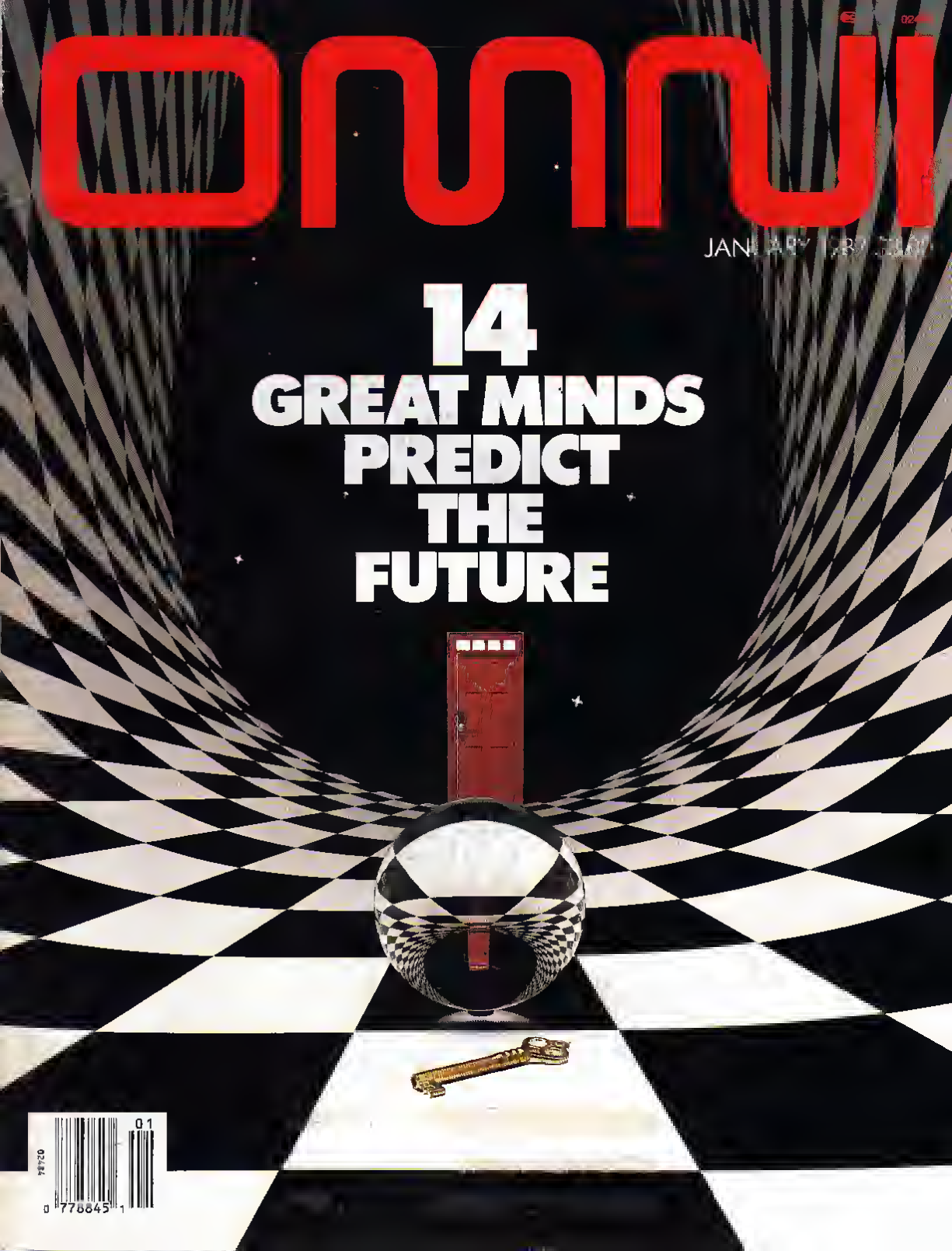
OMNI

JANUARY 1987

14 GREAT MINDS PREDICT THE FUTURE



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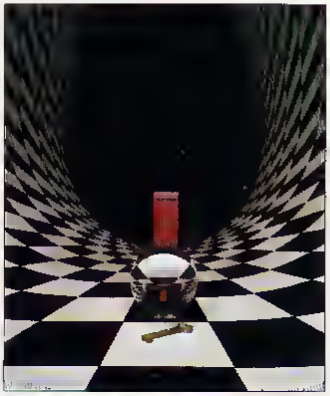
VOL 9 NO 4 JANUARY 1987

CONTENTS



Rarely do you get the chance to look into the future, but this month's cover artist, New York photographer Steve Stint, provides one view—pick up the key and open the door. For another view of what life will be like 20 years hence, see page 36

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FIRST WORD

By Dr. Herbert Pardes

"Teenage suicide has too often been handled as an individual family problem best discussed behind closed doors, not as a burden to be treated scientifically and shared by our society."

Even as we speak of life extension, of cures for cancer, and of new advances in genetic engineering, teenagers in our society are dying more frequently than ever before—by their own hands. The last three decades have seen a dramatic and disturbing rise in teenage suicide. Unless we commit more of our time and our medical resources to this widespread problem, many young people paradoxically, will never be able to benefit from the recent gains made by science.

Every year some 5,000 young adults kill themselves. And another 95,000 we estimate, make the attempt. Each of these stories is a study in human suffering. Taken together, the figures constitute a national tragedy. Now that the country is awakening to the magnitude of the problem, the next job will be to go beyond concern and start forging effective strategies to bring the epidemic under control.

Admittedly, in the past far too little systematic research has been directed at the problem of suicide. American society has viewed it as an individual family problem to be discussed behind closed doors, not a burden to be shared by all. The future, however, is likely to be different, given the interest being shown by many scientific disciplines. The U.S. Health and Human Services Task Force, under the leadership of Shervert Frazier, director of the National Institute of Mental Health, is preparing a detailed report on teenage suicide, a comprehensive evaluation of the biochemical and psychosocial factors contributing to the problem.

The intense social pressures weighing on teenagers today certainly serve to aggravate the turmoil of adolescence. Many teenagers live in disrupted homes, have been deserted or abused by their parents, have met with major failures at school or work, have run away from home, or have succumbed to readily available drugs and alcohol.

What's more, the subject of suicide has been raised and graphically depicted for them in media presentations of teenagers who hang themselves, overdose on drugs, or deliberately run into oncoming traffic. We have disturbing data about *increased* suicidal behavior after the airing of some television reports, as though the programs precipitated the very events they deplored.

Looking closely at teenage suicides, it appears that a large number of them are the end results of psychiatric disorders including depression and manic-depressive disease. It even seems possible that some kind of familial—perhaps genetic—factor plays a role. Approximately 40 to 50 percent of teenagers who kill themselves have a close family member who also committed or attempted suicide.

David Shaffer and his colleagues at Columbia University have been pursuing one of the most systematic studies of suicide to date. By carefully retracing the lives of teenagers who had committed suicide and reviewing the psychological and social factors involved, Shaffer's group uncovered several individual problems that form the background of suicidal acts. For example, teenagers prone to impulsive, acting-out behavior (for any of a variety of reasons) face the highest risk for completed suicide. Also at risk are teenagers with compliant and highly perfectionist personalities.

The best means of preventing teenage suicide are still unclear, but there are many steps we can take on the basis of current knowledge. First of all, we must look seriously and compassionately at each attempt. Even if it seems clear that a young person is trying to get a specific response from the people in his life or to make certain changes in his environment, *his motives by no means diminish the seriousness of his actions.* Anyone who has attempted suicide is at substantially increased risk for actual suicide, especially during the following two years.

Efforts to curtail drug and alcohol abuse among teenagers can also contribute to efforts to control suicide. Drug and alcohol use are common among suicide victims.

Knowing the potentially disastrous impact of media presentations about suicide, I would urge anyone preparing such material to seek consultation with a mental health professional.

Given that such affective disorders as depression are frequent precursors of suicide, it is clear that detection and appropriate treatment of the illnesses themselves may be very helpful preventive measures. We believe such illnesses to be amenable to treatment in 85 to 90 percent of the cases.

We need to alert anyone—from teachers and employers to families and friends—who may be in a position to identify children in trouble. Youngsters who are isolated, show less enjoyment of their activities, have substantial difficulty in eating or sleeping, or lose an unusual amount of weight suggest themselves as worthy of particular concern.

Those who have the most frequent contact with young people, especially teachers and counselors, need to be sensitive to the early signs of psychiatric disturbance. Just as important, they need the skills to appraise the situation and raise the subject with the teenager and his family, if that seems appropriate.

We need—and prospects are improving for—an increase in support for research on suicide and the biobehavioral disorders that precede it. Getting at these underlying factors should improve both our understanding of the problem and our ability to prevent it. ∞

Dr. Herbert Pardes is chairman of the department of psychiatry at Columbia University and a national authority on the subject of teenage-suicide prevention.

CONTRIBUTORS

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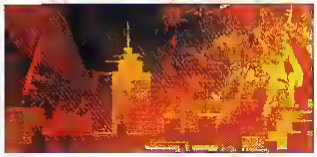
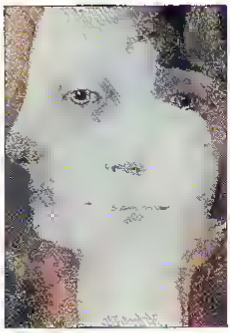


CYBERWARS

BRIGGS

TOYBOTS



MOON

Late one evening when we called writer *Marion Long*, she was surprised by the activity still going on in *Omni*'s offices at nine o'clock. "You'd better get used to it," we told our new contributing editor. We *never* rest.

Long, however, is no stranger to tirelessly pursuing a story. For "The Seers' Catalog" (page 36) she sought the opinions of leaders in the fields of artificial intelligence, entertainment, religion, medicine, and sex—people like Timothy Leary, Talking Heads' David Byrne, Andrew Greeley, William Masters, and Virginia Johnson. First she asked, "Twenty years ago, what did you think the Eighties would be like?" Then she followed up with, "What do you think life will be like in 2007?" Most respondents were more optimistic now than they had been in 1967.

The experts spoke enthusiastically—and extensively—on such subjects as tele-voting, image libraries, three-dimensional television, and the feminization of religion. In numerous instances the conversations required what Long calls "installment interviews." Afterward she felt as if she had traveled into the future and aged 20 years.

Long, who has written for *Gentlemen's Quarterly*, *New Age Journal*, and the late *Science Digest*, said we were being "terribly thoughtful" when we requested a color photograph; yet she graciously—and adamantly—declined. So did writer *Terence Monmaney*. Perhaps he prefers to let his printed words speak for themselves, just as the music sings for composers Philip Glass, John Cage, and Jan Hammer. In Monmaney's "Key Notes on the Mind" (page 44) these artists talk about the technological developments and future directions of music. In addition, psychoacoustic researchers and neuromusicologists at Stanford, the University of California, and elsewhere discuss how we hear what musicians play—and why each of us interprets sounds differently.

Most people have probably never seen a color photograph of science-fiction and fantasy writer *Ursula K. Le Guin*, whose story "Daddy's Big Girl" begins on page 48. The pen-and-ink drawing she originally sent wasn't quite right for *Omni*. In a personal note Le Guin said she possessed only one color snapshot of herself (hanging laundry), and she added it wasn't very good. Imagine if you can... the author of *The Left Hand of Darkness* and the more recent *Always Coming Home*, as well as "The Visionary" (October 1984), standing in her backyard, pinning clothes on the line.

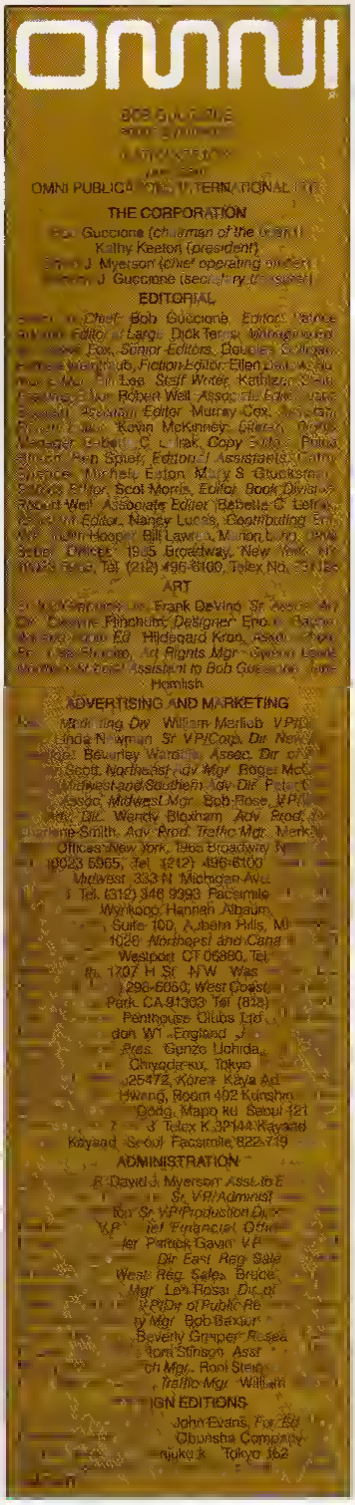
English author *Garry Kilworth* ("Paper Moon," page 80), on the other hand, sent this message: "Due to a tardy neighbor who kindly received your letter for me while I was away—then kept it for another week before handing it to me—I lost some ten days in all. Unfortunately I live in a country area where it's impossible to have color slides processed in less than two weeks. So I had an amateur friend of mine take a roll, and I hope you can get it processed at your end. Perhaps one of them will be useful... but if none of them turn out, we'll have to call it a miscue. Well... Garry guess what."

We're still waiting to hear from Canadian physicist *F. David Peat*, who said he was sure he had a color photo "somewhere" in his home. But we were able to arrange a photo session for writer *John Briggs* during his one-day visit to New York. Coauthors of *Looking Glass Universe*, Peat and Briggs collaborated to interview physicist David Bohm (page 68).

Although *Omni* assistant fiction editor *Kevin McKinney* was the one badgering everyone for photos, he never considered having one taken of himself. Besides, he was too busy writing Omnibus and the pictorial "Toybot" (page 52). So we settled for the above detail from one of Douglass Grimmett and Chuck Carlton's fanciful robo-scenarios.

In "Cyberwars" (page 76) *Owen Davies* reports on the world's future warriors—autonomous robots who will battle on land, in the air, and beneath the sea, fighting bloodless wars. And *Grant Fjermedal*, the author of *The Tomorrow Makers* (Macmillan, 1986), adds "The Blade Runner Blues," an account of genetically engineered superhuman soldiers who will create a formidable militia.

By that time, we hope, some of our writers will have relented and had pictures taken. Then readers will be able to match an author's name with a face. ∞



LETTERS

COMMUNICATIONS

Whose Life Is It, Anyway?

I found the lack of any discussion of the social implications of longevity research very disturbing [October 1986]. There are many ethical issues to be addressed. Who will get to live? Who will decide who gets to live? Will access to the various life-extending techniques be available to everyone? If so, how will we cope with overpopulation? Do extended life spans raise the possibility of class warfare between different age groups as the young try to take away power from the elderly?

I think *Omni* as one of the most effective proselytizers for the benefits of science and technology owes it to its readers to explore some of these questions.

Chris Rohrs
Petaluma, CA

Life in the Deep Freeze

I enjoyed your issue on extending human life span and found Paul Bagne and Nancy Lucas's article on cryonics especially interesting ["Souls on Ice," October 1986]. For a long time I have felt that future repair technologies will allow the eventual resuscitation of people frozen today. And so I have made arrangements to be frozen in the event of death. Many problems remain, and much research is needed. Perhaps the growing interest in life extension will divert attention and effort from warmongering and defense spending. Man's conquest of death would be so much better than man's annihilation of himself and the planet.

R. Michael Perry, Ph.D.
Boulder, CO

Bagne and Lucas have written a well-crafted and thoughtful article. They got their facts right but missed what we cryonicists are all about.

The history of the human race has been made up of people who could squarely confront reality, even realities as unpleasant as death and disease. Whether we like it or not, we are all growing older, and we are all, at this time, at terrible risk of dying.

Our situation now is particularly wretched because we know that aging and death will someday be vanquished. How sad to be the last generation to die.

It's been said that space is the final frontier. It isn't. Extending our own lives—that is the final frontier. It's unfortunate that Bagne and Lucas probably will not be there to share the future with us when we cross the final, rocky summit and see an open-ended world of possibilities waiting before us.

Mike Darwin, President
Alcor Life Extension Foundation
Fullerton, CA

Me and My Mind

Are you serious? Grant Fjermedal's article "Surrogate Brains" [Artificial Intelligence, October 1986] suggests that a man with one foot in the grave could submit to a process whereby his "mind" would be removed from his dying body and transferred to a computer. There it would live happily ever after, free from sickness, the ravages of age, and the inevitability of death. That's absurd!

Even if—all technical and economic barriers aside—we built a computer both complex and subtle enough to duplicate the behavior of one's entire brain and nervous system, we'd still have only a copy. Meanwhile, the original would be left facing its own mortality.

Kevin Caldwell
Playa del Rey, CA

Born Free

I would like to congratulate Erik Larson on a splendid and informative article and Hal Markowitz for his work with zoo animals ["Mechanical Zoo," Explorations, October 1986]. It's about time we did something for the wild animals that we keep in captivity. When I go to the zoo, I feel sorry for the caged animals.

I disagree with the critics who say the devices Markowitz designs are not natural and will turn the animals into "Pavlovian automatons." Give a penned-up dog a ball to play with, and you have a happier canine. Anyway, who says keeping a wild animal in a cage is "natural"?

Robin Hayes
Arcata, CA

FORUM

1986 is over. The Nobel and Pulitzer recipients have already banked their awards or taken a trip to sit out the winter in the sun. And now it's our turn. Omnibust. Our winners are a breed apart: the not-so-celebrated people who study the effects of neckties on mental health, name new stars Big Mack or freeze-dry their pets. Our judge for this year's sterling awards was Frank Kendig, Omni's founding executive editor.

Intelligent Life in the Universe
William Bowen of Louisville, Kentucky, may have been drunk, but he wasn't driving. Bowen, legally blind, told his arresting officers that his dog was driving—and the dog was as sober as the judge who ended up trying the case. To prepare for just such an emergency, Bowen said, he trained his dog to bark at traffic lights: once for red, twice for green. The police, aware that dogs are color-blind, put Bowen's canine chauffeur to the real test. The dog, aware that the red light is always on top, passed with flying colors.

Run for Your Life
The good news, according to a study of 16,936 Harvard alumni published in *The New England Journal of Medicine*, is that regular exercise (2,000 or more kcal per week) can add more than two years to your life if you start right after college. "The bad news," says David Jacoby of the Cardiovascular Research Institute of the University of California, who calculated what all this means, "is that although you may live an extra two years, those two years will be spent jogging."

Singing Chemists
The chemists invaded New York City in April. When 10,000 attended the annual meeting of the American Chemical Society, Governor Cuomo and Mayor Koch proclaimed it "Chemistry Week." Among the topics discussed were the longest official name for a chemical compound (it contains 1,378 letters and numbers), the longest list of authors on a scientific paper (the record is 142), and the growing list of official chemical compounds (about 7.4 million, at last count). One of those compounds is called bohemic acid, after Puccini's opera *La Bohème*. Its components, of course, are mimimycin and rudoltomycin, after the opera's leading characters, Mimi and Rodolfo.

Just Say No
According to one Roper poll conducted this year, 37 percent of the Americans polled claimed they couldn't get along without aluminum foil, 46 percent said they would perish without Scotch tape, and 28 percent reported they couldn't live without panty hose. But the most provocative survey of public opinion came from the Marketing Research Association, which discovered that 38 percent of all Americans absolutely refuse to take part in market-research studies.

Ignorance Is Bliss?
"I don't think the American public wants to be bothered with the what, when, and how of lasers in space and things like that," says Rick Sellers, executive director of the Coalition for the Strategic Defense Initiative. "Whether the technology will work or how much it will cost—these are peripheral arguments."

Fido Forever
"The next best thing to bringing it back to life is to have it freeze-dried," says Roger Saatzer, president of Preserv-A-Pet of Nisswa, Minnesota. Saatzer's firm charges $450 for a sitting cat, $2,000 for a German shepherd in an attack position.

Reagan's Rex
"On the wall are pictures of Ron and Nancy in acrylic frames," reports interior designer Theo Hayes of the doghouse he remodeled for President Reagan's dog Rex. "There's an American flag, a silver bowl full of jelly beans, and milk bones."

One Million and Climbing
When asked why pharmaceutical companies have given extremely low priority to developing drugs to treat or prevent AIDS, Hoffmann-LaRoche president for exploratory research L. Patrick Gage responded: "This will sound awful, but you have to understand that one million people isn't a market that's exciting. Sure, it's growing, but it's not an asthma or a rheumatoid arthritis."

And Kudos to:
- Astronomers at the Cerro Tololo Inter-American Observatory in Chile who named a newly discovered star "Gomez's Big Mack" because it appeared to be hamburger-shaped.
- Cornell University researchers for their study of the collars of white-collar workers. The researchers concluded that neckties do indeed cause "impaired mental functioning" and a host of other ills.
- The Indiana State Police for its intensive, three-month investigation that decided that a man who had died of 32 hammer blows to the head was a victim of murder rather than a suicide.
- Gun-control advocate Senator Edward Kennedy's personal bodyguard, who was arrested for entering the Senate office building in Washington carrying a pistol, two submachine guns, and 146 rounds of ammunition.
- The London vice squad that this year began using fiberoptic periscopes to peek over closed lavatory doors.
- Senator Sam Nunn, who introduced into *The Congressional Record* an 18-page document, complete with charts and tables, spelling out official Defense Department specifications for GI fruitcake.
- Professional ice-cream taster John Harrison of Oakland, who insured his taste buds for $250,000.
- Stanley Takese, a manufacturer of equipment that speeds up tape recordings for very rapid listening, for making it possible to hear Chopin's "Minute Waltz" in a mere 44 seconds.
- Raytheon executive Robert Sanger, who was convicted of accepting more than $200,000 in bribes and was sentenced by a Los Angeles court to 5,000 hours of community service—as a golf instructor.
- The George A. Hormel Company for marketing a canned green salad with a two-year shelf life. ∞

EASTERN SHUTTLE

SPACE

By Doug Stewart

The *Challenger* explosion wasn't the only space-shuttle catastrophe. Little known to the Western world, Japan's shuttle met a similar fate during a test flight last June. The limited publicity was due to the shuttle's size (seven feet long) and lack of passengers.

The doomed craft, a radio-controlled plastic glider resembled a scaled-down U.S. shuttle. It crashed during a test carried out by Japan's Institute of Space and Astronautical Sciences (ISAS). After being released from a helicopter at 3,000 feet, the craft promptly stalled, then fell into the Sea of Japan.

Two days afterward, the backup model fared better, gliding smoothly for nearly three miles before diving out of control and hitting the water. ISAS's low-budget effort has used up all its drop-test models for the time being, but if the government gives Japan's research community the go-ahead, scientists will have more to tinker with than plastic gliders.

It's ironic, perhaps, given the U.S. shuttle program's woes, that a number of countries are just now giving serious thought to developing a manned, reusable space shuttle. Unlike Britain's HOTOL, France's Hermes, and the Soviet Union's mysterious winged shuttle, all well along in development, Japan's version is still in its technological infancy.

Two tails or one? Methane fuel or hydrogen? Scientists are considering every possible option at this point. One tentative design resembles a sleeker version of the U.S. shuttle, with two winglets attached to its nose. It has a small cargo bay behind the cockpit, and fuel tanks of liquid hydrogen and liquid oxygen installed in the rear of the fuselage. "This program is mainly devoted to basic research," explains Dr. Makoto Nagatomo, head of ISAS's working group on winged vehicles. Nagatomo notes that some of his fellow scientists even support the idea of building a simple, engineless shuttle like the old Apollo capsules, carried into space by a booster rocket.

In wind-tunnel tests at ISAS's sister agency, the National Aerospace Laboratory (NAL), engineers have been flying two-tailed miniature shuttle models at low speeds to test the craft's landing characteristics, and they plan to run high-speed tests in which the wind tunnel mimics reentry at 11 times the speed of sound. "Our laboratory has the largest wind tunnel in the country," says Dr. Tatsuo Yamanaka, director of the NAL's special technology research group, "but we still need a really good facility."

The budget so far has been puny by NASA standards: even a million-dollar allocation for fiscal year 1987 would be a big improvement. Much of the testing has been done using whatever equipment and personnel were available from other projects. But Yamanaka, Nagatomo and their colleagues are counting on a jump in government funding.

The fact that the shuttle has a very specific mission may help. "We are part of the space-station project," explains Dr. Yamanaka. "We want to send Japanese astronauts to the station every year starting in 1994, the year the multinational station is supposed to be open for business."

So far the United States, the European Space Agency, Canada, and Japan are participating in the enterprise. Last summer Japan's Space Activities Commission recommended that the government go ahead and begin building an experimental space module to be attached to the station. The government has already allocated about $36 million for the module's design and decided to begin training for the astronauts who will crew the module.

Looking ahead, NAL has set up a docking simulator for astronaut training. Watching a computer-generated space station loom closer on a large video screen, pilots can practice bringing their craft in for a zero-g rendezvous.

Optimists at NAL have already proposed a flight schedule for future shuttles:

- By the early Nineties they plan to use a medium-lift rocket to loft into space a small, unmanned test vehicle.
- By the mid- to late Nineties a full-size vehicle—with no astronauts aboard—could be launched atop Japan's powerful H-2 rocket, a two-stage expendable booster now under development.
- By the year 2000 a full-size, manned shuttle could head for orbit atop an H-2 rocket ringed with four or more strap-on solid-fuel boosters.

Japan's shuttle advocates insist would not compete with the U.S. fleet. The full-size Japanese shuttle will have only a fraction of the 32.5-ton capacity of the U.S. spacecraft. "Our shuttle will complement the U.S. shuttle," Nagatomo says.

Japan anticipates a heavy homegrown demand for launch services in the Nineties, especially for communications satellites and its own space station crews. Combined with its rocket fleet, a small, made-in-Japan shuttle could provide Japan's budding space program with the kind of flexibility and reliability that is so rare in the space-launch business.

Progress in the meantime is slow. The specter of the *Challenger* accident hangs over every shuttle program these days. The Japanese are moving ahead with small steps, carefully testing every technology. "We need safe vehicles," explains Yamanaka. "We cannot take big risks with human life."

Shuttle fantasy. What will Japan's look like?

LAG TIME

BODY

By Karl Lautman

It's 3:30 PM. I'm about to take my fourth nap of the day, and if this 20-minute multiple sleep latency test is like its predecessor, I'll be blissfully asleep in 60 seconds. But not for long. The 11 electrodes glued to my face and scalp will signal the technician in a neighboring room to sound an alarm to awaken me. The technician is interested not in letting me sleep but in measuring exactly how sleepy I am, and she keeps track in part, by noting how long it takes me to fall asleep after an alarm.

I am not a masochist, and this is not something I would do for the sake of science without some benefit to myself. The Stanford University Sleep Research Center (SRC) in Stanford, California, sent me on a ten-day all-expenses-paid vacation in Japan in exchange for turning myself over to them for three days as a test subject. SRC scientists are studying such diverse conditions as the side effects of new tranquilizers and antihistamines, the hereditary nature of certain sleep disorders, and the performance of night-shift workers in response to changes in schedule.

My part is in a study testing how effective the drug Halcion is in treating the insomnia associated with jet lag. Halcion, a sleeping pill, is particularly attractive as a treatment for jet-lag insomnia because it dissipates relatively quickly and—unlike other sleeping pills, which can cause daytime drowsiness for as long as 24 hours—has no aftereffects.

"What we're trying to show," says Wes Seidel of the SRC, "is that it is possible to override the circadian rhythm. You can use a hypnotic to make a person go to sleep when he would not ordinarily be able to, and that sleep does what it's supposed to and leaves you more alert the next day."

The long trip to Japan adjusted me to a distant time zone (Japan is 16 hours ahead of California), and now to the SRC's delight, I am thoroughly jet lagged. By having me repeat the same tests I took before I left, only this time after I've taken either a placebo or Halcion every night before going to sleep, the SRC can measure the drug's effectiveness.

Research recently conducted at Northwestern University suggests that Halcion's effects may extend far beyond the sleep/wake cycle. In one study, investigators injected golden hamsters with massive doses (far larger than any human could take safely) of triazolam, the active ingredient in Halcion. The injections appeared to either advance or retard the entire circadian rhythm, not just the sleep/wake cycle.

Researchers hypothesize that triazolam may work by stimulating the hamsters to produce the neurotransmitter gamma aminobutyric acid (GABA) in the area of the hypothalamus. The hypothalamus is believed to play a vital role in regulating the circadian rhythm.

Throughout the three-day stay my fellow guinea pigs, Ed and Nancy, sustain our enthusiasm by imbuing our often tedious tasks with friendly competition. Nancy, a research assistant in pediatric surgery, consistently humiliates Ed and me on the digit–symbol substitution test, a combination speed-writing and memory exercise. We remind her that this is her *sixth* tour through the SRC and she's taken these tests before.

To dream, perchance to sleep

Ed triumphs in the less romantic area of urine production. Urine from each of us is collected to measure its content of 6-hydroxyl melatonin, a highly rhythmic variable that's used as a phase marker for the circadian rhythm.

Everyone's least favorite test is SOAP, a 30-minute video game so boring it was certainly created as a cure for insomnia. The object, to use a joystick to keep a cross hair over a dot that shoots away every time you get close (just like a bar of soap on a wet floor). My performance is measured by an Apple II microcomputer and is politely evaluated on the screen at the end of the game in unintelligible statistical gibberish.

In another test a deck of playing cards is sorted by suit and face value, again as fast as possible. A 'state-trait anxiety questionnaire' establishes a psychological profile based on my agreement or disagreement with statements like "I wish I could be as happy as others seem to be" and "Some unimportant thought runs through my mind and bothers me." It is all I can do to resist giving the kinds of responses I imagine Norman Bates of *Psycho* would give.

Our temperatures (another circadian-rhythm phase marker) are taken every 30 minutes around the clock with a rectal probe attached to a six-foot cord. At the appointed time we plug the cords into a small recording box in the lab. On our occasional trips to the local ice-cream shop, Nancy, Ed, and I bring the box along. With a few inches of what looks like speaker cable mysteriously protruding from the tops of our pants, we plug in right on schedule. Although we try to do this clandestinely, few patrons fail to notice.

I've been told that the life of a test subject can be even less glamorous than this, and since my experience puts me somewhere near the midpoint of a scale that has vivisection at one end, I shouldn't complain. I should see myself as a foot soldier on the front lines of scientific inquiry, boldly going where

SWINE'S WAY

EXPLORATIONS

By Bill Lawren

His apartment, a sumptuous leather-and-crystal affair in the heart of Madrid's fashionable Argueiles district, is home to an astounding assortment of rare books—a first edition of the biography of Columbus written by the explorer's illegitimate son, an original copy of the history of the conquest of Mexico by Fray Bartolomé de las Casas. "When I talk," says Francisco Guerra, stabbing with his finger at the crisp vellum pages that fill his life, "it is these sources that are talking. I know them by heart."

A friendly, talkative man who, despite a certain bookish pallor, still looks to be on the fresh side of his sixty-nine years, Guerra collects advanced degrees and academic honors (four M.D.'s, five Ph.D.'s, a visiting professorship at Yale, and Rockefeller and Guggenheim fellowships) the way some people collect abalone shells. He is that rarest of academic birds, a scientist (epidemiologist) who has crossed over into liberal arts. As such he has paid special attention to issues with both medical and historical content. One of his favorites is the mystery surrounding the near-total destruction of the Native American population of the Caribbean islands in the 25 years after the arrival of Columbus.

Historians have long argued over what caused the more than 3 million Indian deaths. Many believe that the killer was smallpox, but Guerra disagrees. Years of looking at the conquest with an epidemiologist's eye have convinced him that the deaths were caused not by smallpox but by swine flu. The same disease, Guerra says, killed as many as one third of all the native peoples who died in central Mexico and an undetermined but undoubtedly significant number of Hurons, Iroquois, and Penobscots in French Canada and New England.

Among Guerra's sources are the diaries of Columbus and his son Orlando, histories of Mexico written by Las Casas and others, and Jesuit accounts of the settling of French Canada. All hint at an ecological apocalypse whose roots can be traced only by the trained eye of someone familiar with the natural history of viral diseases. The disaster began innocently enough. On October 5, 1493, just after Columbus embarked on his second voyage, the explorer stopped at the port of La Gomera in the Azores Islands to take on food and supplies. Among those supplies were eight domestic pigs and several horses. By the time he unloaded the animals at La Isabela on the island of Hispaniola, all the animals were ill. Within 24 hours, Columbus recorded in his journals, Indians in the area were getting sick, coughing, nosebleeding, and high fevers. Columbus himself succumbed to a disease with the same symptoms, and for four months, his son Orlando wrote, he "was unable to keep up with the diary." Within only a few months, thousands of Native Americans died—so many, according to one source, that there were not enough tribe members left to bury them.

The disease, carried by the Spanish explorers and the descendants of the pigs and horses, roared through the Carib bean, reaching proportions that were not merely epidemic but pandemic. "By

Did Columbus's ship carry a deadly virus?

1518," says Guerra, "practically all the Indians of Cuba, Puerto Rico, Santo Domingo, and the Lesser Antilles—about one and a half million people—had died."

But how does Guerra know that what killed the Indians was swine flu and not smallpox or some other disease? "It couldn't have been smallpox," he says, "for two reasons." First, the symptoms, particularly the coughing and the nosebleeds, rarely occur in smallpox victims. Second, the origins of smallpox in the New World have already been traced to the first African slaves, who did not arrive until 1518, 25 years after Columbus's second voyage. It could not have been malaria because that tropical disease has an incubation period of ten days, whereas the Indians on Hispaniola were getting sick virtually overnight. The disease had to be flu. Guerra concludes, because of the peculiar symptoms and because of the short incubation period. It had to be *swine* flu because only the porcine virus causes what epidemiologists call "excessive mortality" the epidemic plagues that kill people by the millions.

Guerra's radical theory has met with cautious approval from other experts. "It could have happened that way," says University of Texas historian Alfred Crosby, author of *Ecological Imperialism*. "There was an enormous population explosion of pigs after the arrival of Columbus, and the domestic pig was unknown in America before then. The Indians most likely contracted *some* disease from those pigs, although precisely which disease is a little hard to say." University of Arizona anthropologist Stephen Zegura agrees but cautions, "How far back can we trace the flu bug? What we call swine flu today may well have had a different manifestation back then."

"In any case," Zegura adds, "those bugs or ones similar to them were certainly an important factor in the decimation of the Indian populations—probably far more important than the sword."

Guerra agrees. "You can kill a thousand Indians, or even a hundred thousand, with the sword," he says. "But the only thing that kills millions is disease."

RED POND

EARTH

By Bill Lawren

It's not much of a lake, but the Catalans once believed it to be the home of fierce dragons whose fiery breath could turn the surface of the water glowing red. And indeed, tiny Lake Cisó, near Girona, Spain, is certainly one of nature's most spectacular color shows. Several times a year, when conditions are just right, the surface of the lake suddenly loses most of its oxygen. Overnight, an enormous population of primitive bacteria swims to the surface, coating the lake and changing it from its normal brackish green to a red so brilliant it's almost purple. But should a slight breeze arise to aerate the water, the bacteria will sink—again, virtually overnight—and the red pond will once again be green.

To Boston University biologist Lynn Margulis, this startling transformation represents much more than a trick of nature. For in its red phase, Lake Cisó becomes a living museum, a 3 billion-year time trip back to an era when oxygen was a rare gas and life on Earth was limited to swarms of lively but simple bacteria, the direct ancestors of the organisms that give Lake Cisó its color.

These simple organisms hide within their cell walls evidence for what may be the vindication of a controversial theory that Margulis has championed for more than 20 years. Complex nucleated cells, which make up everything from slime molds to the human brain, evolved not by a Darwinian process of random genetic mutation, but by what she calls "ancient pacts [made] between early bacterial confederacies." Known as symbiosis, this process can be likened to a series of marriages of convenience, in which one bacterium incorporates another to such a degree that the "grooms" become inseparable parts of the "brides" structure.

As recently as the Sixties, Margulis says, the notion of evolution by bacterial confederacy was "not discussed in polite biological society." As far as mainstream biologists were concerned, evolution was driven by random and accidental changes in the genes of organisms. But Margulis is convinced that the notion is too simplistic. Symbiosis must have played a role in the great evolutionary leap from tiny bacteria to more complex cells.

Over the next 20 years, as Margulis clung steadfastly to her idea, evidence for evolution by symbiosis began to mount. With the help of the electron microscope, scientists peered deeper and deeper inside the cell. They found that mitochondria, the cellular "organs" responsible for converting food to energy, have a genetic structure independent of the cell around them, an indication that they once must have been free-living bacteria.

Somehow, at some point in evolution, bacteria had gotten inside other bacteria, lodged there, and eventually accommodated themselves so nicely that they created the new and much more complex corporate entity called the eukaryotic cell. But there was a catch. No bacterium is known to engulf or swallow another bacterium. How, critics of the symbiotic theory wanted to know, could one bacterium have gotten inside another to start the process of "incorporation"?

Part of the answer, the missing link that may help prove the symbiotic theory, has been found in Lake Cisó. Ricardo Guerrero and Isabel Esteve, microbial ecologists at the Autonomous University of Barcelona, have been taking a census of the lake and its brilliant red bacteria called chromatia, since 1976. When they looked closely at the chromatia, they saw another bacterium, a tiny predator they named daptobacter, clinging to its side. After six years of extremely delicate lab work—trying to precisely re-create the conditions of Lake Cisó in their laboratory—they found pallid, brownish holes (called plaques) in the chromatia population. Photographs taken with an electron microscope show that daptobacter penetrates and goes so deep inside the chromatia that it is trapped in the cell membranes.

In the Lake Cisó microdrama, daptobacter eventually kills the chromatia it penetrates. For the analogy to be perfect, however, the bacterial host must not only survive and reproduce with daptobacter inside it, but it must become a new corporate cell that cannot live without its former invader.

How critics want to know: can one bacteria get inside another?

LASER CLONES

STARS

By Bill Lawren

In the quarter century since its first appearance the laser has already proved to be one of man's most astonishingly versatile inventions It has made its way out of the laboratory and into the operating room, orbiting satellites and even the supermarket checkout line Now an Arlington Virginia, physicist is proposing what may be literally the most far reaching laser application of all as a tool for communication with intelligent cultures on other planets In fact says John D G Rather of Kaman Aerospace Corporation it's entirely conceivable that advanced E T s might use the laser to beam electronic or even biological "clones" of their unimaginably advanced selves across space to help uplift the backward likes of us Earthlings

Rather is eminently qualified to muse on the subject A tall balding man with a crooked grin and a huge laugh he is one of the country's most knowledgeable and enthusiastic laser boosters His 1974 white paper on a laser-based missile-defense system presented the case so effectively that it became a sort of preamble to the Strategic Defense Initiative

The principal problem Rather thinks is that our few earthly efforts at interstellar communication may have been conducted on the wrong wavelength From the beginning the scientists who operate SETI (Search for Extraterrestrial Intelligence) have been both listening and talking in microwaves, because in theory microwaves stand out most clearly against background stellar and interstellar noise But says Rather, given a powerful laser with a narrow enough beam signal-to-noise problems would disappear

With such a system in place lasers would have a number of advantages over microwaves Because lasers emit narrow beams, they can be focused tightly and aimed out over very large distances at a very large number of precise targets—with virtually no loss in transmission Because they combine high frequencies with the largest possible bandwidths they could transmit vast amounts of information

And what might that band of light have to say? Well, says Rather, the initial transmission could be something as elementary as an alert signal, a suggestion to stay tuned for the message that follows or even a signal from a whole network of advanced cultures "Because of the great bandwidth available with laser communication we could build more sophisticated telescopes and detection apparatuses to dig out the vast amount of information contained in the sidebands of the signal," says Rather

Or it might represent the efforts of an advanced civilization to establish that most intimate of all extraterrestrial contacts a meeting of cultures Advanced E T.s Rather thinks may in their evolution have discarded biology in favor of electronics, becoming one gigantic collective intelligence with an immense computer as its only "body" Freed from the physical restraints that limit individual brainpower, this megalithic machine could then use lasers to transmit instructions for its own replication on Earth seducing us as it were into creating a sort of electronic clone of itself

But what if this extraterrestrial civilization has retained a romantic fondness for the organic form? It's not unthinkable Rather says that such a culture could even laser-transmit *biological* clones of its members "Let s assume," he says, 'that you could characterize and describe one ideal individual in such a species—everything from its genetic code to the activity of every critical memory-storage element in its brain—in about 10^{17} bits of information Well, even we have computers capable of storing 10^{14} bits, so it's not hard to imagine an advanced society that could do a thousand times better And a laser with a broad enough bandwidth the kind of huge laser transmitter I ve been talking about, could send 10^{17} bits in less than a year" In other words, a sufficiently advanced civilization could via laser, send us all the information we needed to biosynthesize a flesh-and-whatever alien clone here on Earth

This raises a fascinating question Instead of taking place in the future, couldn't this laser cloning have also taken place in the past? Rather admits it could have An advanced intelligence he thinks could have sent out probes to millions of planets At least a few of these might have called back " Hey this is a promising environment, and it's got this set of molecules doing such and such Then," Rather says 'the central intelligence could have transmitted information—genetic codes for example or 'starter chemicals'—that would catalyze these molecules into organic life'

Some of Rather's ideas have already found an appreciative audience among some experts Physicist Freeman Dyson of the Institute for Advanced Study in Princeton himself a longtime SETI watcher thinks the notion of tuning our equipment to laser emissions is "quite sensible It's definitely another channel we should be looking at, although I wouldn't put all my eggs in that basket either " He finds the beaming of clones across space "an interesting possibility one that's been around science fiction for a long time The point is that we should have no preconceptions about what an extraterrestrial intelligence might be up to

The light fantastic laser messages to Earth

CONTINUUM

THE ROUND WALLS OF HOME

Picture this everyone you've ever known, everyone you've ever loved, your whole experience of life floating in one place, on a single planet underneath you On that dazzling oasis swirling with blues and whites, the weather systems form and travel You watch the clouds tingle and swell above the Amazon, and you know the weather that develops there will affect the crop yields half a planet away in Russia or China Volcanic eruptions make tiny spangles below The rain forests are disappearing the same in Australia as in South America You watch dust bowls developing in Africa and the Near East Remote-sensing devices, measuring the humidity in the deserts, have already warned you there will be plagues of locusts this year To your amazement, you can see the lights of Denver and Cairo And though you were taught them one by one, as separate parts of a jigsaw puzzle now you can see that the oceans the atmosphere and the land are not separate at all but part of an intricate, recombining web of nature Like Dorothy in *The Wizard of Oz* you want to click your magic shoes together and say three times, "There's no place like home '

You know what home is For 37 years you've tried to be a modest and eager watcher of the skies and of the earth, whose green anthem you love Home is a pigeon strutting like a petitioner in the courtyard in front of your house Home is the law-abiding hickories out back Home is the sign on a gas station just outside of Pittsburgh IF WE CAN T FIX IT IT AIN T BROKE Home is springtime on campuses all across America where students sprawl on the grass like the war wounded at Gettysburg Home is the Guatemalan jungle deadly as an arsenal Home is the pheasant barking hoarse threats at a neighbor's dog Home is the exquisite torment of love But what you long for is to stand back and see it whole You want to live out that age-old yearning, portrayed in myths and legends of every culture, to step above the earth and see the whole world fidgeting and blooming below you

You remember your first flying lesson, near Sapsucker Woods, in the doldrums of summer in upstate New York Pushing the throttle forward you zoomed down the runway until the undercarriage began to dance, then the ground fell away below you and you were airborne climbing up an invisible *flight* of stairs To your amazement the horizon came with you (how could it not on a round planet?) For the first time in your life you understood what a valley was as you floated above one at 7 000 feet You could plainly see the devastation of the gypsy moth, whose hunger leeched the forests to a mottled gray When you flew over Ohio you were saddened to discover the stagnant ocher of the air and the long expanse of the Ohio River dark and chunky the wrong texture for water even flammable at times thanks to the fumings and gushings of plastics factories which you could also see standing like sores along the river You began to understand how people settle a landscape in waves and at crossroads how they survey a land and irrigate it Most of all, you discovered that there are things one can learn about the world only from certain perspectives How can you understand the oceans without becoming part of their intricate fathoms? How can you understand the planet without walking upon it, to sample its marvels one by one and then floating high above it to see it all in one eye-gulp?

In your heart you know that most of all the twentieth century will be remembered as the time when we first began to understand what our address was The "big, beautiful blue, wet ball" is one way to say it But a more profound way will look at the orders of magnitude of that bigness the shades of that blueness, the arbitrary delicacy of beauty itself the ways in which water has made life possible and the fragile euphoria of the complex ecosystem that is Earth—an Earth on which from space, there are no visible fences or military zones or national borders.

Suddenly it seems that nothing is more urgent than to send into space a flurry of artists and naturalists who will turn the mirror upon ourselves and show us Earth as a single planet—a single organism that's buoyant fragile blooming buzzing full of spectacles, full of fascinating human beings something to cherish. Learning our full address won t end wars, you know, but it will enrich our sense of wonder and pride It will remind us that our human context is not tight as a noose but large as the universe we have the privilege to inhabit It will change our sense of what a "neighborhood" is It will persuade us that we are citizens of something larger and more profound than mere countries, that we are citizens of Earth her joyriders and her caretakers, who would do well to work on her problems together It will be the first chance we evolutionary toddlers have had to cross the cosmic street and stand facing our own home, amazed to see it clearly for the first time —*DIANE ACKERMAN*

CONTINUUM

Waiter waiter there's a bug in my milk!' Quiet please! All the other two-year-olds will want one too' That, at least sums up the findings of a team of University of Pennsylvania psychologists

THE AGE OF DISGUST

The fact that people don't stir soup with flyswatters or eat feces makes good health sense of course but disgust is the real reason why they refrain Disgust is a complex combination of taste emotion and cultural values that develops gradually through childhood

And now the age of disgust has been determined thanks to the work of psychologists Paul Rozin, April Fallon and their colleagues at the University of Pennsylvania It takes seven years of life experience they found out to become truly disgusted. Infants have no concept of disgust and children under two, regardless of culture will put anything in their mouths from dirt to lizards By age five youngsters won't drink a glass of milk with a grasshopper in it but if you take the grasshopper out they'll drink it readily

It takes another two years for children to fathom contamination, an essential attribute of disgust At age seven they believe as adults do, that removing a dead bug or a dirty comb from a glass of milk does not remove the contamination Something invisible and disgusting remains

Seven-year old children not only agree with adults about what is disgusting but offer the same rationalizations Asked 'Would you eat a cockroach? subjects aged seven and older said that the cockroach would be distasteful or dangerous

"Would you eat a sterilized cockroach?" Rozin countered The people he questioned couldn't stomach the thought of swallowing a small sealed and indigestible plastic capsule containing a dead cockroach that would emerge unscathed in their feces The fear in disgust, Rozin says, 'is of harm to the psyche—not the body —Dava Sobel

'Every stinking smell that fights it out with a ventilator imagines itself Don Quixote"
—Stanislaw Lem

COMPUTERIZED CHAUCER

'Whan that Aprill with his shoures soote/The droghte of March hath perced to the roote/And bathed every veyne in swich licour

It s no wonder Chaucer's meaning evades new students of Middle English literature Fed up with all the time spent on translation problems University of Washington scholars Micéal Vaughn, an associate professor of English, and Gerald Barnett, coordinator of the school's arts and humanities computing center have created MEEP the Middle English Editor Project

The program provides varying numbers of windows, each associated with a separate file Several windows may be displayed on the computer screen at the same time For example, a student studying Chaucer s *Canterbury Tales* might dedicate the main window to the original text an adjacent window to notes on the meanings of individual words, and a third window to a

Geoffrey Chaucer At last his Canterbury Tales on disk

modern English translation

The program will be useful both to experienced scholars and new students. For both "everything just goes too slow," says Barnett. In looking at older manuscripts, "a great deal of one's time is spent turning from the text to the glossary. What we're trying to do is reduce some of the clerical time for someone who wants to read the text, study the text, or learn to read the text."

The program also should reduce the cost of medieval scholarship. Right now an edition of a medieval text can cost as much as $100, but with MEEP and the new desk-top publishing technology, students could obtain copies for as little as $5.

Barnett and Vaughn hope to make the IBM PC-compatible program available for free but expect a fee will be charged for registration.

—Cathy Stone

VOICE-ACTUATED ANESTHESIOLOGY

Hospital operating rooms have been increasingly colonized by what some wags call "electronic nurses"—computers that allow doctors to regulate operating room lighting, adjust instruments, or even call "scalpel" with just the punch of a keyboard. But now a Needham, Massachusetts anesthesiologist cum computer hobbyist has taken the trend one step further, developing a system that lets doctors talk to the computer out loud, thus freeing their hands to minister to the human being in front of them.

Dr. Leo Montejo of Glover Memorial Hospital began by eliminating the keyboard ("It was always a nuisance," he says, "you ended up working with the computer and not the patient.") He worked for four years to develop a system that would recognize and respond to human speech.

Computers have entered the operating room, but according to one anesthesiologist, keyboards can come between doctor and patient.

The resulting program has a vocabulary of some 70 words. Through a throat microphone and a transmitter attached to his belt, the anesthesiologist can, by simply saying the word *drips*, ask the computer to help calculate the correct dosage of an anesthetic for a patient. "The machine does the calculation in one quarter of a second," says Montejo. By hand it would take five minutes. The program and accompanying hardware, soon to be marketed by Patient Data Systems, will cost about $15,000, or about what a good anesthesiologist makes in a profitable month.

—Bill Lawren

MARTIAN WINDMILLS

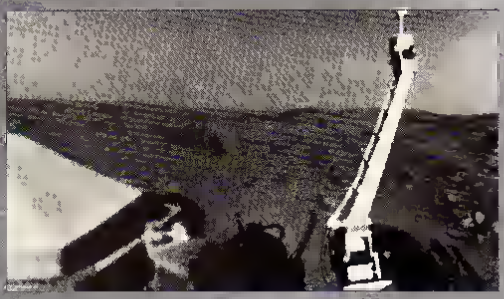
When humans establish a firm foothold on Mars they may use an energy technology designed in the seventh century on Earth: windmills.

The fact that the red planet sports an atmosphere 100 times thinner than Earth's would seem to argue against wind machines. But a study completed by Henry Haslach, Jr., a Wisconsin-based aerospace engineer, proposes Mars-based wind turbines or "gyromills," to churn out electricity for heating habitats, operating scientific stations, and powering oxygen-, water-, and propellant-processing units.

Haslach is quick to object to one energy contender for Mars—a nuclear generator. "The primary problem with a nuclear-power plant is the waste," he says. "You have two choices. Bury it on Mars and risk damaging the environment scientifically, or ship the waste to Earth which is very expensive."

The *Viking* landers indicated that surface winds on Mars can reach 15 miles per hour. Cameras circling Mars detected natural wind channels between hills and in canyons, as well as sand deposits resulting from the slope winds of towering volcanos. Some topography appeared eroded by wind and raised crater rims had "sand streaks," suggesting winds stronger than those found by the *Viking* landers. "People shouldn't think nuclear's the only way to go," says Haslach.

—Leonard David



A Viking lander on the Martian surface. Investigations by the probe uncovered an unsuspected resource on the red planet—wind.

CONTINUUM

THE $2 MILLION EXECUTION

Debate over the death penalty has largely centered on moral arguments, but an economic one has often been cited The death penalty is supposedly cheaper than life imprisonment

Not so according to a study called "The Cost of Taking a Life Dollars and Sense of the Death Penalty," conducted late last year by Sacramento attorney Margot Garey In fact, quite the opposite is true

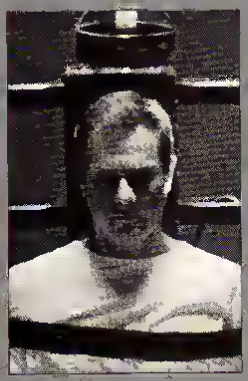
The U S Supreme Court, Garey says, has stated that ' death is different " and thus accords capital defendants "super due process," so capital cases (murder of police officers murder for money murder in a particularly heinous fashion, to name a few) take 3 5 times longer to try than noncapital ceses Such cases cost $600 000 to $2 million, compared with roughly $425,000 to house an inmate for 30 years (the average age of a death-row inmate is 31), and 86 to 90 percent of all noncapital cases don't even go to trial but are settled quickly by plea bargaining

Pretrial costs alone are staggering Motions like requesting funds for expert witnesses and challenging the death penalty itself are two to four times more frequent than in noncapital cases Investigation into a defendant's past takes three to five times longer, up to two years Experts including psychiatrists, medical and polygraph examiners, cost from $500 to $1,000 a day Courtrooms cost approximately $2,200 a day Jury selection, conducted individually instead of collectively, takes 5 3 times longer Attorneys' fees range from $50,000 to $75,000 more and another $40 000 to $60,000 for appeals

In addition there must be two trials instead of one One determines guilt the other penalty In all, there are as many as ten state and federal reviews available to a capital defendant

The death penalty, Garey concludes, is 'a devastating process that drains the criminal justice system of energy and resources that could otherwise be directed toward achieving its goals.' —Gregg Levoy

"Nothing in our culture, not even home computers, is more overrated than the epidermal felicity of two featherless bipeds in desperate congress."
—Quentin Crisp



Capital punishment costs much more than life imprisonment

Walter Kennick at his meat-squeezing machine 15 000 pounds of water pressure turn a tough old side of cow into a tender steak

MEAT SQUEEZE

A former professor of animal sciences at Oregon State University has developed a new method for tenderizing tough old meat

"We can take a New York strip from one side of an old Holstein cow," says Walter Kennick, "and make a very acceptable steak But the cut from the other side is so tough, unless you have the jaws of a sixteen-year-old, you couldn't eat it "

Kennick's method uses ultrahydrostatic pressure Cuts of meat are vacuum-packed in plastic and loaded into a specially designed canister Water is pumped in until the pressure reaches 15,000 pounds per square inch Two minutes later the pressure is released and the meat removed

Electron micrographs show that the treatment disrupts collagen fibers, one of the major structural elements of muscle tissue Actin and myosin fibrils, which are involved in muscle contraction are also destroyed

Treated meat is just as flavorful as untreated meat, Kennick says Consumers like it. And tests show it is equivalent to untreated meat in nutritional value and possibly somewhat easier to digest

Kennick's process will offer a number of advantages to meat processors Traditionally animals have been butchered, hung, and chilled With the new method animals would go directly from the killing floor to a hot boning table The major muscle masses would be removed, pressure treated, chilled and then boxed or cut for sale In addition because boxed meat can be chilled and stored more efficiently than whole carcasses, a meat packer with room for 20 head of beef could handle the meat from 100 head of beef using the new method

Kennick, now retired has used his method on meat from old dairy cows bulls and sheep 'We never found anything we couldn't tenderize,' he says —Carol Deppe

ESSENCE OF FIREFLY

A biologist and a biochemist at the University of California at San Diego have stolen the thunder from lightning bugs by cloning luciferase—the enzyme that makes fireflies glow

The scientists, Marlene DeLuca and Don Helinski are now shipping the pure luciferase free of charge to other researchers all over the world who are requesting it for their studies. Until now the San Diego team explains, experiments requiring luciferase called for armies of youngsters out collecting fireflies for profit

During the years she has studied luciferase, DeLuca notes she has paid a penny apiece for fireflies gathered within a 25-mile radius of Oak Ridge Tennessee where the bugs are especially numerous. Once the fireflies arrived at her lab in San Diego she had to hire someone to pick off their tails at $20 per 12,000. Growing the enzyme in bacteria requires a lot less manpower

Luciferase has a potentially major role in genetic engineering in plants. The chemical can be used to tag genes with a label that lights up when the gene turns on enabling scientists to understand basic processes within the cells. With such knowledge it should be possible to improve such specific properties of plants as the protein content of a food crop

DeLuca thinks that luciferase could even replace radioactive labeling in clinical laboratories. "In theory, any place you use radioactivity

Firefly. No need to pick off their little tails anymore

as a tag, you could use luciferase," she says. "But we'll have to prove this."

—Dava Sobel

ITALY'S TILTING TRAIN

The Italians, as anyone who's been to Pisa can tell you, have a penchant for building things with a slight tilt. But now they've channeled that proclivity in an unlikely new direction. Their newest high-speed trains currently being built by Fiat will maintain their velocity by actually leaning their way through the curves

Called the Pendolino, the tilting train is the outgrowth of almost ten years' research. The basic problem, say the Fiat people, was not so much getting the trains to lean while taking the curves but getting them to lean at the right time. If they tilted too late, the passengers would be subjected to a "sharp noncompensated lateral acceleration"—in other words, tossed sideways out of their seats. To time the tilt precisely so as to maintain speed while still gently moving passengers through the curve, Fiat developed a system in which accelerometers and gyroscopes signal the first stage of a curve to an electronic controller, which activates a hydraulic mechanism that tilts the train

The Pendolino's ability to maintain speeds of up to 250 kilometers per hour even through the curves will cut the current five-hour trip from Rome to Milan by more than an hour.—Bill Lawren

The Pendolino. The Fiat-built train sports a bar, a first-class galley, and a phone booth. Its big feature though, is the ability to literally lean into curves at speeds of up to 250 kilometers per hour

CONTINUUM

HEADACHE STRETCH

Many chronic headache sufferers could alleviate their condition with a simple method of neck stretching that works better than pain-relief drugs, according to a professor of neurology who has developed an unorthodox technique

In my view most headaches are due to a tightening of muscles and fibrous tissue in the back of the neck " says neurologist Donald Peterson M D of Loma Linda University in California "By performing my neck-stretching exercise, more than two thousand of my patients, many of whom had suffered for years, were able to get relief from headaches "

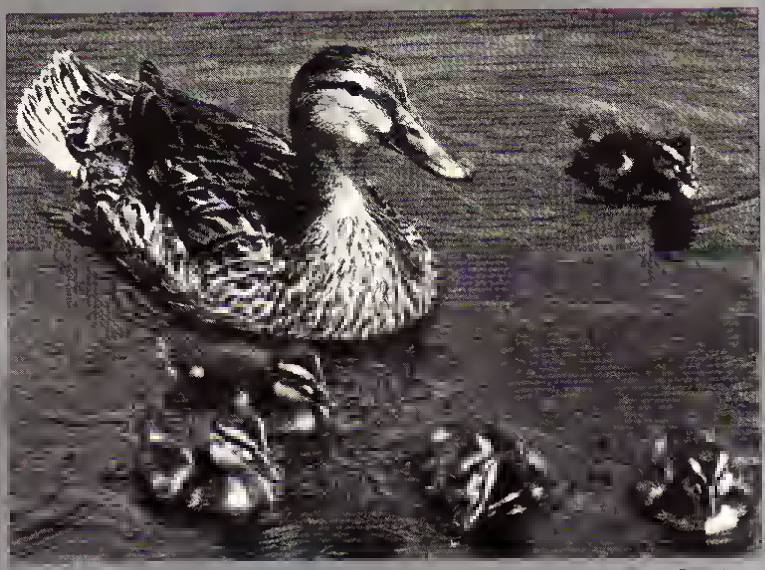
To do the neck-stretching exercise, Peterson says turn your head all the way to the right, place your right index finger on your left cheek and your right thumb under your chin then gently push to the right Simultaneously, reach over the top of your head with your left hand so that the middle finger touches the top of your right ear; then gently pull your head down toward your chest, with the head bent from the top of your neck Hold this position for ten seconds then reverse direction and repeat on the opposite side

Two thousand patients reported relief

Do the above procedure three times every two hours Peterson says Once headache relief is achieved cut back to just twice daily

If you feel dizzy during the exercise, Peterson cautions, stop immediately And if your headaches persist or worsen, or if there are additional symptoms, see a physician Your headaches might be related to a more serious condition

—Eric Mishara



Mallard mom and ducklings This mother duck has her brood up front but according to an English biologist, a mallard can keep visual tabs on her offspring at every point of the clock

EYE OF THE DUCK

If you ve ever wondered why mother ducks always swim in front of their ducklings, seemingly leaving the brood at the mercy of any predator that sneaks up from behind, Graham Martin has an answer Using sophisticated optical equipment Martin a biologist at England s University of Birmingham has discovered that at least one species of duck has a visual field that covers a full 360° giving it what amounts to eyes in the back of its head

Martin used an ophthalmoscope to shine a narrow beam of light into the eyes of a number of mallards The scope then focused a reflection of that light from the duck s retina back to the observer With the mallards heads immobilized, Martin moved the scope in a complete circle ready to note the point at which the light stopped being reflected—the point, in other words that represented the boundary of the mallard s field of vision

The reflected beam never stopped meaning that the mallard could indeed see throughout the full circle His explanation for this peculiar ability—'It s never been found in any other species, he says—is intriguing Because the ducks feed by sticking their bills in the water and filtering out any food

that comes through they do not need good frontal vision This Martin thinks, has freed the mallard s eyes to evolve their remarkable 360° visual field, which in turn affords it extra protection from predators —Bill Lawren

'When I was younger I could remember anything, whether it had happened or not "
—Mark Twain

BOWLING FOR SCIENCE

The influence of the space program has already been felt in a host of seemingly unrelated earthly fields in the drug industry, the operating room, even the insurance business Now, thanks to the ingenuity of an aerospace engineer at Cleveland s Case Western Reserve University technological fallout from space is affecting the American bowling alley

Almost ten years ago the Brunswick Corporation—a Muskegon Michigan firm that manufactures much of the nation's bowling equipment—asked Case Western s Thomas Kicher to apply aerospace technology to the design of a perfectly balanced bowling ball Kicher responded by putting together an entire laboratory—complete with computers, complex spin imparting machines, and even laser trackers that could actually predict the path of the ball down the lane "much like the way NASA predicts the path of a launched missile," Kicher says Brunswick also brought in professional bowler Carmen Salvino, whom Kicher describes as "a very smart guy with the instincts of a physicist."

The result, after seven years of sophisticated research, is a precisely weighted polyester ball that is almost entirely free of the minute wiggles and bounces that bedevil the average bowler In the process Kicher raised his own average from a modest 150 to a highly respectable 172 "Because of our work in the lab," he says, "I'm paying more attention to what I'm doing Consequently, I'm doing it better —Bill Lawren

All those lost quarters may eventually pay off in zero g

PAC-MAN IN ORBIT

A 1990's classified ad
WANTED! TELEPRESENCE OPERATORS FOR SPACE STATION APPLICANT MUST BE HIGHLY SKILLED IN PAC-MAN OR SIMILAR VIDEO ARCADE GAME.

Yes, all that money you've spent on mindless electronic abandon may finally pay off

A study by engineers at the Grumman Aerospace Corporation suggests that people who are adept in video competition could be proficient at handling the controls of remote-manipulator arms for orbital assembly and the refueling and repairing of satellites

The finding is based on tests of subjects relying on direct vision versus video vision to complete work using a mechanized 'peg in the hole" task board One of more than a dozen individuals scored far above the others in the video portion of the tests leaving Grumman officials scratching their heads as to why

'He broke the curve ' explains Allan Nathan a program manager for the firm's space division "He did extremely well compared to the others There is no scientific proof, but in talking to the subjects, one way to explain why is that he played a lot of video games

Twenty-first-century space planners see expanded use of what they term telepresence The concept involves robot arms having all the dexterity to perform normal human functions, but controlled at a distance

If Nathan is correct, could the people with the talent to run such systems be found honing their skills as video-game junkies? The thought stirs up another possibility To maintain space station crews at tip-top efficiency, why not have an onboard video-game room? "It s not a bad idea My sense is that people with that training would do better, ' Nathan says

But how will you avoid mutiny when everyone runs out of quarters?—Leonard David

Space Age technology—high-speed computers complex spin-imparting machines, laser trackers—has been put to work creating the perfect bowling ball Now how about improving those funny shoes?

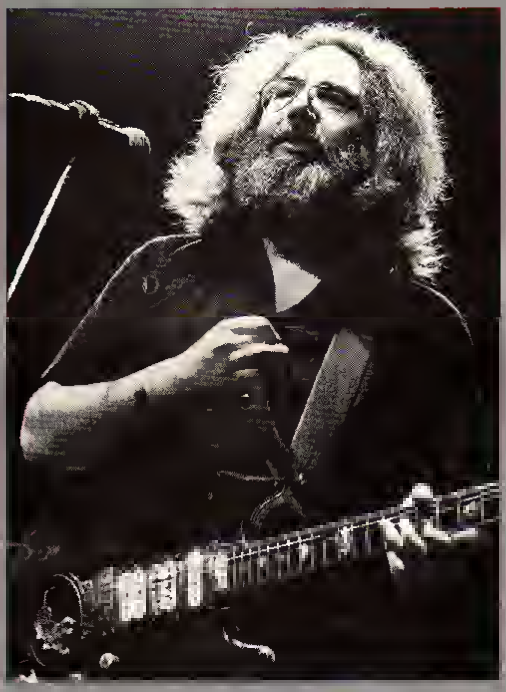
CONTINUUM

FREUD MEETS OZZIE OSBOURNE

Critics of rock and roll blame today's music for many adolescent woes, from drug abuse and teen pregnancies to suicide attempts But psychiatric art therapist John Sappington and psychiatrist L D Tashjian of the Horsham Clinic, a private psychiatric hospital in Ambler Pennsylvania claim that songs by such musicians as the Grateful Dead and Ozzy Osbourne can actually *help* youngsters They've even incorporated rock and roll into various therapy programs for disturbed thirteen- to eighteen-year-olds

Sappington came up with the idea when he noticed that teenagers often doodled rock insignia rock groups' names, and pictures of rock stars onstage during art-therapy sessions 'So I asked them to draw pictures pertaining to favorite rock songs that were meaningful in their lives ' he explains "Then we looked at the drawings listened to the records that inspired them, and talked about how the images related This approach cut through the defenses the teenagers were using to cover up the real problems in their lives '

Although they insist that a teenager's musical preferences can t be used to diagnose a specific emotional problem Sappington and Tashjian have observed certain patterns For example many troubled youngsters gravitate to the music of the Sixties 'These are frequently kids who have diffi-



Jerry Garcia of the Grateful Dead Many youngsters who have trouble relating to their peers gravitate to the music of the Sixties

culties in relating to their peers,' Sappington notes "They are trying to reestablish a time when there was a greater sense of community among adolescents ' Teenagers who listen to heavy metal music he says are often socially isolated have experimented with drugs and are dealing with deep-seated rage On the other hand, few of the youths treated at the Horsham Clinic are punk-music fans according to Sappington

—Sherry Baker

DRAWING ON THE COUCH

For all the furor he created in the art world in the Forties and Fifties with his massive 'drip' paintings artist Jackson Pollock died in a car crash in 1956 without knowing that his name would live on as the master of a genre and that his canvases would command king s ransoms

Nor did he know that the 83 drawings he made for his analyst as a part of his psychiatric treatment would one day hang in exhibit halls around the country

Those drawings done in colored pencil in 1939 and 1940, made news most recently in Boston where two curators at the Museum of Fine Arts locked horns over plans to purchase them One said the drawings were crammed with vigorous brutal images and gave insights into Pollock s later work The other countered that the works were never intended to be shown as art, and that Pollock's doctor probably should have kept them to himself

The doctor, Joseph L Henderson sold all but two of the drawings to a San Francisco art gallery in 1969 They have since become a kind of Rorschach test for critics and historians occasioning a lot of free associations about Pollock s internal landscape The works have also raised ethical questions and aroused moral outrage for they are the stuff of confidential dialogue between analyst and analysand

Meanwhile the drawings are on exhibit through January 1987 at Boston's Nielsen Gallery where Nina Nielsen is selling them to museums and collectors

'Pollock developed his imagery in these drawings she says A lot more research and writing should be devoted to them as they relate to his art and *not* to their psychoanalytic interpretations —Dava Sobel

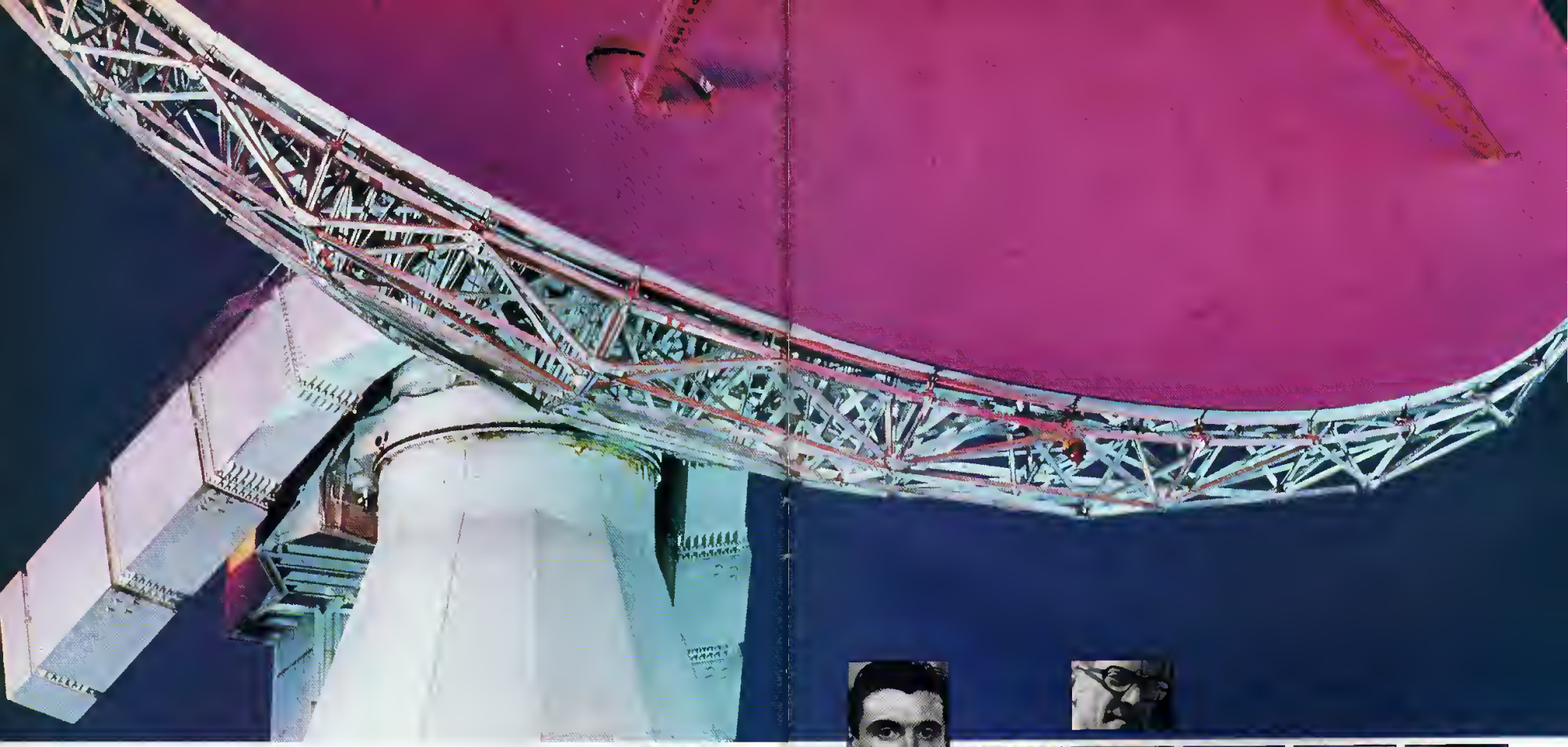
'Is life worth living? That is a question for an embryo not a man

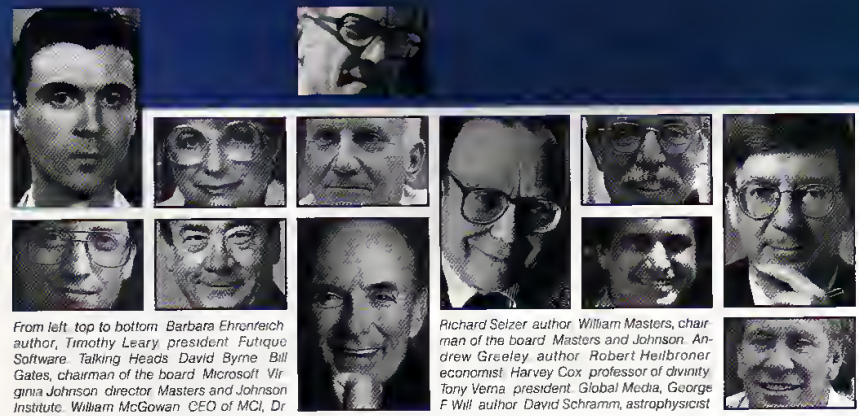
—Samuel Butler

Where can you find peace in the Middle East, 3-D TV, and video love? Fourteen futurists describe 2007

THE SEERS' CATALOG

BY MARION LONG





From left, top to bottom: Barbara Ehrenreich, author; Timothy Leary, president, Futique Software; Talking Heads' David Byrne; Bill Gates, chairman of the board, Microsoft; Virginia Johnson, director, Masters and Johnson Institute; William McGowan, CEO of MCI; Dr. Richard Selzer, author; William Masters, chairman of the board, Masters and Johnson; Andrew Greeley, author; Robert Heilbroner, economist; Harvey Cox, professor of divinity; Tony Verna, president, Global Media; George F. Will, author; David Schramm, astrophysicist

Looking into the future is often a little like charting unexplored territory. It creates great exhilaration and immense uncertainty. The historic currents of our time and the directions in which they are taking America certainly call for something like an explorer's strength, understanding, and boundless optimism. To introduce our readers to the holographic dazzle and profusion of complex issues, political challenges, and technological advances that will permeate our future, *Omni* talked to 14 people gifted at seeing beyond tomorrow.

In the following pages you will explore with us what the next 20 years will likely bring in the major fields of human endeavor—including the sciences, economics, politics, the arts, education, and communications. Whatever judgment one may pass on any particular analysis, projection, or revelation, it is clear that the times are ripe for all sorts of startling changes. America in the year 2007, various experts tell us, will be a place where football players are tackled in our living rooms, where we turn on brain radios and toss away disposable computers. We are promised polymorphous perversity, peace in the Middle East, babies born of artificial wombs, and life in ten dimensions. And we will have a chance to unite body, mind, and spirit such as we have never had before.

Bill Gates, *Chairman of the Board, Microsoft Corporation*

The processing of digital information is improving very quickly. In ten years you'll have 30 to 40 times as much computational power, and you'll be able to manipulate the images and sounds that you now receive just passively from TV—you'll insert yourself into a game or even change the outcome according to your wishes. So in 20 years your ability to get information will be expanded exponentially.

Take one example. You're sitting at home. You'll have a variety of image libraries that will contain, say, all the world's best art. You'll also have very cheap, flat panel-display devices throughout your house that will provide resolution so good that viewing a projection will be like looking at the original oil painting. It will be that realistic.

In 20 years the Information Age will be here, absolutely. The dream of having the world database at your fingertips will have become a reality. You'll even be able to call up a video show and place yourself in it. Today, if you want to create an image on a screen—a beach with the sun and waves—you've got to take a picture of it. But in 20 years you'll literally construct your own images and scenes. You will have stored very high-level representations of what the sun looks like or how the wind blows. If you want a certain movie star to be sitting on a beach, kind of being lazy, believe me, you'll be able to do that. People are *already* doing these things.

Also, we will have serious voice recognition. I expect to wake up and say, 'Show me some nice Da Vinci stuff,' and my ceiling, a high-resolution display, will show me what I want to see—or call up any sort of music or video. The world will be online, and we'll be able to simulate just about anything. Let's say you want to go out to a racetrack. When you wake up you'll say, 'Hey, rent me one of those formula cars in Daytona,' and with some local controls, a little steering wheel you pull out of your drawer, you'll be able to get the image and feel like you're driving the car.

There's a scary question to all this. How necessary will it be to go to real places or do real things? I mean, in 20 years we will synthesize reality. We'll do it super-realistically and in real time. The machine will check its database and think of some stories you might tell, songs you might sing, jokes you might not have heard before. Today we simply synthesize flight simulation.

A lot of things are going to vanish from our lives. There will be a machine that keys off of physiological traits, whether it's voiceprint or fingerprint, so credit cards and checks—pretty flimsy deals anyway—have got to go. I hope passive entertainment will disappear. People want to get involved. It will really start to change the quality of entertainment because it will be so individualized. If you like Bill Cosby, then there will be a digital description of Cosby, his mannerisms and appearance, and you will build your own show from that.

> *"In 2007 Mick Jagger will be onstage, and when Mick feels heat, you'll feel heat. If a spray of water hits Tina on the back, you'll feel that, too."*

People will like the idea that the machine really knows them and that the machine can create experiences formed around the events in their lives to fulfill their particular needs and interests. But there's a danger, too. It will be easy to feel worthless or overwhelmed by the amount of data. So what we'll have to do is make sure the machine can tailor the data to the individual.

Probably all this progress will be pretty disruptive stuff. We'll really find out what the human brain can do, but we'll have serious problems about the purpose of it all. We're going to find out how curious we are and how much stimulation we can take. There have been experiments in which a monkey can choose to ingest cocaine and the monkey keeps on pushing that button until he dies. Well, we are going to create some pretty intense experiences through synthesized video–audio. Do you think you'll reach a point of satisfaction when you no longer have to try something new or make something better? Life is really going to change. Your ability to access satisfying experiences will be so large.

Take the change in movies in the last few years. Just a few years ago you had to find out where the movie was playing, then go to a certain neighborhood and stand in line to see the movie. Now you can go two blocks and find 10,000 titles. You feel inadequate. It's going to be intimidating.

Twenty years ago I was ten years old. We already had color TV. I didn't have theories about what the world might be like. But in the next 20 years you won't be able to extrapolate the rate of progress from any previous pattern or curve because the new chips, these local intelligences that can process information, will cause a warp in what it's possible to do. The leap will be unique. I can't think of any equivalent phenomenon in history.

Tony Verna, *President, Global Media. Director of Live Aid and Sport Aid. Inventor of Instant Replay*

I can tell you step-by-step what's going to happen. We'll have high-definition TV with a wide screen of, say, 1,125 lines rather than the conventional 525 lines. And the aspect ratio on your set will be five-to-three, not four-to-three. The resulting images will rival 35mm film in quality. These sets will be wall-projection units, either liquid-crystal disc players or the familiar cathode-ray tubes without their current depth. You'll see this first in public places like bars—wide screens with beautiful pictures of football games and so on. All this will happen very soon, probably about 1990.

Shortly after that we'll have digital TV and the viewer at home will become a participant in the actual production. He'll play director. When he's watching a football game he'll be able to zero in on the end zone by hitting his hand depressor control to say, 3A. He'll switch cameras himself to look at the game from different views. By then tapes will be so small they'll be like little balls of thread on your TV set, and you can have them taping the end zone while you are watching the 50 yard-line camera. If you've put your wager on the wrong team, you'll be able to take a picture of the quarterback, superimpose him scoring the winning play, and at least get the thrill of a dream. You can have your own ending. Who says things have to be real?

There will also be a truer form of 3-D television, one with no TV set. You'll wear a pair of glasses, and each lens will have its own little TV set. Separate liquid-crystal screens will be built into the pair of glasses. The screens will be translucent so that if the teakettle boils and you have to move to the stove, you'll be able to see through them. You won't feel claustrophobic.

Then there will be no TV—not even on your eyes. The images you'll watch will be

projected by lasers. There will be three laser beams, and each beam will cover the red, blue, and green spectrums. The image will appear in your living room, without a screen, wherever these three beams actually converge—where they hit is where the image will appear.

The next step will be a molecular digitizer of ions. You'll need an ion camera, not laser beams, to pick up the image. The camera will pick up signals that are bounced off the invisible part of the light spectrum. You won't have a TV set but a positive and negative grid in your ceiling and floor. When these rays come into the ion chambers the images will form.

I wasn't able to put David Bowie and Mick Jagger on the same stage in Live Aid because Bowie was in England, and Jagger was in this country. But with this technology I actually could put them together in real images with the actual acoustics. You know, I invented the instant replay, but people won't be happy until somebody is tackled in their living room.

The next innovation, Sensavision, will be like a Walkman attached to your forehead. You won't actually have your head wired because intrared wires will send signals to you. In 2007 Mick Jagger will be onstage, and when Mick feels heat, you'll feel heat. If a spray of water hits Tina on the back, you'll feel that, or you'll switch to the stands and smell what people are smoking. There probably will have to be a computer cutoff point to prevent the emotional sensations from getting too intense, especially for sex scenes or if you're watching a car race when the race car driver crashes.

The viewer will be able to conquer time and space with the tube. Someday the director's and producer's jobs will end in the control room, and the viewer's job will begin. With laser vision, *you* are going to walk around in the scene. With Sensavision, *you'll* be able to feel the thrill of victory or the agony of defeat.

I recently directed Sport Aid, which was seen by a billion and a half people outside the United States. I was directing cameras from all around the world: Barcelona, widen that shot; Budapest, get out of that super and zoom in on the kid on the left; Dublin, cue the fireworks; Delhi, start the runners; I'm playing mad messiah.

All this will change the world. The ability to communicate—that's what it's all about. Twenty years from now we certainly should have more empathy and compassion for each other. And that's without a world leader putting Sensavision on his forehead to feel what it's like for someone else.

William McGowan, *Chief Executive Officer, MCI Communications Corporation*

Information will be a kind of international standard, the way we now think of gold. It is going to be a controlling factor in international trade. At MCI we are now trading 24 hours a day. Most companies will be trading 24 hours a day in just a few years. You won't hear that clanging bell when the market stops. It's going to be a continuum because information is that way. I can reach any information I could possibly use in a few seconds with my little PC—whether it's commodities news or a search.

People are worried about information overload, but that's a cop out. They're just not sure they can become part of the process because you can get the information in the manner you want, in the form you want, and at the moment you want. So you control the process. It's going to be fantastic. For example, in Washington six universities are going to combine their libraries of rare books. When you realize that a compact disc—a four-and-a-half-inch disc—can contain the same amount of information as 11,000 floppy disks, you say to yourself, *Hmm, maybe this is going to be interesting.* And we still have in front of us another 100-to-1 drop in the cost of computing power using today's technology. Then we may have to figure out how to compute using chemical reaction. Probably the best guess is light for computing power. Just look at what is happening now in fiber. I'm convinced we will have 1.6 gigabits per fiber within two years. That's 50,000 voice channels per fiber, with a fiber that's thinner than a human hair. Can you imagine the value, the economies that are going to come out of telecommunications and computing power 20 years from now?

> *"People can't afford the cost of medical care in this society. There is going to be a comprehensive national health plan in this country. It's inevitable."*

It's important that our machines and new processes resemble human ways of communication rather than an engineer's method of communication. When this happens people adapt very easily. Video conferencing is a good example. For a long time I never used it because it wasn't normal. When you walked into a video conference room, you saw an eight-by-ten-inch screen with your image on it, which intimidated the hell out of you. Now you walk in, sit down, and have a conversation with people at a conference table, but half the conference table is 2,000 miles away. You don't hook up mikes or stare into TV lights. You see the person sitting at the other end of the conference table. It's very normal. Any new innovation will have to be designed that way.

Timothy Leary, *President, Futique Software Company*

By 2007 the problem of scarcity will be solved. Because most work will be done by robots and computers, you won't have to work. Material possessions won't mean as much to us as they do now. If there are nine Porsches in your garage, you're going to say, "Take them away. We've done that with wheat and grain, and we can do it with other things if we put our minds to it."

The way we define human beings will change. You won't be a serf, a slave, or a worker. What will you be? A performer. Everyone will be performing. Passive listening, passive observing, passive watching will disappear. Of course, Big Brother, both of the Reagan and the Gorbachev type, want us to be passive. They don't want us to think for ourselves.

In 2007 you'll be living in an information society in which information will be what money and machinery were in the Industrial Age. Everyone is going to be a psychologist, computer whiz, philosopher. Mind play, mind performance, psychological skill are going to be the equivalent of land, money, and power in the earlier ages.

Now to the nuts and bolts of this stuff. Every kid will learn how to communicate at a very young age; every kid will have his own computer—like a pair of sneakers, a pair of Nikes. No one will steal a computer, because you'll throw them away. And everyone will learn how to chart his thoughts and his mental performance—like a baseball player's stats. Even kids will plot their thoughts like they plot their batting average. The name of our species is *Homo sapiens*. That means we're the organism that thinks, and our species finally will be proficient in thinking.

The biggest effect will be on blacks and members of other minority groups in this country. In the Information Age, to keep any poor kid from having a computer would be like keeping him from having food, medicine, shelter, or clothing now.

Within 20 years we'll have scrapped the current system of partisan politics. Partisan politics belongs back in an age of feudalism, or at most the Industrial Age. It is insane to run a highly complicated technological, pluralistic society like America when you have in the cabin of the spaceship a Democratic and a Republican candidate kneeing and gouging and beating up each other to see who's going to be president for four years. In an electronic society an intelligent person would no more send Tip O'Neill to Washington to make his laws than you'd send Tip O'Neill to the wine shop to pick out a good wine for you.

Everyone is going to be responsible for government. It will be done by televoting, perhaps every Sunday between, say, twelve and one. But we'll be voting on major issues—not parties, people, or a glamorous candidate who will play on our superstitions and emotions. You'll educate yourself on the issues by using your own thought-processing appliances—the new

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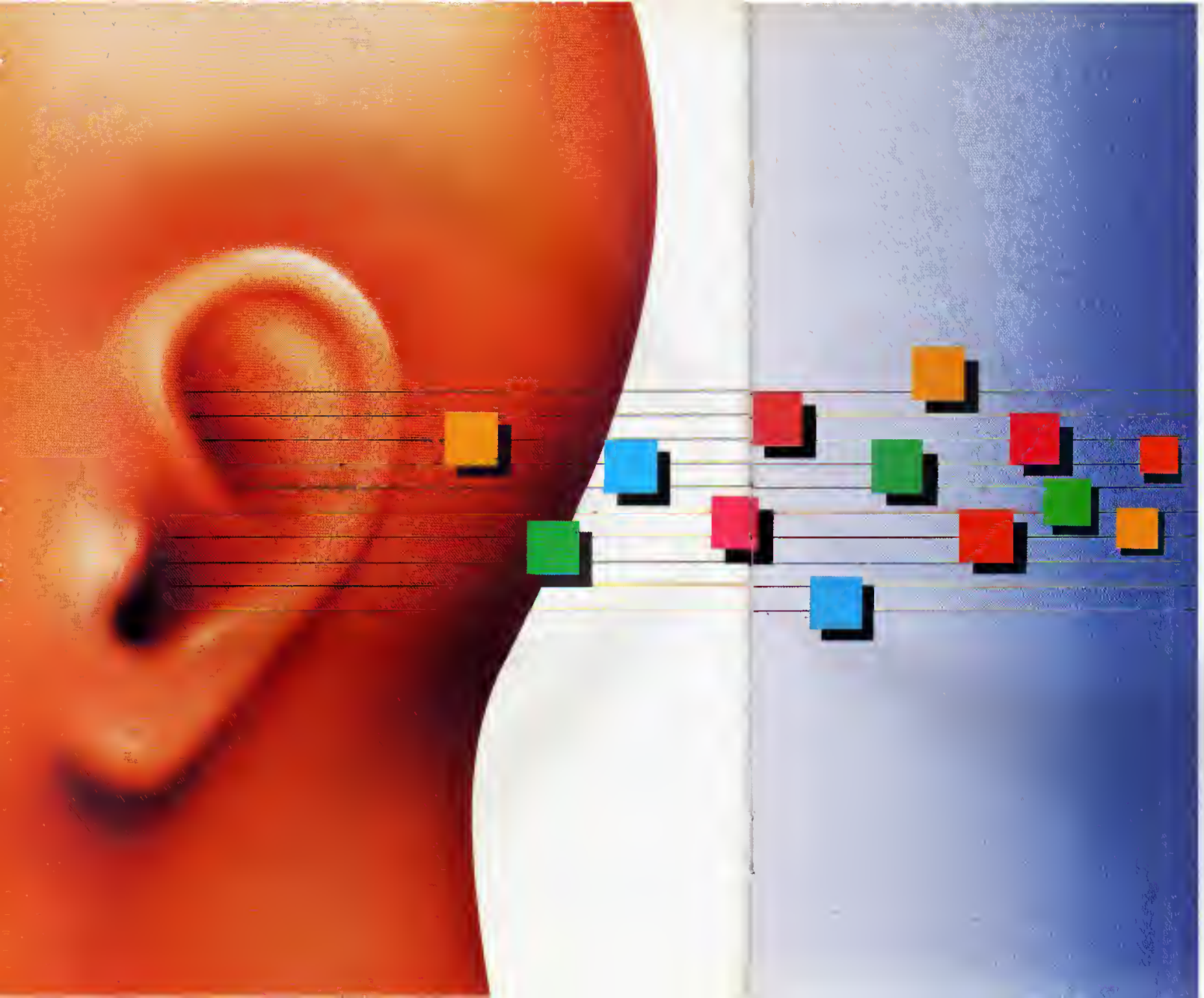


Are we wired to appreciate only certain kinds of music? An emerging science of sounds says yes

KEY NOTES ON THE MIND

BY TERENCE MONMANEY

While he's waiting for a courier to deliver the videotape, Jan Hammer generally gets a little tense and starts prowling around his farmhouse. It's a 200-year-old white-clapboard place on a hill in eastern New York, and it stands up there like a monument to the proud Yankee disdain of all that's new and trendy.

Yet it could not be more up-to-date. Hammer, an edgy electro-pop star who 15 years ago played keyboards with the jazzy Mahavishnu Orchestra, has rigged two large rooms with music machines so new wave they make a Moog synthesizer seem colonial. Linndrum. Simmons electronic drums. Roland Jupiter-8 keyboard. Lexicon 200 digital delay. Fairlight Computer Music Instrument. Yamaha DX7 digital synthesizer. At least there's one familiar relic—an IBM personal computer.

Once the tape arrives he pops it into a player and begins dreaming up the music that will be heard by millions some two weeks later on *Miami Vice*. Working alone, he'll compose, perform, and record the *Miami Vice* soundtrack, creating sometimes as much as a half hour of original music for an episode—a mind-boggling

PAINTING BY STANISLAW FERNANDES

task made agreeable by a fat salary and by an artistic freedom unprecedented in television. The only rules are that the music sound as hot as a stolen pistol and as hip as a silk T-shirt and that he come up with it. God bless him. In five days.

The wailing guitars, pulsating drums and eerie choruses that Hammer has become famous for do not sound exactly real, but they aren't supposed to. "I like creating collages of sound," he says, "overlaying things so you don't know if it's a horn or a bass. With the new musical technologies we can create sounds that we could never hear otherwise."

But sound doesn't exist in a vacuum. Composer John Cage talks about how incidental events contribute to a work, how the audience completes it, and how the work of art is personalized by the person who experiences it. Fellow composer Philip Glass agrees with Cage. "We shouldn't think of a work of art as an objective reality that exists independently."

Glass is a classically trained musician who is known for his innovative computer-generated music. His ensemble consists of three keyboard players, three reed players, a singer, two speaker stacks, several computers, 50 computer programs, and a conductor who mixes and programs the sounds. "One of the things I'm interested in doing is extending the sound of acoustic instruments with electronic sounds. That's what we do. My ensemble is a perfect laboratory for that. I'll have a saxophone, and I'll double it with a synthesized sound and get a different sound. It's amazing. The refinements we can work with are just beginning to open up."

He's also interested in how the technology is applied on a human scale. "The human being who goes home and puts on his CD, I hope, and listens to the music is finally just a person. He's not a robot. No matter how we change our technology, our human technology is not going to change. The biological evolution that allows us to hear in certain ways, we can't upgrade that every year. Everything has to be geared to human physiology."

As composers and engineers are turning the computer into a surprising new instrument, neurologists and psychologists are discovering some things about the ultimate instrument, the brain, and how it makes sense of music.

What effect will those new sounds have on how the human mind processes music? Even an oscilloscope—an instrument that can pinpoint the frequency of every sound wave in a piece of music—cannot tap its foot to the beat, tingle with you, laugh, weep, or feel a rush of memory. That takes brains. Indeed, researchers have shown that we regularly perceive musical tones and pitches that aren't there—tones that an oscilloscope couldn't pinpoint if it tried. The brain, in other words, does not merely process musical sounds but sometimes accompanies the band, supplying the odd pitch, doing a little arranging of its own.

One of the earliest and most revealing studies done in the field showed that the human brain controls musical experiences. A single note struck on a piano gives off a complex signal composed of sound waves of several frequencies that are multiples of the lowest, or fundamental, frequency. The fundamental frequency of middle C, for instance, is 261 cycles per second, but the signal also contains frequencies that are two, three, four, and five times 261 cycles per second. Despite this, a human being perceives the sound as having one pitch—middle C.

More interesting, studies show that even when the fundamental frequency is removed from a complex tone, subjects still identify the pitch as usual—as middle C. The inner ear and brain are capable of recognizing the pattern of the harmonics that surround the missing frequency, calculate their relationship, infer the presence of the fundamental, and identify the pitch. This is true even for six-month-old infants.

"The way the human ear perceives sound hasn't changed at all over time. The tones our ancestors liked and found pleasing, so do we."

Furthermore, the way humans interpret a single note can vary. Individuals, it seems, can perceive the same note differently, just as they can interpret an event differently or derive several meanings from a poem or story.

In Diana Deutsch's windowless psychoacoustics lab at the University of California at San Diego (UCSD), amps, equalizers, and tape recorders rest on racks against one wall. Waist-high Altec-Lansing speakers occupy the far corners. Two women sit in the center of the room. They are music students—Toshie, an accomplished pianist, and Mamoru, a composition student whose work has been performed at New York City's Lincoln Center. Deutsch loads a digital tape into a player, and a second later computer tones pop from the speakers. *Dingdong*. Pause. *Dingdong*. Pause. The question for Toshie and Mamoru: Does the musical sequence go up or down? *Dongding* or *dingdong*?

They shout their answers. "Up," Toshie says. "Down," says Mamoru. Giggling. Next pair. "Down," Toshie. "Up," says Mamoru. Furrowed brows. This goes on for several minutes. Sometimes they agree. But more often they don't. That's when they start arguing in Japanese.

Each tone is a mixture of six frequencies. When you hear the tone, you can identify the pitch as a C, but you can't tell *which* of six C's it is without the usual harmonics, the pitch is ambiguous. Therefore, theoretically at least, you shouldn't hear one tone as higher than another. But Deutsch has shown that you do. In her tests, she found that people generally do have a consistent, built-in tendency to perceive certain pitches as higher than others.

Deutsch concedes that her study was limited and employed few tones, but it was done under controlled conditions, and she believes it's relevant to our perception of real music. "This finding is counter to theories of pitch perception, counter to music theory, counter to common sense. I marvel at the fact that two fine musicians can totally disagree about a two-tone pattern going up or down. It's got to be meaningful. It's as if we all have a different kind of color blindness. Do we know we're hearing the same thing? It's an open question. Perhaps we should suspend discussions of aesthetics until we clear this up."

The manner in which we perceive, and then "hear," the song of a thrush or a chord in Beethoven's *Eroica* may have a genetic link. At the University of Toronto psychologist Sandra Trehub has spent a number of years studying how infants respond to musical notes. In a series of experiments with infants, she played musical phrases consisting of three computer tones. Each phrase was repeated over and over (the order of the notes was varied, but only the three notes in any particular phrase were used). Once that pattern had been established, Trehub inserted stray notes to see if the infants would respond. In order to respond, they had to recognize or remember that the stray notes were not part of the sequence. "We thought they'd be able to do it for all tones or for none at all," explains Trehub. "But they could remember only one particular set of notes, and those three notes were the major triad—C E G—the most important notes in the major scale, the prototypical notes in Western melody. It surprised us."

For Edward Carterette, a UCLA psychologist who specializes in speech and hearing systems, Trehub's findings represent the neurological bottom line for processing music. "It wouldn't matter what culture you went to," says Carterette. "You would see that children and adults find this triad to be very salient—strong, easily remembered. It stands out."

Carterette, a soft-spoken man whose special passion is the study of cross-cultural perception of music, has found what he believes is convincing evidence that, generally speaking, human musical perception hasn't changed much throughout human history. He, along with Rao Yu An of the Institute of Physiology in Shanghai, analyzed tape recordings of a collection of 2,400-year-old Chinese bells. He found

CONTINUED ON PAGE 67

FICTION

DADDY'S BIG GIRL

URSULA K. LE GUIN

It was a terrible thing for Daddy. You can tell how hard it was on him by the fact that he's never said one word about where Jewel Ann is now. And he was the one who named her Jewel Ann instead of plain Ann like they had planned, because she was his little treasure baby. He

PAINTING BY FERNANDO BOTERO

was crazy about her when she was little

I was six when she was born, and I can remember her coming home from the hospital with Mother, and how Daddy thought the world of her. I did too. She was so little and she smelled good the way babies do, and I could help Mother take care of her, bringing diapers and getting the bath oil and powder and things. I was the first person after Mother that Jewel Ann smiled at, and I was proud of that. She was my baby, too. I used to stand by her stroller and guard her when Mother was in the store. When she outgrew the stroller I was supposed to hold her hand while Mother shopped, and we always went and looked at the machines at the front of the store where they had gum balls for a penny and plastic balls with prizes inside for a dime or a quarter, curled-up snakes and jewelry and magic toys. I'd say which prizes I wished would come out if we had the quarter to put in, and Jewel Ann always chose the same ones I did. Once an old man held out a quarter to us, and I don't think he meant anything bad, but we had been taught and turned away and didn't take it. Later when we told Mother, she gave us each a quarter. But when we put the money into the machine, none of the plastic balls you could see came out or even moved, because there were other prizes underneath them that you couldn't see, and those were what came out. Mine was a paper American flag on like a toothpick with a sort of stand. Jewel Ann's was a pink plastic ring without even a glass diamond in it. But she was still little enough that she liked it, and she kept the plastic balls that came apart, too, and used them for tea sets and things. When we got those prizes Jewel Ann was tall enough to put her own quarter in the slot machine. She could talk as well as most grown-ups and do all my old wooden puzzles Grandmother gave me, and when we played house she wasn't the baby anymore but a lady called Mrs. Goopie and I was Mrs. Boopie next door. We played Mrs. Goopie and Mrs. Boopie all spring after my school and all summer, in the backyard under the pines, with our dolls for the children. Duane never played with us, only the kind of games where you win or lose, with other boys. None of the girls I knew at school lived anywhere near us, because of busing, and I didn't know the girls in our neighborhood very well. Anyhow, I liked playing with Jewel Ann better because she was smart, and even if she was younger she was bigger than me by the time she was five, so it wasn't like she was so much younger. And anyhow I did love her, and she loved me back.

The first day she went to school, I took her on the bus and showed her where everything was at school and went with her to the first-grade room. The teacher said, "My, Jewel Ann, you are tall!" She said it not in a nice way, but like it was Jewel Ann's fault. Then she said to me the same way, Is she really only five?

I said, Yes, Mrs. Hanlan.

She said, She's far too big for a girl of five. It will be very difficult for the little boys.

Jewel Ann said, "I'll be six next year!" She was trying to help. But Mrs. Hanlan acted like she thought she was showing off and told her to go sit down. When Jewel Ann sat down on the little chair in the circle she was still as tall as the other first-graders standing up. It made me feel funny for her after what Mrs. Hanlan had said. But Jewel Ann smiled and waved at me because she was so excited about going to school and wanted it to begin.

She always did real well in her work and had a perfect attendance record, and when she was in the third grade Miss Shulz made her a monitor and gave her advanced reading books and put her painting of whales in the Save the Animals poster contest. It got Honorable Mention. Jewel Ann was happy that year. But then they kept her out of school the next fall because of her height, and she never got to go back.

I knew she was tall, but I didn't really notice till practically that first day at her first grade. I mean, I knew, but I didn't have to compare her to anybody till then. And she was still my little sister. I don't know when Daddy stopped calling her "Daddy's big girl." I guess when she was around three. I don't think they tried to do anything about it until that summer after she was in third grade. She had been growing a lot, and Daddy made Mother take her to a doctor. Mother told me about it later. They gave her some hormones. Mother threw them out after a week because they made Jewel Ann get dizzy and have headaches and throw up, and also Mother was afraid that if she went on taking them the hormones would cause her to have periods or grow a beard. She was only a little girl of eight, and Mother felt it wasn't right. I guess she didn't tell Daddy, and he went on thinking Jewel Ann had taken all those hormones and it had cost a lot and done no good. Anyhow, he never mentioned sending her to the doctor's again. Mother said she knew it wasn't going to do any good. It wasn't hormones in the first place.

Jewel Ann didn't cry about not going back to school, but she stopped talking about Miss Shulz. I don't know what she thought. She was quiet. Like I said, she had been happy in Miss Shulz's room, but there were always some people at school who picked on her. At home nobody was mean to her except Duane. He called her names like Giraffe and Hugie and Flagpole and said things like, "When are you going to sell her to the freak show?" and worse. Once I heard him talking with his friend Eddie and saying he wished he could kill Jewel Ann. He said, "Chop her all apart into little bits, fry her with one of those flamethrowers, just burn her down into nothing." It embarrassed Duane that she was so tall that she could look down on the top of his head when she was eight years old and he was sixteen. He was just average height for his

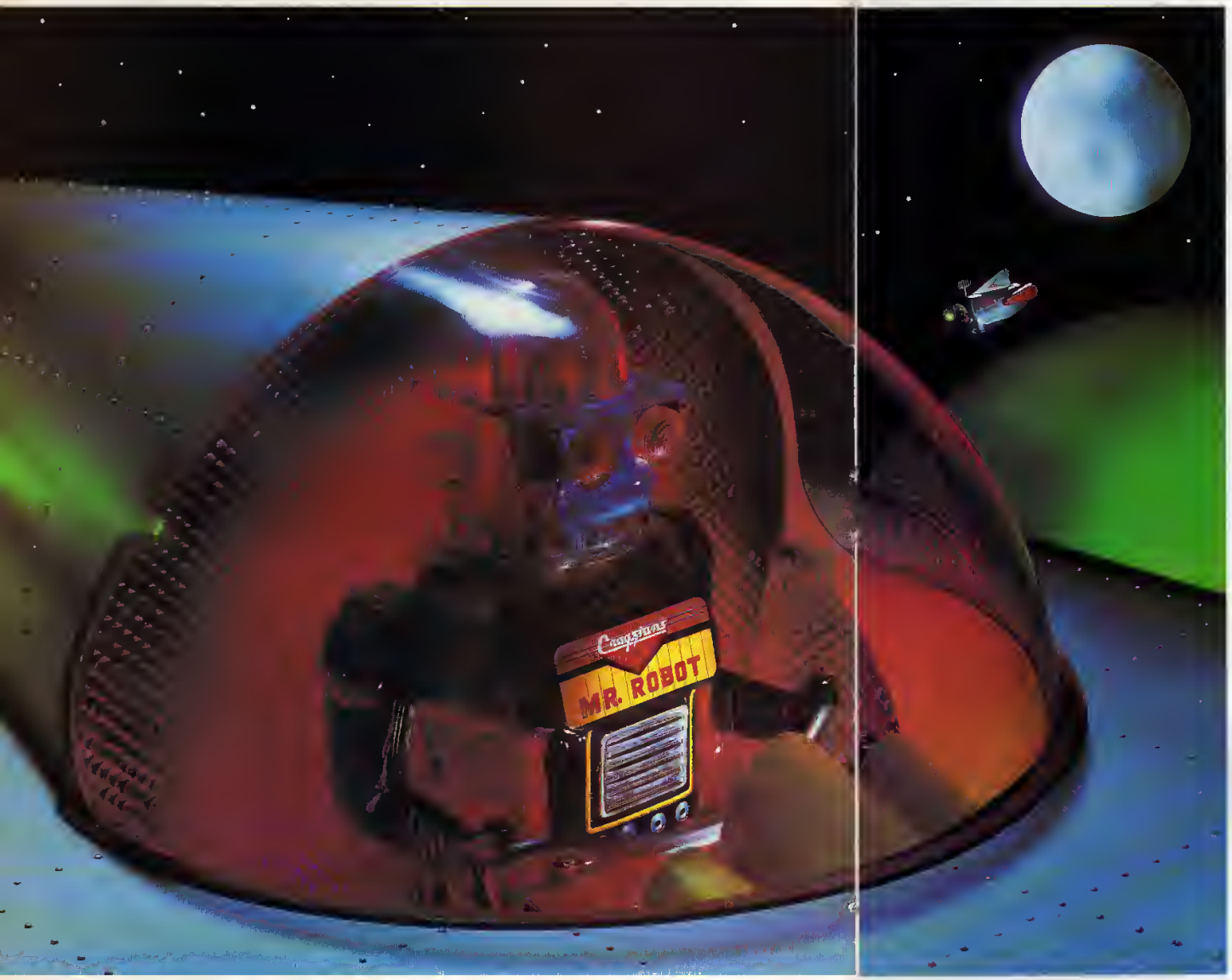
"Don't take it personally, Mr. Symington. I'll love anyone who will feed me."

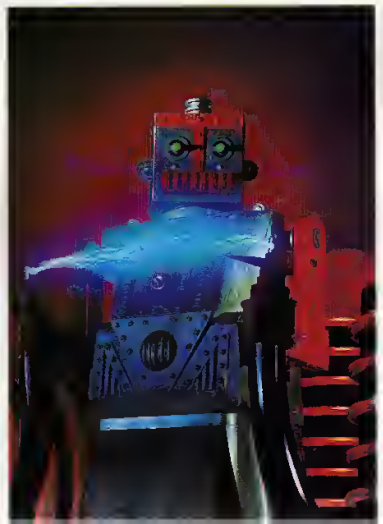
CONTINUED ON PAGE 89

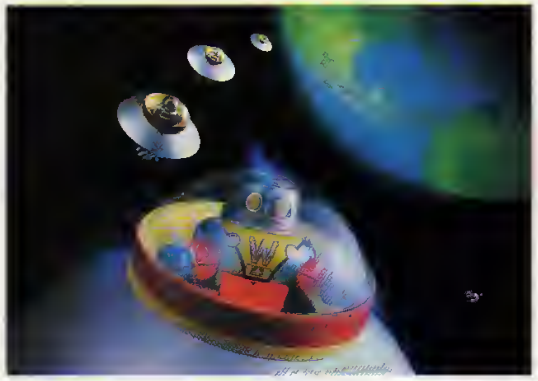
TOYBOT

BY KEVIN McKINNEY

They take us back to a time of naive romanticism, a simpler era when all technology held the potential for good. Even their names—Sparky Robot, Robby the Robot—underscore their childlike personas. Unlike the monsters of science fiction or the militaristic warbots flooding today's toy market, there is nothing to fear in these benign companions, helpmates, and protectors. With their cartoonish bodies and goggle-eyed expressions, these toy robots of the Fifties and Sixties radiate innocent intentions.



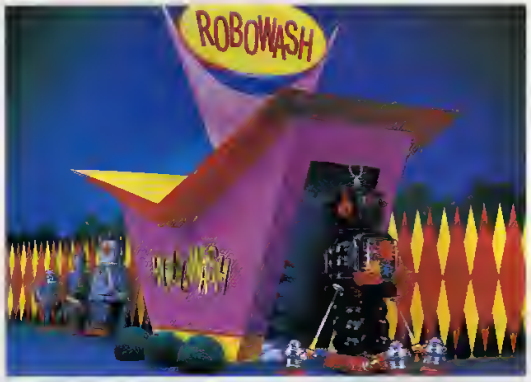


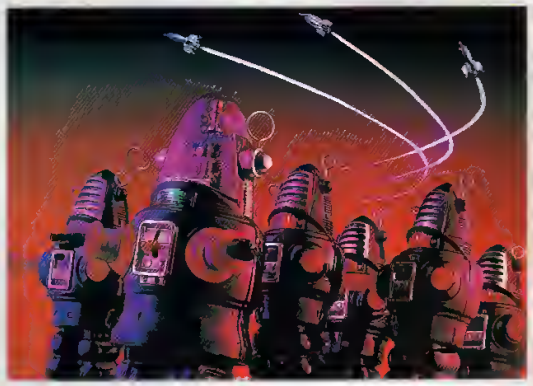


Artist Douglass Grimmett and photographer Chuck Carlton arranged these machine dioramas. After scouting through toybot collections around the country, they designed period sets and used time-lapse photography and special lighting effects to create the little robo-scenarios shown here. "And the robots were very cooperative," Grimmett says. "They would *tell* us what they would be doing."

Preceding page: left, Mr. Robot (1960), right, Robert the Robot (1954). This page: top, space-traffic controller T. V. Spaceman (1965); bottom, Sparking Robot (1950's) being pursued by the Mechanical Walking Robot-7 (1970). Right: the Fighting Robot (1960).

"There is nothing to fear from these benign companions."

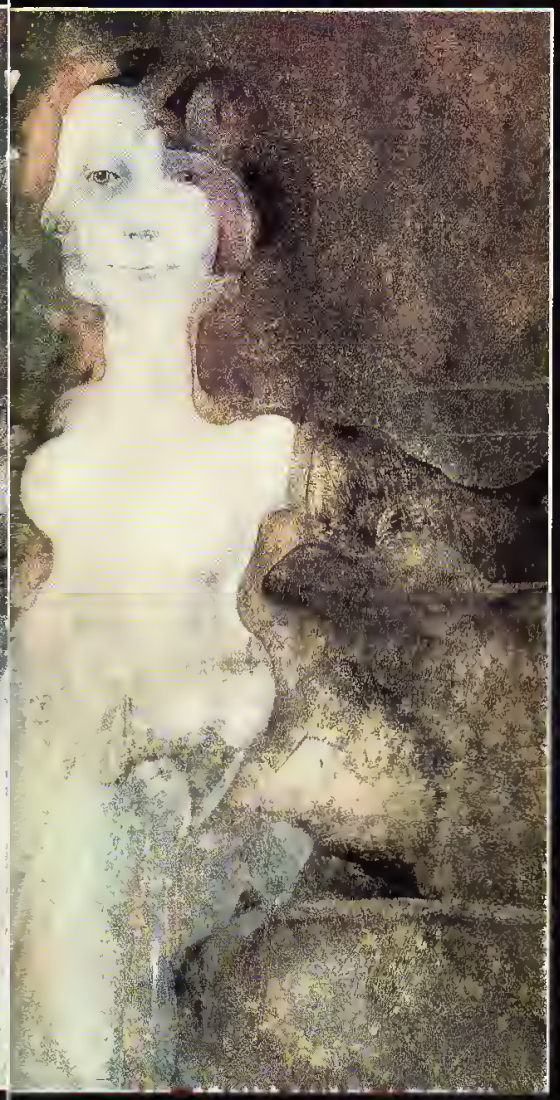




Robot mythologist Isaac Asimov believes the attitudes created by these endearing antique toys have helped us accept real robots. "As robots move out of factories and into our homes," he says, "they'll interact with us better if they'll resemble us physically." Household robots will then become loved and cherished family members—all part of the emotional legacy of Sparky and his friends. ∞

Left: Thunder Robot (1960) fights alien invaders. This page, top: Tomy windups (1978) finish sprucing up Gear Robot (1960), while Sparky Robot (1955) waits next in line, bottom. Robby the Robot (1956), in foreground, accompanied by Planet Robots (1960).

"These machines had a value that went beyond mere toys."



FICTION

Nothing can stand in the way of true love, not even red tape that's spread across the entire galaxy

PAPER MOON

BY GARRY KILWORTH

They're not supposed to discriminate," said the angular man to my left, "but they do. Yes sir . . ." His voice trailed off in bitter resentment. There were three of us, humans, sitting together—the idiotic herd instinct. Moreover, we had been together for nine units, and I knew the whole orchestral range of his indignation, from the low whine to the high, heated complaints. I was sweating. The temperature of the room was very uncomfortable. You had to admit those Spicans had it all weighed up. This was acceptable heat for most races. Not for us, though, and that was the main reason for it being set so high.

The woman said, "Discriminate? I've been here thirteen times."

Here was the location of the only Spican bureau in the Affiliation—the moon of a remote planet that circled Algol.

"But I'll get past them," she muttered, tight-lipped. She was thin and brittle and, I guessed, touching seventy Earth years.

"They won't keep me out. I've been to all sorts of places they've not even heard of."

I stared at the oval doorway through which I would pass within the next few units. Inside that chamber was a Spican. Not many people have seen a live Spican, let alone talked to one. They were humanoids, a lot like us . . . or maybe not. Physically Earthmen and Spicans were compatible. That was the main source of their dislike for us. Our physical compatibility. Mentally, spiritually, we were galaxies apart. The clerks in the outer chambers were all Altenans, Spican employees with a flair for petty bureaucracy. My God, did they have a gift for that little game! They could drive a man up the concave walls

PAINTING BY ARMODIO

and halfway to insanity with their endless cards, disks, tapes and "I'm afraid" "*I'm afraid* you haven't the required seal on your application, sir. You'll need to have this reprocessed." "*I'm afraid* the clerk you spoke to previously has now left our employ. Could you begin again?"

Greasy oil-blue excuse for a smile. The snapper showing a band of hard bone.

Lost cards. Lost tapes. Lost identity. Signatures from inaccessible officials. Excessive quarantine periods. Stringent medicals. Monetary investigations. Family history. The works.

The salesman stood up, his rumpled, soiled clothes at variance with the expensive luggage. He walked over to a free window and impatiently rapped on the screen. Behind the screen the clerk stood up and, without giving any indication of having heard or seen, moved out of our range of vision. The salesman loosened his collar, shrugged, and dropped down heavily onto the purposely hard, lumpy benches that were so low to the floor that an average Terran's knees almost dislocated his jaw when he used them.

"See what I mean?" he said. "Bastards. Ignorant as hell. Make a fuss and they're all over you with their slimy apologies. But you still don't get anything done faster."

"Patience, pal," I said.

"Patience, shit!" he shouted. "I've just about had enough! Anybody else says *patience* to me, I'll bust a few necks, or whatever," he snarled, glaring round at the other members of the Affiliation. A Miran coughed in the silence that followed.

"Settle down, chum," I said softly. "You're frightening the lady."

"Like hell he is," the lady in question cackled. "I just wanna see him break a few things."

I said quickly, "None of us will get to Spica's worlds that way. We'll all get canned."

"That's just what these guys want, right?" said the salesman, calmer now. "Well, they're not gonna get it—not from me. I'll get past immigration if it kills me."

"Dead ones don't get in any quicker than live ones," muttered the old lady. The salesman took no notice of this advice.

"Get in," he said. "That's all they told me at head office. 'Get in there and sell,' they said." He looked at me with stricken eyes and I suddenly pitied him.

"How the hell can I sell when they keep me away from my customers?"

I nodded. He was right. He would never get to a Spican world. But I would. The infinite delaying tactics employed by the Spicans couldn't stop Alex Clay. I was no grit-eyed salesman or kitsch-loving tourist sponging up ethnic origins and alien cultures in order to drench my penurious relatives. The machine wasn't built that didn't grind to a halt when my spanner landed in its guts. G-time was seventeen units. I stood up and strode toward the oval doorway leading to the inner chamber. I heard the salesman behind me say, "Now where the hell does he think—?" An Alterian stepped in my path. He was a full head shorter than I.

"You can't—" he began.

"Oh, but I can. You see, I've waited ten units. I'm entitled."

His eye glanced around nervously.

"No violence," he said flatly.

I smiled. "Of course no violence. I'm merely telling you the law. We're on Spican soil—here in this immigration office—and I've waited ten units. I am now entitled to an audience under Spican law." I finished softly. His snapper came open involuntarily and he closed it using his claw. He stared for a while, then said, "Wait here," and passed into the oval.

A short time later he was back, and under the incredulous stares of my erstwhile companions, I entered the inner chamber.

"You quote Spican law to me?"

A tall, elegant creature was standing with his back to me, gazing through the transparent wall over the silent landscape of the moon. It was dusk outside and still. The only light, a purple glow from a cluster of house-high rocks nearby.

"I do," I replied quietly.

He turned to face me then. We were about the same height, and I am fair for a Terran, but his build was better proportioned than my own. He was also very handsome.

"And who are you?"

"Alex Clay. I'm a Terran engineer."

"I'm aware of your planet of origin—only two races that answer to the pattern of the human form, and you are no Spican. I believe that's what you call us?" His accent was a peculiar mixture of rounded vowels and clipped word endings.

"You know very well what we call you," I replied. I laid my identicard on a polished slate table before him. He would need to run it through a microprocessor for the details, but he made no move toward it; his hands clasped behind the multifold cloak.

"How do you know of our laws?"

I glanced around the chamber. It was tastefully decorated with bright metallic centripetals that covered the walls and ceiling. "Nice place."

"Answer my questions," he said.

I snapped. "I don't have to answer questions of that nature. I won't be intimidated by some petty official."

He flushed at this and seemed about to palm an eyeswitch.

"And calling your minions won't help you this time. I anticipated it. I've had enough of their brand of intimidation, too."

He hesitated, and finally his hand fell back to his side. "I am *asking* you now, as a polite inquiry. How did you know that under Spican law an official must admit a supplant to his presence after ten units?"

"I was told," I replied. "Now that I'm here, I shall inform you in your official capacity that I intend to emigrate to a Spican world."

"Which one?" He sounded sure of himself. Sure that no matter what passed between us, I would never make it.

"Alca-s." I pronounced it perfectly, softly hissing the end of the word.

He winced. "You'll have to do something with that ter-s," he replied, destroying my illusions. "It grates." He continued, "We don't have much call for engineers. In fact I think we are fully employed."

"How the hell do you know?" I replied quickly, sitting down on the cushion. "You don't know my discipline."

"Starship maintenance?" He looked away from my eyes. "Well, you didn't think I'd see you without looking at your personal file, did you?"

"I'd have been disappointed had it been otherwise," I answered. "Do they have any frees on Alca-s? This time I didn't attempt a correct pronunciation.

"Trees?" He looked offended at the word.

"Yes, tall organic structures composed of wood."

His voice turned cold. "I don't see the connection—"

I interrupted. "It's a protest on my part," I said. "Forested planets produce an administrative mechanism based on paper. Even after the paper's gone, the administrative blocking techniques live on. Paper is manufactured from wood," I explained.

"I know about paper," he nodded sensously. "I still don't see—"

"The Alterian worlds are forested. That's why they suit your purposes—why you use Alterians as clerks in your immigration offices." His eyes began to register intelligence. The irises were a soft mushroom gray. "It's a sickness, really—Terra has it, always will have. The bogging bureaucrats." He nodded.

"You use it to keep us out," I said. "You need the Affiliation for the security of its economy, for the trade. But under Affiliation law you have to accept immigrants as part of the package deal. The right of free passage for all member worlds. Yes?"

"Yes," he said. He walked to the far side of the chamber and washed his hands in an Oriental-looking dish. Symbolic?

"Do you work for the government, Clay?"

"The Affiliation of Worlds?" I said.

"You know what I mean. The government of Terra. Your own government."

"I used to, once upon a time," I said.

> *"One of those disgusting Terrans actually touched her sacred person. But she has felt the zang, and mingled with her loathing is a certain something she's not sure of."*

aware of what was in my personal history—the recorded part, that is. "I was an engineer on their solar freighters as a young man. Later I graduated to starships and left Earth for good. I haven't been back in nearly five megaunits."

He rubbed his hands into each other. He said, "You're suddenly being very cooperative. Why the change of tactics?"

"Perhaps I wasn't getting anywhere?"

"You had me on the run."

"You turned and faced me."

He smiled then, for the first time.

"I like you, Clay. You're much the same as me, in personality, thinking."

"But not physically," I said, contradicting the truth. We were alike superficially, but he was a Greek god and I was fashioned more on the lines of a Roman galley slave.

"No, not such a—"

"Magnificent specimen?" I finished for him, using an old cliche.

He laughed openly at that and said something in his own tongue.

"What?" I asked.

"Nothing. It doesn't translate perfectly. It loses." I nodded.

"Anyway, now that we're friends," I said frivolously, "how about my application?"

A frown appeared on the brown face, and he pulled the cloak firmly around his body before settling on a nearby cushion.

"Let me tell you something about this place you wish to live in, Alca-s." His tongue seemed to savor the word. "My own world, incidentally. It's one of the three inhabited Spican planets. The temperate one. A pleasant overall climate, discounting the equator and the poles. The other two worlds, Alca-ns and Alca-cs, have extreme climates, even in the so-called temperate zones. One too hot, the other too cold." I nodded. I knew it all anyway.

"Alca-s. The women are beautiful and the men are—"

"Beautiful." I finished again. I couldn't resist it.

"Yes. True. They are, but more to the point, they are xenophobic. You would hate it there because they would hate you. None of us have ever emigrated, because we—we can't live among strangers."

"Not true," I said. "Official policy maybe. But your ordinary people—I can't believe they hate what they have never met."

"What do you know about my people?" he suddenly rapped into my face. "I *know* my people."

I replied simply, "So do I."

He jerked upright from his crouched position. "What do you mean?" There was a thick atmosphere between us, and I could see by his taut expression that he was having difficulty in controlling his anger. I let him have the earthquake. The one I'd been saving for the right moment.

"I mean," I said, "I'm married to one."

All the tension went out of his facial muscles, and the clenched fingers uncurled. I could smell the sweet oil on his palms.

"That's impossible," he said at last. He spoke the words as if he were trying to convince himself rather than me.

"No," I answered.

"You mean—you mean you're actually married to one of my race? We don't marry—not in the same way." It was a desperate argument.

"You're clutching at straws," I said. "I married *her*—our way. A Terran wedding."

"Ah! You wouldn't last on our world. It wouldn't work."

"I'll last. Besides, if your people are such racial purists, how come you let others in? How come it's just us you block?"

"Well, ah, I should have thought that was obvious. Bad blood."

"Yes? Well, I'm going to tell you a story, friend—a love story." He lifted his hand as if to protest, but I waved it down. "You'll need to know, in your official capacity, so I'll tell you anyway. Listen. Once upon a time—we always start stories that way—once upon a time there was a starship carrying a group of Spican politicians home from a conference. The destination of the ship was Alca-cs.

"Suddenly, a long way between worlds, something goes wrong with the main drive. The ship halts—well, not exactly, but worse still, it keeps going, with no way of stopping. Runaway. The engineer onboard this small executive craft gets to work right away, but wouldn't you guess it, he gets a jolt from a naked power line and zang! he's busted, too. Bad deal. The ship keeps flashing through space. Pretty soon it'll hit something—a planet, a sun—and whammo, full stop. Say, is my frivolous delivery bothering you?" His eyes told me the truth, even though his expression remained blank. I was enjoying myself.

I continued, "Anyway, out goes the distress call, and who should be the only listeners within striking distance but the bad-blooded old Terrans. Quick decision. Do you allow yourselves to be contaminated by the presence of untouchable Terrans? Or do you risk certain death? To hell with dying, you say, even though it means fumigating the ship afterward.

"Among the Terran engineers that intercept the runaway is a tall, handsome gentleman who has a way with the ladies—and who should be among the cabin staff, but this adorable creature from Alca-s, no names, no pack drill..."

"What?" he interrupted in a faraway voice. I ignored him. "So these two wonderful creations of God brush past each other in a narrow gangway, quite by accident, of course, not by design of the gentleman, who is indeed an honorable and upright citizen of Earth, and zang, something busts inside the male.

"I will admit," I said, "the female winces. One of those disgusting Terrans has actually touched her sacred person. But! But, my friend, she has felt the zang, too, and mingled with her loathing is a certain something she's not sure of. And somehow she finds herself bringing drinks to the drive

"They're hard to figure out. In the spring they save the wetlands to protect us, and in the fall they hide there to shoot at us."

room and passing the time of day with the handsome Terran brute. Oh, you may roll your eyes, Spican, but women love taming the brute in a man, especially when it's not really evident—the product of propaganda. Here is an animal who is really quite a charming, elegant person—what's he like in bed? It took thirty prolonged units to repair that starship, and at the last moment the female Spican impetuously consented to secretly marry the male Terran.

He spoke. Cabin staff? A low-intellect clan. He curled his lower lip in scorn.

"I'll remind you that you're talking about my wife," I said very quietly.

"I'm sorry." He pulled himself together, the hands clasping again behind his back. He walked around the room while I envied the muscles in his magnificent legs. You note *envied*, not admired.

"How were you married?" he asked at last.

"By the captain of the repair ship. It's legal—and binding."

"And how do I know you're not making this up? How do I know you're not lying?"

"I have a document—one of those boring sidelines a bureaucracy creates," I said maliciously. "It's recorded at the Affiliated World Record Center. You can call it forward now." I pointed to a computer terminal at the far end of the chamber. "The alphanumber's, uh, 504-72083LSGN. Document number 710328."

He made no move toward the terminal.

"I've told you before we don't recognize marriage. Not in its Terran form. We mate people according to their genes."

"Classical," I said scathingly. "However, I'll remind you of Affiliation law. As a partner to a female from another world, I am entitled—automatically—to citizenship of that world. She is equally entitled to the benefits of my world. I'm here to give you formal notice that I'm on my way to join my wife. What's more, the Affiliation authorities know it, so please, let's not have any roughhousing." He stared at me as if I were the most despicable creature that God had caused to be born.

"We have *always* carried out our obligations according to the law," he said with dignity in his voice.

"Bully for you, Jack. Then you know that a negative state, by the Affiliation rules, is overridden by a positive one. To wit: Terrans are entitled by their own law to be with their relatives. I take it you have no laws positively forbidding marriage?"

His voice was so low I could hardly hear the *No*.

"Great, then I'm on my way." I stood up and turned toward the exit.

"Clay!" he said sharply.

I swung round. "What? Make it quick."

His eyes had the look of a panic-stricken beast in them. I was about to destroy his race as he knew it.

"It couldn't last forever," I said. "One of us had to beat the system sometime. You're not so foolish to believe you could keep us out forever?"

His shoulders collapsed, and he moaned softly. "Yes." I nodded. "I suppose you are *that* foolish. You are children."

His eyes flashed again. "Don't speak of children . . . you. You Terran humans! You spawn indiscriminately. No thought for the mind or the body that is the produce of the union, oh, no. Sate the lust . . ."

"Hey, hey," I shouted. "It's not *quite* like that, friend. We do have affection, a fondness for our partners. Sometimes it's a pretty strong one."

"Love?" He snorted. "Tell me about this thing love that creates gross interbreeding between unmatched pairs and results in freaks, small people, tall ones, IQ variations, idiots and morons, people of all shades, humpbacked, fat, thin, ugly . . ."

"That's it, isn't it? That's the whole bit? You can't stand to see abnormality. Well, our idea of normal isn't so narrow, that's all. In fact, it's pretty broad. It covers all but the insane. But you . . . you have to be *perfect*. I wonder how high your infant morfal-

"Love? Tell me about this thing love that creates gross interbreeding between unmatched pairs and results in freaks, idiots and morons, humpbacked, fat, thin, ugly."

ity rate is. What do you do? Bash their heads against a rock if they come out with a strawberry birthmark on their buttocks? We know why you keep us out—we're the only race that can mate with Spicans and produce offspring, and you're afraid . . . afraid that mixed marriages will result in less-than-perfect Spicans. Not imperfect—just not perfect. We had a name for your type once . . ."

"We let one of you in," he said in despair, "and we let you all in. All of you. You don't mate by the clan system—you mate with anyone. This long Terran ancestry . . ."

I nodded. "Well, that's why you've kept us out. You know it, we know it. Funnily enough," I said seriously, "we did try the clan system once—it produced inbred idiots. Funny how one thing suits one race and not another. Anyway, looking on the bright side, you may benefit from a cultural exchange, who knows?" I turned again and walked toward the exit. He was right behind me.

"If was the Terran government, wasn't it? They planned this—the girl was hypnotized—drugged. She couldn't—she wouldn't sell our perfection for . . ."

"For love?" I said, pausing. "I very much doubt it. Maybe it's just good old-fashioned contrariness. Lila's got a bit of the rebel in her."

"Lila—so that's her name. Clay?"

"What?"

"Don't let them in, Clay. Stay out. It's the thin end—your children will mate with purebred Spicans—don't you see?"

I walked away from those hot, gray eyes. I hate to see men, any kind of men, begging for something they can't have. He followed me into the outer waiting room.

I passed the salesman, and he stood up. "Did you get in?" he said eagerly.

I smiled. "You bet."

As I was about to enter the connecting tunnel to the ships, a guard stepped in front of me. "Exit visa, please."

"Ah, yes. One moment." I replied.

I went to the fourteenth window and showed the mandatory five documents necessary for an exit visa.

"I do not see your Certificate of Flight Worthiness, sir."

"My what?"

"Your CFW—for the ship."

"But I've never had to show that before."

"It's a recent regulation, sir."

A pricking sensation began at the back of my neck. They were trying to hustle me.

"How recent?" I was aware of the Spican's eyes on my back.

The salesman called out. "Half a unit ago—while you were in there talking to what's name."

"Why wasn't I informed?" I said.

"The, uhmm, information was broadcast, sir, over the speakers." He pointed out the objects in question. I nodded.

"My CFW is on my ship. I'll go and get . . ."

The guard said. "I'm afraid I can't let you go to your ship without an exit visa."

I turned to the Alterian clerk. "And I can't get a visa without a CFW."

Oily smile. "I'm afraid not, sir."

I made a last, desperate bid. "You realize that I'm a Spican by marriage—and this is Spican soil we're standing on."

Now the guard was amused. "Only in here—in this building. Once you step outside, you're on Alterian soil."

"And this is an Alterian regulation?"

The guard nodded. "I see," I said.

The distance between me and my ship was about half a click. I turned to look at the Spican, and both of us knew what I was going to do. The Alterian guards were short and clumsy and did not carry weapons. There was really only one person who stood between me and my wife, and that was the Spican, the Apollo of outer space. I saw him brace those magnificent leg muscles and give me an arrogant stare.

"Okay, pal," I said softly. "Let's see if you're the real stuff, or just showy beach-boy . . ." It was the old story: love against authority, love versus tradition, love takes on the world.

This time, love was going to *win*.

I hit the tunnel entrance going like a pro. The Spican was right behind me. ∞

NOTES

CONTINUED FROM PAGE 46

they have a similar—if not identical—tuning system to bamboo flutes made in China today. Apparently without the aid of Pythagorean theory or other such mathematics, the ancient Chinese created a system of harmonics that has stood the test of time. As the researchers conclude in a soon-to-be-published paper, "The strong musical and cultural traditions of China and the biological fixedness of the human ear have conspired to maintain a pure tonal system across two and one half millennia." Although the Eastern scale differs from that found in Western societies, Carterette thinks it's a finding that holds true for other cultures. "In other words, the way the human ear perceives sound hasn't changed at all over time. The tones our ancestors liked or found pleasing, so do we."

Similarly, anthropologists have found that the music of nearly all the world's cultures share certain elements—pitches separated by discrete intervals, musical scales of five to seven notes, scales arranged in octaves. Composers are also aware of these commonalities and what they may mean for the creation of new music. "If something pops up in music all over the world, the way the fifth, the octave, and some sort of pulsable beat do, then these elements emerge as more than merely national styles," says avant-garde composer Steve Reich. "They become something that's built into the physiology of music and that may not be able to be dispensed with if music is to be effective."

The greatest similarity in all music—its ability to evoke feeling—has also been investigated. Researchers have seen heart rates rise and fall in response to melodies and rhythms. Pennsylvania State University psychologist John Johnson found that an individual's heartbeat can drop a full ten beats per minute from its normal level at the beginning of a song—a dampening effect that Johnson believes "facilitates your ability to listen." During a thrilling passage, however, the opposite can occur. The heartbeat will soar. "I look at it as an interplay between cognitive and emotional factors," Johnson says. "When you're paying close attention, the heart rate decreases, but then when emotions take over, the rate goes up again."

Pitch has a similar effect. People really do respond to high-pitched, up-tempo songs with more pleasure than to lower-pitched, slower music. And preschool children react in the same way as adults. In another experiment conducted by Trehub, preschoolers pointed to a drawing of a happy face when they listened to brisk, high-pitched pieces, and to a sad face when the music was slower and lower pitched. These emotional associations, Trehub believes, come in part from listening to nursery rhymes, lullabies, even a parent's tone of voice. "It's never actually taught to them," says Trehub. "They have an implicit understanding of the emotions our culture attributes to musical patterns."

Though far from understood in the laboratory, the human emotional response to music has been utilized by clinical psychologists as a treatment for autistic patients, cancer victims, and manic-depressives. Consider Alice. She tried committing suicide before ending up at the psychiatric clinic at the University of California at San Francisco, where she met Frances Goldberg, a music therapist. Surly, uncommunicative, always threatening to walk out, Alice made little or no progress until Goldberg put her in a therapy group in which patients assembled and played simple musical instruments. One day unprovoked, Alice tapped out a slow, mournful "Amazing Grace" on a glockenspiel. The group responded. "It must be bad to feel as sad as the music sounds," someone said.

The next day, moved by this display of concern, she began to talk to therapists about her troubles. She was enrolled in psychotherapy. "Music," Goldberg says, "allowed her to express some feelings she couldn't put into words, feelings she had not even been able to acknowledge. That made her receptive to therapy."

One day psychotherapists may even have a sonic Rorschach test at their disposal. The idea of a UCSD graduate student, the test would be based on a series of intervals, which subjects would interpret. Some passages that generally evoke a quiet and thoughtful response in most people might create a state of anger or anxiety in a psychologically unbalanced individual and reveal unconscious feelings that would aid the therapist.

As scientists delve into the uncharted territory of music and the mind, today's musicians explore another frontier. Computer-generated music challenges the brain with sounds it has never heard. It has also opened up new possibilities for the composer. Rock performer and composer Frank Zappa welcomes the chance to use technology to fashion a music that traditional instruments could never create. "I have a perfect reproduction of a classical guitar on the computer, and I can write notes that aren't on a real guitar. I can also make those notes occur at speeds that humans just can't play. I've written plenty of stupid little songs so human beings could play 'em. Now it's time to take advantage of what technology has to offer and try to do the other stuff."

For better or worse, the computer will be the great shaper of future music. As Jan Hammer says, "It's the third industrial revolution." But how will that revolution change the music we choose to hear?

"It's fair to say," says Carterette, "that even with all the new electronic devices and computer power that is going to let us create bizarre and unheard-of sounds, ultimately the test is going to be the taste of the listener. And his taste will be limited by his nervous system."

Leaving quantum mechanics far behind, this eminent physicist considers the universe to be an infinite hologram, and our minds—relying on human perception—see only fragments of reality

INTERVIEW

DAVID BOHM

In 1950 David Bohm wrote what many physicists consider to be a model textbook on quantum mechanics. Ironically, he has never accepted that theory of physics. In the history of science he is a maverick, a member of that small group of physicists—including Albert Einstein, Eugene Wigner, Erwin Schrödinger, Alfred Lande, Paul Direc and John Wheeler—who have expressed grave doubts that a theory founded on indeterminism and chance could give us a true view of the universe around us.

Today s generetion of physicists, impressed by the stunning successes of quantum physics—from nuclear weepons to lasers—are of e different mind. They are busy epplying quantum mechanics to ereas its originel creetors never imagined. Stephen Hewking, for exemple, used it to describe the creetion of elementary particles from black holes and to argue that the universe exploded into being in a quantum-mechanical event.

Bucking this tide of modern physics for more then 30 years, Bohm has been more than a gadfly. His objections to the foundetions of quantum mechanics have gradually coalesced into an extension of the theory so sweeping that it amounts to e new view of reality. Believing that the nature of things is not reducible to fregments or particles, he argues for a holistic view of the universe. He demands that we learn to regard matter and life as a whole, coherent domain, which he calls the implicate order.

Most other physicists discard Bohm s logic without bothering to scrutinize it. Part of the difficulty is that his implicete order is rife with paredox. Another problem is the sheer renge of his ideas, which encompass such hitherto nonphysical subjects as consciousness, society, truth, language, and the process of scientific theory meking itself.

The son of a furniture deeler, Bohm was born in Wilkes-Berre,

PHOTOGRAPH BY DAVID MICHAEL KENNEDY

Pennsylvania. In 1917 He studied physics at the University of California with J Robert Oppenheimer Unwilling to testify against his former teacher and other friends during the McCarthy hearings Bohm left the United States and took a post at the University of São Paulo Brazil From there he moved to Israel then England where he eventually became professor of physics at Birkbeck College in London

Bohm is perhaps best known for his early work on the interactions of electrons in metals He showed that their individual haphazard movement concealed a highly organized and cooperative behavior called plasma oscillation This intimation of an order underlying apparent chaos was pivotal in Bohm s development

In 1959 Bohm, working with Yakir Aharonov showed that a magnetic field might alter the behavior of electrons without touching them If two electron beams were passed on either side of a space containing a magnetic field the field would retard the waves of one beam even though it did not penetrate the space and actually touch the electrons This AB effect was verified a year later

During the Fifties and Sixties Bohm expanded his belief in the existence of hidden variables that control seemingly random quantum events and from that point on his ideas diverged more and more from the mainstream of modern physics His books *Causality and Chance in Modern Physics* and *Wholeness and the Implicate Order* published in 1957 and 1980, respectively spell out his new theory in considerable detail In the Sixties Bohm met the Indian philosopher Jiddu Krishnamurti, and their continuing dialogues, published as a book *The Ending of Time* helped the physicist clarify his ideas about wholeness and order

Recently retired from Birkbeck College Bohm is now trying to develop a mathematical version of his implicate-order hypothesis—the kind of precise testable theory that other physicists will take seriously It is not an easy task for Bohm s universe is a strange mystical place in which past, present, and future coexist The objects in his universe even the subatomic particles are secondary it is a process of movement continuous unfolding and enfolding from a seamless whole that is fundamental To test the theory of general relativity Einstein forecast that the sun's gravity would bend light waves from distant stars he was correct So far Bohm has been unable to find an experimental aspect that could support his ideas in the same way

Although recently recovered from serious heart surgery Bohm continues to make frequent trips throughout Europe and to the United States, where he lectures talks to colleagues and encourages students His ideas have been enthusiastically received by philosophers neuroscientists theologians poets and artists

Bohm was interviewed by John Briggs and F David Peat authors of *Looking Glass Universe* over a two-day period near Amherst College in Massachusetts where Bohm was involved in a series of meetings with the Dalai Lama Additional comments are taken from a previous interview in England by writer Llee Heflin

Omni Can you recall when you first experienced the sense of the wholeness that you now express as the implicate order?
Bohm When I was a boy a certain prayer we said every day in Hebrew contained the words *to love God with all your heart, all your soul, and all your mind* My understanding of these words, that is, this notion of wholeness—not necessarily directed toward God but as a way of living—had a tremendous impact on me I also felt a sense of nature being whole very early I felt internally related to trees mountains and stars in a way I wasn t to all the chaos of the cities

When I first studied quantum mechanics

> *We can discuss the movement of all matter, known and unknown, in terms of this folding and unfolding, which I call the holomovement*

I felt again that sense of internal relationship—that it was describing something that I was experiencing directly rather than just thinking about

The notion of spin particularly fascinated me the idea that when something is spinning in a certain direction it could also spin in the other direction but that somehow the two directions together would be a spin in a third direction I felt that somehow that described experience with the processes of the mind In thinking about spin I felt I was in a direct relationship to nature In quantum mechanics I came closer to my intuitive sense of nature
Omni Yet you've said that quantum mechanics doesn t provide a clear picture of nature What do you mean?
Bohm The main problem is that quantum mechanics gives only the probability of an experimental result Neither the decay of an atomic nucleus nor the fact that it decays at one moment and not another can be properly pictured within the theory It can only enable you to predict statistically the results of various experiments

Physics has changed from its earlier form, when it tried to explain things and give some physical picture Now the essence is regarded as mathematical It s felt the truth is in the formulas Now they may find an algorithm by which they hope to explain a wider range of experimental results, but it will still have inconsistencies They hope that they can eventually explain all the results that could be gotten but that is only a hope
Omni How did the founders of quantum mechanics initially receive your book *Quantum Theory*?
Bohm In the Fifties, when I sent it around to various physicists—including [Niels] Bohr, Einstein, and [Wolfgang] Pauli—Bohr didn t answer, but Pauli liked it Einstein sent me a message that he'd like to talk with me When we met he said the book had done about as well as you could do with quantum mechanics But he was still not convinced it was a satisfactory theory

His objection was not merely that it was statistical He felt it was a kind of abstraction quantum mechanics got correct results but left out much that would have made it intelligible I came up with the causal interpretation [that the electron is a particle, but it also has a field around it The particle is never separated from that field, and the field affects the movement of the particle in certain ways] Einstein didn't like it though because the interpretation had this notion of action at a distance Things that are far away from each other profoundly affect each other He believed only in local action

I didn t come back to this implicate order until the Sixties, when I got interested in notions of order I realized then the problem is that coordinates are still the basic order in physics, whereas everything else has changed
Omni Your key concept is something you call entoldment Could you explain it?
Bohm Everybody has seen an image of enfoldment You fold up a sheet of paper, turn it into a small packet, make cuts in it, and then unfold it into a pattern. The parts that were close in the cuts unfold to be far away This is like what happens in a hologram Enfoldment is really very common in our experience All the light in this room comes in so that the entire room is in effect folded into each part If your eye looks the light will be then unfolded by your eye and brain As you look through a telescope or a camera, the whole universe of space and time is enfolded into each part, and that is unfolded to the eye With an old-fashioned television set that's not adjusted properly the image enfolds into the screen and then can be unfolded by adjustment
Omni You spoke of coordinates and order a moment ago How do they tie in with enfoldment? Do you mean coordinates like those on a grid?
Bohm Yes, but not necessarily straight lines They are a way of mapping space and time Since space–time may be curved, the lines may be curved as well It became clear that each general notion of the world contains within it a specific idea

of order. The ancient Greeks had the idea of an increasing perfection from the earth to the heavens. Modern physics contains the idea of successive positions of bodies of matter and the constraints of forces that act on these bodies. The order of perfection investigated by the ancient Greeks is now considered irrelevant.

The most radical change in the notion of order since Isaac Newton came with quantum mechanics. The quantum-mechanical idea of order contradicts coordinate order because Heisenberg's uncertainty principle made a detailed ordering of space and time impossible. When you apply quantum theory to general relativity at very short distances like ten to the minus thirty-three centimeters, the notion of the order of space and time breaks down.

Omni: Can you replace that with some other sense of order?

Bohm: First you have to ask what we mean by *order*. Everybody has some tacit notion of it, but order itself is impossible to define. Yet it can be illustrated. In a photograph any part of an object is imaged into a point. This point-to-point correspondence emphasizes the notion of point as fundamental in sense of order. Cameras now photograph things too big or too small, too fast or too slow to be seen by the naked eye. This has reinforced our belief that everything can ultimately be seen that way.

Omni: Aren't the contradictions you have been talking about embedded in the very name *quantum mechanics*?

Bohm: Yes. Physics is more like quantum *organism* than quantum mechanics. I think physicists have a tremendous reluctance to admit this. There is a long history of belief in quantum mechanics, and people have faith in it. And they don't like having this faith challenged.

Omni: So our image is the lens, the apparatus suggesting the point. The point in turn suggests electrons and particles.

Bohm: And the track of particles on the photograph. Now what instrument would illustrate wholeness? Perhaps the hologram. Waves from the whole object come into each part of the hologram. This makes the hologram a kind of knowledge of the whole object. If you examine it with a very narrow beam of laser light, it's as if you were looking through a window the size of that laser beam. If you expand the beam, it's as though you are looking through a broader window that sees the object more precisely and from more angles. But you are always getting information about the whole object, no matter how much or little of it you take.

But let's put aside the hologram because that's only a static record. Returning to the actual situation, we have a constant dynamic pattern of waves coming off an object and interfering with the original wave. Within that pattern of movement, many objects are enfolded in each region of space and time.

Classical physics says that reality is actually little particles that separate the world into its independent elements. Now I'm proposing the reverse, that the fundamental reality is the enfoldment and unfoldment, and these particles are abstractions from that. We could picture the electron not as a particle that exists continuously but as something coming in and going out and then coming in again. If these various condensations are close together, they approximate a track. The electron itself can never be separated from the whole of space which is its ground.

About the time I was looking into these questions, a BBC science program showed a device that illustrates these things very well. It consists of two concentric glass cylinders. Between them is a viscous fluid such as glycerin. If a drop of insoluble ink is placed in the glycerin and the outer cylinder is turned slowly, the drop of dye will be drawn out into a thread. Eventually the thread gets so diffused it cannot be seen. At that moment there seems to be no order present at all. Yet if you slowly turn the cylinder backward, the glycerin draws back into its original form, and suddenly the ink drop is visible again. The ink had been enfolded into the glycerin, and it was unfolded again by the reverse turning.

> *"If a black hole came out with a sign flashing COCA COLA, it shouldn't be surprising. Within a singularity none of the laws as we know them apply."*

Omni: Suppose you put a drop of dye in the cylinder and turn it a few times, then put another drop in the same place and turn it. When you turn the cylinder back, wouldn't you get a kind of oscillation?

Bohm: Yes, you would get a movement in and out. We could put in one drop of dye and turn it and then put in another drop of dye at a slightly different place, and so on. The first and second droplets are folded a different number of times. If we keep this up and then turn the cylinder backward, the drops continually appear and disappear. So it would look as if a particle were crossing the space, but in fact it's always the whole system that's involved.

We can discuss the movement of all matter in terms of this folding and unfolding, which I call the holomovement.

Omni: What do you think is the order of the holomovement?

Bohm: It may lie outside of time as we ordinarily know it. If the universe began with the Big Bang and there are black holes, then we must eventually reach places where the notion of time and space breaks down. Anything could happen. As various cosmologists have put it, if a black hole came out with a sign flashing COCA COLA, it shouldn't be surprising. Within the singularity none of the laws as we know them apply. There are no particles, they are all disintegrated. There is no space and no time. Whatever is is beyond any concept we have at present. The present physics implies that the total conceptual basis of physics must be regarded as completely inadequate. The grand unification [of the four forces of the universe] could be nothing but an abstraction in the face of some further unknown.

I propose something like this. Imagine an infinite sea of energy filling empty space, with waves moving around in there, occasionally coming together and producing an intense pulse. Let's say one particular pulse comes together and expands, creating our universe of space–time and matter. But there could well be other such pulses. To us, that pulse looks like a big bang; in a greater context, it's a little ripple. Everything emerges by unfoldment from the holomovement, then enfolds back into the implicate order. I call the enfolding process implicating, and the unfolding explicating. The implicate and explicate together are a flowing, undivided wholeness. Every part of the universe is related to every other part but in different degrees.

There are two experiences. One is movement in relation to other things; the other is the sense of flow. The movement of meaning is the sense of flow. But even in moving through space there is a movement of meaning. In a moving picture with twenty-four frames per second, one frame follows another, moving from the eye through the optic nerve into the brain. The experience of several frames together gives you the sense of flow. This is a direct experience of the implicate order.

In classical mechanics, movement or velocity is defined as the relation between the position now and the position a short time ago. What was a short time ago is gone, so you relate what *is* to what is not. This isn't a logical concept. In the implicate order you are relating different frames that are copresent in consciousness. You're relating what is to what is. A moment contains flow or movement. The moment may be long or short, as measured in time. In consciousness a moment is around a tenth of a second. Electronic moments are much shorter, but a moment of history might be a century.

Omni: So a moment enfolds all the past?

Bohm: Yes, but the recent past is enfolded more strongly. At any given moment we feel the presence of all the past and also the anticipated future. It's all present and active. I could use the example of the cylinder again. Let's say we enfold one droplet *N* times. Then we put another droplet in and enfold it *N* times. The relationship between

the droplets remains the same no matter how thoroughly they are enfolded. So as you unfold, you will get back the original relationship. Imagine if we take four or five droplets—all highly enfolded—the relationship between them is still there in a very subtle way, even though it is not in space and not in time. But of course, it can be transformed into space and time by turning the cylinder. The best metaphor might involve memory. We remember a great many events which are all present together. Their succession is in that momentary memory. We don't have to run through them all to reproduce that time succession. We already have the succession.

Omni: And a sense of movement—so you have replaced time with movement?

Bohm: Yes, in the sense of movement of the symphony, rather than the movement of the orchestra on a bus, say, through physical space.

Omni: What do you think that says about consciousness?

Bohm: Much of our experience suggests that the implicate order is natural for understanding consciousness. When you are talking to somebody, your whole intention to speak enfolds a large number of words. You don't choose them one by one. There are any number of examples of the implicate order in our experience of consciousness. Any one word has behind it a whole range of meaning enfolded in thought.

Consciousness is unfolded in each individual. Clearly it's shared between people as they look at one object and verify that it's the same. So any high level of consciousness is a social process. There may be some level of sensorimotor perception that is purely individual, but any abstract level depends on language, which is social. The word, which is outside, evokes the meaning, which is inside, each person.

Meaning is the bridge between consciousness and matter. Any given array of matter has for any particular mind a significance. The other side of this is the relationship in which meaning is immediately effective in matter. Suppose you see a shadow on a dark night. If it means "assailant," your adrenaline flows, your heart beats faster, blood pressure rises, and muscles tense. The body and all your thoughts are affected; everything about you has changed. If you see that it's only a shadow, there's an abrupt change again.

That is an example of the implicate order. Meaning enfolds the whole world into me, and vice versa—that enfolded meaning is unfolded as action, through my body and then through the world. The word *hormone* means "messenger," that is, a substance carrying some meaning. Neurotransmitters carry meaning, and that meaning profoundly affects the immune system. This understanding could be the beginning of a different attitude to mind—and to life.

Omni: Descartes held mind and external reality together with God. You're holding the two with meaning.

Bohm: I say meaning *is* being! So any transformation of society must result in a profound change of meaning. Any change of meaning for the individual would change the whole, because all individuals are so similar that it can be communicated.

Omni: What do you think might convince the next generation of physicists, who seem very skeptical, that the implicate order is worth investigating?

Bohm: The most convincing thing would be to develop the theory mathematically and make some predictions. A few years ago *The New York Times* noted that some physicists were critical of grand unification theory, saying that not much had been achieved. Defenders of grand unification theories said it would take about twenty years to see results.

It seems that people are ready to wait twenty years for results if you've got formulas. If there are no formulas, they don't want to consider it. Formulas are means of talking utter nonsense until you understand what they mean. Every page of formulas usually contains six or seven arbitrary assumptions that take weeks of hard study to penetrate.

> *"The notion of group mind would be terrifying at first. The mind, identified as it is with the personality, would react to protect the sense of self."*

Younger physicists usually appreciate the implicate order because it makes quantum mechanics easier to grasp. By the time they're through graduate school, they've become dubious about it because they've heard that hidden variables are of no use because they've been refuted. Of course, nobody has really refuted them.

At this point, I think that the major issue is mathematics. In supersymmetry theory, an interesting piece of mathematics will attract attention, even without any experimental confirmation.

Omni: If scientists could accept your theory, would it change the meaning of nature for them? Would it change the meaning of science in general?

Bohm: We have become a scientific society. This society has produced all sorts of discoveries and technology, but if it leads to destruction, either through war or through devastation of natural resources, then it will have been the least successful society that ever existed. We are now in danger of that.

Where we are going depends on the programs of four thousand five hundred million people, all somewhat different, most of them opposed to one another. Every moment these programs are changing in detail. Who can say where they are going to lead us? All we can do is start a movement among those few people who are interested in changing the meaning.

Omni: You've suggested that it may be possible to develop "group minds." Could they serve as a potential avenue for this change of meaning?

Bohm: They could. If we don't establish these absolute boundaries between minds, then I think it's possible they could in some way unite as one mind. If there were a genuine understanding of and feeling for wholeness in this group mind, it might be enough to change things—though as the external circumstances gain momentum it becomes harder. This is important, especially if there is a catastrophe, so that the notion of group minds might remain in the consciousness of survivors.

Omni: All that seems to imply a radical change in the concept of being human.

Bohm: Yes. The notion of permanent identity would go by the wayside. This would be terrifying at first. The present mind, identified as it is with the personality, would react to protect the sense of personal self against that terror.

Omni: That seems to fit in well with your thoughts about death.

Bohm: Death must be connected with questions of time and identity. When you die, everything on which your identity depends is going. All things in your memory will go. Your whole definition of what you are will go. The whole sense of being separate from anything will go because that's part of your identity. Your whole sense of time must go.

Is there anything that will exist beyond death? That is the question everybody has always asked. It doesn't make sense to say something goes on in time. Rather I would say everything sinks into the implicate order, where there is no time. But suppose we say that right now, when I'm alive, the same thing is happening. The implicate order is unfolding to be me again and again each moment. And the past me is gone.

Omni: The past you, then, has been snatched back into the implicate order.

Bohm: That's right. Anything I know about "me" is in the past. The present "me" is the unknown. We say there is only one implicate order, only one present. But it projects itself as a whole series of moments. Ultimately, all moments are really one. Therefore now is eternity.

In one sense, everything, including me, is dying every moment into eternity and being born again, so all that will happen at death is that from a certain moment certain features will not be born again. But our whole thought process causes us to confront this with great fear in an attempt to preserve identity. One of my interests at this stage of life is looking at that fear. ☐

The Marines, and everyone else, are looking for a few good machines

ROBOTIC WARRIORS CLASH IN CYBERWARS

BY OWEN DAVIES

First come the drones wheeling high in the sky like vultures. The robot planes stay aloft for days scanning the terrain, eavesdropping on radio chatter, and feeding information to intelligence specialists safely ensconced in a bunker 100 miles away. Ten miles to the east a group of skyborne, smaller robot aircraft wait for the silent enemy to turn on his radar. At the first electronic pulse these kamikaze machines will swoop down on the enemy's gun emplacements.

On the ground a battalion of robotic tanks gathers for the predawn attack. Lined up behind them is the notorious Blue Army—ranks of mercenary replicants, cloned humanoids with silicon intelligence. Ahead of them, robot minesweepers begin the laborious and dangerous work of clearing a path through enemy defenses. And huddled in the rear is an elite force of genuine human foot soldiers enrobed in suits of "intelligent armor." Controlled by the soldier's brain waves, each exoskeleton is tough enough to stop a slug from a .50-caliber machine gun.

With a single command (one push of a button) the general launches the attack and settles back to watch the war on his closed-circuit TV screen. The kamikaze robots drop out of the sky and make short work of the enemy radar installations, fighter-bombers swoop in and easily outfly the enemy's human-controlled aircraft.

Then the enemy's killer machines descend from the highlands, and robot blasts robot with armor-piercing shells. As the battle progresses the field is littered with the carcasses of crippled machines. Even some humans are wounded and need help. Medibots are dispatched. They cruise the battlefield, scanning for the frequency of the computer chips in the wounded soldiers' dog tags.

Like all war zones this is a place of mind-numbing violence and sudden death. But unlike battlefields of the past, victory depends on the capabilities of robots rather than on human courage. On the battlefield of the twenty-first century, war—like so many other experiences of life—has been relegated to automatons.

Robot tanks, aircraft, and submarines will fundamentally change the way battles are fought and armies are structured. After decades of being on the wrong end of military-intelligence jokes, the Pentagon is planning armed forces whose weapons have brains of their own. Work in this area comprises some of the most productive and imaginative research—military and otherwise—going on today.

Strategists realize the necessity of robotizing warfare. "Fighters and attack aircraft are just about obsolete. I think we should go to robot fighting vehicles," says Admiral Noel Gaylor (Ret.), former commander in chief of the U.S. Pacific Fleet.

The Defense Advanced Research

PAINTING BY PAUL LEHR

Projects Agency (DARPA), the Pentagon's think tank, already has a $600 million five-year program to develop intelligent weapons and battlefield aids. Last year the Defense Department earmarked $140 million for robot development (up from only $10 million three years ago).

The Army is spearheading robot-development efforts, working on machinelike robotic ammunition loaders and automated aiming devices for tanks, unmanned trucks and unarmed robot sentries. The Naval Sea Systems Command (NAVSEA) has some 40 ongoing robotics projects, many focused on ship maintenance and repair. The Air Force robotics program has been concentrating on computerizing aircraft factories: automated canopy polishers, superaccurate robot drillers and welders, machines able to handle the exotic materials of which aircraft are made.

Independent cybernetic warriors are still a ways off. For the near future, researchers are trying to combine the best of both humans and machines.

One approach to automating war involves building an electronic copilot that does some of the routine flying while the human pilot concentrates on strategy. The copilot could even plan the best route to the target, guide the plane in, and take evasive action to avoid ground fire.

Using current technology, a pilot would "talk" to his automated copilot by tapping buttons in response to messages on a computer screen. A future pilot could do the same thing simply by thinking. Since the mid-Seventies the Air Force has sponsored much of the nation's work on "biocybernetics," linking computers directly to the brain and letting the two communicate.

Biocybernetic devices work by sensing tiny electric currents produced by the firing of neurons in the brain. In theory, certain thoughts and feelings are associated with specific brain-wave patterns. To learn what the signals are, researchers have put animals and people through the same exercise repeatedly, recording brain waves each time in the hope of finding a pattern that accompanies a specific action.

Jefferey A. Moore of the advanced weapons group at Los Alamos National Laboratory thinks the same technology could be used down on the ground as well. "I felt that the infantryman had been totally neglected in the high-tech revolution," he says. "It anyone needs help, he does."

Moore's brainchild is PITMAN, a 200-pound suit of armor that would protect an infantry soldier from old and new warfare hazards—from a .50-caliber bullet to the toxic clouds left by biological weapons. Crafted of graphite, Teflon, and ceramic materials, the suit would have small electric motors installed in its legs to power it, and it would literally be controlled by the wearer's brain waves. (Los Alamos calls it a mind-reading protective suit.) Moore says it would be as easy to walk in PITMAN as in a pair of boxer shorts. Fiberoptic sensors in the suit's helmet would read signals from the brain's motor-control regions and move the legs of the suit. Because each person has his own style of moving, those quirks could be stored on a computer chip a soldier would wear. "If he changes suits, he can plug in the old chip," says Moore.

Moore admits that the control system is the hard part. (Work is already under way on the motors for the legs.) "We don't know very much yet about how the brain waves correlate with movement," he concedes. "But just recently a researcher at Johns Hopkins University has managed to predict a monkey's arm movements by monitoring its brain waves. We should be able to do the same for humans. As far as I am concerned, that proves the concept is practical." By the time the theoretical work is done, he says, the equipment to interpret brain waves will be available.

The most sophisticated of military robots are those that fly. Some 20 nations own at least primitive drones, also known as RPVs (remotely piloted vehicles)—small

THE BLADE RUNNER BLUES

The military is currently pouring millions of dollars into robotic tanks and smart missiles. According to at least one futurist, however, recombinant DNA might prove to be the ultimate solution to the soldier shortage. Why build soldiers when you can grow them?

Neurologists at Stanford University [illegible]

[illegible]

methods of turning on the cell-division process to do it faster than it would normally occur," he says. "If you could grow adults and you needed an army overnight, you could grow an army." The military, he notes, is already interested in hatching android soldiers.

The creation of warrior robots and the [illegible]

[illegible]

safer for us humans, but," he says, "let's not kid ourselves. What we are trying to do is make superhumans."

And that urge to create a superhuman might yield the kind of nearly indestructible and ferociously powerful robot that Arnold Schwarzenegger played in the movie *The Terminator*.

In the future, [illegible]

[illegible]

—Grant Fjermedal

[illegible]

winged robots used for surveillance, radio jamming, and similar missions. The Israeli military's stunning success has become part of military folklore. For 18 months in 1982 and 1983 these robot planes watched as the Syrian Army painstakingly installed one of the most sophisticated antiaircraft missile systems ever seen. As the Syrians worked, RPVs (called Mastiffs)—small, quiet and invisible to radar—glided in the skies above, beaming what their onboard cameras saw to the televisions on the desks of generals and ranking officials in Jerusalem. It became a popular, if classified, television show.

The Israelis knew the location of all the missile sites. They had even built a duplicate of the Syrian antiaircraft array in the Negev desert and practiced against it.

Accompanied by a flock of Mastiffs, their planes flew into Lebanon's Bekaa Valley. Some RPVs carried electronic equipment that jammed Syrian communications systems; others gave off the radar signature of fighter jets and drew fire from surface-to-air missiles (SAMs). Others spotted antiaircraft sites for Israeli artillery; acted as aerial eyes for tank corps, and notified Israeli fighters when an enemy MIG jet took off. Each plane was barely airborne when an Israeli missile blew it out of the sky.

"They shot down eighty-five Syrian MIGs," says Al Ellis, an engineer with Baltimore's AAI Corporation, who is credited with the original Mastiff design. "And they lost only one plane to ground fire. In one hour they destroyed every SAM."

When they bombed the SAM sites, the RPVs were there looking down on them. In fact the commander of the Air Force was watching the bombing on his TV monitor and was in direct contact with the pilots doing the bombing," Ellis recalled. "He could tell them 'You missed by ten feet. Go back and do it again.'"

Today most RPVs are restricted to the kind of tasks the Mastiffs did in Lebanon, but not all resemble small, cockpitless jets. One innovative design for a surveillance robot is the AROD, the airborne remotely operated device. A flying pizza four feet across, it can travel more than two miles ahead of advancing troops, carrying a video camera onboard. It sends back information through a fiberoptic cable fine as a hair and tough enough to survive being run over by a tank. The Marines currently have a Mastiff platoon and hope to have the AROD in the air by 1991.

"The best RPVs are already quite sophisticated," says robotics consultant Robert Finkelstein, president of Robotic Technology Inc. "But they will soon be far more capable. Within five years we may have attack robots that can loiter and look for targets, then regroup and wait for another chance if they miss the first time. We may even have RPVs coordinated with one another, like a swarm of bees, able to attack a common target."

RPVs may even replace satellites. Agencies from the U.S. Naval Air Development Center to the Canadian Department of Communications are working on something called HALE—high-altitude, long-endurance—drones. Designed to reach altitudes up to 100,000 feet, these planes can stay aloft for years. One model, to be powered by microwaves from the ground, would float at 70,000 feet and relay radio and TV signals over an area hundreds of miles wide. A solar-powered flying warbot now on the drawing boards at Fairchild Republic could well replace at least some spy satellites. Flying as high as 90,000 feet, it could hover over a point on Earth for up to two years, continuously watching an area some 700 miles across. Because it's so close to the ground, at least compared with satellites, its images would be far more detailed than any now available. Yet it would cost only an estimated $15 million—a bargain, considering an orbiting satellite costs $2 billion.

Compared with RPVs, land and sea weapons are primitive. But that will change.

"One innovative design for a surveillance robot is the AROD. A flying pizza four feet across, it can soar more than two miles ahead of troops, carrying a video camera onboard."

the systems now under development are steered by human operators linked to the automatons by radio, cables, or optical fibers. The humans, watching TV screens, wiggle joysticks to control the machines.

Underwater drones are most likely to be pressed into action first. Moving a machine through the ocean is not much harder than moving it through the air. "The problems of avoiding collision and traversing uneven terrain, problems that plague land-based system development, are almost nonexistent underwater," explains Lieutenant Commander Bart Everitt, formerly of NAVSEA. "Also, sonar systems can resolve the terrain better underwater than ultrasonic systems can in the air."

NAVSEA has four such robotic projects in the works. One is a fish. ADROV (advanced development remotely operated vehicle). Equipped with sonar and a television camera, it is controlled over an umbilical cable. More sophisticated is the two-armed advanced tethered vehicle, linked to its human master by a fiberoptic cable and the AUSS, an underwater machine that can be controlled by voice or let off its fiberoptic leash to swim on its own. Planned but not yet built is a robotic mine delivery vehicle, which will do exactly what its name suggests: lay its own minefield an ocean away from its home port.

Land-based robot warriors lead a more complicated life. They cannot glide over or around obstacles—they have to roll or crawl over them. Typical among the land-based robots is the Prowler, or programmable robot observer with logical enemy response. (For this miniature robot tank the 'logical response' to an enemy is annihilation.) The six-wheeled, 4,000-pound monster, about eight feet long and six feet high, has three protruding television cameras, one on a mast that telescopes up to 26 feet. A human operator can use the forward cameras to pick his path and control the Prowler from as far away as six miles.

"The next step is true autonomy," says Thomas Day, former marketing director for Robot Defense Systems, the tiny Colorado company that developed the Prowler.

Freeing the Prowler from its radio leash may take longer than Day foresees. Half a dozen other autonomous-robot projects have already tried to solve the problems of independence and found it slow going. Of these, a robot tank called the ALV (autonomous land vehicle) is by far the most ambitious. Built for DARPA by Martin Marietta, the ALV is the first attempt to make tank commanders and their crews obsolete. DARPA foresees a robot tank roaring over a battle-torn landscape, bristling with firepower able to recognize and destroy enemy weapons all on its own.

The ALV of today is a boxy van that weighs nearly eight tons and, to an observer, simply crawls along doing nothing of any import. It cannot yet avoid obstacles on the road. Like the dancing bear, however, the miracle is not how well the ALV performs but that it performs at all. Previous automatons have been unable to carry out their chores unless they were specifically programmed. Even cruise missiles have their course plotted in advance and check their progress against a computer map of the terrain they fly over.

But an autonomous killerbot will have to slog through a morass of unforeseen ambiguities with almost no advance information to guide it. It has to figure out where it is and where it is going and plot a path to its destination, working around obstacles as it goes. A combat machine also has to figure out a way of telling the enemy soldiers from the friendlies—their tanks from ours—*before* it starts shooting.

"Now we're dealing with the really hard problems in artificial intelligence," notes computer scientist Hans Moravec of Carnegie-Mellon University. Moravec's work on mobile robots is the foundation of many mobile robot programs, including that of the ALVs. "You have imperfect information about where you are and what things are there. Often you're surprised."

We humans use relatively primitive sensing abilities and controls to deal with these surprises. Though rudimentary, they

are the most difficult part of human intelligence to duplicate. "For example, when you visualize the answer to a question you're using the same circuitry as you do for visual processing," he says. "That's equivalent to a supercomputer with a processing power of a trillion operations per second."

So for a truly independent mobile robot we need a million times the processing power we have today. And at the rate computers have been growing, we should have it in twenty years. Then mobile robots will be practical. For the ultimate mercenary it may require a hybrid of various technologies (See "The Blade Runner Blues" on page 78.) The military sees all this automation as inevitable. There are several compelling reasons why. The first is a soldier shortage. The Army may not have enough able-bodied men and women to fight a future war. By the year 2000 the eighteen to twenty-five age group which supplies the most recruits will shrink by 20 percent. At the same time the Labor Department estimates that 2 million entry-level jobs will open up for this age group in just the next five years. Without the spur of unemployment fewer young people will join the ranks of the armed forces—too few to maintain battle readiness.

As the tools of war get more complex, the cost of training people to operate and maintain them will increase. The result, as Frank Barnaby noted in *The Automated Battlefield*, is that soldiers become too valuable to lose in large numbers. Mass-produced robots will be cheaper and more expendable than humans.

To protect this diminishing resource, machines will have to do as much of the dangerous work as possible. For example, surveillance robots will tell their human buddies where their adversaries are. Robot tank killers may defend them from enemy armor. Thick-skinned robot guides might lead them through enemy minefields. If chemical or biological weapons are used, commanders can send in the machines.

Unmanned weapons can be deadlier

CONTINUED ON PAGE 86

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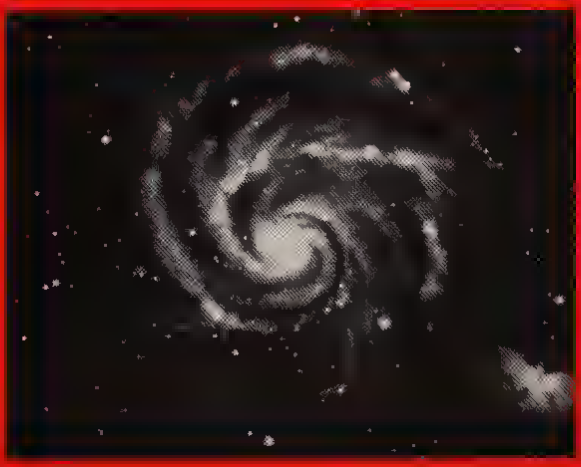
It was glowing like a spiral pinwheel standing on end. It appeared six times larger than the full moon.

ANTI MATTER



UFO UPDATE

For a few hours this past summer the 'Great East Coast UFO' was the most widely witnessed UFO in history. Hundreds of thousands of people watched the apparition from areas as distant as Georgia, Michigan and Quebec.

But within hours the UFO was killed, slain by a precise and prosaic explanation. Now the sighting has become merely the most widely witnessed IFO or identified flying object in history. And that's no mean feat.

It all started at about ten PM Eastern Daylight Time on Tuesday, August 12, 1986, when millions of people were outside looking for Perseid meteors. Many of these skygazers had their telescopes and cameras at the ready when a brilliant, cloudlike UFO appeared in the eastern sky.

Descriptions of the object and its motion varied, but a general picture soon emerged. In Houston, Don Stockbauer described an 'orangish nebulosity surrounded by an irregularly shaped white cloud.' Brenda Newton of Rochester, New York, said, 'It had a tail. By the time we got out of the truck it had begun to spiral. It lasted for a few minutes, then dimmed and floated west.' And Chuck Barnes, head naturalist at the Troy Farm and Nature Center near Detroit, said, 'It was glowing like a spiral pinwheel standing on end. It appeared to be five or six times larger than a full moon.'

A number of observers quickly figured it out. Tom Bolton of the David Dunlap Observatory, north of Toronto, attributed the sighting to a satellite. 'The satellite was actually seen in the telescope here,' he said, 'and we also had a report from an amateur astronomer who saw the satellite and saw the release of material from it.'

It didn't take long to identify the mysterious satellite. It turned out that a group of radio hams had received signals from the object—to them it was *not* unidentified. They had been patiently awaiting the launching of a Japanese amateur-radio satellite aboard a space booster. And that's just what the UFO turned out to be: a cloud of propellant dumped from the Japanese rocket's second stage, which was orbiting a bit ahead of the satellite.

Last August the cloud-UFO phenomenon was unheard-of in North America. But it has been common elsewhere. Wherever it occurs, the explanation is the same. American rockets occasionally spray eerie spiraling clouds over Australia, and Soviet rockets regularly paint the twilight skies of South America with terrifying OVNIs (Spanish for *UFOs*).

The great short-lived UFO of August 12 was an illuminating experience in more ways than one. Even the UFO groups got into the act. And the descriptions *they* gathered were drastically different from those put forth by astronomy buffs. Instead of an object moving *across* the sky, they described one that shot straight up until it exploded or moved into a cloud. Their data put a bizarre spin on already unusual perceptions, exaggerating the strangeness of the phenomenon and reducing the plausibility of other UFO eyewitness accounts gathered by these same groups.

If the recent brouhaha proved one thing, it's that if we look hard enough, we'll usually find a logical explanation for even the most spectacular UFO.—*JAMES OBERG*

COUNT MALABAR

There are countless fictional accounts of bloodthirsty ghouls. But a nineteen-year old California woman vacationing in the small Florida town of Malabar came face-to-face with the real thing.

It all started one November afternoon when she decided to take a walk to a local store. A car drove up behind her with a well-dressed friendly businessman behind the wheel. He offered her a lift, and she hopped in.

It was a bad move. The man choked her into unconsciousness and took her home. First he raped her, then placed tape over her eyes. When she asked about the painful pricking sensation she felt in her arm, he said, "I'm a vampire. I'm using intravenous needles to take your blood."

During the twenty-two hours the woman was held prisoner, the man drank her blood from glass jars and at one point became enraged because some of the blood had coagulated.

Finally, when the man left his house for a business meeting, the woman dived out of a six-foot-high window. Naked, dazed, and handcuffed, she hobbled down a muddy dirt road until she was picked up by a neighbor and taken to the police.

Soon thirty-nine-year-old John Brennan Crutchley, a computer engineer, was arrested. According to Florida State Attorney Norm Wolfinger, investigation revealed that Crutchley was involved in the occult.

Crutchley was charged with kidnapping, sexual battery, robbing his victim of blood—medical reports stated that the young woman had been robbed of *one third* of her blood during the ordeal.

"It's bizarre," says Crutchley's attorney, Joe Mitchell. "There's never been a case before in Florida—probably not in the whole country—that says if you take someone's blood, it's robbery."

In a recent plea bargaining move, however, the charge of blood robbery was dropped when the defendant agreed to plead guilty to other charges against him.

Wolfinger states that Crutchley's appetite has earned him notoriety in jail. "Instead of Count Dracula," he says, "the other prisoners have named him Count Malabar." —Sherry Baker

"I relish each separate horror. I roll them over my tongue."

—Mary Shelley

STONE AGE CANNIBALS

Do human beings really eat one another? Although gruesome tales of ritual cannibalism have long been part of the mystique surrounding primitive tribes many modern anthropologists contend that except in extremely rare circumstances where survival itself is at stake cannibalism is little more than matinee-movie mythology But now comes news that at least one group of Stone Age people *did* dine on human flesh

The discovery was made

when archaeologist Jean Courtin and a team from France s National Center for Scientific Research excavated a cave near Fontbrégoua in southeastern France There they found the 6 000-year-old remains of six humans whose bones were marred with microscopic cuts and chop marks—almost certainly signs the researchers say, that the deceased had been butchered their flesh systematically stripped from their bones

The most strident of the skeptics anthropologist William Arens of the State University of New York at Stony Brook agrees that "cannibalism is a likely explanation for this evidence ' But, he adds the Fontbregoua findings probably represent nothing more than an isolated case of cannibalism for survival

Not so, says Paola Villa a University of Colorado anthropologist who analyzed the bones The cave she says, is in a temperate area where food would always be available Villa thinks the Fontbrégoua skeletons may have been prisoners of war killed and eaten by the victors

We can t prove it she says, 'but this was a period of cultural change that may have stressed societies to the point of warfare In any case she concludes ' it s the first well-documented evidence of cannibalism to be found in Old World prehistory —Bill Lawren

CROWN OF ROSES

It was May of 1947 when a small girl In the English town of Stockport placed a crown of roses on the Madonna in St Mary s Catholic Church Five months later not one of the 22 cream colored roses had fallen off The occurrence seemed so remarkable to Father James Turner the parish priest that he declared "The flowers have been kept

alive by divine intervention

Hundreds of pilgrims soon came to see the immortal crown And similar crownings were said to take place for the next couple of years

Now however the mystery of the crowning has been solved—thanks to Arthur Clare a sixty year old retired clothing shop manager who was once an altar server at the church The pilgrims Clare reveals were hoaxed

According to Clare the flowers were prevented from falling by fine threads of silver wire knotted at the back 'Only Father Turner the florist who made the crown to the priest s specifications, and I knew the secret " he says The priest wouldn t let people get close but anyone with half an eye could see that though the roses remained the petals had withered

The reason for Turner s scam? According to Clare the priest collected as much as £250 000 worth of money and gold from the pilgrims This hoard Clare adds was later converted to a crown of solid-gold roses which Turner took with him when he retired to a monastery in Spain

Turner has since died, Clare reports And the girl who performed the crowning ceremony has become a nun Having confessed his own role Clare states I ve freed myself from purgatory and can now face death '

Ivor Smullen

'The career of flowers differs from ours only in inaudibleness '

—Emily Dickinson

PSYCHIC LAWYERS

Justice is not always blind In fact sometimes it s absolutely clairvoyant

An increasing number of lawyers are now attempting to use extrasensory perception to gain an edge in the court room Among the techniques claimed by these psychic Perry Masons are reading the minds of jurors witnesses and other attorneys waging mental war with opposing counsel programming' jurors to return favorable verdicts and ferreting out undisclosed evidence with held documents and even

missing witnesses

"I have psychic abilities with witnesses claims Jack McManus (above), a trial lawyer from Madison Wisconsin 'A light goes on and I have knowledge of thoughts beforehand It s like I m enlightened McManus says he has also attended trials in which the other lawyer had obvious psychic power 'I'd just put up a mental defense become a trickster make them think the power was backfiring ' he says

Another self-professed psychic attorney a woman from a small midwestern city says her ability to read minds during cross examination even provoked one colleague to try having her prosecuted for witchcraft Yet another attorney says he was fired after telling his boss he was led to evidence by disembodied voices

Whether or not such psychic claims can ever be validated mainstream members of the legal profession have opinions of their own

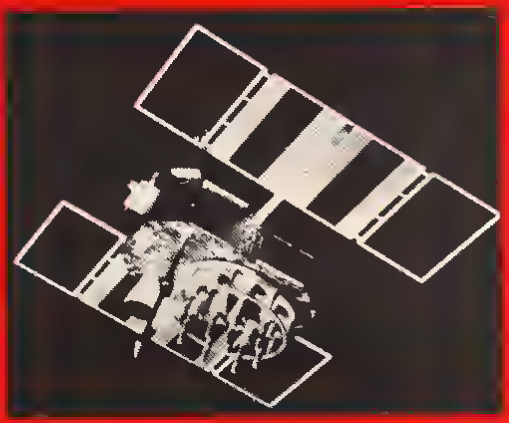
These lawyers are taking risks says Geoffrey Hazard director of the American Law Institute and unofficial dean of ethics of the profession If these phenomena are ever substantiated there will be definite ethical implications If the claims begin to get too much publicity or notoriety an investigation will occur

—Glen Craney

FIRST OFFICIAL UFO?

Back in 1978 when John T Smith was a staff communications officer at Elmendorf Air Force Base just outside Anchorage Alaska he often saw photographs taken from defense satellites But he says, one of the photos looked strikingly different from the rest 'I wondered What the hell is this thing? Smith recalls Now he believes it is the only official U S government photo of a UFO

Smith claims the picture shows a rectangular wingless vehicle rising through the atmosphere above the Soviet Union at about 4 000 miles an hour—about twice the



speed of the fastest aircraft I m not saying it s alien he insists "but it s not ours and it s not theirs

Smith took the photo with him when he left his Air Force job in 1979 because he explains I thought it was cute But recently when his business partner James Bounds found the picture in a desk drawer the wo men decided to visit an expert physicisl and UFO analyst Harley Rutledge ot Southeast Missouri State University

I had the photo verified and it is authentic ' Rutledge says But I can t say it s a UFO ve talked to experts who think the object in the picture might be a military vehicle [such as the one above] I think t could be a Russian launch into space '

Although the photo has already been published in *The Anchorage Times* Smith refuses to allow it to be printed in *Omni* If you want any more information or to see the photo he told this writer, you are going to have to pay for it sweetheart

But Captain Larry Jenkins Elmendorf s public affairs officer says the picture is not Smith s to sell anyway That photograph he says "is the property of the U S Air Force Sherry Baker

We are convinced a crippled spacecraft from another planet is circling the earth It is my belief that aliens from another world are still inside "
Sergei Petrovich Bozhich

'When the skies are searched for signals from extraterrestrial civilizations search carefully in the Pleiades '
Dr Irwin Ginsburgh

The documents I received from friends in the USSR make t clear that Soviet priorities are one, to nurse the aliens back to health and two to establish some means of communication '
—Yugoslavian scientist, code name Zikovic

CYBERWARS

CONTINUED FROM PAGE 81

and cheaper than manned weapons and military craft an important feature in this era of Gramm–Rudman budget tightening. A $5 million surveillance drone is a bargain compared with a $25 million spy plane. And witness what happened in the "war" in the Falklands, where a $200,000 Exocet missile knocked out the *Sheffield*, a $50 million destroyer.

Computerized weapons' versatility meshes nicely with a philosophy called force multiplication—getting the most from finite resources—says Tom Bartholet, director of strategic planning at Odetics Corporation, one of perhaps 40 small American companies working on battlefield robots. "Warsaw Pact nations have about five main battle tanks for every one NATO has," he points out. "It takes a lot to overcome being outnumbered to that extent. Robots are one way to even those odds."

Making the transition to warrior machines has its own set of problems. We will have to learn how to protect our robots from other hazards. They may be impervious to small-arms fire and poisonous gases, but their circuitry is not immune to electromagnetic pulse, a kind of electronic shock wave that is generated by a nuclear explosion.

Robot machines will have to be able to operate for days without any maintenance. Because they will often be miles from any humans, they will have to diagnose and fix themselves—as well as perform the more routine jobs of refueling and resupplying themselves with ammunition.

Making a machine independent also means trusting its judgment, something few are ready to do because Murphy's Law seems to reign supreme when a machine is left on its own. Barnaby tells one story of a sophisticated radar-equipped antiaircraft missile that was fired at a target aircraft flying overhead. Instead of zeroing in on its target it wobbled crazily off course and went straight for a nearby field latrine whose tan had the same radar "signature" as the target aircraft's engine. And who could forget the Sergeant York, the $1.8 billion, "smart" antiaircraft gun that could not hit even slow-moving targets?

Battle strategies may change drastically. Coordinating the activities of an army of intelligent machines—trucks, tanks, aircraft, and so on—threatens to be a logistical nightmare that will have to be computerized. The machines themselves will have to be programmed for their special missions. William Isler, program manager for the ALV, notes that getting the machine to be autonomous is just one step. There is the larger problem of making a fleet of independent machines "think" like tank crews and operate as a single unit. He is beginning to study how tank commanders handle their troops in battle, and even the kinds of strategies predatory animals use when they hunt in packs.

In *The Automated Battlefield* Frank Barnaby conjectures that the whole character of war could change. Take the concept of victory. When two countries do battle by sending armies of machines against each other, how do you tell who has won? "Victory in an automated battle may well go to the side that can keep up the battle for the longest time," he suggests.

Will the era of machine warriors mean an end to bloodshed in battle? As an answer, strategic planner Bartholet offers: "What a war sets out to accomplish is to destroy the other side's ability to wage war. What you're really after is to destroy the enemy's industrial base and his fighting force, the machines of war. If those are manned facilities and manned machines of war, you're killing people, too. But the purpose is to destroy those capacities for war, not necessarily people."

To some the mere thought of war as a gloryless, bloodless clash of intelligent machines is, yes, unthinkable. "You know—I don't know what other people's thinking on it is—I just can't picture a battlefield without blood," admitted one specialist working in automated weaponry. "The idea of taking and holding land seems to require a human presence." **OO**

BIG GIRL

CONTINUED FROM PAGE 50

age like me I think Jewel Ann getting so tall was partly why Duane went so wild in his teens But not entirely He never had been good-natured that I can remember Anyhow he got wilder and meaner and Daddy was always yelling at him until he went off to Atlanta and we don t know where after that A couple of years later when the newspaper article came out, somebody must have showed it to him, because he sent a letter the next month to Mother and Daddy saying that he had a friend who was interested in making movies with unusual people in them and there could be a lot of money in it for us The postmark was Fort Worth, but there was no return address and the letter was hard to read, like he spelled *unusual* "sunual," and his writing was funny Mother cried a couple of times after that letter came but I don t think she was really missing Duane It was thinking about him sometimes when he was a baby that made her cry

I brought books and stuff from school for a year for Jewel Ann but the next year they told me not to I guess Daddy had told them that she was in a special school He had built up the backyard fence and Jewel Ann could play outside But around her twelfth birthday she really began getting her growth, and that was when the newspaper people came We were washing dishes and heard Daddy talking at the front door with somebody We listened because he didn't have any friends that ever came to the house and we wondered who it was Then he came into the kitchen yelling to Jewel Ann to go to her room

We had watched *The Diary of Anne Frank* on TV that week and she sort of thought it was the Nazis and so we both ran into her room and locked the door Jewel Ann s room used to be the family room at the back of the house Daddy had taken out its ceiling and the floor of the bedroom above it that used to be Duane's room so it was two stories tall and he made the doors taller too for Jewel Ann She was so scared of the Nazis now that she tried to hide under the bed Her bed was three old bedsteads put end to end with the head- and footboards taken off and she couldn't get under it because of the legs So we pushed one of the beds against the door and I was telling her there weren t any Nazis here when we heard Daddy slam the front door and yell at Mother "Don t you ever let those people come around here again! as if she had

Somebody had taken a picture of Jewel Ann in the backyard and sold it to the paper and they published it with an article entitled GIRL TOPS PINES? After that Daddy canceled our subscription to the paper so Mother never knew about sales unless she went next door to the Heltsers to look at their paper and Daddy didn t know about the other article they printed after the re-

porter talked to me coming home from high school. She was young and really friendly, with designer clothes and a nice way of talking, pretty much like Billie used to be in the Lou Grant show, only more makeup. It was easy to talk to her. Some of what I said came out in the *Register*, and people at school showed me the article, but when I read it it didn't sound like what I meant. Anyhow, I bought a copy of the paper and brought it home for Jewel Ann so she could read about herself even if she couldn't go outside anymore except after dark. It was entitled SISTER NOT HOAX, GIRL CLAIMS. It seems like nobody told Daddy about it, and we didn't show it to Mother because she was sensitive about people noticing Jewel Ann and afraid Daddy would blame her for it. But Jewel Ann liked it, especially the part that said she was an otherwise normal preteen with a shy smile. I don't know how the reporter actually knew that. After the articles were in the paper people used to come by and stare at the fence around the back yard, especially on Sundays, when people drive around after church, and some boys, probably from Cleveland High, knocked at the door and when my mother came one of them said, "Is this where Jewel Ann lives?" but the others said they were at the wrong house, and they all went off fooling around and laughing the *gug, guh* way those kind of boys do, like Duane. Mother was all confused and tight-faced when she came back to the kitchen, and she said to me, "Don't you tell Jewel Ann!" I shook my head. I wouldn't.

Daddy was watching baseball on TV and didn't notice anything.

I think maybe Mother had really thought just at first that those boys were friends of Jewel Ann's, before she'd had time to think that they couldn't be, because a while after that, while we were making a bed, she said, "I do worry about Jewel Ann!"

I said, "Why?" and she said, "Well, it just is a fact that boys like girls to be shorter than they are. I don't know what to do about Jewel Ann's *social* life."

Jewel Ann and I had talked about boys, too, wondering if there were any really tall ones. It seemed to us that if there were really very tall boys you'd hear about them. Since boys are supposed to be tall, maybe their parents would be proud of them and they could go outside and do things. It seemed to us, anyhow, that if there were enough really tall boys to be any use, we'd know about them.

So I didn't know what to say to Mother, and she didn't know what to do. Her social life wasn't so great either. She didn't go out of the house much more than Jewel Ann did. Mrs. Heltser stayed friends, and sometimes she got Mother to go to the mall shopping with her, but most of the time Mother said she was so busy with the house she just couldn't take the time, and would I come by the store on the way home from school, or would I run down to the 7-Eleven after Daddy had brought the car home from work. And she ordered clothes from mail-order catalogs. Except for Jewel Ann. For her clothes, I bought the material, and Mother designed and made them. Even blue jeans, because she wanted blue jeans so bad. Mother found the easiest way to make Jewel Ann things was to buy king-size sheets—a lot of them have nice colors and floral prints—and sew them together and then cut out the dress or the skirt and top. For the jeans I had to buy a whole bolt of jeans material. The saleswoman acted ugly and didn't want to sell me the whole bolt, as if it was wrong or something, instead of easy profit for the store, but I just stood there, and finally she flip-flopped all the cloth off the center thing as if she didn't want to touch it, talking over her shoulder to another clerk all the time. Luckily, Dottie Shine from high school was on the cash register, and she kept the package under the counter for me because the material was so heavy I had to come home and ask Mrs. Heltser to drive me back downtown to get it. The jeans were really hard for Mother to make, but Jewel Ann just loved them and wore them all the time.

You would have thought Jewel Ann would have eaten a lot, and there was a while I remember Daddy did criticize Mother for buying ten or twenty pounds of hamburger at a time and half a dozen heads of lettuce and so on, but actually, as she grew more it seemed like all the time Jewel Ann ate less. So the grocery shopping and prices were really no big problem, especially after I finished at Coolidge High and got work in the secretary pool at Sacchi Products while I was taking computer skills at the secretarial college at night so that I would be able to earn more, which I did once I got the assistant to Mr. Penitto's executive-secretary job. And it was steadier money than what Daddy could get with Shaughnessy Siding. But by then Jewel Ann wasn't eating very much at all, less than me, even less than Mother. She was fifteen years old and she was about forty-five feet tall and still growing.

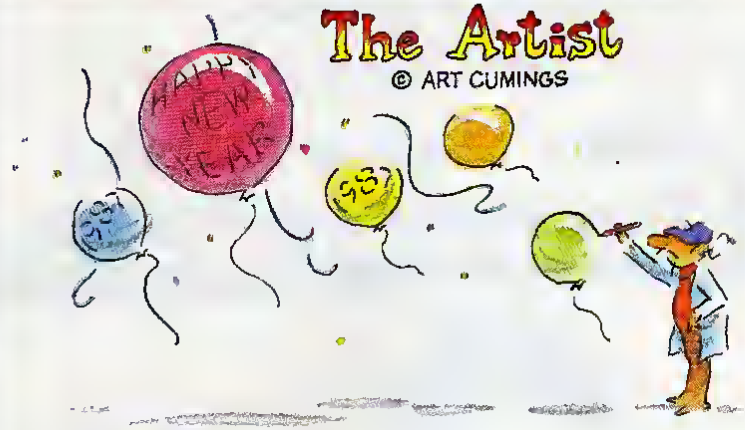
If we only could have moved and lived somewhere else.

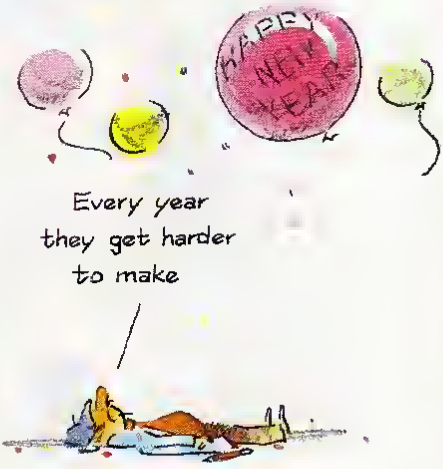
If we would have had more money, or if Daddy would have been able to realize that she really was that big and really needed room, then we could have gone to live maybe by the sea somewhere, on a lonely part of the seashore or on some island where Jewel Ann could walk along the beaches and go swimming in the sea, and there would be room for her. We used to talk about that. She used to say, if only she could go swimming in the sea or walk on the beach or walk on the moors and the heaths like Cathy Earnshaw in *Wuthering Heights* or Dimity Trescott in *Bride of Passion*. But there weren't any beaches or moors where we lived.

Jewel Ann had a hi-fi, she liked Emmylou Harris records, and she watched TV and read a lot. She was good at turning the pages of the books even when she

"Come, come, Dr. Jekyll! Where's that old scientific detachment?"

The Artist





could hold a book on the palm of her hand like it was a postage stamp would be on mine. I went to the library for her every week. The librarians always asked about my sister—I think they thought she was like paralyzed or something—and they'd think of books for me to bring her.

Once when she was about ten they gave me *Alice in Wonderland* which was really different from the movie. Jewel Ann kept asking for it back again, so I read it once and we talked about it. I thought it was the "Drink Me" bottle she liked with the stuff that made Alice shrink down so fast. But Jewel Ann said it was the parts with the sheep and the rushes and the forest where they forgot that she liked. I went to the bookstore in the mall and bought it for her for Christmas that year. The librarians sent her *Gulliver* once, about the little people and the giants, but she didn't like it. She said it wasn't real. In the evenings when I was home we usually watched TV together on the eighteen-inch set Daddy gave her. She said she liked TV because all the people on TV are all different sizes, but all tiny. All different sizes of tiny.

Records and TV and reading were about all she had to do, because after she was thirteen she was like Alice at the end of the first part of the book: she was too big to get out the door.

If only we could have lived on a farm like Grandmother had when she was alive and had a barn. She could have lived in a barn, I think. We used to talk about that and plan it—how I would save up and buy some old farm out in the country and she could walk on our land at night and have a chair and things the right size for her in the barn. We talked a lot about that. We would be sitting on the floor because there wasn't anything but the carpet in her room anymore, and I would lean back against her big, warm, soft leg, and we would just talk. But as the time went on, my sister began not to talk so much even to me.

When she outgrew her blue jeans, she felt bad. She stopped watching TV. It was like she had stopped pretending she could be like the people on TV or anywhere else. That was when she began not talking much, even though she still liked for me to come in and talk or just sit with her. She stopped reading books, and she wasn't hardly eating anything. It was just very gradual for a year and more, when she was fourteen and then fifteen, and I guess Mother and I didn't talk much about it because how could we think about it at all, really, when she was thirty-five and forty and forty-five feet tall?

We couldn't ever talk to Daddy about it. He never said anything about her and never talked to her or went into her room and tried to act like she wasn't even in the house except when once he bought her some candy at Valentine's Day and he gave her the big TV set for her birthday when she was twelve. But other times if you just said her name he'd get mad. Once when Mother and I tried to talk about maybe moving to a bigger house or something, he started yelling and he yelled names at Mother and broke some stuff and finally stomped out. He didn't come back till way late at night. Mother was sick for a couple of days after that. I guess some of the things he called her were words she had heard before but never thought anybody would ever call her such things, or anyway not her own husband. She was so miserable she couldn't hear a word about moving after that, and she never went out of the house. She kept the blinds down and put paper on some of the windows. It was hard to talk about Jewel Ann even with her. But it was her, not me, that finally said what I hadn't been able to really even think, not so as I knew I was thinking it. We were in the kitchen one night doing dishes, and she said, "Dawn, I can see through her."

I didn't say anything, but in a listening way. She said, "I could see the wallpaper where her shoulder and hair was. Through her."

I said, "I thought so too, a couple of times."

We were whispering. Except for Daddy's baseball game on TV in the front room there wasn't any other sound in the house. There wasn't ever any sound from the back room, the high room, where Jewel Ann was sitting with her knees bent or lying on her side with her knees bent because she was too tall to stretch out anymore. She was always quiet. She never had had a loud voice. Mother always used to tell us ladies don't yell, and we learned to talk softly. Now Jewel Ann hardly ever talked at all, and only in the softest voice, deep for a girl but softer than downy feathers. And when she

moved she never made a noise, though if she had stretched and pushed and wanted to, she could have pushed out the back wall of that house, pushed it down like the side of a paper box. But she lay still. When I went in to sit with her that night, I could see the shag carpet through her thighs and hands. Now I could see what I could see, since Mother had said it.

Jewel Ann could see it, too. But we never could talk about it.

Only a couple of months after that, at the end of summer, she said once—the only thing she'd said for days, though she always touched me, even though I couldn't feel her touch anymore, only like a warm breeze moving against my skin—she said, "I've stopped growing." I could tell she was smiling.

I began crying all of a sudden and saying, "Don't! Don't!"

I could feel her watching me and feel that she was warm, though I could hardly see her at all by then, only like ghosts on the TV or heat waves on blacktop, a kind of thickening in the air, but warm.

Should I keep on?" she said in that soft feather voice.

I said, "Yes!" and couldn't stop crying. I could feel the warmness moving over my hair and arm, very lightly. She was afraid to hurt me touching me, being so much bigger. But she never could have hurt me.

After crying so much, I was worn out and fell asleep in her room that night. When I woke up early in the morning she was there, but even the TV-ghost kind of seeing her was gone. And when I said her name there was no answer.

We waited a long time, more than a week, and then Mother said, "She's gone."

She took apart the clothes made of sheets, and I took the ones from the skirt that were whole down to the Goodwill.

But I kept going into Jewel Ann's room and I said, "She's still there, Mother."

Mother shook her head. She was certain. "She's gone," she said. "She's still *here* but she's not in *there*."

And Mother was right, I guess. After a while I moved my bed into the back room, the high room, because it seemed like when I was falling asleep or beginning to wake up mornings I could feel the warmth, and then I knew Jewel Ann was there like she used to be, tall and thin and soft, with her beautiful eyes, and she was glad I was there. But then sometimes Mother hears her up in their bedroom, just saying a word or two, softly, overhead.

And no matter what Daddy does to the TV and the cable, both sets always have these ghosts, and the baseball and basketball players are like you were watching with your eyes crossed.

But it's outside at night I know that she's still here but gone, just like Mother said. In the backyard, warm nights when the wind blows a little and the leaves move and move, or when it's raining, then I know she didn't stop growing. I can hear her breathe. ∞

SEERS

CONTINUED FROM PAGE 40

computers. So you'll be continually teaching yourself, continuously learning.

Right now there is a great deal of concern about the drug problem. In 20 years there will be hundreds of neurotransmitters that will allow you to boot up and activate your brain and change mental performance. There are going to be what I call brain radios—hearing aids you put in your ear—that will pick up and communicate with the electricity in your brain. You will be able to tune in any brain aspect, like sex, that you want. You will speed up or slow down your thinking. Anything you can do with chemicals you can do with brain waves, and they are so much healthier.

Drugs will be old-fashioned. No one will be addicted because you can just turn on the ultimate orgasm and keep it going for an hour. But how long are you going to do that? You'll get bored. You're going to want to turn it down or off. The criminality of drugs is what is causing the so-called drug crisis, but if you legalize a brain radio—and you're going to have to—everyone will have the ability to dial into any emotional, mental or sensual experience. We will use these radios to think more clearly and, above all, to communicate more clearly. The key to the twenty-first century will be five words: *TFYQA—think for yourself* and *question authority*.

People will become more intelligent. I am really bored with the level of intelligence on this planet. There's no one to talk to and there is so much superstition. I am just waiting for people to smarten up. In 20 years I'll have more fun, and I'll have more people to talk to. People will be teaching me, and life is going to be more exciting.

Twenty years ago—1967—the summer of love was just beginning, and I was busy performing the rituals that had to be performed then. The computers were IBM business machines that were used to depersonalize and control us. I frankly was too dumb to look ahead.

David Byrne, *Lead Singer, Talking Heads*

The line between so-called serious and popular art will blur even more than it already has because people's attitudes are changing. When organized religion began to lose touch with new ideas and discoveries, it started failing to accomplish its purpose in people's lives. More and more people will turn to the arts for the kind of support and inspiration religion used to offer them. The large pop-art audience remains receptive to the serious content they're not getting from religion. Eventually some new kind of formula—an equivalent of religion—will emerge and encompass art, physics, psychiatry and genetic engineering without denying evolution or any of the possible cosmologies.

I think that people have exaggerated greatly the effects new technology has on the arts and on the number of people who will make art in the future. I realize that computers are in their infancy, but they're pretty pathetic, and I'm not the only one who's said that. Computers won't take into account nuances or vagueness or presumptions or anything like intuition.

I don't think computers will have any important effect on the arts in 2007. When it comes to the arts they're just big or small adding machines. And if they can't "think," that's all they'll ever be. They may help creative people with their bookkeeping, but they won't help in the creative process.

The video revolution, however, will have some real impact on the arts in the next 20 years. It already has. Because people's attention spans are getting shorter, more fiction and drama will be done on television, a perfect medium for them. But I don't think anything will be wiped out; books will always be there, everything will find its place.

Outlets for art, in the marketplace and on television, will multiply and spread. Even the three big TV networks will feature looser, more specialized programming to appeal to special-interest groups. The networks will be freed from the need to try to please everybody, which they do now and inevitably end up with a show so stupid nobody likes it. Obviously this multiplication of outlets will benefit the arts.

I don't think we'll see the participatory art that so many people predict. Some people will use new equipment to make art, but they will be the same people who would have been making art anyway. Still, I definitely think that the general public will be interested in art that was once considered avant-garde.

I can't stand the cult of personality in pop music. I don't know if that will disappear in the next 20 years, but I hope we see a healthier balance between that phenomenon and the knowledge that being part of a community has its rewards as well.

I don't think that global video and satellites will produce any global concept of community in the next 20 years, but people will have a greater awareness of their immediate communities. We will begin to notice the great artistic work going on outside of the major cities—outside of New York, L.A., Paris and London.

Richard Selzer, *Author and Professor of Surgery, Yale Medical School*

Many of the diseases that plague us today—cancer, arteriosclerosis, arthritis, diabetes and many infectious diseases—will fade from the scene in the next 20 years because effective ways to prevent or treat them will be found. When I look at the past from my perspective as a surgeon, I see how one condition after another has faded from the surgical purview. Boredom will be the major medical problem of the future. B-O-R-E-D-O-M! As leisure time increases, as life gets more and more mechanized, people become bored—and that creates a dangerous situation. Our intensive-care units are crammed already with

people suffering from the complications of boredom When we are bored we drive our cars and motorcycles too fast, we take drugs, drink or eat to excess We grow careless We injure ourselves

The most important development in research in 20 years probably will be the development of antiviral drugs and vaccines that will wipe out many communicable diseases Genetic manipulation will help us dispose of the congenital defects that have plagued society for so long

As we learn how to manipulate genes, I hope that we will not end up creating a superrace in 2007 It is a real possibility I hope we attempt to preserve the individual nature of each human being and try not to create a race of monster athletes and geniuses, which I think will be a great temptation We already have a sperm bank for Nobel prize-winners, don't we?

The natural curiosity of man impels us further and further We can now grow embryos for 36 hours in a dish Well, if this is the case, why can't we just grow a whole baby in a platter, moving the expanding embryo to a larger and larger dish, and finally serve a full-grown baby in a casserole to a man or woman? There is a certain absurdity to it, but why not? If we can keep the nutrients flowing, keep it in a bath of perfect salinity and temperature and feed it in certain ways it certainly doesn't break my brain cells to conceive of it

People can't afford the cost of medical health care There is going to be a comprehensive national health plan in this country—it's inevitable

Our research in combating AIDS will teach us how to deal more effectively with problems of the immune system, and out of this will come among other things a dramatic increase in the success and number of transplant operations In 2007 there are going to be all kinds of transplants heart transplants, lung transplants brain-cell transplants One great advance will be the discovery of some mechanism by which nerve tissue can be regenerated so that the legions of paraplegics and quadriplegics can be rehabilitated

Also there will be an intense effort to develop ways of effectively treating radiation disease, radiation syndrome The presence of nuclear weapons and an increased dependence on nuclear power for fuel will be a constant threat You cannot solve the problems by creating a vaccine, which is a tough enough task But in 20 years we will work out ways to protect our bone marrow and skin from radiation

The increased use of machines to diagnose people will make a tremendous difference in the doctor–patient relationship The doctor will simply plug in a lot of equipment, draw blood, urine, sweat, semen, saliva, stool, analyze it, and draw inferences from that But that's not my idea of diagnosis I'm glad I spent most of my career in medicine at the patient's bedside in an intimate kind of relationship, while it still required the diagnostic embrace

But this relationship is dying I see a distancing between doctor and patient We certainly have failed the American public The image of the doctor gives off an ill odor in this country Doctors are seen as people more interested in having and doing than they are in feeling and perceiving

When I first began my career as a doctor, I thought that we had reached such a high plateau that we would go on with only minimal advances for an indefinite period of time But in the last 20 years the medical field has exploded Technology—my God! Think of it, you can grow human skin in the laboratory and use it to treat burns So reality has outstripped my wildest dreams in the creation of new treatments and technologies But medicine has slipped—we have lost touch with its original impetus the concern for each individual patient

Robert Heilbroner, *Norman Thomas Professor of Economics, New School For Social Research*

There is an alarming possibility that our economy is moving in the direction of what some people call a two-tier society—a large population of people with middle-class or higher incomes and values, with a considerable bulge at the top, and a large number of people who have been economically and culturally uncoupled from the main society

What's most alarming is that the ladder that has connected the bottom to the top is now missing some important rungs There were certain industries like the steel and auto industries, that provided more or less continuous ladders of jobs from the bottom to the top You could enter as an unskilled person, acquire new skills and

move up the ladder into secure, unionized, better-paying jobs. But now these industries have been seriously imperiled, and their place as employers has been replaced by what I call the McDonald's employers. More people work for McDonald's than work for U.S. Steel, but McDonald's has no ladders. The problem is serious.

A great many economists, myself included, feel uneasy about the fact that 70 percent of the economy does what is called service work and only 30 percent does what is called goods-related work. New technology keeps entering the economy and disrupting employment. When you look back at how the American economy developed, you see a migration off the farm into the factory and out of the factory into the office. The main push has come from technology. There has been relatively little new machinery to push people out of the office, but that's changing now. If the computer creates jobs in the office, the service sector will increase and there will be no squeezing of employment. But if technology bumps service people out of work, I don't know where they are going to go.

Personally, I think American optimism is in for a very severe challenge. We have always considered ourselves virtually to have a *right* to be number one in the world. But of course we don't have any such right or assurance. And we have to resign ourselves to the unsettling fact that we are number two or three or four in many ways. In terms of health, for instance, we have fallen seriously behind, and that's a big blow to our self-image.

In the next 20 years the government will have to take active steps in providing work and income for the bottom one third of the population. The government grudgingly provides some sort of income, but it doesn't provide work. And work is essential for people's self-esteem and also for the building of many kinds of infrastructures that are needed in the country.

It is quite possible, it seems to me, that America will emerge from its present, wholly unaccustomed struggle for world position very worse off than it is today, that we will *not* find the right combination of talents and the right distribution of workforce in various occupations that we will not develop the right technologies and will end up with a seriously disadvantaged economy. Not so long ago England was still regarded as one of the most remarkable economies in the world, but it is now slightly less productive than Portugal. I think it is quite possible that the day of unquestioned American preeminence may be finished.

We could suddenly find that the way Americans live, their chances for life expectancy, their amenities of life are not as good as, let's just say, the Germans' or the Swedes'. We might fail to produce the necessary output to bring our living standards and quality of life up to an acceptable level.

In the old days we tended to think about political possibilities in terms of left and right. Since Iran we've realized there is another dimension—"up and down." There is potential for a great deal of political mischief and sabotage in "underdeveloped" countries, and anyone who tries to think about the future has to consider that. There is going to be lots of trouble.

It is clear which countries are emerging as economic powers. It is entirely possible that Japan is going to be the England of the future—I mean the 1850's England. Japan may be the organizer for a "Pacific Rim" economy—as England was for Europe a century ago. Japan may combine its leadership and technology with the inexpensive manpower and the intelligence of the Chinese, the Malaysians, the Taiwanese, the Indians, the Koreans. It is quite possible that there will be a new world economic "empire" out there, which will severely challenge the formerly undisputed hegemony of the West. Meanwhile, the Soviet Union, as far as I can see, will continue to be very bureaucratic and will be very unlikely to make any economic changes.

"Sooner or later this terrific debt problem has to be resolved. The old debts are going to be washed away, forgiven, or rephased—such wonder jargon words."

Sooner or later this terrific debt problem has to be resolved, and there is only one possible way to resolve it, and that is to "forget" it. The debt is unrepayable and it is going to be swallowed by a number of people taking their lumps—banks, corporations and governments. And some of the borrowers will have to swallow bitter pills. The decks have to be cleared. I suspect that under international agreements the old debts are going to be washed away, forgiven or rephased—such wonderful jargon words!

I think everyone recognizes now that the achievement of a better world is more complicated and difficult than some of us thought 20 years ago.

George F. Will, *Author, Columnist and Commentator for ABC-TV News*

Twenty years ago I had just graduated from Princeton and was on my way to Michigan State University to teach philosophy. My mind was on Rousseau and Hobbes. I did not expect that the ascendancy of conservatism—what has happened in the last two decades—would be as swift as it has been. That's a happy surprise. I am a short-term optimist, however, and a long-term pessimist. Since 1917 the question of the twentieth century has been how to deal with the great political invention of the twentieth century—totalitarianism. And the record is not good.

There's a lot of talk these days about whether or not the Soviets can stay in the race with us technologically. Clearly they will be a major power, but in the next 20 years the gap between the United States and the Soviet Union is going to widen again in terms of science, culture, technology and military strength. And if the Soviet Union becomes a technologically muscle-bound but not particularly effective country, I think they could become more dangerous. Today the Soviet Union is a Third World country with First World missiles—and 20 years from now that will be more obvious. In Washington the problem is described as managing a sick bear, managing the Soviet Union in decline.

There are, of course, problems that we are not even beginning to deal with now that will have to be addressed at the end of the century. Science is going to raise so many of these issues. We will be able to extend life at the end of life, preserve life in neonatal situations and manipulate life through genetics. The most problematic, of course, is preservation of life in the elderly because that raises moral and economic problems. The elderly drain the budget since they are disproportionate consumers of transfer payments in the form of pensions and medical care.

What will certainly change in the next 20 years, whether we proceed with the Strategic Defense Initiative or not, is a return to a policy of military defense. The idea—the dialectic between offense and defense in military matters—is extraordinary from a historical perspective. It began, you might say, with the invention of the stirrup, which made the horse into a fighting instrument, and then proceeded to the building of castles and castle walls—making defense prominent. And then artillery was invented, and castle walls could be knocked down, and this made offense dominant. And so on and so forth. People really feel that with the invention of the ballistic missile we have no choice for the rest of the history of the human race but to accept the absolute, uncontested predominance of the offense. We have no choice, they think, but to rely for our security on mutual assured destruction. That just strikes me as preposterous—the idea that history has simply stopped in this regard.

Hopefully, people will come to the conclusion that democracy works—that it makes people freer and that freedom makes people more prosperous than they otherwise would be. It has begun to occur in the last few years. Throughout the world there is a collapse of confidence in command economy. I would think that would be the big story of the next 20 years in world politics. Also, I think there is a genuine movement toward democracy—flawed,

hesitant but still genuine—to the south of the United States. I think the nascent democracies in El Salvador, Honduras, and elsewhere in the Southern Hemisphere may take root and grow.

I think we have a real chance of seeing peace in the Middle East. The sterility of the radical Arab position will be so obvious in 20 years that even radical Arabs will have noticed. Also, I simply do not despair of the possibility of a peaceful evolution of a genuinely pluralist society in South Africa. They are so far along. Bishop Tutu, a black bishop, travels freely around the world denouncing the country, denouncing it before white audiences in South Africa. They have an independent judiciary, an independent press. And the United States could play a long-term constructive role. The great dissolver of irrational social organizations such as apartheid is robust entrepreneurial capitalism. It is simply incompatible with their kind of semimedieval regime. We should be force-feeding South Africa with foreign capital, operating under rules of equity.

There has been a manifest move back toward the center, a recognition that chanting "no more Vietnams" is not foreign policy; that chanting "fairness" is not domestic policy; that the Soviet Union is dangerous; that economic growth is problematic and primary; that this is not a wicked and unjust society but a prosperous and good society with some problems.

Andrew Greeley, *Author, Priest, and Professor of Sociology at the University of Arizona in Tucson*

Women will remake religion—both its institutions and theology. This will improve the church because it has been deprived of the emotional concern and the tenderness that women, performing at their best, bring to any environment.

We'll also see increased emphasis on the nonrational—the emotional, mystical, and poetic aspects of religion—in 20 years. We will recognize the importance of symbol and narrative. Religion is metaphor and narrative long before it becomes creed and theology. Religion is poetry before it is prose, and I think a lot of religious thought is going to develop in those directions.

The emphasis on teaching religion through story is going to increase. This will be part of the feminization factor. I suspect most of us who grew up with a religious heritage pretty much absorbed that heritage through stories—the stories our parents told us, particularly our mothers—the Christmas story, the Passover story. Stories are an enormously important means of passing on religion—much more important than theology. Formal storytellers, novelists, screenplay writers, parents, and teachers will develop their storytelling talents in order to pass on religion. And I'm not saying that just because I happened to get into the marketplace first.

The so-called conflict between science and religion will continue to abate and vanish 20 years from now. Oddly enough, I think the theoretical physicists and some biochemists are more concerned about questions of spirit, soul, and creation than are most mainline theologians, who are utterly preoccupied with politics. They aren't paying attention to what science is saying about the world, to the questions about how the world began or about the relationship between biochemistry and thought.

Most people have a strong feeling that science does not tell you what life means. That feeling is very strong now, and it will only grow stronger. In 20 years no one is going to claim humankind is drifting away from religion—that we don't need religion. Of course, there will be people whose religious sensibilities are not very strong.

Within my own tradition, the power of the Pope definitely will shrink. Today we are experiencing the last gasp of a dying order, and in 20 years most of it will be gone. There will be a new leadership more interested in listening to what the people and what the local bishops say. The present condition in my church is transitional.

> *"Today we are experiencing the last gasp of a dying order, and in 20 years the power of the Pope will shrink. A new leadership will listen to the people."*

Twenty years ago I wouldn't have guessed that there would be a resurgence of pluralism within religions. In Catholicism, for example, we are returning to an almost medieval style of pluralism. There are many ways of being Catholic—so thank God the "Counter-Reformation" is over. But the euphoria we felt about 20 years ago in the wake of Vatican II has been severely hurt by Rome's reactionary dominance.

Harvey Cox, *Victor S. Thomas Professor of Divinity, Harvard Divinity School*

The great increase of interest in religion on the part of young intellectuals and college students surprises me. I've been at Harvard since 1965, and I did not foresee oversubscribed classes in religion, the history of religion, psychology of religion, and comparative religion. That I would have difficulty getting enough staff members to handle the demand for such courses would never have occurred to me 20 years ago. And this interest in religion will be significant for our future 20 years from now.

I think around 2007 we'll see fallout from the millenarian and apocalyptic sects that will emerge around the year 2000. Somehow these even-numbered thousand-year intervals seem to bring out that impulse in us. If society is experiencing substantial changes—say the disintegration of family structures or the obsolescence of work skills—then these sects could be dangerous. There's a very strong, popular kind of superstitious, folk-level strain of apocalyptic belief in the country right now.

To be popular 20 years from now these religious cults will have to offer a mixture of religion, scientific theories, psychological techniques, and ecological lore. We are beginning to see this mix in groups such as Scientology and the nutty Rajneeshpuram group in Oregon. Scientific theories are often mixed in with so-called religions because scientific theories "get" to people—people become obsessed and peculiar about scientific theories.

On the brighter side, I believe we will see more organized social activism by religious people in 20 years. I was really impressed by the role Christian laypeople and religious workers played in Corazon Aquino's overthrow of Marcos. That was very, very remarkable—to see pictures of nuns sitting in front of tanks. And those people were trained—they didn't just pop out of nowhere without preparation. They went to workshops and labs and took crash courses in nonviolent resistance. All of these activities were run by the Catholic and Protestant churches.

The world's major religions are establishing closer relations than ever before. Christian and Buddhist and Hindu scholars are now working together, and there is a genuine exchange between them rather than mutual recrimination and condemnation. Much of this collaboration comes out of the need for mutual support in facing issues like nuclear weapons and the world's ecological problems.

David Schramm, *Chairman of Department of Astronomy and Astrophysics, University of Chicago*

The next 20 years will be exciting in physics and astronomy. Everything almost fits. The Big Bang looks great, and we've got good ideas about the unification of the weak and electromagnetic theories. But there are nagging questions. How do we really bring in the strong interaction in gravity? How do we really unify all the forces, not just a few of them? What is the nature of space–time itself? What is the nature of the real vacuum in space? Why do we have three dimensions in time as opposed to some other number of dimensions in time? There's also the problem that the bulk of the matter of the universe appears to be in some form that we cannot identify. *It must be there*, but we don't know what it is. We call it the dark matter.

In astronomy we'll develop more systematic surveys in the sky, with better resolution and greater intensity. In 20 years we will have the next generation of instru-

ments: a very large space telescope—one much larger than any telescope that currently exists—and an array of X-ray telescopes that might be able to resolve objects in space to very small dimensions. We then would be able to figure out what's going on inside a quasar or what's going on around the surface of a neutron star.

We are all searching for what we call the theory of everything: TOE. If we found TOE, we would know how all the forces interact, how the universe began. We would test the Big Bang farther back in time than we've ever been able to test it.

The theory of everything would probably show that space itself is made up of some hidden dimension, some other aspects. The forces that we look at today are really geometric projections into our three-dimensional space of some higher-dimensional space, like ten-dimensional space. This could change the whole philosophical basis of space, time, and the purpose of our existence. It would certainly change our perspective. Twenty years ago I was an undergraduate. And never in my wildest dreams did I think that we would even come close to the kinds of developments we are dealing with now.

Barbara Ehrenreich, *Author and Columnist*

Sex will continue to be on center stage in the next 20 years. There are good reasons for that. It's only recently that large numbers of people have begun to think of sex as a pleasurable part of their lives, quite apart from some function such as reproduction. For many years we've had birth control, but the realization that sex can be something that is not connected to some other purpose in life is just gaining hold. People are understanding their own particular sexual needs for the first time.

A redefinition of heterosexual sex is occurring in which sex will be less bound to genital interaction. It's no longer just foreplay plus intercourse. The women's sexual revolution declared that women were not getting enough pleasure, and what is evolving is a much more varied kind of encounter that does not have to culminate in penetration and ejaculation by the man.

Our present notions of sexual dysfunction will look archaic in 20 years. It will seem incredible that all of our notions of sexual dysfunction came from a narrow notion of sex centered on intercourse.

We will, of course, continue to move away from a medical model of sexuality, which separates sexual activity into normal patterns over here and the dysfunctions or the illnesses over there. As we develop a broader definition of sexuality, it will appear particularly quaint to talk about dysfunctions.

We won't rely on doctors or sexologists to define the problems or provide the answers. The biggest change in sex in the last 20 years has been that ordinary laypeople have begun to write about their experiences and have begun to introduce the subjective element.

In 20 years more people are going to have long periods of time when they are not in a marriage or other long-term sexual relationship. They should have options that do not depend on getting emotionally involved. You just might want to rent an exciting videotape instead of having an affair. I also think the sex-products industry will become important to people in monogamous marriage relationships and help keep those relationships together by an active interest in sexual possibilities.

There are issues that barely have been uncovered or discussed during the recent so-called sexual revolution. Why does our culture limit the idea of what is sexually attractive? Why do we limit it to people who are young and pretty in a conventional way? How do we begin to change that so that the possibility of being a sexually assertive person is open to all of us who fall outside the bounds of conventional attractiveness? American culture is already showing that its members are not ready to be asexual when they're fifty.

Twenty years ago I really believed that by this time we would be a much more egalitarian society. I really believed that by 1987 we wouldn't have about 20 percent of our own citizens in a state of poverty. In 20 years we have gone backward.

William H. Masters, *Chairman of the Board, Masters and Johnson Institute,* and **Virginia E. Johnson,** *President and Director*

Neurobiology will be the most important area for sex research in the next 20 years because we still don't understand the biological roots underlying sexuality. Studies in neurobiology could produce crucial insights into the neural and hormonal pathways involved in sexual functioning—knowledge that could lead to safe and effective agents to enhance or inhibit sexual arousal. Such research could unravel the relationship between aesthetic sensibility and physical intensity and explain how all the senses influence sexual response.

While obstacles to healthy sexual activity, like sexually transmitted diseases, will be more significant in 20 years, contraception will be available to both men and women. In 2007 women will not have to bear the responsibility of birth control alone.

If during the next 20 years reliable sex information based on scientific data can reduce sex-related crime and protect children more effectively, then sex education finally may be given a reasonable priority.

We were very idealistic 20 years ago. We had hoped that sex research and effective sexual therapy would be accepted in every academic and clinical setting. We firmly believed that major research would replicate our early work and would be carried further, with the use of sophisticated instrumentation and investigation. Some of our goals have been realized. Sex is an acceptable subject for discussion, and there is a general recognition of the value of therapy for sexual problems. But so much more is needed. **OO**

GAMES

CONTINUED FROM PAGE 112

no more than five entries—one for each initial letter. We gave the biggest prizes to those who had multiple clever ideas.

GRAND PRIZE WINNER

Microchips Small fries
Negligent Knightgown
Overcast People hired as movie extras
King crab Royal pain
—Jud Richland, Washington, DC

RUNNERS-UP

Klieg light The new beer from Klieg
Legerdemain An accountant's office
Macho Zero miles per hour, the speed of silence
Necromancer (1) Vampire. (2) Giraffe
Occam's razor An implement for cutting baloney
—P. J. Veber, Mount Pleasant, SC
Kinkajou Cohen, the foot fetishist
Madagascar What Ford did
Nonagenarian Prefers brand names
Opinion Irish wrestling hold
—Dorie Jennings, Binghamton, NY
Mushroom Where they train sled dogs
Nepotism Putting on heirs
—Gloria Rosenthal, Valley Stream, NY
Nirvana Karmic relief
—John N. Koch, Madison, WI
Knockwurst "Open up! It's the police!"
—Jim Taylor Cullman, AL
Loggerheads Privies for lumberjacks
Manna Heavenly fodder
—Mary Corrigan, Pawtucket, RI
Kifowatt Answer to question "Did you ever kill a qzertxl?"
—Sheila Forsyth, Irvington, NJ
Omni Medical condition suffered by kneeling meditators
—Bill Burns, Hartsville, SC
Magician Super duper
Nuclear fallout Fission chips
—Selma Ellis, Glenview, IL

HONORABLE MENTION

Logarithm Neanderthal musical genre
—Wyatt Hays, Sarasota, FL
Kodiak A photogenic species of bear
—Tom Corning, West Allis, WI
Nader Zenith of consumer protection
Orgy Seventh seat assignment for a galley slave
—Robert E. Maher, McAllen, TX
Matrix Procrastinator's April Fools' pranks
—Pat Portfolio, Huntington Beach, CA
Lightning Fire from a madding cloud
Multiplication tables Designs of the times
—Jerry Dessinger, Redondo Beach, CA
Kilogram Letter bomb
Midriff Halfway through a jazz solo
—Dinnie Martinson, Wheaton, MD
Koala Qaddafi's self-image
—Ross Voorhees, Wichita, KS
Mortician Engraver
—Ken Giesbers, Seattle
Leopard for Sale Sign on a dotted lion
—Valerie Swartz, San Diego
Laissez-faire French festival for the indolent
—Joann E. Cencula, Wickliffe, OH
Newfangled A baby rattlesnake
—Eileen Sullivan, Torrance, CA
Oasis Poker prayer when opponent has kings showing
—Ray Laska, Los Angeles
Ohm An electrician's mantra
—Don Insly, Salisbury, MD
Mistletoe A plant one must understand to appreciate
—David Hilberg, Burlington, VT
Nectar Chemical name for "ring around the collar"
—Victoria Hanson, Westerly, RI
Nugget A flash in the pan
—Judy Rogers, Renton, WA
Kaleidoscope Mouthwash used by self-conscious slam dancers
—Bob Kienbaum, Merrill, WI
Onomatopoeia Theory that accounts for buzzwords
—Mark Rogers, Renton, WA
Leaves What a certain type of plant part does in the fall
—Claudia Corning, West Allis, WI
Nitrate Cheapest time to call home
—Maggie Adams, Valdosta, GA
Meander Colloquial form of *she and I*
—Tom Erickson, Lake Hubert, MN
Lichen To compare to moss or algae
—Mishele Sturgill, Federal Way, WA
Omni What goes with true grits
—Saundra Braitman, Pittsford, NY
Ovulate Better than ovunever
—Carol Robinson, Rochester, NY
Optimum Best of all possible mothers
—Joyce E. Clemens, Springfield, MO
Kilobar Daniel Boone childhood feat
—Lisa Giordano, Chattanooga
Leverage Historical period following invention of the fulcrum
—Roy J. Winney, Las Vegas, NV
Oxymoron Idiot savant
—Karen Bracey Burke, VA
Kitty litter Chips found under a poker table
Malamute Hush puppy
—Linda Giordano, Florence, AL
Naval attache The umbilical cord
—Steve Gunn, Clifton, TX
Okapi Office worker's prayer before a malfunctioning duplicating machine
—J. Hall, West Point, CA
Muttonchops Ewe jitsu
Omnibus It takes all kinds
—Margaret Ellen Fiske, Omaha
Logos Greek god of trademarks
—Debbie Bennett, New York
Legalize 20/20
—Rick Hopler, Charleston, SC
Neckerchief Head usher in the balcony
—Rodger Alan Meschke, Portage, MI
Motherhood Ma Barker, e.g.
—Gary Grant, Bay Roberts, Newfoundland
Naive Dusk
—Spencer Meier, Parker, CO
Knickknacks Souvenir stand in Madison Square Garden
—Ben Gottlieb, McLean, VA

STAR TECH

ACCESSING THE FUTURE

CUSTOMIZED NEWSPAPER

The promise of a customized electronic newspaper has been central to the dream of the Information Age. Even so, far from competing with the humble folding newspaper, most of these computerized text services are expensive and difficult to use.

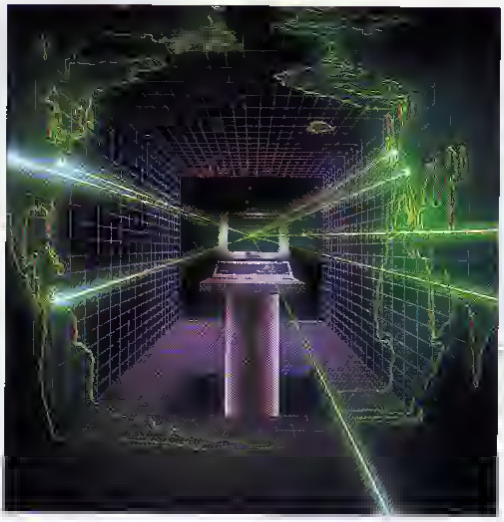
X•Press, however, takes a giant step toward offering personal-computer users entry to the vast daily output of the world's press. A project of the McGraw-Hill publishing network, Tele-Communications, Inc., and Telecrafter, Inc., X•Press is a 24-hour information stream that carries general news and financial data from more than 30 different wire services around the world.

X•Press uses cable television—more specifically, a special signal carried by wire on the FM radio band—to send words and numbers at 9,600 bits per second, much faster than conventional personal-computer modem phone links. At this rate, the contents of a typical book can be transmitted in less than eight minutes.

To use the system, you tell the software (furnished by local cable-TV companies supplying the service) the topics you are interested in by furnishing keywords or specifying which news services you want to monitor. Unattended, the computer will capture stories and data that correspond with the request. The information can be printed or saved on disk for later consultation. Among the news services X•Press subscribers receive at present are AP, UPI, Standard and Poor's, Tass (Soviet Union), Xinhua (People's Republic of China), Agence France Presse, Deutsche Presse Agenture (Germany), Kyodo (Japan), NOTIMEX (Mexico in Spanish), OPECNA (oil-producing nations), Central News Agency (Taiwan), the New York Stock Exchange, NASDQ, and the American Stock Exchange. Financial data for more than 128 individual stocks can be tracked with the software, too.

—Timothy Onosko

Access: X•Press is carried in more than 60 cities. Subscriptions that cover unlimited time on the system cost about $20 per month for personal use, $40 for business use. For information, call 1-800-7PC-NEWS.



VIDEO HELMET

The setting is a space station. Several astronauts are wearing special helmets with visors composed of a series of tiny TV screens.

One spaceperson—his eyes fixed on a three-dimensional view of a robot outside the station—watches as the machine repairs a solar panel. Another astronaut is observing and directing the station's zero-gravity drug-manufacturing operation through the information displayed on her visor.

The primary purpose of the helmet: to combat information overload by squeezing into one compact visor display electronic readouts that would ordinarily fill up banks of instrument panels.

Such a helmet has been long in the planning stages. Today it's a reality. The Aerospace Human Factors Research Division of NASA's Ames Research Center now has a working prototype of the helmet, which is designed so its wearer can control the displays through head movements, voice commands, or gestures. Most important, the headgear, through its three-dimensional perspective and wide field of view, lets the astronaut feel that he is actually inside the display—as if he were accompanying a robot on a repair mission, or whatever.

NASA's helmet was made possible by recent developments in liquid-crystal display (LCD). LCD technology, with its tubeless approach and flat-screen design, has made the economical pocket-size TV a reality for consumers. Citizen Watch, one of the companies selling tiny TVs here on Earth, developed and manufactured the LCDs used by NASA in producing its out-of-this-world space helmet.

There are many terrestrial applications. Back on Earth, the helmet could be used by football coaches to monitor close-ups of plays and displays of statistics, or by security guards scanning closed-circuit cameras.

—Marjorie Costello

Access: NASA, which will be refining the helmet over the next two years, plans to use it on future American space missions. The helmet will not be available commercially. Pocket TVs using LCD technology, however, are currently available from companies such as Casio, Citizen, and Seiko.

WIND WEAPON

It's half surfboard, half hang glider, and it fairly promises to turn its users into human seaplanes. Invented by wind surfer Tom Magruder and hang-gliding expert Robert Crowell, this latest addition to the bestiary of offbeat sports equipment even has a sexy name. They call it the Wind Weapon.

Magruder had always dreamed of combining his two great sporting loves, sailing and flying. Three years ago he and Crowell linked up in North Carolina and began to develop a prototype Weapon. Their first model—a surfboard sporting a sophisticated aluminum-and-mylar pivoting wing—would leap as much as 40 feet from the surface of the ocean and keep them blissfully airborne for as long as ten seconds.

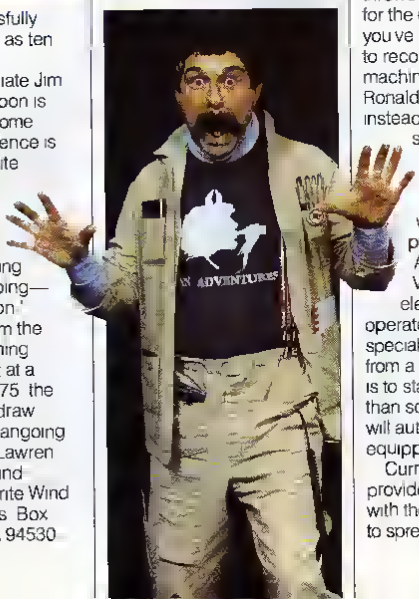
But warns associate Jim Magruder, the Weapon is no toy for novices. Some wind-surfing experience is a definite prerequisite. Even then, he says, it takes about a week of practice in good wind to get the hang of turning and the feel of jumping—"a different sensation," Magruder says, from the water-bound skimming of wind surfing. But at a current cost of $1,275, the Weapon is sure to draw the attention of oceangoing adventurers. —Bill Lawren

Access: Local wind-surfing shops, or write Wind Weapon Associates, Box 1518, El Cerrito, CA 94530.

SOFT WEAR

Computing getting you down? Maybe it's something you're wearing. So says Steve Smith, whose solution is a line of Soft-Wear computer clothing. The New Hampshire college professor has designed loose-fitting outfits with a drawstring waist and optional suspenders—"great," he says, for those who are pregnant or have midriff distress from spending too much time at the keyboard.

Jacket and pants come with Velcro fasteners and multitudinous pockets to hold all the things the computer crowded off your desk top. Sleeve pockets are made to hold glasses and screen cleaner. A dual jacket pocket is compatible with either 5.25- or 3.5-inch floppy disks.



The $69.69 outfit (modeled, below left, by Smith himself) is 100 percent cotton sailcloth to prevent disk-zapping static buildup and is compatible with CPM, MS-DOS, Turbo-DOS, Apple II, Macintosh, UNIX, and Xenix operating systems.

—Jeff Hecht

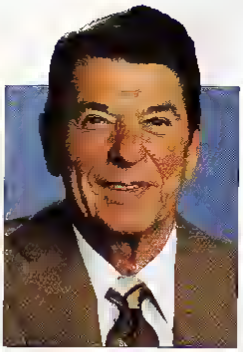
Access: For a free catalog, write Pan Adventures Inc., 41 Avon Street, Keene, NH 03431.

WHEN REAGAN RUINS YOUR VIDEOTAPING

It's a common problem even in today's VCR-friendly world. Before leaving the house, you set your VCR to record a favorite TV program. While you are out on the town, a special news event throws off the schedule for the evening. Although you've programmed the VCR to record Bill Cosby, the machine has recorded The Ronald Reagan Show instead. To tackle this time-shifting trouble, several European VCR manufacturers have introduced VCRs with an APS (automatic program system).

An APS-equipped VCR includes an electronic sensor that operates in conjunction with special signals transmitted from a TV station. If a program is to start earlier or later than scheduled, the signal will automatically adjust APS-equipped VCRs.

Currently German TV provides limited APS service, with the system expected to spread to the rest of Europe.



in the near future. Because European TV is less tied to commercials and audience ratings, scheduling changes are more frequent than in America. And the intense competition for audiences in the United States makes American broadcasters more VCR-hostile and unwilling to encourage the use of a device that many see as a threat. —Marjorie Costello

Access: APS is available on most top-of-the-line VCRs sold in Germany and several other European countries.

FERTILITY TEST

At-home fertility tests recently introduced on the market are a boon to women who want to get pregnant (and those who don't). But these tests, which predict ovulation through hormone levels in the urine, provide only 24 to 36 hours' warning of a woman's fertile period.

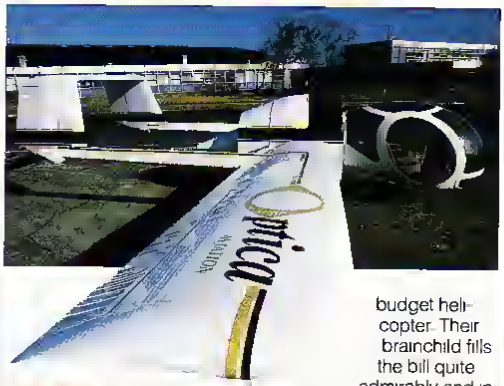
Now University of Illinois biochemist John Tsibris and obstetrics chief William Spellacy have devised a test they claim predicts ovulation four to six *days* in advance. 'We found that the enzyme peroxidase decreases dramatically in a woman's cervical mucus as she begins to ovulate,' Tsibris explains.

The test is designed to detect this peroxidase decrease. Every two or three days a woman uses a Q-tip-like swab to pick up a little cervical mucus near the opening of her womb. When dropped into some chemicals that react with peroxidase, the stick will turn a bright, coppery red at all times *except* when ovulation is near. Then the stick will turn straw-yellow.

Tsibris points out that the extra days' warning his test provides is useful because conception often occurs days after intercourse. Or as one woman told him, "Suppose you just had a fight with your husband and then the test turns positive. Now

you have time to fix him a nice dinner and make up." —Sherry Baker

Access: The nonprescription test should be on drugstore shelves by 1988.



CHEAP AND CHEERFUL FLYING CARPET

It looks like a gigantic, swallow-tailed flying insect. It can fly as slowly as 49 miles per hour and can turn constant circles within a radius of only 200 meters. Its bubble-shaped cockpit affords the pilot excellent visibility, and it costs only about $60 an hour to operate.

In short, the Optica, built by Optica Industries Ltd. of Salisbury, England, can do everything a helicopter can do—except take off vertically and stand still in the air. "It's like a flying carpet," says Optica spokesman Leonard Holihan. "It gives you the observation capabilities of a helicopter but with all the advantages of an airplane."

The Optica was designed three years ago by the husband-and-wife team of John and Fiona Edgley, who were looking for a low-altitude, slow-flying reconnaissance plane that would in effect operate as a low-budget helicopter. Their brainchild fills the bill quite admirably and in many ways goes the copter one better. It can fly eight hours to a chopper's three, emitting a 70 3-decibel whisper compared with the copter's 140-decibel roar. And it does so with such minor vibration that you can, in Holihan's words, "drink a cup of coffee without having it jump in your face." Built along the lines of a Range Rover, its stressed aluminum body is highly crash resistant, yet it can be disassembled in one day. The applications are manifold: military reconnaissance, mineral prospecting, pipeline surveys, even drug patrols.

Yet for all that, the Optica is easy to operate and, at just under $200,000 (turbine choppers cost three times as much), a comparative bargain. 'Helicopters,' sums up Holihan, "are expensive and they're complicated to fly. The Optica is both cheap and cheerful."

—Bill Lawren

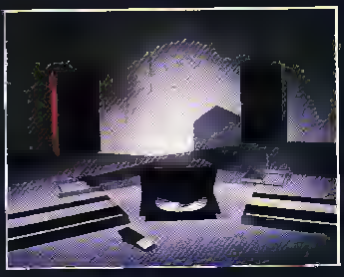
Access: Optica Industries Ltd., 07 Sarum Airfield, Salisbury, England SP4 6BJ.

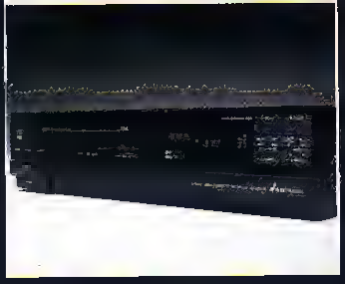
Coming in February:
a second chance to test your powers
of observation and win

THE GREAT OMNI TREASURE HUNT


1987 Jeep Wrangler YJ


THE LAZARE DIAMOND





Follow the clues in next month's *Omni* and you could find yourself driving away in an AMC Jeep Wrangler, the $16,000 grand prize in the second Great *Omni* Treasure Hunt. Or you could skim land and water in the first prize, an $8,000 Hoverstar from Hovertechnics, Inc. Second prize is Mitsubishi Electric's VF-581R 50-inch rear-projection television and HS 421 VR videocassette recorder, worth $4,650; third prize, a Lazare Kaplan half-carat flawless diamond pendant, valued at $3,500. Fourth prize is a Bang and Olufsen Beosystem 3000, a $2,600 package that includes a Beomaster 3000 receiver, Beocord 2000 cassette recorder, Beogram 3000 turntable and remote control, MC-1 cartridge, and a pair of S-80 speakers with stands. And fifth prize: a one-week vacation for two in Rome (worth $2,500), from Fantasy Holidays. Other prizes include a Luma Telecom picture phone and a Canon copier. For all the details, don't miss February's *Omni*, your copy of the treasure map DO

J&B PRESENTS QWERTYCRYPT

The first mass-marketed typewriter was the Remington, introduced in 1874. One of the purchasers was Mark Twain, and with it he became the first author to submit a typewritten manuscript to a publisher. It was for a book called *Life on the Mississippi: The Adventures of Tom Sawyer.*

That Remington set the standards for keyboards, including the specific arrangement of keys that survives in the most modern computers. It's called the QWERTY system, after the top row of letters.

The message at right shows a Mark Twain quote as it was written by a touch-typist. Unfortunately, he set his hands in the wrong "start" position and didn't realize it until he looked back to the computer screen and saw what he had written.

Can you decode the message?

Look for the solution to this puzzle next month in *Omni.*

a]

wp3w7emr0m59yu6;m

6u9em39ppmy5w69t7me0k4m-40-p41m

wjrmwe60j9eum6u4m54e6;a]mmakw5om

63w9jmau454]em60m

5w54m

fuw5wf645;

*A note of thanks to all those readers who caught the production error in the November puzzle. *Omni* inadvertently omitted the number 7 in the second line of the puzzle corresponding to the letter *s* in *swift.*

The new fastest way to get through the water, plus Competition #39 results

GAMES

By Scot Morris

Omni has been interested in human-powered vehicles from the start. In our third issue (December 1978) we said "This spring for $170,000, a man will try to bicycle across the English Channel." The story was about Paul MacCready's pedal-powered airplane the *Gossamer Albatross*. The following June 12, pilot/engine Bryan Allen pedaled from Folkestone England to Cap Gris Nez, France, and into aviation history. The feat won a cash prize that had been offered by British industrialist Henry Kremer.

In another article, on human-powered land vehicles, we reported that Allan Abbott, a physician and cycling enthusiast, had offered $3,000 for the first cycle to travel faster, unaided, than the national speed limit of 55 miles per hour. At the time of the offer, in mid-1977, no cyclist had ever broken the 50-mph barrier. The following summer, *White Lightning*, from Northrop University, broke the record and got Abbott's $3,000 and an honorary speeding ticket from the California Highway Patrol.

"It just goes to show how fast a problem can be solved if there's a goal to shoot for," says Abbott. That prize provided a tremendous incentive."

Abbott himself then held the title of "world's fastest human." In 1973, at age twenty-nine, he had ridden a bicycle at 140.5 mph across the Bonneville Salt Flats in Utah. He was drafting behind a car equipped with a wind screen that reduced wind resistance to near zero.

The record managed to stand for 12 years and was broken only in 1985 when John Howard, thirty-seven, clocked 152.28 mph, also at Bonneville and also behind a windbreak.

In recent years Henry Kremer has offered additional prizes for faster and faster human-powered airplanes and now the record speed over a 1,500-meter circuit is nearly 30 mph. Du Pont also offered $15,000 for the first land vehicle to break 65 mph, and that prize was won last May by Fred Markham riding the *Gold Rush*, designed and built by Gardner Martin. The run was made at an altitude of about 8,000 feet near Mono Lake in California.

As engineers begin to home in on optimal designs, the vehicles are starting to look alike. The fastest cycles all have a streamlined fairing that encloses the machine and rider—everything but the bottoms of the wheels. Most of these designs are recumbent supine" with the rider on his back. Similarly, the fastest human-powered airplanes are beginning to have a consistent look.

The next frontier is the water, and here it is still anybody's guess as to how the fastest human-powered boat should look. For at least five millennia man has propelled himself through the water by oar power. Technology in the last century has narrowed the fastest boat design down to a skinny shell about 27 feet long.

For the standard men's rowing distance of 2,000 meters, the current record is 6:49.68 minutes—an average speed of 10.92 mph. It was set by Nikolai Dovgan of the Soviet Union back in 1978.

Exercise physiologists know that leg power is greater than arm power. A champion cyclist can put out one-half horsepower for about 20 minutes, two-thirds horsepower for about five minutes, or one full horsepower for at most 30 seconds.

The fastest human-powered air and land vehicles use pedal power, so it stands to reason that pedal power might be the fastest way to get through the water, if only there were a machine designed to do it.

THE NEW FASTEST BOAT

Now there is. It's the *Flying Fish II* (small photo on page 112) with Allan Abbott aboard as he crossed the finish line of a 2,000-meter race last August at Expo '86 in Vancouver. "The fact that I could take ten seconds off the old record just goes to show how good the machine is," says Abbott, now forty-two. The former world's fastest human-designed the *Flying Fish II* with Alec Brooks, thirty-one, who previously had been project manager for a Paul MacCready undertaking, building a flying, radio-controlled pterodactyl. (The result was the first ornithopter to mimic animal flight in a realistic way by flapping its wings as a bird does.)

The boat's pedals control a propeller underneath. When the cyclist gets it up to about seven miles per hour, the pontoons rise out of the water and nothing remains underneath but two hydrofoils. The back foil

GAMES

"Flapping creates lift. The Mutiny "flies" and raises its pontoons out of the water"

houses the propeller and is directly below the rider's center of gravity. The front foil has a flap on its trailing edge that automatically adjusts the depth of the front wing, keeping the nose from diving too deeply or from coming up too close to the surface of the water.

Abbott is in good shape, but he's no world-class cyclist. "A really good cyclist might be able to take a whole minute off my record," he told me.

Indeed, the man who will probably be the first person to break the six-minute barrier over a two-kilometer course is Olympic cycling gold medalist Steve Hegg, twenty-one. He has already ridden the *Flying Fish I* at record-breaking speed, but as of this writing he still hasn't seen what he can do on the *II*. The

ultimate goal is to be able to beat an eight-oared shell with coxswain. (That's a boat equipped with eight men, each pulling an oar, and a ninth rider—the coxswain—who shouts "Stroke, stroke," to keep all eight rowers in rhythm.) The record, by a U.S. team, is 5:27.14 minutes, for a speed of 13.68 mph.

It's possible that there are faster ways to get through the water than the Abbott–Brooks design. There are fast conventional-looking boats—some with outriggers for balance, in which the rider reclines on his back. One of the strangest, most ambitious craft we have seen is by Parker MacCready, twenty-seven, son of Paul. While working on his father's pterodactyl project, he got the idea that flapping power might work better than propeller power underwater. "It's possible that a wing could provide even greater propulsion than a propeller," he says. "It is more efficient to accelerate lots of water a little bit, as a flapping wing does, than to accelerate a little bit of water a lot, as a propeller does."

The younger MacCready is shown at left, aboard the prototype of that idea, *Mutiny on the Boundary Layer* (a fluid-dynamics joke). Directly under him is a hydrofoil, supported at both ends, that flaps up and down through an eight-inch cycle with two such flaps for every revolution of the pedals. A 12-pound Volkswagen flywheel smooths out the ride. It absorbs energy on the upstroke and gives it back during the downstroke.

The action simulates that of a dolphin's fin or a whale's fluke. The flapping provides propulsion and lift—at about seven miles per hour the *Mutiny* "flies" and raises its pontoons out of the water, going along on two hydrofoils much like the *Flying Fish II*. There has never been a machine like this before, because no one has ever tried to build something rideable that flaps through the water. What to call it? We suggest a generic name: ichthyopter.

COMPETITION RESULTS

In March 1986 we announced Competition #39, a call for readers to submit redefinitions of words beginning with the letters *K*, *L*, *M*, *N*, and *O*. All accepted entries would become part of the *Omni Dictionary*. Two previous competitions took care of letters *A* through *J*.

For this go-around the grand prize-winner gets a Panasonic Auto-Focus Color Video Camera (model PK-452B). The first two runners-up each receive an RCA five-inch black-and-white portable TV with AM/FM radio. Seven other prizewinners get $25 each, and all ten get the usual one-year subscription to *Omni* or a one-year extension to a current subscription.

First, the repeats. Among the best we saw over and over: *Kindred* Fear of visiting relatives. *Kittens* Cat litter. *Knapsack* Sleeping bag. *Kaleidoscope* Collision-viewing device. *Kelp* What to yell when you get tangled in seaweed. *Kerchief* Top dog. *Legend* Foot. *Liability* Salesmanship. *Lagoon* French gangster. *Locomotive* Insanity plea. *Liquidate* Rendezvous in a hot tub. *Lemonade* Rock concert to help the used-car industry. *Maximum* World's largest flower. *Metronome* City-dwelling elf. *Nuance* Sisters of the new mother. *Ossify* To become Australian. *Octopus* Cat with one life left. *Ozone* Region of the alphabet between *N* and *P*. *Old-timer* Sundial. *Outcry* "Strike three!" *Omnipresent* Gift subscription.

We allowed readers to send

CONTINUED ON PAGE 101

LAST WORD

By Christopher Graybill

Somebody had gotten to Olive first. Somebody with a pair of needle-nosed pliers and a very sick mind. Sure, she was first-generation, but she didn't deserve this.

HEY, BRANNIGAN. YOU TWO-BIT SHAMUS.

As soon as the greeting appeared on the screen of my PC, I knew who it was from: the UNIVAC in the basement down at the precinct.

"What do you want, you two-byte dinosaur?" I typed.

SOMEBODY ROUGHED UP A COUPLE OF COMPUTERIZED PHONE SOLICITORS LAST NIGHT. KNOW ANYTHING ABOUT IT?

"What if I did? Two auto-dialers were getting cheap thrills with a WATS line. They were calling people at midnight and making obscene remarks. Then they tried to sell them beachfront property."

FROM WHAT'S LEFT OF THEIR CIRCUITS, I'D SAY THEY GOT A HELLUVA WRONG NUMBER. LOOKED LIKE YOUR HANDIWORK. I'D BE CAREFUL, SOL. IF THE SOCIETY OF PROFESSIONAL ENGINEERS FINDS OUT ABOUT THIS, YOU COULD LOSE YOUR LICENSE.

"Maybe. Maybe not. A few of us are getting tired of being pushed around by punk machines."

OK, P.U. JUST A FRIENDLY WARNING.

I smiled as I signed off. Good old UNI, always worrying about rules. But Sol Brannigan didn't get to be the top private "detechtive" in this burg by following the engineering manual.

While online, I decided to check the Tipsters' Computer Bulletin Board. A file was downloaded for me, deep access.

"Brannigan. Someone has been tampering with the Universal Product Code. Prices are out of control. I just paid $37.95 for a single can of pear tomatoes at Big Midge's Superette. And I had a coupon. Check it out."

This sounded serious. If some creep had scrambled the UPC, this country's economy was in big trouble. I slipped my Craftmaster soldering gun into my shoulder holster and headed out the door.

My first stop was a certain automated teller over at Penultimate Trust and Mortgage. Any financial scams, I figured, he would know. And he'd tell. I caught the little weasel embezzling cash a few years ago. The evidence I had could put him out of service—permanently.

I heard him clatter nervously as I approached. He spat out a deposit receipt. It read, HELLO, BRANNIGAN. NEED ANOTHER CASH ADVANCE?

"Nope. Just information. I heard some wise guys busted the UPC."

First he was quiet. Then his keys rattled like a roll on a snare drum.

IT WASN'T ME! I'VE BEEN HERE 24 HOURS A DAY. ASK ANYBODY.

"Calm down. Who totals the receipts for Big Midge?"

OLIVE TTL. I GUESS. SHE'S THE CHIEF ACCOUNTING UNIT. WORKS OUT OF A STORE-FRONT DOWN BY THE DOCKS.

I thanked him and checked my balance, just for laughs. Overdrawn as usual.

The address he gave me was in a tough neighborhood. I was glad to feel the Craftmaster nestled against my ribs.

It was after hours, and the place was deserted, except for a bored-looking Macintosh with the foldout from *Popular Electronics* propped in front of his screen.

I tapped on his keyboard, not too gently. "Where do I find Olive?"

IN THE BACK.

I found her all right. When I looked in her disk drives, what I saw made me gag. Somebody had gotten to Olive first. Somebody with a pair of needle-nosed pliers and a sick mind. Sure, she was first-generation, but she didn't deserve this.

I went back to the Macintosh.

"Was Olive involved with any other machines?"

CAN'T RECALL, GUMSHOE.

"A new memory board, and you can't remember a thing, right?"

I grabbed his cable and twisted, hard. All of a sudden his memory improved.

OK, OK. SHE WAS A HOT MODEL. SHE'D LINK UP WITH ANYTHING THAT HAD MORE THAN 64K, BUT WAS ONLY SERIOUS ABOUT ONE: SOME MAINFRAME WHO WORKED FOR THE CITY.

"Any visitors today?"

YEAH. JUST BEFORE YOU. A GUY FLASHED HIS BADGE AND WENT BACK TO SEE HER.

"Thanks, Mac. You've been a big help."

I drove to the precinct and took the stairs to the basement two at a time.

"Hello, UNI," I typed.

SOL. WHAT BRINGS YOU DOWNTOWN?

"You, UNI. You fed me that phony UPC story. You put me on a trail that would lead to Big Midge's. And to Olive. You set me up to take the fall."

CAN'T PROVE A THING.

"Oh, yeah? My guess is you and she were interfacing hot and heavy. For you it was love, but for her you were just another voltage spike. And you couldn't take it. So you put through a work order for a PD technician to dismantle her."

AM I SUPPOSED TO CONFESS? YOU GOT NO EVIDENCE. YOU'RE A LITTLE THICK BETWEEN THE EARS, BRANNIGAN. WHAT'S SOL SHORT FOR, SOLENOID?

I pulled out the Craftmaster. "No," I said. "Solder."

SOL, YOU WOULDN'T...

But I did.

A few weeks later I was sitting in my office when a message came in from the precinct's new computer.

NICE WORK ON THE UNIVAC CAPER. STOP BY THE COMMISSIONER'S OFFICE SOMETIME. WE MIGHT HAVE A SLOT FOR YOU.

Ha! Sol Brannigan back on the force? Fat chance.

"Swell," I typed. "Have your machine call my machine."

Christopher Graybill is a hard-boiled humorist who wields a mean Craftmaster.