other. Finally Justin stepped forward. "Howdy," he said.

"Good afternoon, Mr. Jeffries," said the guide.

"We... uh... we'd all, I mean the three of us and a couple of other guys, we wanted to see you about something."

"Ahhh, there is some problem with the tour?" asked the guide.

"No, no, everything's great," said Justin and glanced back at the other two. He sat down and leaned toward the Vietnamese. His voice was a hoarse whisper. "We... ah... we wanted a little more than the regular tour."

"Oh?" The guide blinked. His mouth was not quite curled in a smile.

"Yeah," said Justin, "you know. Something *extra*."

"Something extra?" said the guide.

Justin and the other four had come in shouting and firing. There had been no opposition. The 32 villagers, mostly children and old people, knelt in the dust at the center of the village.

Roger Sayers stepped forward. "We want some special action," he said.

"Ahhh," said the guide and finished up his drink.

Justin leaned forward again. "Nat Pendrake told us it was okay," he whispered loudly. "He said he... uh... arranged it through Mr. Tho."

"Mr. Tho?" the guide said blankly. But the smile was there now.

"Yeah. Nat said that... uh... a special action would be about a thousand."

"Two thousand," the guide said softly. "Each."

"Hey," interjected Sayers. "Nat was here just a few months ago and..."

"Quiet," said Justin. "All right. That's fine. Here." He slid his universal card across the table.

The Vietnamese smiled and pushed Jeffries's card back. "Cash, please," he said. "You will have it tonight. American dollars."

"I don't know about..." began Sayers.

"Where?" asked Justin.

"The frontage road beyond the hotel maintenance buildings," said the guide. "Twenty-three hundred hours."

"Right," said Justin as the guide stood up. "See you then."

"Have a nice day," said the guide and was gone.

The trucks transported them to a point in the jungle where the road ended and a trail began. The five men jumped down and followed the guide through the darkness. The trail was muddy from the evening rains, and wet fronds brushed at their cork-smudged faces. Justin, Jeffries and Tom Newton kept close to the guide. Behind them, stumbling occasionally in the dark, came Sayers and Reverend Dewitt. Lieutenant Naguchi brought up the rear. Each man was in uniform. Each carried an M-16.

"*Shit*," hissed Sayers as a branch caught him in the face.

"Shut up," whispered Justin. The guide motioned them to a stop, and the Americans pressed close to peer at a clearing through a gap in the foliage. A few kerosene lanterns threw cold light from the doorways of the dozen huts of the village.

"Vietcong sympathizers," whispered the guide. "They can tell you where the cadre headquarters is. Everyone in the village knows the VC."

"Huh," said Sayers. "So our job is to get the information, right?"

"Yes."

"And they're VC sympathizers?" whispered Tom Newton.

"Yes."

"How many?" asked Lieutenant Naguchi. His voice was barely audible above the drip of water from palm leaves.

"Maybe thirty," said the guide. "No more than thirty-five."

"Weapons?" asked Naguchi.

"There may be some hidden in the huts," said the guide. "Be careful of the young men and women. VC. Well trained."

There was a long silence as they stared at the quiet village.

Finally Justin stood and clicked the safety off on his rifle. "Let's do it," he said. Together they moved into the clearing.

Ralph Disantis and Nguyen van Minh sat together in a dark booth in an old bar not far from what had once been Tu-Do Street. It was late. Minh was quite drunk, and Disantis let himself appear to be in the same condition. An ancient jukebox played recent Japanese hits and oldies but goodies dating back to the Eighties.

"For many years after the fall of my country, I thought that America had no honor," said Minh. The only sign of the little man's drunkenness was the great care with which he enunciated each word. "Even as I lived in America, worked in America, became a citizen of America, I was convinced that America had no honor. My American friends told me that during the Vietnam War there was news from my country on the televisions and radios every day, every evening. After Saigon fell... there was nothing. Nothing. It was as if my nation had never existed."

CONTINUED ON PAGE 142

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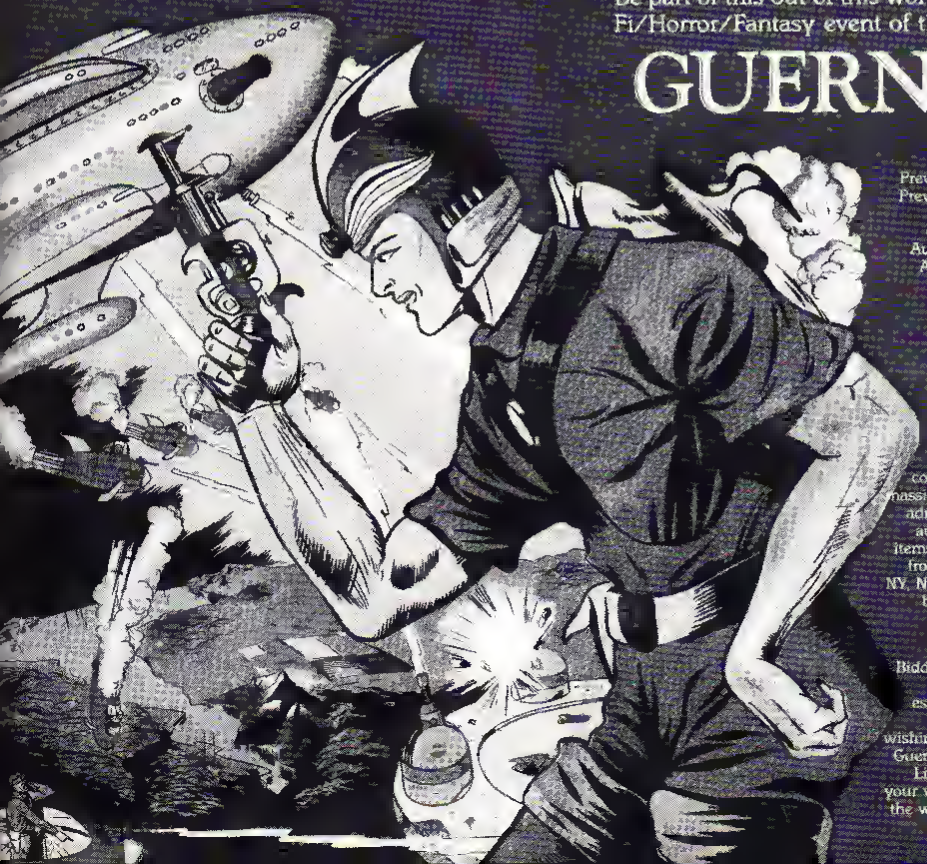

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Preview: Friday Dec. 11, 10AM–6PM
Lectures: Friday Dec. 11, 8 PM*
Gala Party: Friday Dec. 11, 9PM*
Auction: Saturday, Dec. 12, 10AM*
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The sequencer ace of DNA is tracking down the secrets of human origins His souped-up machines will enable scientists to read our genes and predict our futures before we're born

INTERVIEW

LEROY HOOD

This is just a Model T DNA sequencer right now" Leroy Hood pats the top of an unassuming-looking box the size of a desk-top copier "In five years we'll have the super Cadillac version It'll probably be one hundred times as fast and one hundred times less error-prone"

Hood the chairman of Caltech's biology division is the inventor of the DNA sequencer And this remarkable machine is causing a revolution in molecular biology "It'll take another five to ten years before we seriously sit down and sequence the whole human genome" he predicts modestly Before Hood invented the DNA sequencer the gargantuan task of determining the structure of the entire human genetic code appeared as if it would take forever

The human genome the genetic repository of all the information for constructing a human contains from 100,000 to 300,000 genes on 46 chromosomes The smallest chromosomes consist of around 50 million base pairs the chemical units of genetic material So far scientists have sequenced only 12 million base pairs And a good lab technician could manage to sequence accurately only about 20,000-base pairs a year Hood's

PHOTOGRAPH BY ALAN LEVENSON

Model T' can sequence that many in a week—automatically

A complete map of the human genome would have an enormous impact on biology profoundly expanding knowledge about human development evolution aging, cancer and genetic diseases In the future, being familiar with this genetic terrain will enable experts to analyze an individual's chromosomes, peer into a newborn's genes to predict his future strengths and weaknesses "When a baby is born" says Hood "we'll 'read out' his genetic code and there'll be a book of things he'll have to watch for This has the potential to do enormous good If you have a propensity toward heart disease rheumatoid arthritis, or cancer you could modify your diet or change the environmental substances you're exposed to"

The DNA sequencer is the fourth in a quartet of instruments Hood calls the Microchemical Facility The immunogeneticist and his Caltech colleagues have developed them with experts at Applied Biosystems, Inc , a San Francisco-area company that sells all four devices for around $90,000 Hood's passion for understanding the microbiology of the immune system drove him to essentially create the technology for investigating it In 1975 his team built a protein sequencer a machine that uses automated chemical analysis to determine the structure of a specific protein or peptide Next Hood's group built a DNA synthesizer to make strands of DNA then they designed a protein synthesizer for making protein in the lab Finally they completed the DNA sequencer in 1986 Working in concert the machines will be able to manipulate and analyze proteins and DNA in ways that were utterly impossible before

The backbone of DNA, deoxyribonucleic acid—the genetic blueprint for all life forms—is composed of just four chemical units These nucleic acids are adenine (A), guanine (G) cytosine (C) and thymine (T) In the DNA molecule adenine is always linked to thymine, and cytosine to guanine These A–T and C–G combinations, or complementary base pairs resemble the rungs of a ladder The legs of the ladder are made of phosphate and sugar units This ladder twists about its axes to form a double-helix structure Because of the "complementarity" or affinity of the A–T and C–G units, one strand of DNA acts as a template or pattern for another creating generations of identical DNA molecules Because every three consecutive base pairs represent one particular amino acid DNA is essentially a code for the eventual production of proteins The number of proteins that can theoretically be generated by this code is enormous—far more than the number known to exist

Before Hood's machines decoding DNA was devilishly difficult One standard technique involves taking four sets of genetically engineered DNA fragments and attaching a different radioactive label to each base Each set of fragments is then passed through a slab of special gel Photographic film is then laid on top of each gel slab By reading the resulting spots on the developed film the researcher interprets the DNA sequence It's a time-consuming and boring process involving radioactive tracers that are hazardous and costly Tedious work that has to be done by hand this sequencing process can cost up to $5 a base Hood's machine and its advanced models will drop that price to pennies per base Hood's DNA sequencer has automated much of the process First he replaced the dangerous radioactive labels for the DNA fragments with four special fluorescing compounds, chemicals that glow when stimulated by light Then the team built a detector array that uses a low-power argon laser to read the unique color of each fluorescent dye A specially programmed personal computer stores the color data it receives from the laser detector and translates each color into the corresponding base components Voilà! A complete DNA sequence in hours instead of weeks

> "What drives science isn't the individual but development of new instrumentation, new technologies and chemistries Science then exploits these in a zillion different ways"

The son of an electrical engineer for Mountain States Telephone Company Hood forty-nine was born and raised in Montana—first Missoula and later the tiny town of Shelby about 35 miles from the Canadian border The nearest big cities were Great Falls, 70 miles to the south and Lethbridge Canada some 95 miles northwest Hood thrived in that setting quarterbacking the football team (undefeated in his last three years of high school) acting in plays editing the yearbook and becoming the first Westinghouse Science Talent winner from Montana The world's leading genetic alchemist still carries Montana with him His voice has that flat Big Sky accent And Hood's love of the wild outdoors still asserts itself in his passion for rock and mountain climbing

Writer Joel Davis caught up with the swiftmoving scientist after his daily five-mile run The conversation began with a look at the machines The next time *Omni* checked in with Hood, he was about to leave for the Brooks Range in Alaska—to do "a little ice and snow climbing"

Omni: What do your peers think of your spending so much time building elaborate machines?

Hood: Oh, I think biologists will never really give credence to people who go out and make machines They look down on them, see them as engineers who produced a useful tool so that they, the scientists, can do real biology [Laughs"] Yet it one knew my other interests in the molecular biology of the immune system, he'd have a different response [Besides designing machines, Hood runs a lab of more than 60 people His lab has discovered a diagnostic tool and a potentially more effective, safe vaccine for hepatitis B They've discovered a strange new class of proteins called prions designed a simple blood test for diagnosing T-cell leukemia, and defined the process by which cancer genes transform normal cells into cancerous ones—just a few of Hood's other 'interests']

Omni: How many machines have you sold?

Hood: Oh, gosh I knew at one time Certainly of the protein sequencer, the first of the machines there are at least six hundred or seven hundred out there The DNA synthesizer, six hundred to seven hundred The DNA sequencer the newest, we just started selling and have sold around thirty or forty so far The machines have been purchased not only in the States but also in Japan and to a lesser extent in Europe China's bought some Russia's bought some

Omni: What are your machines capable of doing now?

Hood: Our protein synthesizers have been able to make up to one hundred and forty amino acids, and that's the size of a small protein With our DNA synthesizer we start with the raw material, the basic nucleotides [the fundamental units of DNA] and put together one by one an appropriately ordered set of bases constituting the fragments of a gene We can make a fragment of one hundred bases or so A typical gene may be a thousand bases, so we can make one tenth of a gene But because of the complementarity of double-stranded DNA we can synthesize a set of ten smaller, overlapping, sticky-ended fragments, and they all self-assemble into the gene It's a very effective way of making genes

So we have a machine for synthesizing genes, and now we have a machine for determining the order of the bases in the genes—a sequencer We have machines that synthesize proteins and machines that sequence proteins—that is, determine the subunit order of polypeptides

Omni: Could you have developed your machines without recombinant DNA and monoclonal antibody technologies?

Hood: Yes Developing the machines was an independent phase of biotechnology the chemistry and instrumentation used were completely different But what we've found each time we've developed a new type of biotechnology is that it's often very synergetic with preexisting technologies And that was especially true in this case!

No one had any idea the synergy would be anywhere near as enormous as it is. These things operating together in the last eight years have changed molecular biology in ways no one could have conceived of ten years ago. And we're not finished either. We're in the middle. We have another ten years of all these marvelous developments that will change biology even more.

Omni: How do the machines interface with one another and other biotechnologies?

Hood: Let me give you an example of how they work in a synergistic way. Often a medical researcher will have a tiny quantity of some protein that's biologically interesting to him. For example, seven or eight years ago we looked at proteins called interferons. We had vanishingly small quantities of them. This is how we'd examine them now. We'd use the protein sequencer to determine the suborder of all the interferon proteins. Having done that, we'd take this protein sequence and translate it into DNA language, into a DNA sequence. Next we'd use the DNA synthesizer to make a fragment of the gene corresponding to this sequence. Then we'd use classic recombinant DNA techniques with this artificial fragment to clone the gene that encoded that whole protein. Altogether we'd use a combination of two different kinds of machines plus recombinant DNA technology to clone the interferon gene.

Now, with interferon we found there was a whole family of twenty genes or so. What you do in this case is use the DNA sequencer to sequence the genes. Then use the genetic code dictionary to translate the gene sequence back to a protein. Next we'd use the protein sequencer to make peptide fragments that correspond uniquely to each of these twenty genes. Then we'd use rabbits in special immunization conditions to raise antibodies that could not only recognize the peptide fragment but perhaps the whole interferon protein from which the fragment was derived. This, parenthetically, is the way some vaccines have been made.

What these [monoclonal] antibodies will let you do is go to the animal and see where different interferons are used in different cells and when and how they're turned on. What I've illustrated for you here is how we've used all four machines in conjunction with monoclonal antibodies and recombinant DNA techniques to study a gene family. Now this is a model system. We didn't study the interferons exactly that way, but we have done all those things in various combinations.

You see, with these machines I've got this beautiful circle. I can start at any stage [with protein or gene synthesizer or sequencer], and it just takes me right around! We can start anyplace you want in thinking about the fundamental problems of modern biology!

Omni: What are they?

Hood: As I see it, there are three absolutely essential problems for the future. They encompass everything and operate at three levels of information transfer.

One problem is the human chromosome. What are its secrets? How are we going to characterize it? How can we identify evolutionary relationships that might have diverged a long time ago? How can we develop superfast computers just to handle the information in the total genetic code of human beings?

The second big area is, Given this human hardware, the genome, what software processes convert that information into a human creature? How do red blood cells turn on the hemoglobin gene, or brain cells turn on a brain protein gene, and so on? The DNA synthesizer has revolutionized how we study this question. Now we can make at will nucleic acid probes that allow you to study where, when, and how genes get turned on. [A nucleic acid or gene probe is a short piece of radioactive, single-stranded DNA that pairs up only with a DNA strand that is its mirror image. It's like a customized hook that snags only the hooks that match it.]

> *"I could take a chemical created in our peptide synthesizer, one never seen before on Earth, and inject it into you. Your immune system would make antibodies for it."*

And the third level is the most fundamental one from industry's point of view. What rules dictate how you get from one-dimensional linear sequences of amino acids to three-dimensional configurations of functional proteins? Once we figure out those rules, we'll be able to construct any molecule we wish to order. A very important tool here is the protein synthesizer. If we know the rules, we can take any gene sequence and immediately know the three-dimensional structure into which it folds. In the future we'll know how to relate three-dimensional molecular shapes to the functions they carry out. And that means we'll be able to optimize known proteins and make proteins that nature has never seen before—proteins that carry out old functions better or brand-new functions.

Omni: Give me an example.

Hood: We might make a protein that can recognize in a highly specific way the AIDS virus and bring with that recognition something that could uniquely destroy it.

Omni: Do you consider machines as important as researchers?

Hood: One of the visions I received as a graduate student studying with William Dreyer at Caltech in the Sixties was that what really drives the advance of science is not individual scientists per se. It's the development of new technologies, instruments, and new kinds of chemistry. Science exploits these, using them in a zillion different ways in lots of different systems.

Omni: When did your interest in immunology begin?

Hood: In my first year of medical school at Johns Hopkins. I gave a report on theories of antibody diversity. It was obvious that there were questions of fundamental importance still to be answered and that the immune system was very exploitable. Its cells were in the blood, so with available tools of cell biology you could get to them and look at them in ways you can't with, say, brain cells.

Omni: What is antibody diversity?

Hood: Well, our immune system's main job is to recognize foreign invaders or foreign internal invaders like cancer cells. There's enough information in the human genome to encode three million genes. But the immune system has to recognize billions of foreign molecules—proteins, carbohydrates, fat combinations, whatever. The antibody system is one that does this. It has evolved so it can generate hundreds of millions—if not billions—of antibody molecules. Each one can recognize a slightly different pattern.

The immune system has evolved a series of clever, combining mechanisms. These mechanisms recombine or put together pieces of genes that amplify the information from only a few hundred genes. This way the body makes multitudes of different antibody configurations that recognize this universe of foreign invaders.

In 1965 Bill Dreyer and Claude Bennett formulated this concept that antibodies are encoded by two separate genes that have to be rearranged to get them to work. This was one of the first explicit suggestions that the human genome is not an immobile, static thing. They received a lot of ridicule for their daring proposition. How could any responsible, sensible scientist ever come up with an idea like this? Well, there are ideas the world is not ready for, and if you put them forth, smart people can think of a hundred ways to demean them. In the end, the idea turned out to be right.

Omni: Isn't this typical in science. An outrageous idea gets ridiculed, and then in years it's orthodoxy?

Hood: Right. Or the alternative pattern is that in a particular controversy three or four polar points of view emerge. Then, when all is said and done, there turns out to be truth in each. This was true for the idea of antibody diversity. Some people said it was all present in the germ line [the heritable chromosomes in the egg and sperm cells] from the very beginning. Others said it's just one gene that mutates a lot. Another group said, Well, you've got bits of genes and putting them together in every possi-

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ble way makes a lot of diversity." It turns out each is right.

The question was, How could the human immune system react to something it had never seen before—that even the human species had never seen before that moment? I could take a chemical off the shelf, inject it into you, and your immune system will make antibodies to it. It could be a chemical created in our peptide synthesizer just three weeks ago, a chemical never seen before on Earth. And you'll still make antibodies to it.

Omni: You say that antibody diversity evolved?

Hood: Because we were unclear on this, I wanted to see if throughout the vertebrate species, everybody did it the same way. Or did mammals have a sophisticated version of a much simpler immune system? We came to the conclusion that even in the simplest vertebrates we looked at, immunity was pretty complicated. The vertebrate immune system, it seems, emerged full-blown at the very beginning.

This gets you into some interesting evolutionary questions. For example, some genes can be shown to cluster together in what's called multigene families: three or four genes that are closely related and carry out related kinds of functions. Now, a collection of multigene families—plus some single genes that don't have any other close relatives—that have all been derived from a common ancestor evolutionarily are called a gene superfamily. They have a signature that says, for instance, "I am a member of the immunoglobulin gene superfamily." In the immunoglobulin gene, there are at least twenty-seven different kinds of genes in this big, big superfamily. Each is more than seventy-five percent related in its DNA sequence.

By duplicating a multigene family many times over in the lab, you can create myriad multigene families—a gene superfamily. And these new, well, cassettes can begin to code for diverse functions. This experiment suggests that evolution can proceed very rapidly. With the duplication of these large families, you have the potential to change quickly.

Omni: Could you go back to invertebrates, and further still, to see how the immune system evolved?

Hood: Absolutely. With the right tools you could see the early ancestors of what became the vertebrate immune system. But you'd need to design smart strategies for going back more than eight hundred million years. The animals are available, but the genes will have diverged so much that you'll have to figure some clever ways to identify the related things. We're designing chemistries to do that now.

Omni: There seems to be a definite but elusive connection between the nervous and immune systems.

Hood: Right. And for fifteen years I've been intrigued with finding those ties. Now it looks like we'll be able to say that our immune system is constructed from elements that evolved from molecules originally operating in the nervous system. Lots of evidence indicates that stress affects people's immune systems as well as their nervous systems. We're only just beginning to glimpse the fundamental connections. And in one immune gene superfamily, that connection is absolutely explicit! It has eight multigene families and twelve single-gene members identified so far. The genes fall into three categories: those connected only to the immune system, those primarily in the nervous system, and those shared by both the immune and the nervous systems. And we have absolutely no idea what the shared sets do! But it's a beautiful relationship.

Omni: The Harvard geneticist Walter Gilbert has said that the sequencing of the total human genome is the grail of human genetics. Do you agree?

Hood: In a classic sense, yes, it is the grail. After all, genetics is an attempt to understand how the hardware of human information employs itself to construct human organisms. If you're really going to understand a computer, you have to know what each component is and how they are all put together. Sequencing the human genome is a staggering problem. If you envision a page having a thousand words on it [each gene being analogous to a word], then the genome is a book of three hundred thirty-eight thousand pages. In the last decade the total amount of sequencing for all animals has been the equivalent of three hundred thirty-eight pages. We've barely scratched the surface.

> *"With the right tools you could see the early ancestors of what became the vertebrate immune system. But you'd need clever strategies to go back eight hundred million years."*

Omni: Some molecular biologists say that merely knowing the sequence is not as important as knowing what particular segments actually do.

Hood: Sure, but knowing the entire structure of the genome would give us completely new approaches to figuring out which parts of it are involved in important functions. For example, we've developed programs that can pick out those DNA segments that encode genes. So if we were given, say, the hundred to five hundred thousand nucleotides surrounding the region—a million base pairs in length—where the Huntington's disease gene is located, you could use the program to identify maybe ten genes. Then with gene probes you could probably identify one or two gene pairs. And one would certainly be the gene for Huntington's disease. If you compared the two gene pairs with genes from a normal person, you might find a pair that's identical in both. The one that's different could most certainly be the gene for Huntington's.

Today the job of sequencing the entire human genetic code is still utterly beyond us technologically. We lack the computers or software to really handle the task. And I worry about the error rate. Let's say your error rate was a tenth of a percent. With three billion base pairs, we'd have an awful lot of mistakes. What we should do now is stage this whole effort. We could first generate a mapping technique and create a gross road map of the human genome. We'd know in a general sense what is sitting next to what. Then, by pouring an enormous effort into the technology for say five years, we could transform our present DNA sequencer into a super Cadillac. Working that way we'd end up doing a hell of a lot more over a ten-year span than if we dug in and started now.

Omni: You talk about human genetic hardware and software. What do you mean?

Hood: By hardware I mean the sequence of the genome, the twenty-three pairs of chromosomes that contain all the information for constructing a human, okay? By software—known as developmental biology in other circles—I mean the rules and machinery by which this hardware is translated into proteins, the basic construction currency. How are chromosomes converted into protein information? What are the rules for making RNA? How do you control the making of RNA protein, make the right ones and at the right time? Essentially this is the choreography of the genes. I'd like to understand this choreography.

Omni: Do we need to know the entire genome to perceive the choreography?

Hood: I think it's the easiest way to understand it because the information for the construction may constitute only five percent of all the information in the chromosomes. But we don't know where to go to look for it. So it's probably easier to sequence the entire genome. Then you'd have an encyclopedia of how to construct a human, and you could start studying how the genome converts linear information into the three-dimensional information of proteins.

Omni: The idea of unraveling the human genetic code scares some people.

Hood: The tools of any technology we develop are intrinsically valueless. It's how we use the technology. It's incredibly unlikely that sequencing the human genome will lead to our being able to manipulate humans in undesirable ways. Knowing the hardware of a computer doesn't tell you how the software reads it out and uses it. It isn't that we'll be able to design individuals whose intelligence is increased by a

factor of three It isn t that we'll be able to change physical attractiveness or emotional stability Those are all multigenic traits whose nature and dimensions we don t begin to understand What we can do is manipulate single genes and in favorable cases put back something that s missing or correct something that's defective

Omni Nevertheless a lot of people feel that just the possibility of sequencing the genome raises serious ethical questions

Hood I'd argue that sequencing the human genome itself is valueless It does give you the tools to begin to impact on religion, emotional and ethical issues The classic cases are the genetic diseases If we have the structure of the genome and use it to identify genes for cystic fibrosis Huntington's disease Tay-Sachs and so on that means we can make powerful prenatal diagnostic tests That in itself is valueless But when you do the tests then the philosophic debate arises about whether people have a right to abort fetuses carrying defective genes That s the essence of the issue And it s an issue all society not just scientists has to get entangled in We will have a genetic probe for say Tay-Sachs at least a decade before we have a cure No question

Omni And that makes medical ethicists nervous

Hood Yeah well very soon we'll have sequenced genes that can encode for proteins with mind-altering properties Now you can use those proteins in marvelous ways There are many hormones in the brain that have the ability to alter moods and dispositions dramatically Initially what you could do is clone genes that encode those proteins thus creating simple access to the hormones Then as we understood how the proteins worked we could synthesize new combinations new kinds of proteins that have different effects or sets of effects It s very conceivable that we could find or create hormones that could handle the depressive and manic cycles of manic depression It s something we can t touch very effectively right now But you could also use those proteins to create euphorias drug-induced states and things like that Any tool is a two edged sword

Omni Some say it s better not to have the two-edged sword in the first place

Hood The fundamental issue here is that of individual rights—whether people have the right to make these decisions for themselves The issue of abortion is a classic one that we haven't resolved yet I personally think abortion is a fundamental and important natural right for mothers For many reasons—from rape and that kind of abuse to physical threat to the mother, to certain knowledge that a Tay-Sachs child will die a horrible agonizing brutal death within eight to ten months after it's born Women have the right not to have to go through that And they have the right not to let something that will later go on to become a human being go through that kind of experience But having said that I also respect the right of others to have a different point of view People who don t believe in using these prediagnostic tools don t have to go through those analyses

You can extend this two-edged sword idea in interesting ways In the future when we "read out" a baby s genetic code it will have great positive potential But suppose insurance companies get ahold of this readout and say, My goodness this guy has a real chance of developing X when he s forty Or employers could say, Gee by the time this guy s fifty he'll be on unemployment It's all a two-edged sword And my feeling is we have to go ahead! And we have to develop the wisdom to deal with all the opportunities science will present us with This quest for knowledge is a fundamental human imperative I don't think you can legislate it out on phony ethical–social issues

Omni You're not saying that the ethical issues are phony?

Hood No I'm saying that it's phony to hide behind those ethical issues and say Let s not do it because it s too difficult an ethical issue All I'm saying is you've got to meet that difficulty head-on and come to workable solutions

Steroids cause muscles to bulk up, but they also have serious side effects We might design hormones that just do the two things we want, not the five that are harmful

Omni Do you believe in free will or are we the puppets of our genes?

Hood Gosh I guess I have an intrinsic faith that we can chart our own course And I believe in the force of the intellect If you want to go into an area and change the worldview in that subject I think I can do it If I want to change my fundamental personality characteristics I think I can do that too But it is a hell of a lot harder

Omni What might genetic engineering accomplish by 2001?

Hood. I doubt anyone has the imagination to conceive of what we'll be able to do It would've been hard to envision everything that's happened in the last five years During this time we've gone from being skeptical about gene surgery—being able to put genes in animals and having them work—to having that concept utterly verified We can put genes in tissues organs and now even the germ line and have them function in a perfectly reasonable way Within fifteen years there'll be more surprises of that magnitude

Omni What will be the next big advance in immunology?

Hood. Understanding the machinery by which the immune system operates We'll be able to selectively enhance the immune responses to things we'd like For instance we could enormously enhance the response to the AIDS virus Or enhance the response to a variety of venereal diseases that the immune system hasn t been able to handle well at all—gonorrhea for example If we understood those responses, we could optimize any of them

Or we could impede the responses we don t like such as those that cause the autoimmune diseases If a person had rheumatoid arthritis it would be likely that we'd have a way of blocking the immune responses he has to his own joints that lead to their destruction It s likely we'll have a cure in the near future for these diseases but it will go disease by disease We might be able to cure leukemias and lymphomas that relate to the immune system s B and T cells by designing agents that target molecules on the cells surfaces with cell-killing signals I see us finding the key to the organ-rejection process and circumventing that whole difficulty

Omni Could you use the Microchemical Facility to study cancer cells?

Hood Yes you could compare cancer cells with normal ones The DNA synthesizer can make oncogenes [genes that transform normal cells into cancerous ones] as well as normal genes So you can put both genes in any kind of creature you wish and look at the differences in how they function Then with the peptide synthesizer you can make the products of the cancer gene and see how they differ from normal products The DNA sequencer allows you to sequence cancer genes and look at large genetic areas that might be changed in neoplastic [tumor forming] cells

Omni What kind of large areas?

Hood. Many cancer cells have undergone chromosomal translocations where a piece from one chromosome is fused onto another It would be nice to examine large DNA sequences across these translocations to see if there are unique features of these chromosomes that have this propensity to stick together We could then understand why these recombinations associated with cancer occur and could figure out how to block them

Omni What about AIDS right now?

Hood We're looking at a receptor molecule on the T4 cell The AIDS virus plugs into that receptor protein in order to attack the immune system s T4 cells We used the protein synthesizer to make the functional part of the receptor which is what the AIDS virus seems to recognize Next we'll see what portion of the virus connects to that part of the molecule We know it must be a part of the protein-surface coating of the virus So once we've identified the part of the AIDS coat that binds to the T4 receptor

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ARTICLE

Psychologists are striving to unleash the powers of imagination

MAKE BELIEVERS

BY RICHARD KATZ

in its infancy the fire is the people's only light. Like others I am irresistibly attracted to the dance: pulled toward the fire like a moth. One of the !Kung all-night healing dances is in progress, and the whole !Kung community is here. The women sing the healing songs as they sit around the fire, and the men join at times by the women, dance around the singers. The singing breaks into crescendos; the women's voices straining to reach the heavens. The *n/um*, or spiritual energy, that resides within the healers is heating up.

Kau's dancing becomes more intense, and his breathing deeper and more labored. He shrieks in anguish. Another dancer helps him, holding him, rubbing his sides. Kau's *n/um* is boiling. This *n/um* is hot, he cries out. The heat is killing me. Kau is ready to heal. He calls out to the gods. Don't take any of these people at the dance away from us. We love them all. We wish to keep them with us. He bargains with the gods, fighting for the people's health. Without the halting hesitation of the blind that marks his ordinary movements, he goes confidently to the people at the dance, healing each and every one as he lays his hands upon them.

There are no eyeballs in Kau's eye sockets. But he can see when he enters a state of enhanced consciousness, called *!kia*. It is this state that also enables him to heal. "God keeps my eyeballs in a little cloth bag," Kau explains. "When he first collected them, he plucked my eyeballs out and put them into the bag, and then he tied the eyeballs to his belt and went up to heaven. And now when I dance on the nights when I dance and when the singing rises up, God comes down from heaven swinging the bag with the eyeballs above my head, and he lowers the eyeballs to my eye level. And as the singing gets strong, he puts the eyeballs into my sockets, and they stay there, and I heal. And when the women stop singing, he removes the eyeballs, puts them back in the cloth bag, and takes them up to heaven." Blind Kau's vision during the enhanced state is more than mere sight. He becomes a seer. By making contact with the spiritual realm, he becomes a healer of the people.

As hunter-gatherers, the !Kung are representatives of an ancient way of living. They are our link to human prehistory, the source of modern-day cultures. (For 99 percent of human history, people lived as hunter-gatherers.) But for years, the !Kung (also known by the derogatory label of Bushmen) and other so-called primitive tribes have been belittled, their ceremonies mocked as mere superstition.

Today that's changing. Social scientists believe there is much to learn from the spiritual practices and close social ties among indigenous peoples. They are looking appreciatively at the !Kung's approach to the treatment of mental distress and how !Kung society gives emotional support to each individual member. The idea is that if we can better understand and learn from the !Kung's dances and the ritual healing practices of other indigenous peoples, we may improve our own abilities to heal both physical and emotional wounds.

Some very unusual work with enhanced states is taking place in the field of psychology. In these types of therapy, a participant takes an extraordinary journey into the unconscious, observing parts of him or herself hidden from everyday, normal consciousness. The experience is similar to a mystical journey in which everything one sees, feels or thinks about is vivid, powerful or intense. The key to understanding these new modes. The insights one receives surpass ordinary perception.

In a quiet room overlooking a lake, with a wall of books, soft chairs and a large couch, Mary Watkins accompanies her clients through the uncharted landscapes of their own fantasies. A trained therapist, developmental and clinical psychologist and author of the recent book *Invisible Guests: The Development of Imaginal Dialogues* (Analytic Press), Watkins is one of a growing number of psychologists who venture into the fantasy worlds of their patients to help them understand their own myths and images and to teach them how to move more freely through that symbolic part of themselves. Her practice emphasizes holding dialogues with unconscious figures, the invisible companions who inhabit our souls.

> "Kau is blind, but his vision during the healing dance is more than mere sight. He becomes a seer. By contacting the spiritual realm, he becomes a healer of the people."

The imaginal goes on all the time, Watkins says. "It's not something peculiar or faraway." (Watkins uses the word *imaginal*—as in "imaginal other" or "imaginal dialogue"—instead of *imaginary*. What is imaginary doesn't exist. To Watkins, the unconscious is very real; she deliberately chooses *imaginal* to impress upon us the reality of this unseen world.) Take the example of a client who talks about a fight with her husband at the kitchen table. Watkins and client try to understand who the husband was for her in the argument (protector, bullying teenager, helpless child) and who she was as she fought (princess, self-righteous do-gooder, frightened five-year old). In this form of therapy, the client is encouraged to speak with the invisible guest—the one she is fighting against.

"All persons' thought is dramatic. It is inhabited by voices and filled with imaginal conversations," Watkins says. "In therapy we can clarify what remain abbreviated and poorly understood conversations. Plays may be going on in our thoughts, but they haven't been written out, and there is no audience in attendance. Both the client and analyst are there to listen and to converse with the invisible guests."

Carl Jung, whose work with "active imagination" inspired Watkins, wrote: "Start with any image, for instance, just that yellow mass in your dream. Contemplate it and carefully observe how the picture begins to unfold or to change. Don't try to make it into something, just do nothing but observe what its spontaneous changes are. If it is a speaking figure at all, then say what you have to say to that figure and listen to what he or she has to say."

In other words, visit with the image. To help people talk to these figures, Watkins employs rather simple techniques—a warm, relaxing atmosphere in which the patient feels comfortable and the suggestion that they accept whatever voices they hear, talking back if they desire. Watkins believes these conversations are a natural phenomenon, part of being human. No drugs or hypnotic suggestions are needed to move into this altered consciousness and to accept the guests. "Children slide easily between the imaginal and everyday discourse," says Watkins. "With adults it often takes learning how to go back and forth between the straightforward conversations of everyday life and the imaginal underpinnings of these conversations."

If a tall, dark stranger appears in a client's dream, Watkins helps the person figure out what his presence means or whom he represents. Is he a father figure? An old friend?

In a similar fashion, Watkins and her client might ask whom a particular invisible guest is really talking to. Is it trying to communicate with the child in the person, the mother or some other part of the personality? And if they discover that the client is ignoring a particular guest—perhaps because it is threatening or hateful—they pay attention to it and try to understand it more on its own terms.

The idea of speaking to the characters within us has its roots in the distant past. In the Middle Ages, for instance, members of religious orders carried on conversations with the soul, engaging in discussions to ask it questions and to hear answers arising from a source other than consciousness. Watkins explains in her first book, *Waking Dreams* (Spring Publications): "One was aware of things outside the ego and could connect with them, but in a way that could be consciously remembered and experienced."

Watkins's respect for invisible guests comes in part from her own experiences, some of which led her into her present therapeutic work. Her book *Waking Dreams* was inspired by a nightmare in

CONTINUED ON PAGE 164

The document [illegible] says that four small humanlike beings were badly decomposed due to predator [illegible]

ANTI MATTER

UFO UPDATE

This [illegible] the biggest story of the twentieth century [illegible] all time [illegible] one of the most sophisticated hoaxes [in] the history [illegible]

The [cause] of all the controversy [is] the MJ-12 document unleashed on the world last May 29 by UFOlog[ist] William Mo[ore]. According to Moo[re], the document arrived at the home of [illegible] ern California televi[sion] producer Jaime Shandera in December 1984. Stored in [a] roll of 35mm film, [it ap]parently consisted of [an eight-page Na]tional Security briefing dated November 18, 1952. Its purpose [was to] inform President-elect Eisenhower that the United [States had] the remains of two alien craft.

The first craft the document [illegible] was recovered July 1947 from a remote [illegible] Roswell, New Mexico. In addition [illegible] reconnaissance had located the [illegible] small humanlike beings [illegible] badly decomposed due [to] predat[ion] [illegible] The document also claims that [a] second UFO [illegible] occurred along the Texas-Mexico border [illegible] searchers arrived the object had been [illegible]

Finally the document supposedly includes [illegible] man's authorization of an investigation into the [illegible] under the code name Operation Majestic Twelve [illegible] operation members the document states [illegible] luminaries as Vannevar Bush, chief science [illegible] fense Secretary James Forrestal, and [illegible] UFOlogists Harvard astronomer Donald Menzel [who until] his death in 1976 was a militant UFO debunker.

[illegible] of his [illegible] looking [illegible] the [illegible] and For[restal] [illegible]

[illegible] which [illegible] about extraterrestrial vis[itors] [illegible]

Wh[illegible]

[illegible] briefin[g] [illegible] two day[s] [illegible] [inv]estig[illegible] [doc]ument Mo[ore] [illegible] Dr [illegible] will [illegible]

—LARR[Y] [illegible]

OTHERWORLD JOURNEYS

Approaching death, ancient soldiers may have seen dead relatives beckoning toward dark tunnels leading to light. Medieval Christians probably used netherworld visions to reinforce biblical images of heaven and hell. And writers like Virgil and Dante may have based the epic underworld journeys of their heroes on the out-of-body experiences of the people around them.

These are just a few of the possibilities posed by Carol Zaleski, author of *Otherworld Journeys*, a scholarly book that analyzes near-death experiences (NDEs) from medieval through modern times. "I felt that historical insight would be the key to understanding NDEs," says Zaleski, a teacher of religion at Harvard University.

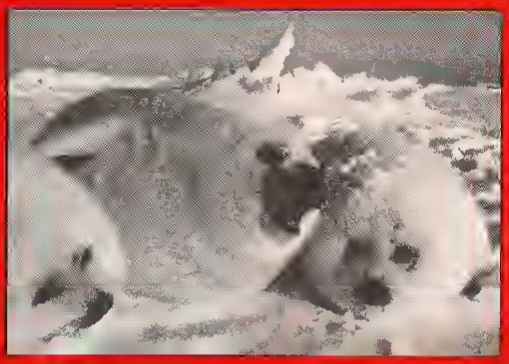
While scientific fields like astronomy or biology have progressed immeasurably over the last 1,500 years, Zaleski says, "some of the most important aspects of human experience, including the NDE, are perennial." For example, the soldier who returns from the dead in the *Dialogues* of the sixth-century pope St. Gregory the Great describes a footbridge where wicked souls fall into the slime of the river below. The blessed, on the other hand, pass to a peaceful meadow on the other side. How does this relate to modern times? Raymond Moody, the twentieth century guru of the NDE, says that his informants, too often return to their bodies over

whelmed by intense sensations of peace. Perhaps the greatest change in the NDE, Zaleski says, is in the church's influence, which has considerably diminished over the last 15 centuries. "The salvation of God," she notes, "has been replaced by a more secular ecstasy."

Zaleski, who just had her second child, also reports that a few women, especially during difficult births, have visions that approximate the NDE. Although her most recent baby was delivered

fairly routinely through a cesarean section her first child was born after a grueling, 36 hour labor was an ineffable experience recalls Zaleski Something happened for which I was very grateful was the closest thing to an NDE in my own life

Is this sheer mythology or legitimate science? Zaleski doesn know But she does see it as evidence of the possibility that a soul exists entirely apart om he body —Robert Weil



[illegible]

A decidedly left-leaning version of Mattel s Barbie doll has been at loggerheads with the Newfoundland Fisheries Ministry in anada The m nistr has ried foul against Mattel because in one of Barbie s adventure books the doll turns activist camouflaging seal pups with dark dye to 'protect them from the ruthless hunters that slaughter the young seals for their soft white skins

The Canadian province s fisheries ministry has asked Mattel to [illegible] on the grou[illegible] hasn t been a whitecoat hunt in four or five years Harold Murphy assistant deputy minister or fisheries, feels the Barbie book suggests that harvesting seals is somehow worse than har vesting other animals

Bu Spencer Boise [illegible] president of public relations fo Mattel says the c[illegible] pany has no intention of recalling the books

We ve received [illegible] of mail from people in Newfoundland thanking us for doin this says Boise We certainly do not intend to offend any on an w egret if we did But we are not pulling the books because of this issue

The Seal Rescue Fund sponsor of the Internati nal Day of the Seal applauds the company stance s True there hasn t been a market for the harvesting f whitecoat pups f the past several years und spokesman ays but once the pups mature they are s metimes still harvested

[illegible] calyp[illegible] says Boise to call her stance an[illegible] one "It s the only one hat I am aware he notes that Barbie has been put in an ec logical situatio

Rick Boling

We old the ths self evident. All men oul be c ematod equal

Vern Parlow

KWIKSCAN BIBLE

[illegible] when Reader's Digest came out with a condensed version he Bible? Not quite. The latest version of the wo ld best selling book goes the Dig better Max Morris, a lorida entrepreneur and retir Southern Baptist minister has me up with a new printing proces alled Kwik . hat he says makes God Word (as wel as any o her asier and aster to ead while increasin eader omprehensi

Kwikscan is basically the to [illegible] know t ill u news[illegible] readers w scan [illegible] ha ead Nor of th morning [illegible] de wi scan prints y an phrases [illegible] idface type he bo ds orm the w ances his says Mor s t reade acquir essential information reading only about 40 nt the [illegible] ith Kwikscan we do r p dens e Morris ay We do not

even change the punctuat every wo here as s in the or inal ca get and impro standing and rete Adds Mor s copies of the Kwik ble a l relet Ap 30 despite the fac that the b k has tised —Rick Boling

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Vladimir Nabokov

FROG LEG FERTILITY

il the bizarre odd chronicled n Charles ort's famous *Book of the Damned*, the best known is the 1804 rain of frogs ear Toulouse France But what would Fort have said about a more recent frog finding the discovery f a slew of ad po es with as many as si x tra hind legs?

The anomalous frogs were foun in an Aptos alifor a pond by Monterey Peninsula C llege biolo y teacher Stephen B Ruth The extra legs (tadpoles normally have only wo the rear) ame in all shapes and sizes some perfec some split abnormally at the thigh calf and some with an unnerving multiplici of toes Analysis by Stanley Sessions of the Developmental Biology Center of the University of California Irvine showed that th sprouting the ex ra legs may have been c used by a massive infestatio f *Metacercariae* trematode o flatworm parasite The wo s resen e apparently overstimulated the cells r gulating the tadpoles limb development

This brings up an intriguing question Some biologists think that evolution oc rs in part when organisms geneti a ly rporate nvading parasites The result a new an improved ani al essence a hybrid ould these tadpoles then represent a rototype or a new wave eight-legged amphibian high jumper Sessions says no Frog legs are so s phisti ated he says hal s hard imagi any improvement Besid tadpo es see their extra legs aroun actually akes them an asier prey for tors So instead froggy avan gard slo hinks the tadpoles ay act e ext

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SOVIET GHOST

ked the po and the oy fathe a ner vous breakdown And through all Sasha K contin ued to ignite fires with matches send objects flying through the air a ur refrigerators psi e down withou ouc he Or so rd rep the S t daily *zvestia* Ac ording the acc t afte ne Sasha's fire starter rl rm ances nearly burned down t fam m h a taken to Moscow for exami nation ng out the rdinary w un A Moscow hys ian dentifi nly as Adr ik as now gone on recor saying ear y a case of a poltergeist

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DINER

CONTINUED FROM PAGE 98

Sergeant Fishing Supervisor Lu Ping greeted the major effusively. He had reports Huang stuffed them in a folder. The air-conditioning was staggering. Mack forgot what it was like between visits.

"I have reportage of events," Huang began. He sat behind the plain wooden table and folded his hands. "It is a happening of unpleasant nature. Eddie Mendez will not mayor himself in Galveston after today."

'And why's that?'

"Offending abuse. Blameful performance. Defecation of authority." Huang looked meaningfully at Mack. "Retaining back of fishes."

'What'll happen to Eddie?'

"The work you do here is of gravity, Mayor Mack. A task of large importance. Your people in noncoastal places are greatly reliant of fish."

"We're doing the best we can."

"I am hopeful this is true."

Mack looked right at him.

"Major, we're taking all the fish we can net. We got sails and no gas and nothing with an engine to put it into if we did. You're not going to help any shorting us on supplies. I've got forty-one families on this peninsula eating nothing but fish and rice. There's kids here never saw a carrot. We try to grow something, the bugs eat it first 'cause there's no birds left to eat the bugs. The food chain is fucked."

"You are better off than most."

"I'm sure glad to hear it."

"Please to climb down from my back. The Russians did the germing, not us."

"I know who did it."

Huang tried Oriental restraint. "We are engaging to help. You have no grateful at all. The Chinese people have come to fill this empty air."

"Vacuum."

"Yes. Vacuum." Huang considered. "In three, maybe four years, wheat and corn will be achieved in the ground again. Animal and fowl will be brought. This is very restricted stuff. I tell you, Mayor Mack, because I wish your nonopposing. I have ever shown you friendness. You cannot say I haven't."

"I appreciate the effort."

"You will find sweets in this shipment. For the children. Also decorative candles. Toothpaste. Simple magic tricks."

Jesus Christ.

"I knew this would bring you pleasure."

Huang looked up. Lieutenant Chen entered politely. He handed Huang papers. Gave Mack a sour look. Mack recognized Henry's posters, the menu from the diner. Chen turned and left.

"What is this?" Huang appeared disturbed. "Flags? Counterproductive celebration? Barbecue pork?"

"Doesn't mean a thing," Mack explained. "It's just Henry."

Huang looked quizzically at George Washington, turning the poster in several directions. He glanced at the cardboard menu, at the KC Sirloin. Scrambled Eggs. Chicken-Fried Steak. French Fries. Omelet with Cheddar Cheese or Swiss. Coffee. Refills Free. He looked gravely at Mack.

"I did not think this was a good thing. You said there would be no trouble. One thing leads to a something other. Now it is picnics and flags."

"The poster business, all right," Mack said. "He shouldn't of done that. I figure it's my fault. The diner, now, there's nothing wrong with the diner."

Huang shook his head. "It is fancirment. The path to discontent." He appeared deeply hurt. The poster was an affront. The betrayal of a friend. He walked to the window, hands behind his back. "There is much to have renouncement here, Mayor Mack. Many fences to bend. I have been lenient and foolish. No more Henry Ortega Diner. No picnic. And better fishes, I think."

"They came aboard to look at the catch. The guards stayed on the dock looking sullen and important, rifles slung carelessly over their shoulders. Lu Ping peered into the hold, clearly disappointed."

Mack didn't answer. Whatever he said would be wrong.

Huang recalled something of importance. He looked at Mack again.

"You have a black person living here?"

"Two. A man and a woman."

"There is no racing discrimination? They are treated fairly?"

"Long as they keep picking that cotton."

"No textiles. Only fishes."

"I'll see to it."

Mack walked back north, past a rusted Chevy van waiting patiently for tires, past a pickup with windows still intact. Rose hadn't seen Henry. She didn't know where he was. "He didn't mean to cause trouble," she told Mack.

"I know that, Rose."

"He walks. He wanders off. He needs the time to himself. He is a very sensitive man."

"He's all of that," Mack said. He heard children. Smelled rice and fish, strongly seasoned with peppers.

"He respects you greatly. He says you are *muy simpático*. A man of heart. A leader of understanding."

A woman with fine bones and sorrowful eyes. Katy Jurado. *One-Eyed Jacks*. He couldn't remember the year.

"I just want to talk to him, Rose. I have to see him."

"I will tell him. He will come to you. Here, take some chilies to Jenny. It is the only thing I can grow the bugs won't eat. Try it on the fish. Just this much, no more."

"Jenny'll appreciate that." A hesitation in her eyes. As if she might say something more. Mack wouldn't ask. He wasn't mad at Henry. His anger had abated, diluted after a day with Major Hua. He left and walked to the beach. Jase and Fleece were there. Jase had a mason jar of wine he'd maybe conned from Arnie Mace.

"Tell Panagopoulos and some of the others if you see 'em," Mack said, "I want to talk to Henry. He's off roaming around somewhere, I don't want him doing that."

"Your minorities'll do this," Jase reflected. "I'm glad I ain't a ethnic."

"It's a burden," Fleece said. "There going to be any trouble with the Chinks?"

"Not if I can help it."

"Fleece thought of two more birds," Jase said. "A cormorant and a what?"

"Tern."

"Yeah, right."

"Good," Mack said. "Keep your eyes peeled for Henry. He gets into that moon-over-Monterey shit, it'll take Rose a month to get him straight."

"I think I'm going to go," Jenny told him. "I think I got to do that. Mack. It just keeps eatin' away. Papa's likely gone, but Luanne and Mama could be okay."

He put out his cigarette and watched her across the room, watched her as she sat at the kitchen table bringing long wings of hair atop her head, going about this simple task with a quick, unconscious grace. The mirror stood against a white piece of driftwood she'd collected. She collected everything. Sand dollars and angel wings, twisted trifons and bright coquinas that faded in a day. Candle by the mirror in a sand-frosted Dr. Pepper bottle, light from this touching the bony hillbilly points of her hips. When she left she would take too much of him with her, and maybe he should figure some way to tell her that.

"I might not be able to get you a pass. I don't know. They don't much like us moving around without a reason."

"Oh, Mack. People do it all the time." Peering at him now past the candle. "Hey, now. I'm going to come on back. I just got to get this done."

He thought about the trip. Saw her walking old highways in his head. Maybe sixty-five miles up to Beaumont, cutting off north before that into the Thicket. He didn't tell her everything he heard. The way people were, things that happened. He knew it wouldn't make a difference if he did.

Jenny settled in beside him. "I said I'm coming back."

"Yeah, well, you'd better."

He decided, maybe at that moment, he

wouldn't let her go He'd figure out a way to stop her She'd leave him in a minute Maybe come back and maybe not He had to know she was all right and so he'd do it He listened to the surf On the porch luna moths big as English sparrows flung themselves crazily against the screen

The noise of the chopper brought him out of bed last on the floor and poking into jeans before Jase and Panagopoulos made the stairs

"It's okay" he told Jenny "just stay inside and I'll see"

She nodded and looked scared and he opened the screen door and went out Dawn washed the sky the color of moss Jase and Panagopoulos started talking both at once

Then Mack saw the fire the reflection past the house "Oh Jesus H Christ!"

"Mack hes got pigs" Panagopoulos said "I seen 'em Henry's got pigs"

"He's got what?"

"This is bad shit" Jase moaned "this is really bad shit"

Mack was down the stairs and past the house He could see other people He started running Jase and Panagopoulos at his heels The chopper was on the ground and then Fleece came out of the crowd across the road

"Henry ain't hurt bad I don't think" he told Mack

"Henry's hurt? Mack was unnerved 'Who hurt him Fleece? Is someone going to tell me something soon?'

"I figure that Chen likely done a house to house" Fleece said "some asshole trick like that Come in north and worked down rousting people out for kicks Stumbled on Henry shit I don't know Just get him out of there, Mack"

Mack wanted to cry or throw up He pushed through the crowd and saw Chen maybe half a dozen soldiers then Henry Henry looked foolish contrite and slightly cockeyed His hands were tied behind Someone had hit him in the face The rotors stirred waves of hot air The diner went up like a box Mack tried to look friendly Chen lurched about yelling and waving his pistol looking wild eyed as a dog

"Let's work this out" Mack said "We ought to get this settled and go home"

Chen shook his pistol at Mack danced this way and that in an unfamiliar step Mack decided he was high on the situation He'd gotten hold of this and didn't know where to take it, didn't have the sense to know how to stop

"We can call this off and you don't have to worry about a thing" Mack said, knowing Chen didn't have the slightest notion what he was saying "That okay with you? We just call it a night right now?"

Chen looked at him or somewhere else entirely Mack wished he had shoes and a shirt Dress seemed proper if you were talking to some clown with a gun He was close enough to see the pigs The crate was by the chopper Two pigs pink and

fat mottled like an old man's hand. They were squealing and going crazy with the rotors and the fire and not helping Chen's nerves or Mack's either. Mack could just see Henry thinking this out, how he'd do it fattening up the porkers somehow and thinking what everybody'd say when they saw it wasn't a joke not soyburger KC steak or chicken-fried fish-liver nice and chili peppers. Not seaweed coffee or maybe grasshopper creole crunch. None of that play food shit. They all pretended was something else not this time *amigos* this time honest-to-God pig. Maybe the only pigs this side of Hunan and only Henry Ortega and Jesus knew where he found them. Mack turned to Chen and gave his best mayoral smile.

"Why don't we just forget the whole thing? Just pack up the pigs there and let Henry be. I'll talk to Major Huang. I'll square all this with the major. That'd be fine with you now, wouldn't it?"

Chen stopped waving the gun. He looked at Mack. Mack could see wires in his eyes. Chen spoke quickly over his shoulder. Two of the troopers lifted the pigs into the chopper.

"Now that's good," Mack said. "That's the thing you want to do."

Chen walked off past Henry, his face hot as wax from the fire, moving toward the chopper in this jerky little two-step hop, eyes darting every way at once, granting Mack a lopsided half-wit grin that missed him by a good quarter mile. Mack let out a breath. He'd catch hell from Huang, but it was over. Over and done. He turned away, saw Rose in the crowd and then Fleece. Mack waved. Someone gave a quick and sudden cheer. Chen jerked up straight, just reacting to the sound, not thinking any at all, simply bringing the pistol up like the doctor hit a nerve, the gun making hardly any noise, the whole thing over in a blink and no time to stop it or bring it back. Henry blew over like a leaf, taking his time collapsing with no skill or imagination, nothing like Anthony Quinn would play the scene.

"Oh, shit, now don't do that," Mack said, knowing this was clearly all a mistake. "Christ, you don't want to do that!"

Someone threw a rock, maybe Jase. Troopers raised their rifles and backed off. A soldier near Chen pushed him roughly toward the chopper. Chen looked defiled. The rotors whined up and blew sand. Mack shut it out, turned it back. It was catching up faster than he liked. He wished Chen had forgotten to take the pigs. The thought seemed less than noble. He considered some gesture of defiance. Burn rice in Galveston harbor. They could all wear Washington masks. He knew what they'd do was nothing at all, and that was fine because Henry would get up in just a minute and they'd all go in the diner and have a laugh. Maybe Jase had another jar of wine. Mack was certain he could put this back together and make it right. He could do it. If he didn't turn around and look at Henry, he could do it. ∞

CONTINUED FROM PAGE 30

jetpack, dash off to school in Italy, and be home in time for dinner. They imagined centers set up to distribute free food and clothing. And they were wondering what to do about the trend they saw in education where opportunities were becoming the province of the wealthy alone.

When Kurth-Schai asked the children about their striking change in attitude they explained that their outlook had improved because they had been stimulated by other children's ideas.

This finding is perhaps one of the most important to emerge from Kurth Schai's project. It's important to think about the future in groups, in an ongoing, interactive way, she explains. If you poll people by walking up to them and asking one question about future life, you get nowhere because they just say what strikes them at the moment. Indeed, studies done by her colleagues and predecessors show that adults generally *don't* think or talk about the future, and this may be one reason why so many people feel as though they have no control over it.

Everybody will have a great family. If they don't, hopefully someone who has a nice family will let them be part of it.

Kurth-Schai found no significant differences in future thinking between the boys and girls in her study sample, although other research has suggested that girls and women tend to have more negative images of the future. In part, women's greater negativity may be connected to their suspicion that their roles in the future will continue to be somewhat limited.

We will know how to use the ninety-five percent of the brain that humans still don't know how to use.

Among the many factors shaping their views, the children cited these as the most important: their own opinions, their spiritual beliefs, and the dreams that came to them in the night. Parents, peers, and television all figured lower on the list.

When Kurth-Schai asked the groups to describe their feelings about taking part in the project, she found that her research had emboldened an otherwise powerless and somehow disenfranchised segment of the population. "*Children can be futurists,*" one child said. "*It made me feel like I could change the future!*"

Another reflected, "*I felt smart because I could let my mind go and really think. I felt proud because I was giving my opinion about things I feel strongly about, and I think people will listen.*"

The fact that children are not encouraged or allowed to make important social contributions, Kurth-Schai maintains, is bad for them and for society as a whole.

Children have a strong ability to imagine superior worlds, she says, very different from ours now. We need to let them express their ideas and to find opportunities for them to make a contribution. ∞

BODY

By Owen Davies

The blind will see, the deaf hear and the paralyzed walk. The messianic promise from the Old Testament book of Isaiah may just be fulfilled by the next millennium due to the work of scientists at several major medical centers. The reason: a new kind of computer microchip that can be implanted in the body to repair or replace the lost functions of damaged nerves. Human trials for devices like artificial ears or stimulators to control paralyzed limbs could begin within ten years; practical implants might be in use in 15 years.

So far doctors can't do much for people who lose a limb or are paralyzed by spinal cord injuries. In these conditions however, the brain remains capable of sending a nerve impulse to twitch a muscle or of receiving an impulse and translating it into sight or sound. But damage to the nerves elsewhere prevents the message from reaching its destination. Find a way past that damage, and doctors could restore the lost functions.

That is where the new microchips come in. For good control or clear senses, a prosthesis should communicate with many nerve cells just as the brain does. But like the brain, it must talk to one nerve cell at a time. Otherwise, it's like people trying to carry on a quiet conversation at a loud party. The message to each nerve is drowned out by the surrounding noise. Ordinary wires are much too big for the job. They pick up the electric pulses from many cells at once, or they stimulate many cells with a signal meant for one.

In contrast, one chip can carry as many as 40 microscopic gold wires that press against the surfaces of single nerves. The more wires on a chip, the better the communication between brain and cell. Each wire picks up one nerve's electrical activity, like a wiretap stealing one conversation from a telephone cable. Engineers will use the chips to build artificial eyes and ears and to control artificial limbs that move as natural arms and legs do—when the wearer wills it.

But people who suffer from amyotrophic lateral sclerosis (ALS, or Lou Gehrig's disease) have no motor control at all, because the nerves outside the brain do not function. For these patients the work of computer scientist Kensall Wise at the University of Michigan may offer the best chance of a more normal life. If researchers detected even crude signals from a couple of nerve fibers in the brain, ALS patients could control a prosthesis.

Wise points out that the nerve fibers on the surface of the brain are so tangled that it is almost impossible to separate their signals. The bodies of the nerve cells below the surface, however, are relatively large and far apart, emitting clear signals. So Wise has spent the last six years delicately stabbing tiny electrode-studded spears into the brains of lab animals to reach the cells below the surface.

"A lot of our work so far has been to confirm that we could get usable signals out of the nerves," Wise says. "In ten years I expect to see artificial ears and stimulators to control paralyzed limbs."

A second approach comes from David J. Edell of the MIT Biomedical Engineering Center. Rather than being spear shaped, his implantable microchips are tiny rectangles meant to lie across the stumps of severed motor nerves. They can detect electrical activity from up to 40 separate nerve fibers. "The first practical application will probably be in a computer terminal that patients can control almost by thinking, much as they would an artificial arm," Edell says.

Nerves go bionic with implantable new chips

Computer scientist Morton Grosser and neurologist Joseph Rosen at Stanford University are taking still another tack. They plan to build a tiny integrated circuit that will function much like a telephone switchboard. Its purpose is to rejoin the two halves of a severed nerve when microsurgeons reattach a lost limb.

In use, the "switchboard" will be implanted between the two pieces of the nerve. After several weeks nerve fibers should grow into each end of the unit. Then the researchers will use a computer to identify which bits of nerve on each side of the cut were originally part of the same fiber. Once that is accomplished, they will set the implant's switches to carry nerve impulses from one end of each fiber to the other. In theory this should restore normal control over the limb.

It's an ambitious goal, and not all nerve specialists believe the scheme will work. "They are talking about extraordinarily complex devices, dealing with thousands of nerves firing hundreds of times a second," says a National Institutes of Health researcher who prefers not to be identified. "It's too big a problem to take on at this point. I've told Rosen that, but he's convinced they can do it."

Most researchers in the field agree that practical implants will be available within the decade. Gerald Loeb surely believes so. After 14 years at the National Institute of Neurological and Communicative Disorders and Stroke, he is leaving to set up his own engineering laboratory. He intends to build an artificial eye that will feed images from a TV camera into a microchip implanted in the visual centers of the brain. "It will take ten years to develop," he says. "The technology we need is now available. I don't see any reason we can't build a device that will bring eyesight to the blind."

E-TICKET TO NAMLAND

CONTINUED FROM PAGE 114

"Hmmm," said Disantis. He finished his drink and beckoned for more.

"But you, Mr. Disantis, you are a man of honor," said Minh. "I know this. I sense this. You are a man of honor."

Disantis nodded at the retreating waiter, removed the swizzle stick from his fresh drink and placed the plastic saber in a row with seven others. Mr. Minh blinked and did the same with his.

"As a man of honor you will understand why I have returned to avenge my family," Minh said carefully.

"Avenge?" said Disantis.

"Avenge my brother who died fighting the North Vietnamese," said Minh. "Avenge my father—a teacher—who spent eight years in a reeducation camp only to die soon after his release. Avenge my sister who was deported by this regime for—" Minh paused. "For alleged crimes against morality. She drowned when their overcrowded boat went down somewhere between here and Hong Kong."

"Avenge," repeated Disantis. "How? And with what?"

Minh sat up straight and looked over his shoulder. No one was near. "I will avenge my family's honor by striking against the maggots who have corrupted my nation," he said.

"Yeah," said Disantis. "With what? Do you have a weapon?"

Minh hesitated, licked his lips, and looked for a second like he was sobering. Then he leaned over and grasped Disantis's forearm. "I have a weapon," he whispered. "Two of them. I smuggled them in. A rifle and my service automatic from the Hac Bao."

He hesitated again. "I can tell you this, Mr. Disantis. You are a man of honor. This time it was a question."

"Yes," said Disantis. "Tell me."

Two of the huts were on fire. Justin and the other four had come in shouting and firing. There had been no opposition. The thirty-two villagers, mostly children and old people, knelt in the dust at the center of the village. Sayers had knocked over a lantern in one of the huts, and the thatch and bamboo had blazed like an incendiary flare. The fat American beat uselessly at the flames until Justin called, "Forget the fucking hooch and get back here."

Tom Newton swung his rifle to cover the cringing villagers. "Where are the VC?" he shouted.

"VC!" shouted Sayers. "Where are their tunnels? Tell us. God damn it!" A kneeling woman holding a baby bowed her forehead to the dust. Flames cast bizarre shadows on the dirt, and the smell of smoke made the men's nostrils flare.

"They don't understand what we're saying," said Reverend Dewitt.

"The hell they don't," snapped Justin. "They're just not talking."

Lieutenant Naguchi stepped forward. He was relaxed, but he kept his M-16 trained on the cowering villagers. "Mr. Jeffries, I will stand guard here if you wish to conduct an interrogation."

"Interrogation?" said Justin.

"There is an empty hut there, away from the fire," said the lieutenant. "It is best to isolate them during questioning."

"Yeah," said Justin. "I remember. Tom, cut a couple of them out of the herd. Hurry!"

Newton lifted a young man and an old woman by the arm and began moving them toward the hut. "Not her," said Justin. "Too old. Get that one." He pointed to a wide-eyed girl of fifteen or sixteen. "She's probably got a brother or boyfriend fighting with the VC."

Newton pushed the old woman back to her knees and roughly lifted the girl to her feet. Justin felt his mouth go dry. Behind him the flames had set a third hut on fire, and sparks drifted up to mix with the stars.

"The cabin resounded with babble, then fell silent as the guide smiled. "A joke, Mr. . . ." Disantis fired. People screamed. The guide flinched and raised his hands instinctively."

Disantis set the ninth plastic saber carefully in a row with the others. "How about ammunition?" he asked.

Minh blinked slowly and smiled. "Three thousand rounds for the rifle," he said. He lifted his glass in slow motion, drank, swallowed. "Thirty clips for the .45 caliber service automatic. Enough." He paused, swayed a second, and straightened his back. "Enough to do the job, yes?"

Disantis dropped money on the table to pay the tab. He helped Minh to his feet and guided the smaller man toward the door. Minh stopped, grasped Disantis's arm in both hands and brought his face close. "Enough, yes?" he asked.

Disantis nodded. "Enough," he said.

"Shit," said Tom Newton. "He's not going to tell us anything." The young man from the village knelt before them. His black shirt had been pulled back to pin his arms. Blood was smeared from the corners of his mouth and nostrils. There were cigarette burn marks dotted across his chest.

"Bring the girl here," said Justin. Sayers pushed her to her knees, took a fistful of hair and jerked her head back sharply.

"Where are the VC?" asked Justin. Smoke came through the open door of the hooch. "Tunnels? VC?"

The girl said nothing. Her eyes were very dark and dilated with fear. Small white teeth showed between her slightly parted lips. "Hold her arms," Justin said to Newton and Sayers. He took a long knife out of its sheath on his web belt, slipped the point under her buttoned shirtfront and slashed upward. Cloth ripped and parted.

The girl gasped and writhed, but the two Americans held her tightly. Her breasts were small, conical and lightly filmed with moisture.

"Jesus," said Newton and giggled.

Justin tugged her black pants halfway down, slapped her knee aside when she kicked and used the knife to tear the cloth away from her ankles.

"Hey!" yelled Sayers. The young Vietnamese had lurched to his feet and was struggling to free his arms. Justin turned quickly, dropped the knife, lifted the M-16 and fired three times in rapid succession. Flesh exploded from the boy's chest, throat and cheeks. He kicked backward, spasmed once, and lay still in a growing red pool.

"Oh, Jesus," Newton said again. "Jesus Christ, this is something."

"Shut up," said Justin. He placed the butt of his rifle against the dazed girl's collarbone and pushed her onto her back. "Hold her legs," he said. "You'll get your turns."

After seeing Minh to his hotel room and putting him to bed, Disantis went back to his own room and sat out on the balcony. Sometime after three A.M. his son-in-law and four other men materialized out of the darkness and sat down around one of the round tables on the abandoned terrace below. Disantis could hear the sounds of beer cans being tossed into trash bins, the pop of more tabs, and bits of conversation.

"How the hell did all the firing start out there?" asked Justin in the darkness. Several of the others giggled drunkenly.

A firm voice with a Japanese accent answered. "One of them ran. The reverend opened fire. I joined him in stopping them from escaping."

"—damn brains all over the place." Disantis recognized Sayers's voice. "I'd like to know how they did that."

"Blood bags and charges every six centimeters or so under the synflesh," came the slurred voice of the young man named Newton. "Used to work for Disney. Know all about that animate stuff."

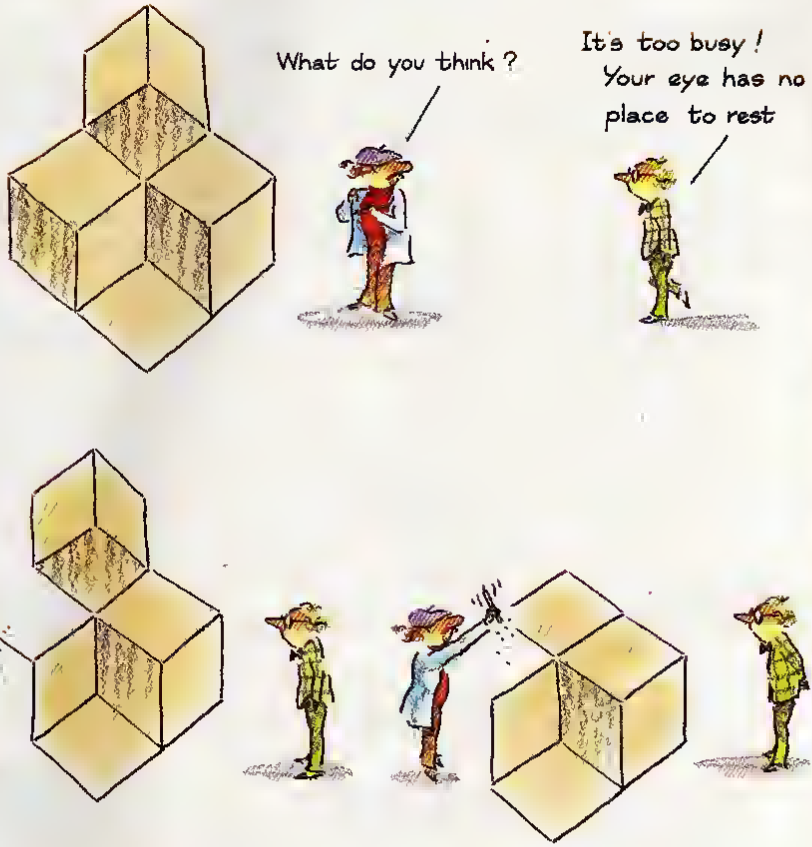
"If they *were* animates," said the Sayers shadow, and someone giggled.

"You damn well know that they were," came Justin's voice. "We never even got out of the goddamned park. Ten thousand goddamn bucks."

"It was so *real*," said a voice that Disantis recognized as belonging to the airwaves minister. "But surely there were no—bullets."

"Hell, no," said Newton. "Scuse me

The Artist



Reverend But they couldn t use real slugs Customers d kill each other by mistake

"Then how

"Lasered UV pulses" said Justin

"Triggered the charges under the skin" said Newton "Easy to reset

"But the blood" said Reverend Dewitt in the darkness "The the brain matter The bone fragments

"All right already!" shouted Sayers so loudly that the other men shushed him "Come on let s just say we got our money s worth okay? They can buy a lot of spare parts for that much right?

"You can buy a lot of spare gooks for that much" said Newton and there was a ripple of laughter "Jesus" he went on "did you see that gook girl wriggle when Jeffries slipped it to her the first time ?

Disantis listened for a few minutes more and then went into his room and carefully closed the sliding door

The morning was beautiful with tall white clouds piled up above the sea to the east when the family had a leisurely breakfast on the restaurant terrace Sammee and Elizabeth had eggs toast and cereal Heather ordered an omelet Disantis had coffee Justin joined them late cradled his head in his hands and ordered a Bloody Mary "You came in late last night dear" said Heather

Justin massaged his temples "Yeah Tom and some of us went to the gaming rooms and played poker til late"

"You missed the excitement this morning Dad" said Sammee

"Yeah what?" Justin sipped at his drink and grimaced

"They arrested Mr Minh this mornin" Sammee said happily

"Oh?" Justin looked at his wife

"It s true dear" said Heather "He was arrested this morning Something to do with illegal contraband in his luggage"

"Yeah " said Sammee "I heard the guy downstairs tellin' somebody that he had a rifle You know like ours only *real*"

Well I ll be damned" said Justin "Is he going to stand trial or what?"

"No" said Disantis "They just asked him to leave They shipped him out on the morning shuttle to Tokyo"

"There re a lot of nuts around" muttered Justin He opened the menu "I think I will have breakfast Do we have time before the morning tour?"

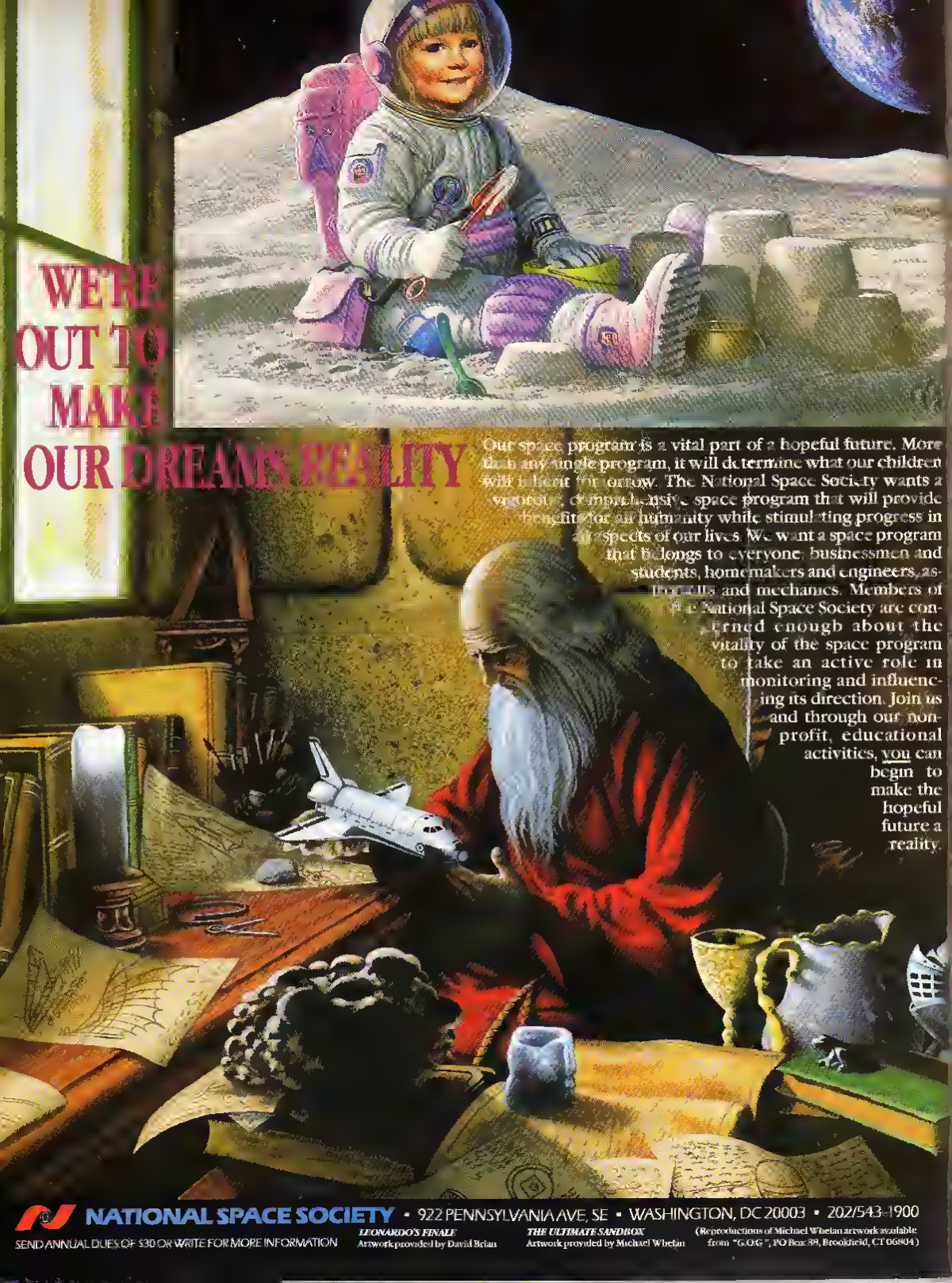
"Oh yes" said Heather "The helicopters don t leave until ten-thirty this morning We re going up the river somewhere Dad says that it should be very interesting"

"I think all this junk is *boring*" whined Elizabeth

"That s cause you think *everything* s boring, stupid " said Sammee

"Be quiet both of you," said Heather "We re here for your grandfather s benefit Eat your cereal "

The twenty-eight Huey gunships moved out in single file climbed above the line of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trees and sorted themselves into formation as they leveled off at three thousand feet. The panorama of highways and housing developments beneath them changed to rice paddies and jungle as they entered the park. Then they were over the river and heading west. Peasants poling small craft upstream looked up and waved as shadows of the gunships passed over them.

Disantis sat in the open door, hands hooked in the safety webbing, and let his legs dangle. On his back was Sammee's blue backpack. Justin dozed on a cushioned bench. Elizabeth sat on Heather's lap and complained of the heat. Sammee swung the heavy M-60 to the left and right and made machine-gun noises. The guide plugged his microphone into the bulkhead. "Ladies and gentlemen, today we are on a mission up the Mekong River. Our goal is twofold—to intercept illicit river traffic and to inspect any area of jungle near Highway 1 where movement of NVA regulars has been reported. Following completion of the mission, we will tour an eight-hundred-year-old Buddhist temple. Lunch will be served after the temple tour."

The helicopter throbbed north and westward. Elizabeth complained that she was hungry. Reverend Dewitt tried to get everyone to sing camp songs, but few people were interested. Tom Newton pointed out several historical landmarks to his wife. Justin awoke briefly, shot a series of images with his Nikon, and then went back to sleep.

Sometime later the guide broke the silence. "Please watch the river as we turn south. We will be searching for any small boats which look suspicious or attempt to flee at our approach. We should see the river in the next few minutes."

"No, we won't," said Disantis. He reached under his flowered shirt and removed the heavy .45 from his waistband. He aimed it at the guide's face and held it steady. "Please ask the pilot to turn north."

The cabin resounded with babble and then fell silent as the guide smiled. "A joke, Mr. Disantis, but not a funny one. I am afraid. Please let me see the—"

Disantis fired. The slug ripped through the bulkhead padding three centimeters from the guide's face. People screamed. The guide flinched and raised his hands instinctively, and Disantis swung his legs into the cabin. "North, please," he said. "Immediately."

The guide spoke quickly into his microphone, snapped two monosyllabic answers to unheard questions from the pilot, and the Huey swung out of formation and headed north.

"*Daddy*," said Heather.

"What the fuck do you think you're doing, Ralph?" said Justin. "Now give me that goddamn relic before someone gets—"

"Shut up," said Disantis.

"Mr. Disantis," said Reverend Dewitt, "you know there are women and children aboard this aircraft. If we could just talk about whatever—"

"Put the damn gun down, Ralph," growled Justin and began to rise from the bench.

"Be quiet." Disantis swung the pistol in Justin's direction, and the big man froze in mid-movement. "The next person to speak will be shot."

Sammee opened his mouth, looked at his grandfather's face, and remained silent. For several minutes the only sound was the throb of the rotors and Heather's soft weeping.

"Take it down here." Disantis said at last. He had been watching the jungle, making sure they were well out of the park. "Here."

The guide paused and then spoke rapid-fire Vietnamese into his mike. The Huey began to descend, circling in toward the clearing Disantis had pointed to. He could see two black Saigon Security Hovercraft coming quickly from the east, the down-blast of their fans rippling the leaf canopy of the jungle as they roared ten meters above it.

The Huey's skids touched down, and the high grass rippled and bent from the blast of the rotors.

"Come on, kids," said Disantis. He moved quickly, helping Elizabeth out and then tugging Sammee from his perch before

Heather could grab him Disantis jumped down beside them

"The *hell* you say" bellowed Justin and vaulted down

Disantis and the children had moved a few feet and were crouching in the whipping grass Disantis half-turned and shot Justin in the left leg The force of the blow swung the big man around He fell back toward the open doorway as people screamed and reached for him

"This is real Disantis said softly "Goodbye "He fired twice past the cockpit windshield Then he took Elizabeth by the hand and pulled her toward the jungle as the helicopter lifted off A multitude of hands pulled Justin in the open door as the Huey swung away over the trees

Sammee hesitated for a moment looked at the empty sky and then stumbled after his sister and grandfather The boy was sobbing uncontrollably

"Hush said Disantis and pulled Sammee inside the wall of vegetation There was a narrow trail extending into the jungle darkness Disantis removed the light backpack and took out a new clip for the automatic He ejected the old magazine and clicked the new one in with a slap of his palm Then he grabbed both children and moved as quickly as he could in a counterclockwise jog around the perimeter of the clearing always remaining concealed just within the jungle When they stopped he pushed the children down behind a fallen tree Elizabeth began to wail "Hush Disantis said softly

The Huey gunship came in quickly the guide leaped to the ground and then the helicopter was spiraling upward again clawing for altitude A second later the first of the Saigon Security Hovercraft roared in over the treetops and settled next to the guide The two men who jumped out wore black armor cloth and carried Uzi miniguns The guide pointed to the spot on the opposite side of the clearing where Disantis had first entered the jungle

They lifted their weapons and took a step in that direction Disantis walked out behind them dropped to one knee when he got to within five meters braced the pistol with both hands and fired as they turned He shot the first policeman in the face The second man had time to raise his gun before he was struck twice in the chest The bullets did not penetrate the armor cloth but the impact knocked him onto his back Disantis stepped forward straightened his arm and shot the man in the left eye

The guide turned and ran into the jungle Disantis fired once and then crouched next to the dead policeman as a wash of hot air struck him The Hovercraft was ten meters high and turning toward the trees when Disantis lifted the policeman's Uzi and fired He did not bother to aim The minigun kicked and flared sending two thousand flechettes a second skyward Disantis had a brief glimpse of the pilot's face before the entire canopy starred and burst into white powder The Hovercraft listed heavily to the left and plowed into the forest wall There was the heavy sound of machinery and trees breaking but no explosion

Disantis ran back to the jungle just as the second Hovercraft appeared It circled once and then shot straight up until it was lost in the sun Disantis grabbed the children and urged them on circling the edge of the clearing again until they reached the spot where the guide had entered the forest The narrow trail led away from the light into the jungle

Disantis crouched for a second and then touched the high grass at the side of the trail Drops of fresh blood were visible in the dappled light Disantis sniffed at his fingers and looked up at the white faces of Sammee and Elizabeth They had stopped crying It's all right he said and his voice was soft and soothing Behind them and above them there were the sounds of rotors and engines Gently ever so gently he turned the children and began leading them unresisting along the path into the jungle It was darker there quiet and cool The way was marked with crimson The children moved quickly to keep up with their grandfather

It's all right "he whispered and touched their shoulders lightly to guide them down the narrowing path "Everything's all right I know the way

INTERVIEW

CONTINUED FROM PAGE 124

then we'll use the protein synthesizer to make fragments of that virus coat protein. Then we'd try to make antibodies against those coat fragments. These antibodies would recognize and attack the part of the virus that binds to the T4 receptor.

Omni: What about Candace Pert's Peptide T, which she claims is connected to AIDS?

Hood: Pert and her people [at the National Institute of Mental Health] have made antibodies to bind to the T4 cell. Peptide T could conceivably be the direct binding-site molecule. Our studies may show that she's already got what we're looking for. Our peptide could be something more complicated than she's found. You see, they haven't gotten large enough quantities of the receptor molecule to do really straightforward, good, direct binding-site studies.

Omni: Tell us about the shivering mice.

Hood: They're an interesting use of microchemical biology. Arthur Roach, a graduate student here at Caltech, asked me how he might get into neurobiology. We eventually decided to clone the gene for myelin basic protein [sheathing around nerve cells]. The amino acid sequence for rat myelin-basic protein had been determined. So Arthur was able to translate it back into a DNA sequence. We used the DNA synthesizer to construct a genetic probe corresponding to that sequence. Arthur was able to make the gene for rat myelin-basic protein.

In the course of this, Arthur found one type of mouse that seemed to have a defective gene for its myelin-basic protein. The mouse was born normal, but after about twelve days it began to shiver and shake. This was a result of demyelination, the loss of the myelin insulation from the nerve cells, which started about that time. Arthur used his DNA probe to show that these shivering mice were totally lacking the RNA for that gene. He went on, with Naoki Takahashi, another grad student, to show that the reason for this was the deletion of three pieces of gene.

Here we have an ideal model for doing mammalian genetics. What we did was construct a transgenic mouse. That is, we injected the gene for rat myelin basic protein right into the nucleus of the fertilized eggs of shivering mice. About one in a hundred of the mice that developed from these embryos contained the gene for myelin-basic protein—and expressed it! The animal is completely normal, while its littermates are classic shiverers. It's the first example of a genetic defect that's been cured in a mammal.

But while we were the first to cure a genetic disease in a mammal, I hasten to add that this has no implications whatsoever for human beings. In the foreseeable future we are not going to inject genes into human embryos. For one thing, only one mouse in a hundred was cured. For an-

other. This gene incorporates randomly so if it connects with some other vital gene in the embryo and destroys its function, the embryo will die.

Omni: What about the military applications of sequencing the genome for tailoring lethal viruses?

Hood: The military implications are minimal. Pathogenicity, like intelligence, is a multigenic phenomenon involving very complex interactions between the pathogenic organism and the host. There isn't a ghost of a chance that we can sit down now or in the near future and use recombinant DNA techniques to design pathogenic organisms. There are much easier, cheaper approaches using techniques that have been around for a hundred years.

Omni: What kinds of information will we uncover in the genes?

Hood: Take something as simple as in the development of the eye. Humans start out as a single cell. It divides and eventually generates a hundred trillion cells. During that process, a subset of those trillion cells devote themselves to making eyes and all the pathways connecting the eyes to the central nervous system. Right now we know nothing about how many genes are responsible for generating the eye system or how those genes are interregulated or controlled so that the right things are turned on in the right cells at the right time. The retinal or optic nerves extend backward from the eye to a major area where they are hardwired into a precise one-to-one wiring diagram. We don't understand how this connecting of neurons is done.

All the information to construct a human is contained in the twenty-three chromosomes, and we don't understand in detail how any one major component system is encoded and expressed.

Omni: Could we set up a genetic bank from which we could lift information to create entirely new life forms?

Hood: Once we understood the basic prin-

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Corrections to the October 1987 issue. **page 13,** René Magritte, *The Future of Statues*, 1935. Tate Gallery copyright ADAGP 1987. **pages 76–79,** René Magritte, *The False Mirror* (*Le Faux Miroir*), 1928, oil on canvas, 21 1/4 × 31 7/8 inches (54 × 80.9 cm), collection The Museum of Modern Art, New York, purchase, copyright ADAGP 1987.

ciples of development it's conceivable that we could construct organisms different from any existing now But within the next ten to twenty years it's more likely that we'll be able to predict the three-dimensional structure of proteins And then we'll be able to eventually match particular functions to particular structures

Omni What would we want to design then?

Hood Well you could design enzymes that operate at very high temperatures that drive faster reactions to expedite commercial operations Or you could tailor-design molecules to carry out their present functions much more efficiently Or even modify them to operate under optimal conditions for what you want them to do rather than what the body normally does For instance you could develop hormones that are much more selective in their effects We hear a lot about steroids While they cause muscles to bulk up they also have lots of serious side effects We might design hormones that just do say the two things we want them to do and not the five things that are harmful

Omni Are the science-fiction scenarios about plagues of intelligently programmed biochips changing humanity or viruses that kill only women potential realities?

Hood It's difficult for any scientist to imagine those scenarios in the next twenty years We don't know enough about how to target specific kinds of cells much less specific sexes! Many tests have been done to see if modified organisms can survive outside the lab if they escape The tests have been reassuring Normal ordinary organisms have a hell of a selective advantage over any organisms we play with and try to manipulate

Omni [President of the Foundation on Economic Trends] Jeremy Rifkin's argument is just the opposite Organisms fabricated in the lab would overwhelm natural organisms

Hood I don't know any scientific reason why that statement should be true The bulk of the data gathered to date says that statement is utterly incorrect

Omni I imagine that you are not a big fan of Mr Rifkin's

Hood [Smiles] Well he's an articulate demagogue who has probably served an important role in society Anybody who makes us think more carefully about these kinds of issues to a certain extent does some good He starts to do damage when at the behest of demagoguery he begins to paralyze the ability to make advances He's perilously close to that position now

Omni Would knowing the makeup of our genetic code take the mystery out of life?

Hood Absolutely not! Would understanding how the latest fancy computer was put together take all the mystery out of all the wonderful things that with the appropriate software you could do with the machine? Not at all Understanding hardware doesn't tell you the essence of the computer the software is every bit as important

Omni James Watson [codiscoverer of the structure of DNA] told *Omni* that "life was just a matter of physics and chemistry" and with the discovery of DNA the mystery of life has already been solved

Hood Well I guess I'm a believer in emergent properties What Watson said is true—it is essentially chemistry and physics But again like computers when you start putting multiple circuits together and they start acting in synergistic ways you cannot simply predict what the outcome will be The genetic basis for the complicated human circuitry plus the circuitry's feedback interactions and controls are dimensions presently beyond us

Omni You are an avid mountain and rock climber It seems to be something scientists are drawn to Can you explain why?

Hood It's therapeutic When I'm climbing I think of nothing else For the next twelve days I'm not going to think one thought about science Climbing is a wonderful combination of physical and intellectual challenge You look at the face of a cliff You have to figure out how to get up it and then you have to be able to climb it You have to have the strength and endurance to do what you've intellectually figured out Those features are really attractive to people who are interested in science

SPACE

CONTINUED FROM PAGE 76

Washington University professor John Logsdon Morrison is a foremost expert in SETI (the search for extraterrestrial intelligence) and Logsdon is head of the Space Policy Institute at George Washington University. In Space Medicine 101, Lawrence Young, director of the Man-Vehicle Lab at MIT, discussed ways astronauts could avoid the bird-leg effect caused by fluid shifts at low gravity. (One method: Sleep with your lower body inside a vacuum.) In Space Business 101, professor for a day Christopher Trump of Canada's Spar Aerospace Ltd. noted that during the Sixties North Americans spent $62 billion on booze and only $30 billion to land a man on the moon. And space attorney Art Dula told his Space Law 101 class that he gets his Texas clients excited about space by showing them pictures of Jupiter and telling them it is the largest natural-gas deposit in the solar system.

Every summer session will have this mixed curriculum plus a specific research project. The project for the 1988 summer session will be to work on a design for an international lunar research base. "We're giving these students a chance to work with their future peer leaders," says Diamandis, "and to be taught by the best possible faculty teachers they might not ordinarily have had any contact with."

While the distant goal of ISU is to begin training a space-bound generation, another purpose is to breathe new life into our space program. "The vision it once had has been lost," notes Diamandis, who until recently had planned to be an astronaut. "It's up to us, the younger generation, to make this happen again."

Editors note: Anyone who is interested in applying to the International Space University summer session should send a stamped, self-addressed envelope to: ISU Headquarters, Suite 201, 636 Beacon Street, Boston, MA 02215.

ISU applicants must:

- have a bachelor's degree in any field and must have taken at least two of the following: a year of physics or engineering, a year of higher math (calculus, statistics, or linear algebra), two science courses in biology, chemistry or geology.
- have graduate-student status, which means they must be enrolled in an accredited graduate program, be accepted into an accredited graduate program or have completed a graduate program no more than three years prior to the start of the 1988 ISU summer session.
- have spoken fluency in English and one other language.
- be a top student in his or her field, demonstrate leadership qualities, have a strong interest in and commitment to space and preferably have had some experience working for either industry or government in a related field. ∞

Small Company's New Golf Ball Flies Too Far; Could Obsolete Many Golf Courses

Pro Hits 400-Yard Tee Shots During Test Round

Want To Shoot An Eagle or Two?

By Mike Henson

MERIDEN, CT — A small golf company in Connecticut has created a new, super ball that flies like a U-2, putts with the steady roll of a cue ball and bites the green on approach shots like a dropped cat. But don't look for it on weekend TV. Long-hitting pros could make a joke out of some of golf's finest courses with it. One pro who tested the ball drove it *400 yards*, reaching the green on all but the longest par-fours. Scientific tests by an independent lab using a hitting machine prove the ball out-distances all major brands dramatically.

The ball's extraordinary distance comes partly from a revolutionary new dimple design that keeps the ball aloft longer. But there's also a secret change in the core that makes it rise faster off the clubhead. Another change reduces air drag. The result is a ball that gains altitude quickly, then sails like a glider. None of the changes is noticeable in the ball itself.

Despite this extraordinary performance the company has a problem. A spokesman put it this way: "In golf you need endorsements and TV publicity. This is what gets you in the pro shops and stores where 95% of all golf products are sold. Unless the pros use your ball on TV, you're virtually locked out of these outlets. TV advertising is too expensive to buy on your own, at least for us.

"Now, you've seen how far this ball can fly. Can you imagine a pro using it on TV and eagle-ing par-fours? It would turn the course into a par-three, and real men don't play par-three's. This new fly-power forces us to sell it without relying on pros or pro-shops. One way is to sell it direct from our plant. That way we can keep the name printed on the ball a secret that only a buyer would know. There's more to golf than tournaments, you know."

The company guarantees a golfer a prompt refund if the new ball doesn't cut five to ten strokes off his or her average score. Simply return the balls — new or used — to the address below. "No one else would dare do that," boasted the company's director.

If you would like an eagle or two, here's your best chance yet. Write your name and address and "Code Name S" (the ball's R&D name) on a piece of paper and send it along with a check (or your credit card number and expiration date) to National Golf Center (Dept. H-588), 500 S. Broad St., Meriden, CT 06450. Or phone 203-238-2712, 8-8 Eastern time. No P.O. boxes, all shipments are UPS. One dozen "S" balls cost $21.95 (plus $1.95 shipping), two to five dozen are only $19.50 each, six dozen are only $99.00. You save $43.00 ordering six. Shipping is free on two or more dozen. Specify white or Hi-Vision yellow.

GAMES

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OFFICIAL RULES FOR THE *OMNI*–McGRAW-HILL CROSSWORD PUZZLE

First published 25 years ago, the *McGraw Hill Encyclopedia of Science and Technology* has expanded steadily keeping pace with the latest advances. Today the recently published sixth edition contains 7700 entries written by 3500 contributors, including such Nobel laureates as physicist Val Fitch, physical chemist Robert Mulliken, and medical researcher Rosalyn Yalow.

The encyclopedia offers a wealth of possibilities for a crossword puzzle. And even if you can't complete our puzzle, the more correct answers you fill in, the greater your chances of winning our grand prize, a 20-volume *McGraw Hill Encyclopedia of Science and Technology*. Three first-prize winners will receive the *McGraw Hill Concise Encyclopedia of Science and Technology* valued at $98.50. And five runners-up will each receive a one-year subscription to *Omni*, worth $24.

You might therefore want to double-check your answers—a time-consuming procedure if you have to labor through numerous texts and references. But remember: *All* the answers do appear in a single source—the sixth *McGraw-Hill Encyclopedia of Science and Technology*, which is available in public and school libraries and other reference centers.

Be sure to read and carefully follow these official rules.

1. No purchase necessary. To enter, fill in as many answers as possible to the *Omni*–McGraw-Hill Crossword Puzzle. Send your puzzle—along with your name, address, and ZIP code, printed on a three- by five-inch piece of paper—to *Omni* Crossword Puzzle, Box 871, Boston, MA 02117. You need not use an original copy of the puzzle; photocopies or printed facsimiles are acceptable.

Enter as many times as you wish, but mail each entry separately. We are not responsible for lost, illegible, or late mail. Entries must be *received* by December 31, 1987. Selection of winners will take place immediately thereafter.

2. Entries will be scored based on the most words filled in *correctly*. Winners will be determined by highest scores earned in completing the puzzle. In the event of tie scores, winners will be selected in random drawings from among tied entries.

Scoring and random drawings will be conducted by Proaction Marketing, Inc., an independent judging organization, whose decisions are final.

Odds of winning are determined by the number of eligible entries received. No duplicate prizewinners. Winners will be notified by mail and may be required to sign and return an affidavit of eligibility and release within 15 days of date on notification. Winners agree to the possible use of their names and likenesses for publicity purposes without additional compensation.

3. The *Omni*–McGraw-Hill Crossword Puzzle is open to residents of the United States, except employees (and their families) of *Omni* Publications International Ltd., McGraw-Hill, Inc., their subsidiaries or affiliates, their advertising and promotion agencies, and Proaction Marketing, Inc.

All federal, state, and local laws and regulations apply. Void where prohibited.

4. Prizes are not transferable, assignable, or redeemable for cash. No substitution for prizes other than as necessary due to availability. All taxes are the responsibility of the winners.

5. For a free copy of the *Omni*–McGraw-Hill Crossword Puzzle and the official rules, send a self-addressed, stamped envelope to *Omni* Crossword Puzzle, Box 894, Boston, MA 02117 by November 30, 1987.

No return postage necessary for residents of Washington and Vermont. Vermont postage will be refunded.

6. The solution to the crossword puzzle and the winners' names will be announced in a future issue of *Omni*, or send a self-addressed, stamped envelope to Crossword Puzzle Winners, *Omni*, 1965 Broadway, New York, NY 10023-5965.

MAKE BELIEVERS

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which she was being "raped and murdered with knives by an older woman. The next day at dawn," she wrote, "I awoke hearing a voice repeat over and over again. 'To love is to listen. to listen is to love.' The voice did not speak inside my mind. it came from beyond the window, flowing into my bedroom just as dawn poured in, saturating the space with light and words in a most uncanny way." In an effort to understand the meaning of her dream, she began to listen to her invisible figures.

The !Kung's *n!um* is said to be an invisible spiritual energy that becomes visible to the healers—they can touch and hold it. !Kung healers also carry on conversations with deceased ancestors in order to bargain for the lives of the sick. These spirits the !Kung believe, have the power to decide who lives and who dies. In modern Western cultures, though, the intertwining of the spiritual and material are ignored. As a result, the role imagination plays in daily life has long been dismissed as useless, nonproductive, even dangerous. Fantasy, after all, can consume a person, trapping him or her in a nightmare reality. The man who believes he's Napoleon Bonaparte is caught inside a world he can't get out of.

Because psychotherapists spend a good deal of time with patients suffering from delusions, they often ignore the positive aspects of conversing with their inner figures. Watkins would like to undo the "psychiatric phobia" about carrying on conversations in one's mind. She believes that ordinary people can become more creative if they learn to talk to the voices inside themselves.

"That's why I don't like to use the word *trance* to describe my work," Watkins explains. "I prefer the term *waking dreams* to describe the place where these dialogues take place, a state midway between waking and dreaming." Yet she is quick to argue that these conversations unfold all the time in our ordinary thoughts.

Taking her cues from images in nighttime dreams and in the language dream figures use, Watkins has learned to enter into her clients' psychic landscapes without imposing her own preferences. "It's important to approach the imagination in this way," she says, "in order to avoid having clients deal with the characters 'you think ought to be there,' rather than the figures who are there. I try to figure out where they are at the moment. Are they drowning in the ocean? Are they in a desert without water? Are they in an old-age home?"

Watkins sees this sort of therapy as beneficial to most of her clients, even those labeled schizophrenic. "Often," says Watkins, "therapists will say, 'Let's not attend to that fantasy life. Let's just get this patient back to normal.' But I believe this can ignore both the meaning implicit in the images that present themselves and the process by which one can relate to the imaginal without being overwhelmed by it. The presence of fantasy isn't a problem. It's when the fantasy washes over the person that problems occur."

Take the case of a man who has heard a voice telling him to commit a violent act against someone else. "As a therapist," says Watkins, "I want this man to engage actively with his invisible guest. listen to the unfolding dialogue, asking it, 'Why do you want me to be violent? What would that violence accomplish?' If the man can begin to talk to this figure, he may begin to separate himself (his own ego) from the voice and stop taking what it says literally, as a command over which he has no power."

Watkins identifies her role as "midwife" to the dialogues between client and invisible guest. "I don't do guided imagery," she says, rejecting that process because the therapist directs the content of the client's images by supplying the image for the client to visualize. "I'm a midwife in a client's relationship between himself and his imagined figures. I don't invite them into the client's world."

"Mary Watkins helps her clients move freely through the symbolic part of themselves and hold dialogues with imaginary figures—invisible companions who inhabit our souls."

But Watkins is not the only psychotherapist to explore the lesser-known areas of the human psyche and to practice forms of enhanced state therapy. Czechoslovakian-born psychiatrist Stanislav Grof and his wife, Christina, a teacher of art and yoga, work in ways more similar to the ancient !Kung rituals than to the methods of Mary Watkins. Among the first to grasp the potential of self-induced enhanced states, the Grofs began developing holotropic therapy—a technique that combines breathing-induced altered states, evocative music, and body work (massage and other techniques)—in the early Seventies.

Holotropic therapy is inspired by ancient ceremonies such as those of the !Kung. Like the !Kung healing dancers, the Grofs use music and a form of hyperventilation to guide people toward an enhanced state. There is also a laying on of hands in both groups. The !Kung healers and the facilitators in the Grofs' workshops place their hands on the heads of the participants or embrace them.

The carpeted, wood-paneled room at the Esalen Institute in Big Sur, California, is now semidarkened. Large window drapes screen out the view for which Esalen is famous—the Pacific surf pounding onto the boulders that have fallen from the shaggy, steep cliffs of Big Sur. Mattresses, soft pillows, and cushions lie scattered across the floor; most of them are being clutched by the ten people who are lying on the floor in various, sometimes unusual positions. Stravinsky's *Rite of Spring* resounds throughout the room.

A few people are shaking violently, rolling and flailing on the floor, almost everyone's breathing is rapid and deep. One person curls into the fetal position; another writhes and twists on the floor like some kind of serpentine creature. Each person on the floor is watched intently by a facilitator who sits close by. One person gently touches the forehead of his partner, who is arching his back and grimacing in pain. Another holds her sobbing partner.

The Grofs move about the room, supporting anyone who seems to have special difficulties. They encourage some participants to go further into their experience, leading one person through a fit of gagging and choking, which slowly subsides. The Grofs have been in this place before. It is midway through one of their group sessions—a time when participants experience a lot of pain. They also know that during the next phase many people will experience a release of emotional and physical energy that may help them resolve the problem that's troubling them.

Stanislav Grof developed his use of enhanced states in the Sixties, when he was working with terminally ill cancer patients. He gave many of his patients LSD—which was a legal therapeutic drug then—in a warm, supportive context and accompanied their journeys with comforting music. "I call this territory of experience nonordinary consciousness," Grof explains. "The territory is the same whether it's triggered by dance, breathing, or drugs. It is the realm of the spiritual, where people experience death–rebirth and the transpersonal. Some cultures use drugs to get there, others, like the !Kung, do not."

In normal states of consciousness we experience ourselves as existing within the boundaries of the physical body and restricted by material reality, the limitations of time and space. A transpersonal therapist such as Grof deals with all the issues that emerge because of these limitations, including mundane affairs, existential problems, biographical data, and the fear of death. But Grof also recognizes a reality not limited by time and space. In enhanced state therapies, people identify with other people, animals, plants, inorganic matter, past incarnations, or their ancestors. Many subjects report fetal and embryonic memories such as birth traumas or even regression to the cellular level. According to Grof, these transcendent experiences "can alleviate emotional and psy-

chosomatic problems including anxiety depression addiction asthma psoriasis and migraine headaches

The spiritual aspirations of people are usually ignored in mainstream psychotherapy which focuses on patients own psychology and their relation to others rather than on how they see themselves in relation to the infinite Grof s work with cancer patients focused on their fear of dying and their feelings about what was to come Grof believed that if he could help people let go of that fear they might be better able to deal with their mortality

But individuals who are not terminally ill must also struggle with their own mortality and their place in the universe It was to help people with these problems that Grof began developing holotropic therapy Underlying his method is the belief that helping people let go of their fears through the physical release of energy may lead them to experience a feeling of renewal a rebirth of spirit Watkins too has noticed a spiritual element to her enhanced state therapies When one is moved by the existence and autonomy of imaginal others and their worlds she explains in *Invisible Guests* one often experiences a luminous or religious quality to these dialogues one comes upon prayer

In one of Grof s sessions for instance a woman found herself rolling on the floor clutching her throat and gagging Her partner comforted her during the trauma and when the session was over they discussed how her actions were a graphic portrayal of her inner state—she had always had trouble speaking up for herself Once this connection was made and some of the initial pain of being emotionally impotent expressed the woman could begin to make behavioral changes Another woman wrote It has been a year since the workshop and I feel that what is with me now is lasting The most satisfying result is that I have truly accepted the place where I live as my home—after some sixteen years of struggling with a strong desire to leave here Claiming to have had a transcendent experience she said I realized I had flown thousands of miles to the workshop in order to be with myself At that moment I began living at home

Of course this sort of therapy doesn t work for everyone and critics charge it is simply a quick fix Lasting changes in how an individual feels and behaves they argue must be accompanied by insights and understanding at each step of the way The Grofs agree and have tried to build opportunities for such understanding into their work But this sort of intense therapy is not right for everyone It can even be dangerous Because of the strong emotional and physical stress experienced in a session people with serious cardiovascular problems shouldn t participate nor should pregnant women Hyperventilation reduces the blood supply to the placenta says Grof In a death–rebirth experience a woman can actually induce powerful contractions of the uterus The Grofs are also very careful when dealing with persons who have a history of psychiatric disturbance We don t want such a person to be in just one session have things stirred up and then be left alone explains Grof We work with such persons only in a long-term setting providing a twenty-four-hour supportive context

Like the !Kung Mary Watkins and the Grofs know that the meaning of these enhanced states may never be fully explained scientifically—and perhaps they shouldn t be We now know that endorphins—opiatelike substances in the brain—reduce the sensation of pain and induce a feeling of euphoria Raymond Prince a Canadian psychiatrist at McGill University has researched the role endorphins might play in healings such as those the !Kung practice and in altered states He believes that enhanced consciousness in healing may be accompanied perhaps even triggered by the body s own release of endorphins This release of endorphins Prince says helps to explain the mysterious ability of healers to endure what should be unendurable pain when for instance they put their heads into the fire or pick up burning coals

But Prince is convinced that neurochemistry is only part of the answer He argues that a wide range of conditions can trigger the enhanced state including darkness rhythmic drumbeats social isolation fasting sensory deprivation even fatigue or simple belief in the healing ritual

The !Kung are among the oldest practitioners of this ancient art of enhanced state healing that present-day therapists attempt to practice All over the world indigenous healers speak of a spiritual power that heals physical and emotional problems Among the Fiji islanders it s called *mana* among the Dakota Sioux *wakan* among the Chinese *chi* and among the !Kung *n!um* But questions remain for Western participants Is the contemporary practitioner a modern-day shaman or merely a limited and superficial imitator of traditional healers? Have Western approaches strayed so far from the sources of spiritual power that it is no longer available for healing? More important how can we as seekers of healing consumers of therapy judge the validity and worth of these new approaches?

If these enhanced states are as powerful as practitioners claim perhaps we must assume that there is a spiritual ingredient partly mysterious to the healing process The !Kung acknowledge this mystery We don t always know how this *n!um* will work That s why we fear it It can kill you if you re not prepared The !Kung tell us that one can lose one s soul even one s life if the healing dance is not done in the right spirit These states caution the !Kung must be handled with care Your healing and mine they are different says Blind Kau but they are also the same because we are both human beings

STAR TECH

ACCESSING THE FUTURE

HEALING VIDEO

Can the way we think relax and imagine actually strengthen our immune systems? Researchers in the new field of psychoneuroimmunology say there *is* a link between the mind and body and that a person can improve his immune response by imagining the immune system at work. Now there's a 20-minute videotape to help people tap into this connection and use imaging techniques to, theoretically, fight disease.

The tape begins with a woman bathed in pink light. Her soothing voice guides the viewer through a relaxation exercise and explains animated segments showing white blood cells zapping diseased cells, the brain sending signals to activate immune responses, and so on. Subliminal noises, including ocean waves and laughter, play throughout, helping to soothe the viewer and stimulate endorphin production, according to Greg Halpern, president of the Om Corporation, the manufacturer of the tape. "People who are ill have a difficult time relaxing and developing these kinds of visual images on their own," Halpern adds. "But a person who watches this tape morning and night for two weeks will be relaxed and learn the images thoroughly." —Sherry Baker

Access: The "Health Imaging" tape sells for $39.95. Call 1-800-468-7874 for more information or write the Om Corporation, 3400 Dundee Road, Northbrook, IL 60062.

LASER VETERINARIANS

Millions of people have benefited from laser medicine, which spans the gamut—from eye surgery to podiatry. But few pets have, because few veterinarians know much about lasers or can afford medical lasers costing $20,000 to $100,000. Now a prestigious medical laser center at the University of California at Irvine has opened an animal center so local vets can treat ailing pets with lasers.

The first beneficiary was Sheily, a 14-year-old schnauzer owned by Robert Reed of San Clemente. Working with an Irvine urologist, San Clemente vet George Peavy removed a plum-size tumor from the dog's bladder. The solid-state laser seals incisions as it cuts, so the dog lost less than a teaspoon of blood and went home in just four days.

Institute director Michael Berns says the animal lab was opened not to experiment on animals but "to help them [and] to get information and experience that can be used on humans." He hopes to build "the first laser animal hospital right next to our present building."

—Jeff Hecht

Access: The Irvine laser facility is available at no cost to local veterinarians. Interested vets should contact Marie Wilson, Animal Treatment Program, Beckman Laser Institute and Medical Clinic, University of California, Irvine, CA 92717. Phone (714) 856-6996. People with sick pets should work through their veterinarians.

HOLOGRAPHY WORKSHOP

Fascinated by holography? You might try making your own holograms. Spend a week at Lake Forest College's summer holography workshop, and you can make your own three-dimensional images.

Physics professor Tung Hon Jeong has been running the hands-on workshops since 1972. In five days he can teach people with no scientific background how to make several types of holograms. A four-day advanced workshop also covers color control, large holograms, and pulsed-laser holographic portraits.

In the past 15 years, Jeong has taught a wide range of people to make holograms, from junior high school students to Ph.D. physicists. Some have practical applications in mind, such as a dentist who wanted to take holograms of teeth. A growing number, however, are artists who see holography as a new medium. One example is sculptor Michael Croyden, a member of Lake Forest's art faculty who took Jeong's course four years ago. His first hologram won him an award at a 1985 exhibit of holograms on the Lake Forest campus. —Jeff Hecht

Access: Tuition is $650 for the introductory course, which carries two semester hours of undergraduate or graduate credit, and $800 for the noncredit advanced course. Contact Holography Workshops, Lake Forest College, Lake Forest, IL 60045. Phone (312) 234-3100.

NEW 3-D VIDEO GAMES

Two video game companies Sega and Nintendo are set to offer the first high-quality 3-D video games for the home Three-dimensional video is nothing new in itself but these games come with a

twist They are designed to work with special 3-D glasses based upon state-of-the-art liquid crystal display technology

Players wearing the special 3-D glasses are actually looking through a pair of liquid crystal shutters that can instantly change from transparent to opaque The glasses are designed to work with 3-D game software that produces a TV picture for the right eye that alternates with one for the left eye When the right eye's picture is displayed, the left shutter—or eyeglass lens—is darkened so that only the right eye receives the picture Likewise when the left eye's picture is shown (The pictures alternate so fast that only one image is seen)

The result is a 3 D effect that game marketers hope will enhance the video game experience—not to mention the bottom line of video game companies

—Marjorie Costello

Access Sega's first two 3-D home video games *Missile Defense* and *Zaxxon* and Nintendo's *Rad Racer* are due by Christmas each carrying a suggested list price of $40 Only Sega however will be selling liquid crystal glasses—at $50 (shown above with adapter plug above left) Nintendo which is waiting for the price of the glasses to come down is entering the home 3-D arena with the more traditional—and lower quality—red/blue tinted 3-D glasses (provided with the game) The Nintendo cartridges can also be played in conventional two-dimensional mode

NOT TOO SMALL FOR WORDS

Casio has developed the world's smallest word processor, a one-pound hand-held unit—complete with built-in printer—called the Handy Writer (at right)

The Handy Writer can store—through a tiny keyboard—up to 1 800 characters in its memory and can show 16 characters at the same time on its liquid crystal display (LCD) Another feature of the Handy Writer is its built-in thermal printer which operates at 13 characters per second The messages stored in the Handy Writer are printed out by sliding the machine across paper including everything from file folders to labels to notebooks

Despite its small size the Handy Writer provides a choice of three fonts and six character sizes as well as underlining and shading The Handy Writer is also something of a math whiz since it includes a built-in calculator that can print out a problem and answer it instantly

The Handy Writer is suited

for creating signs or quick notes with readable and presentable type when a typewriter or conventional word processor and printer is not available Because of its small size memory and printing features the Handy Writer can fill the role of an electronic rubber stamp

—Marjorie Costello

Access The Handy Writer is currently available in Japan and will reach the United States in January 1988 Price approximately $230

ELECTRONIC DEODORANT

Heavy sweaters now have an alternative to antiperspirant creams deodorants sweatbands and the other paraphernalia designed to hide or reduce perspiration It's an electronic device that purportedly keeps even active sports participants dry for up to six weeks

Called Drionic the device was developed by General Medical Company (GMC) of Los Angeles after 14 years of research Drionic uses a mild battery current to control excessive sweating in problem areas the hands feet and underarms GMC says it helps prevent losing control of a ball bat, or tennis racket because of slippery wet hands and can retard the development of blisters or fungal infections due to wet feet. The university-tested FDA-approved process known as iontophoresis stops emotion related heavy perspiration by causing hyperkeratotic plugs to form in sweat ducts Studies have shown that

when excess sweating of the hands feet and underarms is stopped it has no effect on the body s thermoregulation

Drionic units are $100 a pair for hands feet or underarm pads They require only tap-water wetting and a battery No chemicals are used —Allan Maurer

Access The Drionic (below) is available with a physician s prescription exclusively from the manufacturer General Medical Company Department 1935 Armacost Avenue Los Angeles CA 90025

FILMLESS CAMERA

True instant gratification has arrived in the photo field in the form of the electronic still camera Similarly to video camcorders the electronic—or video—still camera produces images that require no developing You can view the pictures instantly because the video camera stores its images electronically on two-inch magnetic floppy disks instead of chemically on film

The floppy disks are displayed on a TV set when played back either by the camera or by a special recorder/player Hard-copy prints are also available with special color printers Some systems offer add-ons that make it possible to transmit and receive still images over phone lines

The first commercially available video still camera was from Canon and now other units are on the market from Sony and Konica These electronic still systems are geared toward professional applications costing upwards of $7 000 for a camera and recorder/player

Consumer participation in electronic still photography however will open up with Casio s introduction of its VS-101 (below) It will sell for about $1 000 and doesn f require a separate unit to play back images on a TV set —Marjorie Costello

Access Casio VS 101 will be available in February 1988 The system will also include an optional printer

INTERACTIVE EROTICA

At a recent San Francisco computer expo the vice squad asked *Maxie* to keep her clothes on

The woman in question is actually a computer program billed as the 'first interactive erotica' for the Macintosh computer We thought the police were kidding says Mike Saenz *Maxie* s creator After all San Francisco is supposed to be sin city They were quite serious though when they told us we were in violation of several city ordinances just by publicly demonstrating the program

Computer-generated illustrations of nude women are nothing new but *Maxie* takes the concept further adding realistic movements and a digital recording of a seductive female voice I think what gets people upset—or maybe what attracts them to it—is that they ve never seen anything like this before says Saenz

—Timothy Onosko

Access Maxie the MacPlaymate works on the Macintosh computer The 400K-disk version costs $29 95 the 800K disk version $49 95 From Pegasus Productions Box 912 Greenwich CT 06836

COMMUNICATIONS

CONTINUED FROM PAGE 12

Ace in the Hole

I was frightened when I read about the ozone hole ["Watch This Space," August 1987]. I didn't realize the situation was so severe. Environmental groups should organize a global summit and invite the best scientists in the world to solve this problem. The agenda also should deal with acid rain and with preventing the destruction of the rain forests, the pollution of the ocean, and animal and plant extinction.

Marilyn Hencken
Los Angeles

Your article on the ozone layer was interesting, but the speculations about the causes of the phenomenon were pure nonsense. I will venture a guess. The South magnetic axis (pole) will be found at the center of the hole.

Joseph Armstrong
Trenton

F. Sherwood Rowland, cited in "Watch This Space," is a professor of chemistry at the University of California at Irvine—not at Berkeley. While Berkeley may be more famous, the reputation of UCI is just as important to the students. After all, it's not easy being the Harvard of the West!

Dean Ulven
Irvine, CA

You Say To-MAY-to

After living in Ohio, Virginia, North Carolina, and Arizona, I have never heard a majority of people pronounce words the way your so-called experts say they should be pronounced ["Games," July 1987]. Just try saying *Tsk, tsk* by supposedly squeezing air between the tongue and palate. Get real. People say *tisk*.

Guy Lucas
Lenoir, NC

Enough is enough! Having spent the better part of my life railing against the mispronunciation of my beloved state, what happens? You people give everyone carte blanche to call it nuh-VAH-duh. Any self-respecting Nevadan worth his or her weight in gaming chips knows it's nuh-VA-duh. The second syllable pronounced like the *a* in *cat, hat, bat*. Get the idea? We Nuh-VA-dans are, by the way, a friendly lot.

Joe Bickett
Reno

Digs

I'm a graduate student in anthropology and archaeology and thought "Future Man" ["Continuum," August 1987] was highly speculative—absurd, actually. Fifty thousand years is a ridiculously short period of time to anticipate sweeping biological changes in human form. Why would humans get shorter when we have been getting larger over the years?

How the Virginia forensic scientist came up with domed cities and rip-stop nylon clothes from paleoosteological evidence escapes me. And someone who can seriously look you in the eye and say the workweek in 51987 will be longer—by looking at a lot of bones—is nuts.

Roy Ledbetter
San Francisco

Kaboom

I object to Terry Runte's callous humor when he describes life after the bomb [Last Word, August 1987]. It desensitizes us to the danger of nuclear weapons.

Yup, life truly would be different after a nuclear war. The only likely survivors: cockroaches and perhaps rats. Nuclear war is not a winnable proposition, not a realistic or sane action, not a subject to be joked about. If the white flash occurs, no one will be around to laugh.

Blaine Cross
Minneapolis

Is Runte going to stay inside a cramped Oscar Mayer wiener truck for weeks, eating nothing but hot dogs and drinking from a thermos of coffee he had with him at the time of the blast? I'd rather be vaporized.

What will Runté do if all those loony survivalists, armed with Uzis and canned goods, survive? I'd barter those hot dogs, grab a gun, and make a run for it.

All in all, a good case for peace.

Nora E. Blevans
Vandenberg Air Force Base, CA

Night Porter

I'm complimented by the article "Into the Night" [July 1987] because I live in the night. TV is better, nobody comes to the door to sell vacuum cleaners, the night even smells better than the day, especially the smell of night rain. I dislike the thought of a 24-hour society—there goes the peace and solitude of the wee hours.

Heather Wooding
Blairstown, NJ

Beau Monde

I'm a Peace Corps volunteer in Senegal involved in constructing a primary-school classroom. Your donation has made it possible to furnish the school: 30 desks, a desk and chair for the teacher, one armoire, four windows, and a door. We hope to be ready to open the classroom for the 1987–1988 school year, which begins in October. Your gift is greater than you realize.

Leslie Welch
Mbour, Senegal

Editors note: Loret Miller Ruppe, director of the Peace Corps, contributed the honorarium she received for writing June's First Word to this project.

Write Stuff

The address for the Teslar watch ["Star Tech," August 1987] is E.L.F. Cocoon International Ltd., RR 1, Box 21, St. Francisville, IL 62460.

PATENTLY ABSURD

CONTINUED FROM PAGE 105

lightened new age of higher knowing, we now have our healing and rejuvenating crystals. These, of course, make more sense. Not only are they compact enough to fit into a suit pocket or briefcase, they are obviously more powerful, as they are known to have been collecting and storing cosmic rays for thousands of years. Things change, people do not.

On the lighter side, we also see the discontent of that era with the unscientific approaches to personality and character analysis. In 1798 Franz Gall developed a method of determining character and mental ability by measuring the skull shape—phrenology was born.

In 1931 Henry Lavery capitalized on this. He invented the Psycograph, a three-part apparatus. The mechanism consisted of a base with a seat, connecting a support column for the all-important measuring helmet—a metal network of 32 adjustable feelers to read your skull's contours. The information was processed in the recording box, which printed out a precise individualized analysis of your mental, spiritual, and emotional faculties. To emphasize the Psycograph's remarkable qualifications, advertising for this service likened it to the marvels of radio, electric energy, hydro- and steam power.

Long past is the elixir era of traveling sideshow salesmen peddling their bottles of cure. A great number of these medicinal elixirs contained alcohol, cocaine, or opium. This would explain the repeat business and positive testimonials. While they probably offered temporary relief, they would have aggravated some of the conditions they claimed to help—problems concerning the liver, kidneys, and bladder.

Other remedies from these dark ages boasted of all natural ingredients. Considering the flourishing health-food industry, it's apparent that people are still seeking natural alternatives to drugs. Shelves are lined with homeopathic herb and flower derivatives reminiscent of Lydia E. Pinkham's Vegetable Compound. These remedies are for both prevention and curing or just for general fortification of the immune system. Certain all-natural liquid flower extracts containing the natural preservative brandy are touted as cures for psychological and personality quirks—best when taken under the tongue, yet effective if merely carried on your person. Makes you wonder how much the Eighties will be contributing to the quackery archives.

The field of medical quackery is fun and fascinating. The FDA, which donated the initial curiosities to the St. Louis museum, has been instrumental in protecting the public from charlatans and their wares. It's no easy task to determine what's legitimate and what's quackery, especially when an item cannot be deemed dangerous and may even be helpful, if only to the patient's psyche.

Test your knowledge of science and technology in The World's Hardest Crossword Puzzle

GAMES

By Scot Morris

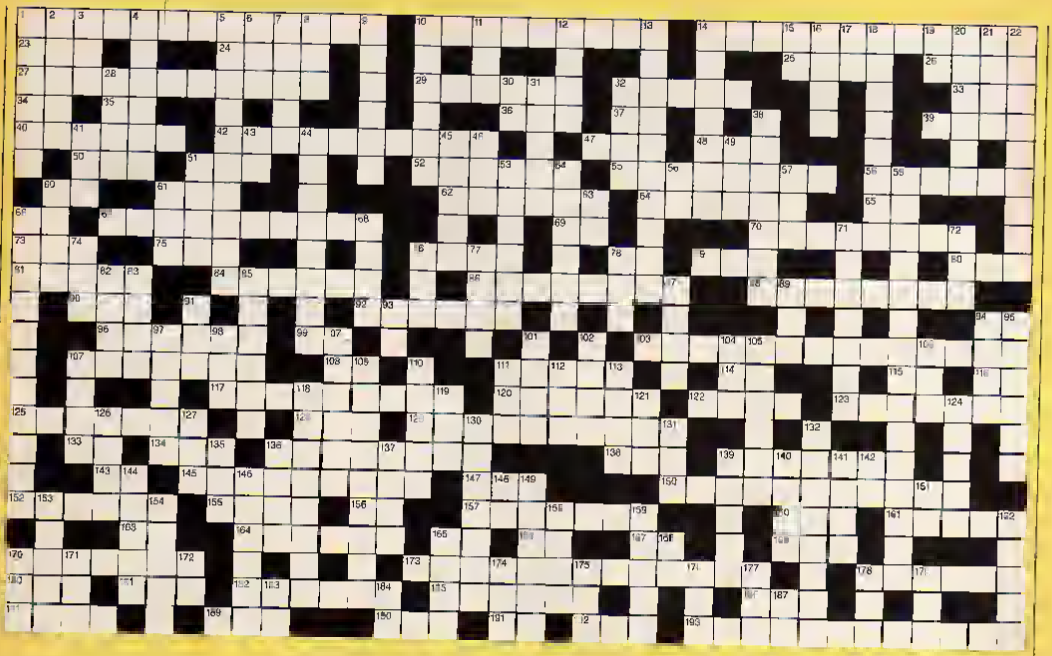
The answers to this month's *Omni*–McGraw-Hill Crossword Puzzle can all be found in the *McGraw-Hill Encyclopedia of Science and Technology*. In creating this puzzle the compendium's editor in chief Sybil P Parker incorporated many terms that appear *only* in the encyclopedia's latest edition. Your goal: to win your own set of the encyclopedia, worth $1 600. For additional prizes and the official rules, see page 160.

ACROSS

1 Study of fluid motion
10 Microwave source
14 Deossification disease
23 Malt beverage
24 Asteroid
25 Intrinsic angular momentum
26 In ____ (original position)
27 *Listeria monocytogenes* infection
29 $C_3H_7O_3N$ (amino acid)
32 Graduated tube
33 Radiation unit
34 Energy for the unconscious
35 ____ gate
36 *Secale cereale*
37 Op. research (abbr.)
39 White ice deposit
40 Steel wire in concrete
42 Ring having families of finite members
47 Single-branching chain (prefix)
48 A coenzyme (abbr.)
50 Metallic element
51 Motion-producing mechanism
52 Distinguishes leptons and quarks
55 Growth of upper leaf surface
58 ____ effect
60 _ _ R radar chart
61 *Felis domestica*
62 Atom with K meson in orbit
64 Tide associated with maximum diurnal inequality
65 Symbol for 87 down
66 Time determined by planetary orbits (abbr.)
67 Group that includes chlorofluorenol
69 Elem. no. 62
70 Math function $L(x)$
73 Charged electron
75 *Thea sinensis*
76 Access tunnel
78 Star diagram (abbr.)
79 Hot Indian wind
80 Female gametes
81 Identical offspring
84 Odorless gas
86 Mimicry of distasteful species
88 Dynatron
90 Circuit with two input-signal ports
92 Aquafortis (acid)
94 Int. Syst. of Units
96 Sixth planet from sun
99 Rare earth elem.
103 Bonding of monomers
107 Solvent transport
108 Operating state
111 Largest asteroid
114 Microscope objective resolving power (abbr.)
115 Ratio of inductance to capacitance
116 Unit of luminance (abbr.)
117 A thermal detector
118 Dam on Parana River
122 Brown seaweed
123 Transistor region
125 ____ Mons
128 Joint made by overlapping ends
129 Attached sfatoblast
133 Elem. no. 54
134 *Glycine max* oil
136 Oriented intergrowth of potassium and sodium feldspars
138 Calculator entry notation (abbr.)
139 Parasitic filamentous nemafode
143 Elem. no. 18
145 Linear operator defined on differentiable functions
147 Tree of genus *Taxus*
150 Order of Triassic reptiles
152 Vector representing spin 1/2
155 Increase signal power
156 Elem. no. 58
157 Self similar geometrical object
160 Naturally occurring liquid hydrocarbon
161 The acid HIO_4
163 Elem. no. 52
164 Source of symbol is natrium
165 Symbol for a noble gas
166 ____ -go gage
167 ____ amp
169 Circuit for locking an oscillator in phase (abbr.)
170 Salamander larva
173 Neuronal system producing norepinephrine
178 Genus of tropical American trees
180 Mineral used for jewelry
181 Rock magnetization (abbr.)
182 Relating to main chamber of an auricle
185 Karmán vortex ____
186 Unit of absorbed dose
188 Programming instruction for condition not met
189 A wing
190 Formicid insect
191 Elem. no. 24
192 Satellite for communications/meteorology analysis (abbr.)
193 Faunal production of magnetic field

DOWN

1 Native salt
2 Organic compound with adjacent positive and negative atoms
3 Standard cryptographic algorithm (abbr.)
4 Functional group of genes
5 Superorder of Aves
6 A rocket society (abbr.)
7 Effect of superimposed curves
8 Spectroscopy using inert gas ions (abbr.)
9 3-D sound pickup
10 Massive block of rock
11 Fish with elongate snout
12 Meshless set of connected circuit branches
13 Lacewing order
14 Wild marjoram
15 Elem. no. 99
16 Relative of ribbonfish
17 3.14159
18 Cancer-causing gene
19 Elem. no. 76
20 Dog Star
21 Unit composed of adjacent bits
22 Sudden brightening of a star
28 Bird of family Todidae
30 ____ (resistance) drop
31 Amide polymer
32 ____ gas (boson assemblage)
38 Bound quarks with quantum number beauty
41 Standard conditions (abbr.)
43 _ _ S (memory switch)
44 Older subdivision of Cenozoic
45 Adhesive resin made from glycerol
46 $C_{10}H_7CH_2COOH$ (abbr.)
49 Plug to cut internal thread
51 Headland
53 Ground radio navigation station
54 Ophthalmologic dispersing prism
56 Elem. no. 77
57 CCl_3COOH (abbr.)
59 Annulment of flowering by reduced temperature
60 Helicopterlike flight technique (abbr.)
61 Braun tube (abbr.)
63 0.01 meter (abbr.)
66 Prostaglandin family of compounds
68 ____ chen Tangla Mountains
71 Crystalline plutonic rock
72 ____ Newtonian fluid
74 _ _ _ Admin.
76 Air pump (syn.) (abbr.)
77 Wading bird
78 Joint of femur and hipbone
82 U.S.N. sat. system
83 A ripened cheese



85 Stretching muscle
87 Gaseous element
89 Female sheep
91 Conductors for common connection
93 2 5 cm
94 Unit of loudness
95 Noncoding gene segment
97 Surface of a doughnut
98 Primary leaf vein
100 SAM missile
101 Genus of Oniscoidea
102 Pinniped
104 Unsaturated hydrocarbon with triple bond (suffix)
105 $C_2H_4(COOH)_2$ (acid)
106 Calcium-regulating hormone (abbr)
107 Banded chalcedonic quartz
109 Genus of tiny moths
110 Solid organic material with no definite melting point
111 Form of isomerism
112 Airfoil transverse member
113 Clay vein in coal seam
118 Cardiac glycoside source
119 Digestion of fibers by enzymes
121 Pharmaceuticals standard (abbr)
124 Data unit of three bits
126 Typical number for a set
127 Colloidal solution
130 Galaxy with small explosive nucleus
131 Yellow crystalline explosive (abbr)
132 Order of tooth shells
135 Type of infrared laser
136 More (prefix)
137 Blood (prefix)
139 Selection rules for beta decay
140 Repeating sequence of computer instructions
141 Rotational movement of aircraft
142 Elem no 49
144 Quantum of rotational motion in superfluid helium
146 Unit of pressure
148 Cytoplasmic system of vacuoles (abbr)
149 Displacement of radar target indication
151 Satellite of Jupiter
153 Smallest unit of electronic picture image
154 Backward (prefix)
158 Center of Earth
159 Unconsolidated calcareous silt
162 Quantum number
165 Dominant of symbiotic pair
168 Elem no 59
170 Subdivision of geologic epoch
171 Spacecraft maneuvering system (abbr)
172 Spacecraft for moon landing (abbr)
174 Discharge of electricity through gas
175 Neutral pseudoscalar meson
176 Mining prop
177 ___ Magnon
178 Bristle on oat bract
179 Insecticide (abbr)
183 Elem no 73
184 Elem no 57
187 Process of varying amplitude (abbr)

LAST WORD

By Christopher Graybill

"Serious inquiry into the essence of humor began with the slapstick work of Professor Ernst Pratt. In his autobiography, entitled Das Laughinstock, *Pratt recounts the origin of his study of funny."*

In 1925 German physicist Wolfgang Pauli, discouraged by the complexity of his science, wrote, "Physics is once again very fouled up, and for me it is so difficult I wish I were a film comedian or something like that." Even though he had a quick wit and one of the funniest names in the history of physics, Pauli never fulfilled his dream of becoming a movie comic. But his comment underscores the important, often overlooked relationship between comedy and science.

Although comedy has fascinated scientists for centuries, serious inquiry into the essence of humor is relatively recent. It began with the so-called slapstick studies of Professor Ernst Pratt (1844–1905) at the University of Heidelberg.

In his autobiography *Das Laughinstock* Pratt recounts the origin of his study of funny phenomena. A historic entry in his personal journal tells how he literally fell into his research.

"March 16, 1903—An intriguing incident occurred at the university today. I was walking down the stairs of the library with Zimmerman, my teaching assistant. Suddenly my foot slipped, and I tumbled all the way to the next landing.

"Zimmerman laughed like a hyena. Yet when I got up and pushed him down the next flight of steps, he did not laugh. Strange. Must investigate further."

For the next several weeks Pratt and Zimmerman spent all their spare time falling down and observing each other's reactions. Based on their painful research they became convinced that comedy was a force that obeyed natural laws.

To test this hypothesis they began what are now considered to be classic experiments. During his lectures at the university, Pratt would purposely fall off the podium. Invariably this drew a big laugh from the students, whose responses Zimmerman carefully recorded.

Quite by accident, they soon discovered that if Pratt also screamed "Whhooo-OOAAA!" as he fell, he got an even bigger laugh. Next the professor introduced variations, sometimes taking a dive in the pike position, sometimes in the tuck. The researchers eventually determined the funniest of Pratt's falls was a one-and-a-half gainer with a full twist.

Eventually these were quantified in the famous formula $L = Fs^2$. That is, the size of the laugh equals the length of the fall times the scream squared.

Unfortunately Pratt did not live long enough to explore the full implications of his formula. Obsessed with his work, he died tragically while going for a really big laugh down the long marble staircase of the Heidelberg Opera House.

Pratt's work remained largely forgotten until 1928, when two French psychologists challenged his theorem with a radical new hypothesis. They were fascinated by the fact that some people just cannot take anything seriously. After years of study they concluded that comedy is an involuntary response.

Their thesis was inspired by a case study of the notorious Marguerite G., a madcap Parisian heiress who loved to laugh. In fact, she laughed at life until the end. Her last words illustrate her addiction to the bon mot.

Marguerite G. was involved in a terrible automobile accident. On a whim, she had commanded her chauffeur to circle the Arc de Triomphe at 195 kilometers per hour. As she lay mortally injured among the twisted metal of her limousine, she was heard to say, *"Eh bien, Marcel, le Mercedes courbe,"* which, roughly translated, is "Well, Marcel, that's the way the Mercedes Benz."

This kind of obsessive joke making, the psychologists contended, was the result of a gag reflex, an autonomic reaction that was caused by a genetic defect.

In the Fifties another discipline made a major breakthrough in humor work when particle physicists began to suspect there was a subatomic component involved. Working in his laboratory in Milan, Italy, Rudolph Zenzi found that some days he could not use his particle accelerator without snickering. Zenzi was unable to explain this phenomenon but did record it in his diary (later used as evidence by the prosecution at his competency hearing). Modern quantum theorists believe Zenzi inadvertently bombarded himself with subatomic elements now identified as screwballs.

Today medicine is on the cutting edge of humor research and rehabilitation. At the Dangerfield Clinic on Long Island, specialists have devised therapies for treating people like Zenzi. The clinic's strength is crisis medicine. Last month a well-known comedian was rushed in by helicopter after he collapsed during his nightclub act in Atlantic City. Symptom: tendency to release punch lines too soon. Diagnosis: premature ejokulation.

Emergency technicians connected the patient to a laugh track while they desperately tried to resuscitate his sense of humor. Working in shifts, professional straight men fed him setup lines for hours. His timing was dangerously off and deteriorating by the minute.

Finally, in a noble self-sacrifice, the founder of the clinic himself donated a few aqueous humor cells for an implant operation. The surgical team waited anxiously in the recovery room for the patient to come around.

"We've done everything for him we could," the chief surgeon sighed. "If this doesn't work, I'm ordering an EEG and an NMR at NYU and a checkup at Mayo."

The patient's eyelids fluttered briefly, then opened. "Doc," he said faintly but right on cue, "I'll have a BLT. Hold the mayo. You pick the check up." ∞

Christopher Graybill is a freelance writer in Arlington, Virginia, whose favorite comedians are Linus Pauling and Morey Amsterdam.