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OMNI®

DECEMBER 1981

CONTENTS

Survival Kit is the title of this month's cover, by Scotsman Colin Hay. Familiar to British science-fiction readers because of his numerous paperback covers Hay draws his inspiration from Gothic cathedrals modern architecture, and machinery He attended the Edinburgh College of Art

FIRST WORD

By Thomas O Paine

• Low-cost space transport will open a rich continent in orbit and generate industries impossible on Earth •

In my perspective, America faces four great challenges

First, to build and demonstrate to the world a creative, polyethnic democracy with brotherhood from sea to shining sea

Second, to preserve global peace using deterrence and persuasion wisely to prevent a calamitous nuclear war between the superpowers

Third, to manage international science and technology in order to raise health and living standards throughout the world

Fourth, to continue to explore the frontiers of science, particularly our solar system and the cosmos, eventually propagating terrestrial life to new worlds

To me the greatest glory of America is our multifaceted democratic society with diverse ethnic and religious values. More races live and work harmoniously together here than anywhere in the history of the world. We do not have to apologize that the task is not yet finished; of course it's not. Much remains to be done, because we are an organic society, still experimenting, adapting and receiving new peoples.

I believe that America's destiny is to demonstrate to a troubled world how people of diverse races and cultures can effectively work together and reach for the stars.

Our second challenge, to preserve global peace and prevent nuclear war, is of overwhelming importance. We will need extraordinary wisdom and determination, patience and strength, vigilance and luck. Military strength and resolution are not enough. We must combine deterrence with diplomatic persuasion and better mutual understanding. We must create more effective economic and cultural incentives for peace. Magnificent opportunities exist for joint programs in space exploration. The future of humankind depends upon our skill and success.

Our third challenge, to manage international science and technology to raise global health and living standards, also contributes to peace and stability. New technologies will be of critical importance: medicine, aerospace, green revolution, agriculture (with genetic engineering promising new breakthroughs), industrial production (including computers and robotics), space communications, and new energy options—all of these will spark further rapid advances for the remainder of the century.

Our final challenge, continued bold research on the frontiers of science, particularly in the exploration of our solar system and the cosmos.

I see greater possible rewards today from research in the physical and biological sciences than at any time in our history. Step by step, we are progressing toward a powerful understanding of our environment and our own makeup, from the innermost structure of subatomic matter to the grand architecture of the universe, and from the beautiful genetic blueprint of DNA's double helix to the cognitive mysteries of the human mind.

Today we face exciting opportunities on transcendent planes.

I believe that America's national security and economic well-being depend upon our continuing technological leadership. As was shown a decade ago, NASA's clear lead in space operations is a sobering deterrent to Soviet miscalculation and a major stabilizing force in maintaining peace. Space surveillance systems, furthermore, offer the best hope for realistic arms control that can be carefully monitored and enforced.

There are many other practical benefits from NASA's programs. Communications satellites today represent a private investment of $1 billion—money raised not from taxpayers but from Wall Street investors expecting a return. More than 100 nations are now linked by the global communications satellite system, soon to be followed by the direct broadcast of many television channels from orbit.

In the next decade, modules derived from the space shuttle will be fitted together to create operations centers in orbit. They will provide permanent facilities for medical and materials research, Earth observations, advanced communications, navigation systems, radio astronomy, and other valuable human activities. From space telescope observation may come discoveries of new fundamental laws of nature, with implications for future technologies as important as the past discoveries of radioactivity, lasers, and semiconduction were to present technology.

Thus the new shuttle rocket planes will open for investment and economic development a rich new continent in Earth orbit. Low-cost transportation to orbit and, eventually to the moon and asteroids, plus vigorous space research, will generate whole new industries. From our new vantage point in space, we will better comprehend the universe and humankind's role as a vitalizing force, propagating terrestrial life outward from its earthly cradle.

This is a sound direction for us today. Let us create a new Golden Age as we soar upward to explore our cosmic environment and, in the tradition of the pioneering Polynesian navigators, open new islands for human settlement across the space frontier. ∞

Dr Thomas O Paine is president of Northrup Corporation and a former administrator of NASA. This article is adapted from his commencement address at the University of Hawaii on May 17, 1981.

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RESTON

DUBOS

In tomorrow's computer factories integrated circuits will not be mechanically assembled, but grown inside genetically engineered cells. EMV Associates, Inc., a small, high-tech company in Rockville, Maryland, already has plans to build a protein chip 1,000 times more powerful than today's silicon wafers—and small enough to interface directly with the human brain. *Omni* associate editor *Kathleen McAuliffe* caught wind of this development when she and her sister Sharon McAuliffe were putting the final touches on their newly published book *Life for Sale* (Coward, McCann & Geoghegan), which explores how recombinant DNA technology will transform our lives. Her report on the biochip revolution begins on page 52.

The world's most talented sleuths are racing to track down a killer that strikes victims with such ferocity as to reduce their brains to a spongy pulp. The assailant has left a trail of death and destruction from the jungles of New Guinea, where Fore tribesmen have fallen prey to mink and sheep ranches in the United States. Dubbed Agent X, this killer may be the smallest living entity known to science. In fact, it may not even qualify as a life form—at least not in respect to our present definition. If was a tiny item in the *Wisconsin State Journal* that drew science reporters *Franklynn Peterson* and *Judi Kesselman-Turkel* into the search for the deadly substance. "The news clipping," Peterson recalls, "mentioned that a researcher had uncovered an infectious agent that may cause everything from senility to Parkinson's disease, but it was sufficiently small to pass through filters fine enough to trap all known viruses." Turn to page 96 for a medical detective story that contains all the elements of the best science-fiction thrillers.

With *To Defend, To Destroy* and *The Amnesty of John David Herndon*, *James Reston, Jr.* established a reputation as a gifted commentator on the social upheavals caused by war and political turmoil. But his latest book focuses on another disquieting force within society. *Our Father Who Art in Hell* is the story of the life and death of the Reverend Jim Jones. As a special feature for our holiday issue, *Omni* contacted Reston to analyze the mounting influence of the world's spiritual leaders on global affairs. "Religion in the Twenty-first Century" (page 80) features Reston's interviews with American presidential adviser Billy Graham, South Africa's black Anglican Bishop Desmond Tutu, Tibet's Dalai Lama, and other prominent figures who provide a definitive look at religion of the future.

Living under the constant threat of nuclear holocaust, with everything in shortage except pollution and people, modern man has come to view the future with gloomy desperation. But *Rene Dubos*, prominent scientist, humanist, and Pulitzer Prize-winner, stands out as a singularly uplifting voice in these troubled times. In "Survival" (page 70), an excerpt from his latest book, *Celebrations of Life*, Dubos challenges the doomsayers' bleak predictions. "Trend is not destiny." Never, he points out, have human beings stood still in the face of disaster when they have been aware of the consequences. Professor Emeritus of Rockefeller University, Dubos is a microbiologist and experimental pathologist who created the first commercially produced antibiotic. Now in his eightieth year, he reports, "I have changed in many ways. The best is that I've become more optimistic about the future of the world."

TV Update: Only a few episodes into the 26-part series, *Omni: The New Frontier* quickly reached critical acclaim. Owen McNally, of the *Hartford Courant*, writes, "The show has a touch of class, style, and star quality right from the start. Its breezy approach might even entice kids nurtured on *Star Wars* and other silver-screen space fantasies to develop an interest in science." Kay Gardella, of the *New York Daily News*, voiced similar sentiments. "*Omni: The New Frontier* speaks a language we all can understand. It's a heralded newcomer to the growing list of programs in this genre." The *New York Post* chose the new series as one of the best listings in town, and UPI reporter Kenneth R. Clark comments, "If the opening episode is any indication of things to come, the old 'wasteland' of television is flowering at last." Check local listings for the broadcast times of upcoming episodes. ∞

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DECEMBER

LETTERS

COMMUNICATIONS

Measuring Up

Why does the magazine of tomorrow continue to use the English measurement system of yesterday?

Peter M. Loge
New Haven, Conn.

You point out a problem that has troubled us for three years. We have tried converting all measurements to the metric system, but we found that some measurements are better expressed in the English system than in the metric one.

Most of us have a good idea of what a kilometer or a kilogram is, but how many of us comprehend what a hectare or a kilopascal is? And what about 100-yard dashes, room temperature, the length of football fields (British or American), and measurements that are given precisely in inches, feet, quarts, or pounds?

We have chosen not to distract readers by drawing undue attention to any measurements in a story since this would lessen the story's impact. Our present policy is to retain the system of measurement that is appropriate to a particular story, keeping in mind that many different people read Omni.

Although we are the magazine of tomorrow, we must consider all our readers, along with the fact that we cannot convert them by pushing a few buttons.—Ed

Lunar Madness

As a firefighter and emergency medical technician for the past ten years, I know I can speak for many policemen, nurses and doctors who collectively prepare themselves for an interesting evening when the moon is full. [Human Tidal Waves, Continuum, September 1981]

The incidence of strange or unexpected injuries and maladies seems to rise sharply when the moon is full. On a warm summer night, emotions that would otherwise remain hidden or controlled seem to rise with the tides, resulting in homicides, suicide attempts, domestic quarrels, traffic accidents, drug overdoses, and drownings.

I've yet to respond to any werewolf attacks, but I must remind myself that there are still many moons to come.

Richard C. Ornberg
Des Plaines, Ill.

Public Access

I want you to know what a fine job I think Kathleen Stein did in covering what must have been a very difficult assignment—describing in lay terms a brand-new advance in a very technical area of brain research. ["Brainstorms," October 1981] Usually the translation into lay terms does not take place until some months or even years after the initial scientific report, and usually several stages of intermediate descriptions are written for nonspecialist scientists. This process was successfully shortened by Ms. Stein, since the initial report of our results appeared in the August 21, 1981, issue of *Science*.

I think it is a credit both to her and to *Omni* that the final story met all the initial goals of accuracy, comprehensibility and timeliness. I would not hesitate to recommend your magazine to my colleagues as a fine medium for presenting their work to the public in an accurate and interesting manner.

Alan S. Gevins
EEG Systems Laboratory
San Francisco, Calif.

Boasting to the Stars

Be advised that Farmers Loop Interplanetary, which was formed in 1976 to mine the asteroids, has every intention of fulfilling its charter. The apparatus we will use is not an electromagnetic mass driver, solar sails, or any of the other devices mentioned in Brian O'Leary's Space column [September 1981]. Our economic analysis and the accompanying technical design for our project were the very best in 1979, when they were conceived, and are still the best.

R. L. Blackmer
Farmers Loop Interplanetary
College, Alaska

Software Slang

Omni's article entitled "Computer Graffiti" [September 1981] contained an erroneous explanation of the origin of the word *foo*. *Foo* is the shortened form of "fubar" (pronounced *foo'bar*), which stands for Fouled Up Beyond All Recognition, an acronym that has been in common use at MIT for many years, perhaps decades.

Martin Plys
Cambridge, Mass.

DIALOGUE

FORUM

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

Write Now

President Reagan's January 1982 State of the Union Address may be historic. The President has the opportunity to use his message to lay out America's agenda of hope for the 1980s, and you and I have the opportunity to ensure that he includes space in the national agenda.

We need a nationwide letter-writing and public relations campaign to influence the President and get him to commit the nation to the goal of a permanent manned base, Skyport One, in low-Earth orbit by 1990.

At the August meeting of the National Coordinating Committee on Space, several space-advocacy organizations pledged their support of this campaign. Our strategy is to write letters to Vice-President George Bush, asking him to counsel the President to declare Skyport One a national space priority during the State of the Union Address this coming January.

I need the help of every *Omni* reader to write the Vice-President, Old Executive Office Building, Washington, DC 20500, and request that he urge Mr. Reagan to lead America into space. While they're at their typewriters, they should also write their senators and congressman, asking them to do the same.

Two decades ago President John F. Kennedy used these words to move the American spirit and get America dreaming again: "Now is the time to take large strides—time for a great new American enterprise—time for this nation to take a clearly leading role in space achievement, which in many ways holds the key to our future on Earth."

After two decades of malaise and stagnation, President Reagan declared that "we are too great a nation to limit ourselves to small dreams." A strong space program is the kind of dream we need to revitalize our national spirit.

President Reagan and Vice-President Bush will lead America into an era of hope, prosperity, and great dreams again. It is up to us to tell them that space must be a part of that era. Please write to Mr. Bush today about this critical matter.

Newt Gingrich
House of Representatives
Washington, DC

A mountain of ice and dust and organic molecules is streaking from beyond Pluto toward the sun. It is probably a fragment left over from the formation of the solar system and may hold clues to the origin of life. The most famous visitor to Earth in human memory, Halley's Comet will once again pass our planet in 1986. It cries out for exploration. All the nations of Earth able to send a spacecraft to encounter the comet are doing so. Only the United States seems reluctant. And only the United States is able to muster a *Voyager*-class mission, thereby greatly enhancing the effectiveness of the first truly multinational exploration of space.

As editorials in many American newspapers indicate, a Halley mission is enormously popular. It is scientifically meritorious. It costs less than 1 percent of the NASA budget (tiny for federal spending, but far too much for public subscription). It will reinvigorate a U.S. planetary program sadly neglected by several administrations and will make us proud of our nation and of our species. And it can still be done.

But only the White House can make an American Halley mission happen at this late date. Therefore it is imperative that your readers send a letter or telegram to President Ronald Reagan, The White House, Washington, DC 20500, urging him to take action without delay.

Such a Halley mission will be celebrated by our descendants in the far future. Help make this historic event possible.

Carl Sagan
President, the Planetary Society
Pasadena, Calif.

CONTINUED ON PAGE 176

SAVE A SEED

EARTH

By Rolf Martin and Kathleen Stein

Several years ago a medium-sized bridge was built over a river in Louisiana. It was an ordinary bridge in most respects, except that it was built over one of the last remaining populations of *Isoetes louisianensis*, a small plant that originated in coal-producing swamps several million years ago. That population of *Isoetes* does not exist anymore because no one made any effort to change the construction site just a few hundred feet.

"There are many causes of extinction," says Ghillean Prance, vice-president for science at the New York Botanical Garden, "but the most pervasive is habitat destruction." Farming, strip mining, urban expansion, and many other human activities devastate vital natural areas. "In Iowa, over ninety-five percent of the land has been altered in one way or another," says Dean Roosa, an ecologist for the state of Iowa. And in many other states comparable areas will soon be affected by human incursions. Plants are simply running out of living space.

More than 50 species of plants native to the United States have become extinct in recent decades. Surveys conducted by the Smithsonian Institution and the Federal Endangered Species Program predict as many as 3,000 more American plants—approximately 10 percent of the plants in this country—will vanish if present trends continue.

In order to adopt a policy to preserve endangered plant species, the American people must face a number of difficult questions. How far should we move bridges, dams, tunnels, and roads to accommodate endangered populations? How many acres of critical habitat should be preserved from development? How large a budget should be allocated for endangered-species research and recovery? Answering these questions is especially difficult while the economy is faltering and budget cutting is the remedy nowadays most often being prescribed.

Many people—particularly conservative business groups—believe the time for arguing whether all plant species should be saved has come and gone. Even many environmentalists concede that it may no longer be possible to save all the 3,000 endangered plants in the United States. Confronted with the task of selecting which plants to rescue and, which to abandon to extinction, some scientists are now considering a cost-benefit assessment of plant species. Once their economic value is estimated, a decision can be made as to whether their total worth exceeds the costs of preservation.

President Reagan apparently has endorsed the idea of cost-benefit analysis by ordering that fiscal evaluations must accompany all new federal regulations. But because of the legal and technical issues involved in assessing benefits, a detailed cost-benefit analysis of plant conservation has not yet been carried out by the federal government. Although the Reagan Administration has no clear-cut idea of the economic value of endangered plants, it already has taken a position concerning preservation. The budget of the Federal Endangered Species Program has been cut by about one third. At this rate the U.S. Fish and Wildlife Service expects fewer than six additional plants will be legally protected during the next year, reducing by half the number of additional plants accorded official protection. Regardless of the proposed merits of the President's cuts, his plan does not encompass 99 percent of endangered American flora.

"There is no doubt that many endangered plants will prove to be extremely valuable," says Paul Ehrlich, professor of population studies at Stanford University, in California. For him, the conservation of rare plants is a matter of personal importance. In their new book, *Extinction*, Ehrlich and his coauthor/wife, Anne Ehrlich, describe how Paul's father might have been saved from Hodgkin's disease by an obscure periwinkle plant that grows in the West Indies.

Unfortunately, purification of one of the plant's ingredients, vinblastine, began several years after his father had died. A similar chemical obtained from the periwinkle, vincristine, is now used each year to treat thousands of people who

CONTINUED ON PAGE 160

Reaganomics force botanists to fix a price on such endangered flora as the Tennessee coneflower.

ASYNCHRONY

MIND

By Walli F Leff

The right half of Peter's body moves faster than his left. His right eye tracks more rapidly than his left eye does, and it focuses at a different point. When he blinks, his right eyelids shut faster. When he smiles, his lips curve up more quickly on the right side of his face. Peter is a dyslexic child and his body is constantly in a state of asynchronous confusion.

Dr. William Condon, of Boston University Medical Center, discovered these right/left asynchronies in children who suffer from dyslexia and autism when he studied patterns of body movements that are associated with speech. In Dr. Condon's study, autistic children—seemingly self-absorbed and withdrawn from reality—had a left/right delay. Children who showed symptoms of dyslexia—a puzzling brain disturbance that affects one's ability to read—had the opposite delay in reactions, right/left.

Using a 16mm Time Motion Analyzer, the device used by football coaches for going over games frame by frame, coupled with synchronized audio equipment, Condon has been able to see the tiny movements people make as they talk to and listen to others. Eyes, mouths, wrists, fingers, hips, knees, and feet move in precise patterns, slowing for consonants, speeding up for vowels, all in time segments as short as one ninety-sixth of a second.

By observing speakers from all over the world, Condon has found that each culture's body movements are in concert with the rhythm of its language.

Condon has also discovered that listeners move in patterned precision along with the speech of another person. "Communication is like a dance, with everyone engaged in intricate and shared movements across many subtle dimensions, yet all strangely oblivious of the fact that they are doing so. Even total strangers display this synchronization," he writes. He calls this entrainment.

Entrainment is evident from birth and probably occurs as early as the sixth month after conception. A newborn infant moves rhythmically with its mother's speech, and this, in turn, lets the mother know that the child is responding. From the earliest moment, an infant is sensitive to the rhythm of language.

Condon found that dyslexic and autistic children lack synchrony within themselves and with other people. "The whole organism of a normal person, both left and right sides, moves with incoming sounds," he explains. "In the dyslexic child, however, the *right* side moves, and then after a delay the *left* side moves, as if one side of the brain is getting the message late. And this seems to occur repeatedly."

When Peter's name is called, for example, the right side of his forehead, his right eye, and his right eyebrow move at the appropriate time. The left side of his face, however, remains still. His right side then shows an appropriate orienting response, turning toward the person who called his name.

Meanwhile, the pattern of forehead, eye, and eyebrow movement takes place belatedly on his left side, then repeats—inappropriately—three more times. When the entire sequence is viewed in real time, Peter's lack of symmetry is not very noticeable. His face just looks interesting. At worst, he appears a little fidgety. When the film is run one frame at a time, the right/left differences stand out.

But many dyslexic and autistic children are visibly jumpy and jerky. Condon's slowed-down films suggest that the children's involuntary twitches and overloud speech, with its distorted pitch and stress, can be traced to delayed and multiple entrainment. In one remarkable example, a child is shown attempting to reach for an object. Then his arm jerks in delayed response to a sound heard earlier, and he knocks the object over. Another film shows a child walking across a room and suddenly lurching to one side as he entrains to a previous sound.

The films seem to indicate that the inner life of autistic people is a booming, buzzing confusion. Although their hearing is normal and they hear each sound only once, they continually look around, one way and another, as if the sound were being repeated. "They cannot attend to anything because they attend to everything," Condon says.

How to read faster

By Bill Cosby

International Paper asked Bill Cosby—who earned his doctorate in education and has been involved in projects which help people learn to read faster—to share what he's learned about reading more in less time

When I was a kid in Philadelphia, I must have read every comic book ever published. (There were fewer of them then than there are now.)

I zipped through all of them in a couple of days, then reread the good ones until the next issues arrived.

Yes indeed, when I was a kid, the reading game was a snap.

But as I got older, my eyeballs must have slowed down or something! I mean, comic books started to pile up faster than my brother Russell and I could read them!

It wasn't until much later, when I was getting my doctorate, I realized it wasn't my eyeballs that were to blame. Thank goodness. They're still moving as well as ever.

The problem is, there's too much to read these days, and too little time to read every word of it.

Now, mind you, I still read comic books. In addition to contracts, novels, and newspapers. Screenplays, tax returns and correspondence. Even textbooks about how people read. And which techniques help people read more in less time.

I'll let you in on a little secret. There are hundreds of techniques you could learn to help you read faster. But I know of 3 that are especially good.

And if I can learn them, so can you—and you can put them to use *immediately*.

They are commonsense, practical ways to get the meaning from printed words quickly and efficiently. So you'll have time to enjoy your comic books, have a good laugh with Mark Twain or a good cry with *War and Peace*. Ready?

Okay. The first two ways can help you get through tons of reading material—fast—*without reading every word*.

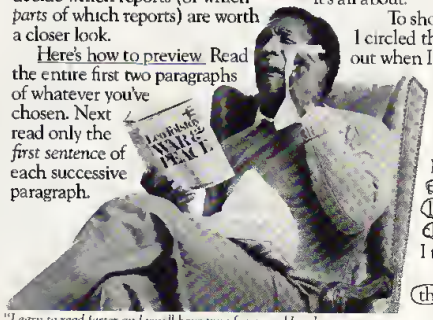
They'll give you the *overall meaning* of what you're reading. And let you cut out an awful lot of *unnecessary* reading.

1. Preview—if it's long and hard

Previewing is especially useful for getting a general idea of heavy reading like long magazine or newspaper articles, business reports, and nonfiction books.

It can give you as much as half the comprehension in as little as one tenth the time. For example, you should be able to preview eight or ten 100-page reports in an hour. After previewing, you'll be able to decide which reports (or which *parts* of which reports) are worth a closer look.

Here's how to preview. Read the entire first two paragraphs of whatever you've chosen. Next read only the *first sentence* of each successive paragraph.



"Learn to read faster and you'll have time for a good laugh with Mark Twain—and a good cry with War and Peace."

Then read the entire last two paragraphs.

Previewing doesn't give you all the details. But it does keep you from spending time on things you don't really want—or need—to read.

Notice that previewing gives you a quick, overall view of *long, unfamiliar* material. For short, light reading, there's a better technique.

2. Skim—if it's short and simple

Skimming is a good way to get a general idea of light reading—like popular magazines or the sports and entertainment sections of the paper.

You should be able to skim a weekly popular magazine or the second section of your daily paper in less than *half* the time it takes you to read it now.

Skimming is also a great way to review material you've read before.

Here's how to skim. Think of your eyes as magnets. Force them to move fast. Sweep them across each and every line of type. Pick up *only a few key words in each line*.

Everybody skims differently.

You and I may not pick up exactly the same words when we skim the same piece, but we'll both get a pretty similar idea of what it's all about.

To show you how it works, I circled the words I picked out when I skimmed the following story. Try it. It shouldn't take you more than 10 seconds.

My brother Russell thinks monsters live in our bedroom closet at night. But I told him he is crazy.

"Go and check then," he said.

I didn't want to.

Russell said I was chicken.

"Am not," I said.

"Are so," he said.

So I told him the monsters were going to eat him at midnight. He started to cry. My Dad came in and told the monsters to beat it. Then he told us to go to sleep.

"If I hear any more about monsters," he said, "I'll spank you."

We went to sleep fast. And you know something? They never did come back.

Skimming can give you a very good *idea* of this story in about half

"Read with a good light—and with as few friends as possible to help you out. No TV, no music. It'll help you concentrate better—and read faster."

the words--and in *less* than half the time it'd take to read every word.

So far, you've seen that previewing and skimming can give you a *general idea* about content—fast. But neither technique can promise more than 50 percent comprehension, because you aren't reading all the words. (Nobody gets something for nothing in the reading game.)

To *read faster and understand most*—if not all—of what you read, you need to know a third technique.

3. Cluster—to increase speed and comprehension

Most of us learned to read by looking at each word in a sentence—*one at a time*.

Like this:

My—brother—Russell—thinks—monsters. . .

You probably still read this way sometimes, especially when the words are difficult. Or when the words have an extra-special meaning—as in a poem, a Shakespearean play, or a contract. And that's O.K.

But word-by-word reading is a rotten way to read faster. It actually *cuts down* on your speed.

Clustering trains you to look at *groups* of words instead of one at a time—to increase your speed enormously. For most of us, clustering is a *totally different way of seeing what we read*.

Here's how to cluster. Train your eyes to see *all* the words in clusters of up to 3 or 4 words at a glance.

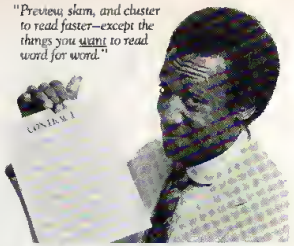
Here's how I'd cluster the story we just skimmed:

My brother Russell thinks monsters
live in our bedroom closet at night.
But I told him he is crazy.
"Go and check then," he said.
I didn't want to. Russell said
I was chicken.
"Am not," I said.
"Are so," he said.
So I told him the monsters
were going to eat him at midnight.
He started to cry. My Dad came in
and told the monsters to beat it.
Then he told us to go to sleep.
"If I hear any more about
monsters," he said, "I'll spank you."
We went to sleep fast. And you
know something? They never did
come back.

Learning to read clusters is not something your eyes do naturally. It takes constant practice.

Here's how to go about it. Pick something light to read. Read it as fast as you can. Concentrate on seeing 3 to 4 words at once rather than one word at a time. Then reread

"Preview, skim, and cluster to read faster—except the things you want to read word for word."



the piece at your normal speed to see what you missed the first time.

Try a second piece. First cluster, then reread to see what you missed in this one.

When you can read in clusters without missing much the first time, your speed has increased. Practice 15 minutes every day and you might pick up the technique in a week or so. (But don't be disappointed if it takes longer. Clustering *everything* takes time and practice.)

So now you have 3 ways to help you read faster. Preview to cut down on unnecessary heavy reading. Skim to get a quick, general idea of light reading. And cluster to increase your speed *and* comprehension.

With enough practice, you'll be able to handle *more* reading at school or work—and at home—*in less time*. You should even have enough time to read your favorite comic books—and *War and Peace*!

Bill Cosby

RABID OVER RABIES

LIFE

By Dr. Bernard Dixon

Imagine a country free of one of mankind's vilest, most lethal diseases but living in fear of that infection's being imported from outside. Envision the disease gradually approaching over many years until just one accident or human error could allow an invasion. Now suppose that officialdom in this same country places constraints on the very research needed to combat this threat.

The setting for this absurd scenario is Great Britain. And the disease in question is rabies. Since the end of World War II, foxes have carried rabies virus inexorably westward across Europe from the German-Polish border. The disease front has traveled at the rate of about 30 kilometers a year, crossing the Rhine River, moving into the heart of France, and now heading toward the Atlantic coast. Today a northwestward flanking movement is evident, bringing rabies toward the Channel ports. By the end of this century if not before, the southeast of England will be at risk. Once the rabies virus has crossed the Channel, it might become irrevocably established in British wildlife.

Faced with this menace, however, the British authorities have all but banned experimental work aimed at the prevention and treatment of rabies. Microbiologists are furious, and one expert, Professor Colin Kaplan, has described the bodies responsible—the Department of Health, the Health and Safety Executive, and the Ministry of Agriculture—as "an international scientific laughingstock." Other distinguished virologists wrote recently to the normally unemotional journal *The Lancet* to announce, "The situation borders on the ridiculous."

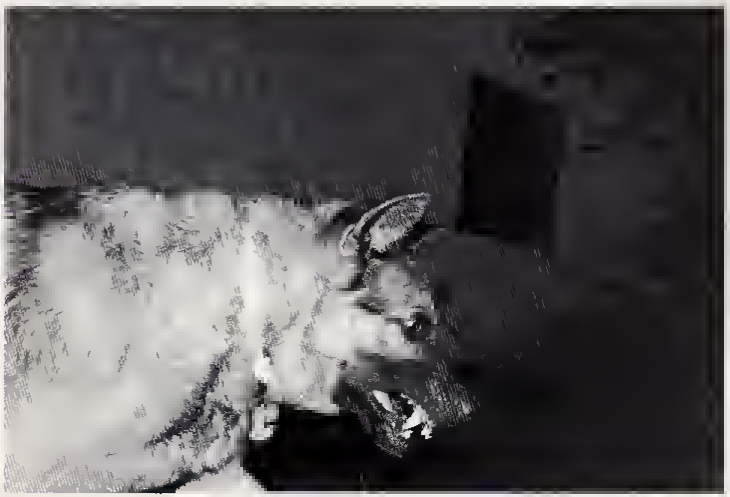
The cause of their rage is a two-year-old initiative, which unnecessarily restricts rabies research to a few laboratories under incredibly tight security. The blame lies with regulatory officials who are not knowledgeable about the virus and who overreacted to the health hazards posed by a totally different disease, smallpox. The ordinance followed two separate incidents in which laboratory experiments with smallpox virus spawned accidental and fatal infections.

The first, occurring in London in 1973, led the government to set up a Working Party on Dangerous Pathogens. The second occurred at the University of Birmingham five years later. The furor surrounding these outbreaks resulted in infectious microbes being put into different categories of risk, such that the more dangerous organisms could be handled only in specially designed containment facilities.

Against the accumulated experience of scientists who had worked safely with rabies over many years, this virus was placed in the same risk group as the vastly more serious smallpox, Lassa fever, and Marburg viruses. To say the least, this is bizarre. These three microbes are contagious. Rabies is not.

As a direct result of such ill-informed regulation, rabies research in Great Britain has steadily declined, and that which is still allowed has become prohibitively costly. There are added inconveniences, too. One distinguished scientist working for the National Blood Transfusion Service has had to use facilities elsewhere, under considerable difficulty in order to continue his vital work in testing new rabies vaccines. Another scientist points out that accidents are, if anything, more likely when technicians have to work in cramped quarters, ostensibly for their own "protection," instead of in a more conventional laboratory. Even more alarming, there will be few virologists in the United Kingdom capable of handling rabies virus when and if the disease does arrive on the nation's shores.

Past experience also confirms the lunacy of Britain's policy. While smallpox has proved highly contagious to researchers, rabies has never been acquired by anyone working in a modern, conventional lab. For that reason European and American virologists at a recent World Health Organization meeting were "bemused and incredulous" when Professor Kaplan informed them of Britain's extraordinarily stringent regulations. As one of them wryly remarked, "You have built fortresses to contain a minor threat, but remain defenseless against a ravaging invasion from afar."



Rabid dogs and other canines are carrying the deadly virus inexorably closer to Britain's shores

PERCHERON

SPACE

By John W Wilson

Perched atop its spindly orange launch platform, the 4' × 55 rocket looked a bit forlorn out there alone on the vacant beach of Matagorda Island northeast of Corpus Christi Texas

It seemed implausible that the engine test scheduled that day was to be the first step toward a proposed launch in 1982 of the nation's first privately funded space enterprise—the Percheron Project named after a breed of draft horses from the Perche region of France NASA's monopoly had created the impression that megabucks were needed to go into space and that such programs were best run by government bureaucrats

Yet here was a rocket funded by Space Services Inc of Houston built by GCH, Inc , of Sunnyvale California, constructed for about $1 2 million with the avowed intention of putting satellites into low-Earth and geostationary orbits for a profit It was an attention-getting situation

The control center for the first engine test was 300 yards down the beach, north of the launch site It was even more implausible than the idea of a private-enterprise rocket Inside the converted Navy electronics van were four GCH employees Eric Laursen technical director David Ross, test director Cliff Horne, in charge of instrumentation, and Caroline Williams the mission's vorce

At T minus seven seconds, Laursen initiated preignition At T minus zero, he opened the liquid oxygen line And a split second later the kerosene flowed into the engine's ignition chamber At T plus three seconds there was a brilliant fireball The top half of the nation's first rocket for profit spiraled lazily into the sky over Texas

There was a moment of silence in the van Then someone muttered ' Oh, shit '

Williams slowly opened the door of the van and asked whether everyone outside behind the sandbags was all right No one was hurt, and soon they were putting out a grass fire started by the explosion

' When it was all over Laursen says there was a strange sense of elation I suppose because no one had been hurt "

The only problem that remained was to figure out why the rocket blew up It s in the nature of rocket explosions for most of the evidence to disappear The Percheron explosion was no exception, but Gary Hudson the founder and president of GCH, thinks he knows what took place

"The valve froze from the liquid oxygen tank because of the high humidity So we had only kerosene burning The heat unfroze the valve, and we had oxygen and kerosene mixing outside of the combustion chamber, triggering the explosion," he says

It's touchy business playing the what if game but the stuck valve points out the problems an entrepreneur in the rocket business faces when making decisions with an eye on costs and ultimate profits

GCH is doing a number of things to keep costs down The company is building one model of rocket and engine designed to provide 75,000 pounds of lift When the weight of the payload increases the rockets will be hooked together in clusters it will spare GCH the cost of developing bigger engines

In addition, the rocket was developed by using technology already available NASA in effect, was the group's research-and-development arm GCH also selected the most cost-effective technology even at the expense of performance For instance, the fuel was pressure-fed instead of pump-fed Pressure-fed rockets are cheaper

Private space venture endures minor setback

Someone also raised the question of a heater line for the liquid oxygen valve Hudson vetoed the item for the sake of economy NASA would have built in every safeguard it could find to make sure the valve would open on schedule Investment return is not NASA's overriding concern

"In retrospect " Hudson says, "it was a bad decision But it was only one of many decisions we made and the rest were good Besides, the valve had worked perfectly the day before "

Hudson says the changes necessary to eliminate the problem were already in the works for the next stage of development 'One thing we're going to do," he says " is use inhibited red fuming nitric acid instead of oxygen It stores at room temperature "

Hudson was not stunned by the loss of the rocket ' We're relatively unaffected," he says "We'll have another ready to launch in about eighteen months '

The Percheron Project got its start when David Hannah, Jr the founder of Space Systems read a story about Dr Gerard K O'Neill s plan for space colonies in orbit at L5 'I was convinced we were closer to a practical use of space than we realized," Hannah says "So I tried to get the Carter Administration interested I talked to several people But in the end none of them were interested '

Hannah, who made his money in Houston real estate is a practical man and hardly a radical visionary He works in the world of dollars and cents and he felt that space could become the source of unlimited real wealth

'I feel it could offer a solution to the world s energy problem " he says "It s a way of being able to have all I want while you have all you want '

Vision in the Carter Administration was severely limited, however and Hannah switched gears 'I guess you could say that

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THE ARTS

By Mitch Tuchman

Away from hokum, away from Raquel Welch in her fur bikini—the filmmakers never doubted theirs would be the path less traveled—and away from what screenwriter Gerard Brach called *fantaisie imbécile*. All films about prehistoric humankind made heretofore Brach dismissed summarily. "*Merde*," he said in a telephone interview from Paris. "Just the beginning of *2001* is good. You remember? Just this one. These five minutes are *fantastiques*. Every other movie is *ridicule*."

Ridicule—One Million B.C. and *One Million Years, B.C.*, *A Prehistoric Love Story*, *When Dinosaurs Ruled the Earth*, *Caveman*, and *History of the World, Part I*. Just what Brach, director Jean-Jacques Annaud, and producer Michael Gruskoff were determined their *Quest for Fire* would not be. "The reality," Brach insisted, "is more exciting, very much more interesting."

"Very much more difficult," he continued. "A realistically rendered remote past is as difficult to achieve as a credibly envisioned extraterrestrial future. "It is immediately necessary to make the film a little bit *scientifique*." At any cost (and that turned out to be $12 million) the documentary aspects had to be credible if the dramatic aspects were not to be as laughable as in those other "cave flicks."

"The director wanted to make these early men convincing in terms of behavior," said Desmond Morris, the Oxford University zoologist and human behaviorist, recalling in a telephone interview his participation in making the film. "Instead of having a kind of science-fiction approach—the sort of thing we've all seen with dinosaurs fighting early man and all that sort of nonsense—he wanted this to have authenticity. He wanted to try, with dramatization of course, to re-create something approaching the primeval condition. So he decided to bring in a language expert, and chose Anthony Burgess, who had studied gestures and body language. He chose me," said Morris, author of *The Naked Ape*.

"Burgess and I spent a couple of days in London advising. We worked with a group of actors at Twentieth Century-Fox who would act out the various gestures or utter the various sounds that either Burgess or I suggested. People were furiously writing notes and making up a kind of dictionary.

"My consultancy was entirely to do with gestures that these people were making [80,000 years ago]. How did they greet one another? How did they use their hands when they were frightened or aggressive? How did they signal their status?

"I used three sources," Morris continued. "One was a sort of reverse distillation, retrogressive distillation from modern gestures, like looking for one's great-great-great-great-grandfather, only in gestural terms; the second was ape and animal signals; and the third was information from modern anthropological studies of tribal gestures.

"For example, when two humans meet, they tend in most cultures to shake hands. This is done by clasping the palm of the other person in your own palm. Now when two apes or two chimpanzees meet, they don't shake hands. What they do is reach out and press the knuckles, the back of the limp hand, to the lips of the other ape.

Stone Age Ulams. No King Kong-ing allowed.

This is the chimpanzee greeting.

"What I did—and, of course, this is only a guess, it's not serious science—was give them a greeting gesture that had a kind of basic validity which could have happened, whether or not it did. In fact, do so. I combined the ape gesture with the modern gesture and suggested that instead of clasping each other's palms and instead of touching the back of the limp hand to the lips, the Ulam should touch the backs of their hands to each other. Not only is this a hybrid gesture but it is also a slightly more cautious gesture. I don't actually give you a chance to grab hold of my hand that way."

"That's just one example. I can give you many more." An Ulam under stress puts his hand to his mouth—we chew our fingernails or smoke a cigarette. An angry Ulam rocks back and forth, stomping his feet—we pace the carpet. How do Ulams kiss? They roll one face across the other's from cheekbone to cheekbone. "It's related to nose rubbing and involves a great deal of skin contact," Morris explained. "It's quite erotic."

Some of Morris's suggestions were adopted unaltered. Others were modified during production. "When you hit a chimp," director Annaud rationalized, "he doesn't react. I tried it in the picture, and it was wrong. I had to show them suffering, so I did. I had girls throwing rocks. The right way was an outward, underhand gesture from the waist [like sowing seed] but the violence was missing. So I had them throw overhand."

The performers—all of whom met the first requirement of a broad forehead and a strong jaw—spent hours watching Jane Goodall's films of chimpanzees using tools, establishing dominance and submission. They spent days at zoos and weeks with British mimes Desmond Jones and Peter Elliott "chimping," bent forward at the hip, knees flexed, elbows turned outward—but no rolling chimpanzee gait. "No King Kong-ing," Elliott admonished.

"The most formidable obstacle," according to Everett McGill, who stars as Naoh, the leader of the quest, "was suppressing natural instincts. A modern

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THE ARTS

By Janel Bladow

By Los Angeles standards the gala unveiling of artist John David Mooney's massive permanent sculpture atop the Metromedia Complex last April was not as stellar a celebration as, say the Academy Awards But it certainly was more illuminating

At night, bathed in 23,000 watts of white light, the 35-foot-high white steel sculpture *Starsteps* looks like an enormous glowing Erector set Designed to finish off the six-story Metromedia building and "to titillate the sky a little bit," according to Mooney, who works in Chicago *Starsteps* takes modern art to the heart of life in the fast lane—the Hollywood Freeway Seen from a car speeding along the highway below, the 41,000-pound supersculpture gives viewers the illusion of a collapsed antenna (imagery to emphasize the entertainment industry?) or a construction segment dangling dangerously above L A traffic Two times each night (at 9 PM and at midnight) the sculpture becomes a performance piece its lights dance once every 30 minutes against the city's smog creating a stairway to heaven During the first 15 minutes the sixteen 1,000-watt floodlights are switched off leaving the steel illuminated by only three 1,000-watt searchlights and ten 400-watt floods During the second phase all 400-watt lights are shut down so that the searchlights alone shine eerily through the steel-formed patterns

A year and a half earlier, at sunset on a clear fall evening, and a continent away, 50 maintenance men a handful of executives and artist James Pelletier began an unusual mission among the skyscrapers of lower Manhattan Carefully following the artist's blueprints, each man switched on certain lights or pulled designated blinds By 8 PM *Night/Light* was complete A dozen buildings along New York's famous skyline suddenly lost their familiar rectangular character and became a single unified, glowing sculpture of geometric patterns—diamonds, triangles, and squares *Night/Light* celebrated the one hundredth anniversary of Thomas Edison's invention of the electric light bulb and was also, according to Pelletier, a tribute to the "magic and mystery of the city night."

Using artificial light for artistic purposes dates almost as far back as Edison's brilliant invention In the early 1900s Thomas Wilfred, the first artist of this century to use electric light for expression rather than illumination of objects, created *Lumia Suite*, now at the Museum of Modern Art in New York But light *as art* lost some of its enthusiasts with the arrival of television 20 years later it wasn't until the late Sixties that the imagination was again sparked by electric light

In 1966 Billy Kulver of Bell Laboratories in New Jersey, formed EAT (Experiments in Art and Technology) to merge industry, science, and art to create large light works A year later the Pulsa Group (now defunct) was organized by seven New Haven, Connecticut, artist/scientists Their plan was to use urban energies—lights, computers, and strobes—to produce sensory phenomena in programmed public environments

Other artists have since used electric light in their work, but it wasn't until Mooney and Pelletier that large-scale environmental light sculptures reached the masses Mooney and Pelletier are also among the first artists to use common light sources—car headlights, searchlights, and building interior lights—to create illuminated "urbanscapes" in darkness Both men have sought to bring form, design, illusion, and continuity to the random evening environment

Mooney performed his first major environmental light sculpture, *Light Space 77*, in Chicago for the city's annual lakefront festival "The relationship between architecture and Lake Michigan," he says, "has kinetic qualities during the day Night, however, creates a very different phenomenon in the city which has no relationship to the water" Thus Mooney devised the spectacular piece—16 searchlights positioned in pairs over eight miles along the shore of the lake Each beam projected 30,000 feet into the sky and was bounced back by the overcast black night, creating pools of light on the water Following Mooney's radio

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Life in the fast lane: sixteen 1,000-watt floods, three 1,000-watt searchlights, and some steel

THE ARTS

By Charles Platt

Public interest in our neighboring planets has never been greater. Those evocative color photographs of Mars, Jupiter, and Saturn have stirred almost everyone's imagination, and yet the number of science-fiction stories set on these planets has dwindled almost to zero. During the past decade, science-fiction authors have taken their tales elsewhere.

Back in the Forties and Fifties, authors used to speculate freely about what we would find on the planets in our solar system. Some of these imaginary scenarios were used so often that they became as familiar to science-fiction readers as the O.K. Corral and Dodge City are to Western buffs.

Venus, for instance, was invariably pictured as a mysterious paradise of swamps and rain forests, giant plants and menacing reptiles. These stock images were used by everyone from Ray Bradbury in his short story "The Long Rain" to Isaac Asimov in his novel *The Oceans of Venus*.

Writers presented Venus this way because the planet is close to the sun and shrouded in a mantle of perpetual clouds. But readings from the Venus probes in the 1960s told a very different story. Those enigmatic silvery clouds turned out to be full of sulfuric acid. The surface of Venus was a rock-strewn hell of intolerable temperatures, around 800°F, and Venus's atmospheric pressure was 100 times that of Earth. Our imaginary forests would have burst into flame, and the reptiles would have been squashed flat. So the myth of verdant Venus was destroyed overnight by a stream of radio data from space.

For a while Mars still offered some promise. It had always been a favorite home for alien races. The assumption was that Mars was a desert world where an ancient race had been driven to the edge of extinction because of a planetwide lack of water, their efforts to build a gigantic irrigation network (the "canals" popularized by astronomer Percival Lowell) had been fruitless.

Then, in 1976, Viking landers sent back their pictures and data from the planet Mars, revealing a wispy atmosphere of unbreathable carbon dioxide, a climate never warmer than −30°F, and soil samples showing no definite evidence of bacteria, let alone the bones of wise old Martians. Mars was proved to be old, cold, and dead, and writers could no longer pretend otherwise.

The outer planets were still available, but they had never been very popular. Clifford Simak set part of his classic novel *City* on Jupiter, depicting a world of frozen beauty where hardy six-legged animals tramped through 500-mile-per-hour winds, admiring waterfalls of liquid methane. We now know that these endearing animals would have a hard time staying on their feet. The *Pioneer 10* probe determined that Jupiter has no solid surface. The planet blends gradually from an unbreathable, corrosive atmosphere, to toxic oceans, to frozen sludge.

Saturn has been found to be equally inhospitable, and Uranus, Neptune, and Pluto, so far from the sun that they exist in a perpetually deep-frozen gloom, are even less inviting.

It's easy to see why authors, faced with these harsh facts, gave up and took their tales elsewhere. Some started setting their stories on moons, asteroids, and orbiting man-made structures. Others abandoned the solar system altogether and restricted themselves to satellites of distant stars.

The advantage of settings on faraway worlds is that such planets are well beyond the scrutiny of TV cameras on future probes. Most stars are so distant that we don't even know whether they have planets or what those planets would be like. This leaves the author free to invent any world and populate it with an alien race, safe from advances in our knowledge of the universe around us.

This is what Frank Herbert did in his all-time best seller *Dune*. The novel deals with a desert planet that might as well be Mars. But by setting the planet in another solar system, Herbert freed himself from the restrictions of our knowledge about the Red Planet. So he was able to develop social and political themes instead.

This "distant star" type of planet story often focuses more on the people than on the planet. A well-known example is

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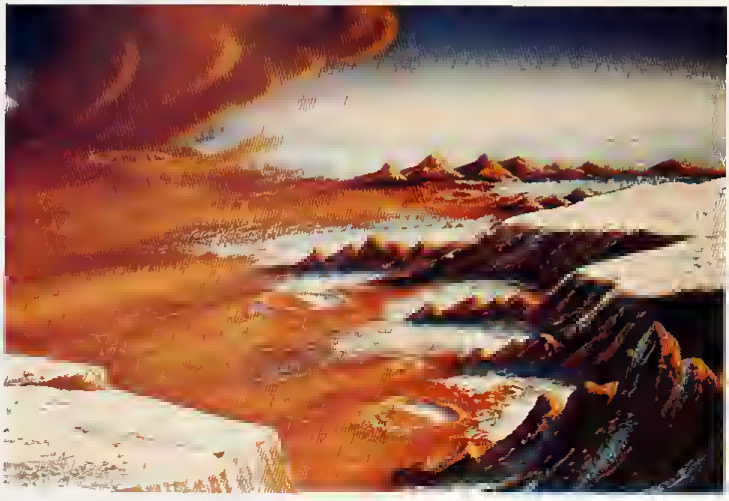

Planetary probes revealing inhospitable conditions rob SF writers of conventional story settings

THE ARTS

By Kathleen Ann Hughes

Except for a time clock mounted on one wall, the small gray room is empty. Throughout the night, every hour an amplified alarm sounds. Sam Hsieh, dressed in a gray uniform, rises quickly from his single bed and enters the room to punch in. He must punch *exactly* on the hour. In his waking hours a beep from his wristwatch alerts him to punch in every hour. A film records his actions for one year.

What sounds like the cruel tactics of an employer gone mad in a *1984* scenario actually took place. For one year "performance artist" Hsieh punched a time clock in his New York loft every hour on the hour, day and night, from April 11, 1980, at 5 PM until April 11, 1981, at 6 PM. "I wanted to explore time and boredom," says Hsieh, a thirty-year-old immigrant from Taiwan. "Most working people do the same things over and over again. I chose the time span of one year to symbolize life and one hour to symbolize work."

As a performance artist, Hsieh explains that his art consisted primarily of the act of punching in. Through advertisements Hsieh invited the public to watch him punch in several times a month. Visitors examined the completed time cards, which were signed by a witness, sealed in plastic, and placed on display. They also examined the time clock, which was covered with paper seals and then dated and signed by a witness to corroborate that the clock had not been tampered with in any way.

To document the passing of one year, Hsieh made the film. Each time he punched in, he exposed one frame of 16mm color film. To dramatize the time lapse, he shaved his head at the beginning of the year. The film shows the hands of the time clock spinning around while Hsieh's hair grows out from baldness to well below his shoulders. Each day passes in one second, and the entire year in six minutes. As the year goes by, Hsieh appears increasingly pale, haggard, and exhausted. Because he stood in a slightly different place in each frame, he appears to be having convulsions.

Time, in the film, twentieth-century industrial time, is a machine racing out of control, and Hsieh is its victim. Working, being chained to the time clock, is destroying his health, aging him rapidly, and causing a nervous breakdown. Hsieh, the industrial worker, is powerless to slow it down and powerless to change its effects. He can only punch in 24 times a second.

At the end of the year Hsieh showed his film to a small audience, slept through 11 uninterrupted hours, and then talked about his year. "I felt very bad about the punch-ins I missed," he said. He had kept a record of why he missed when he did. "But I'm human, and besides, even a machine makes mistakes." During the year Hsieh missed a total of 131 punch-ins (about 1.5 percent of the 8,760-hour total). A punch-in counted only if it was exactly on the hour.

Very few of the missed punch-ins occurred during waking hours. Hsieh said he simply planned his activities to fit within the limit of one hour. He bicycled, jogged, watched TV, talked to friends, and put up posters advertising the performance, always returning home at the sound of a beep from his wristwatch.

"I felt myself becoming more and more like a machine man," he says. "I internalized the rhythm of the clock so that during the day I knew exactly when the hour was up without looking at the watch." Machines, Hsieh adds, have alienated man from his natural senses, including a natural sense of time. And the time clock, invented in the nineteenth century, mechanized the way workers experience time.

If Hsieh did internalize the time-clock rhythm, he was undoubtedly out of synch with his "internal clock," according to Dr. Elliot Weitzman, director of the Sleep-Wake Disorders Center at Montefiore Hospital and Medical Center in New York City. Our internal clock or biological time, Dr. Weitzman explains, is slower than the external clock that is based on sun time. Although it varies with each person, the internal clock day is usually about 25 hours. (The biological day of a person can be determined by when that person, placed in a time-isolated apartment, would think one day had ended.)

The difference between biological time

Every hour on the hour, for one entire year, Sam Hsieh punched in on a time clock.

and solar time. Dr. Weitzman says, allows us to "phase-shift" or adapt to being in Europe or to waking up on a different cycle. Conforming to solar time requires a continual effort and the use of clocks or alarms. No one, he notes, has an internal clock that corresponds exactly to the external clock. It's possible that some process became fixed inside him, so that he had his own external clock.

Hsieh did find, however, that the same mechanical rhythm did not continue after he had fallen asleep. Most of the missed punch-ins occurred at night and were caused by his sleeping through an alarm (90 were attributable to sleep, 31 to tardiness, and 10 to punching in early).

As the number of sleep-caused missed punch-ins increased steadily between April and December, Hsieh found that he had to change the equipment he used in order to wake up and had to learn to control his sleep patterns to "avoid going crazy." It became a contest between his instinctive drive to sleep and his conscious determination to live by the alarm/time-clock rhythm.

"At first I didn't trust the alarm system. So I couldn't sleep well," he declares. His first plan, to use 12 alarm clocks lined up in a row, was jettisoned when he decided they might not be accurate. Instead, he attached his digital alarm wristwatch to a loudspeaker placed next to his pillow. Still anxious about sleeping through a beep, Hsieh often lay awake, worrying for the better part of an hour and would then fall into a deep sleep right before the alarm sounded, and he consequently missed a punch-in.

Though he tried sleeping for 12 to 13 hours a day (albeit interrupted), Hsieh found himself suffering from extreme fatigue. In December he missed two alarms in a row, allowing him to sleep through three hours, the longest period of unbroken sleep he had during the year.

Finally, in desperation, he decided to attach his wristwatch to not just one but two loudspeakers positioned near his pillow. He set the alarm for 30 seconds before each hour (as opposed to 8), allowing him more time to wake up and enter the time-clock room. (Hsieh said he never slept in the time-clock room because it connoted work.)

Although he decided he could trust the two-loudspeaker system and fall off to sleep at last, he continued to experience a severe sense of fatigue. He also found that his skin and scalp itched constantly. "I felt I was losing control of my mind," he admits. A friend told him that at least four hours of uninterrupted sleep are needed to attain a state of deep sleep. Without deep sleep, the friend warned, a person would become mentally unbalanced and perhaps permanently insane.

"I knew I had to *learn* to sleep deeply in one hour or give up the artwork," Hsieh says. His approach was to concentrate on falling into a deep sleep instead of drifting off with the thought of waking up. "I had to forget about time and punching in. I had to trust the machine and stop worrying." He said that this method worked. In January the number of missed punch-ins attributable to sleep dropped from 21 to 3. The fact that he dreamed a lot, he says, is proof that he attained a state of deep sleep every hour. "The real proof, though, is that I didn't go crazy."

However, according to Weitzman, Hsieh may well have been suffering from chronic, or at least partial, REM deprivation. Normally a person falls into stage three or stage four sleep a few minutes after dozing off, he explains. REM (rapid eye movement) sleep, found to be essential to the brain, almost always begins only after 1.5 hours. This is the period in which most dreaming occurs.

If deprived of REM sleep, a brain will exert continuous and strong pressure to attain it, he says. Though this occasionally results in hallucinations (a fusion of the dream process and the waking state), it usually results in REM rebound — simply getting a greater percentage of REM sleep the next night. But while Hsieh's brain may necessarily have induced REM sleep within one hour, Weitzman says, it was probably only partial at best. Though REM sleep constitutes 15 percent to 25 percent of a normal person's sleep, Hsieh probably had far less. "Since an experiment like this is unprecedented," he notes, "the effects simply aren't known. He must have tremendous willpower."

"Whatever an artist does is art if he calls it art," says Castelli. "After all, if we couldn't accept new art forms, we'd still be building pyramids."

Though Hsieh claims that he could control his deep-sleep patterns, he found that he couldn't control his dreams, and he frequently suffered from nightmares. "I dreamed that I wanted to escape and go on vacation," he remembers. "I also dreamed that I wanted to stop punching the time clock and stop being an artist." Other dreams were about wars and about being called back to Taiwan to serve in the army.

Despite the mounting exhaustion, the nightmares, the boredom, Hsieh says he never seriously considered quitting. "I was living my art," he muses. "Like Sisyphus perpetually pushing the stone up the mountain, I just knew I had to go on."

A former painter, he says he chose performance art over painting because "all artists must search for new ideals and new forms. For me this performance expressed daily drudgery better than a painting or a sculpture could have." Although people seemed bored by watching him punch in, Hsieh says the response to the film at the end of the year was so good that he showed it twice.

The time-clock performance was not his first performance work about time. In 1979 he locked himself into a cage for one year and did not read, write, or speak. A friend brought him Chinese takeout meals twice a day. "It represented the solitary working life of an artist," he declares. "Being in a cage is like thinking and creating. It's very lonely work." Some of his other performance pieces have been "Leap," in which he jumps out of a second-story window, "Half Ton," in which he lets half a ton of sheetrock fall on his body, and "Horse Manure," in which he jumps into a large vat containing just that.

According to Leo Castelli, a New York art gallery owner, performance art has been an accepted art form in New York City since the 1960s. Defined as the use of the body itself to express ideas and feelings, it was exemplified by such people as Chris Burden, who had himself nailed to a Volkswagen. "Whatever a working artist does is art if he calls it art," says Castelli, who professes to have "nothing but respect for Hsieh. After all," he adds, "if art couldn't accept new forms, we'd still be building pyramids."

"It may be art, but it's not necessarily *good* art," says Micki McGee, a curatorial intern at the downtown branch of the Whitney Museum of American Art. Although he manages to frame the experience of punching in, good art is not just putting in time, it's creating something new in that time. Hsieh doesn't offer an analysis of the work life or any insights into its horror. People who are forced to punch a time clock would think this was foolish. Ultimately it's nihilistic and a waste of time."

Leslie Walter, an office worker who punches a time clock, disagrees. "The film gave me a different viewpoint on time and punching the time clock," she says. "At first the film was funny, but then it became eerie. I think it's definitely art, and I feel it's excellent."

Hsieh's current piece is called "Outdoors." On September 26, 1981, at 2 PM, Hsieh went outdoors, and he plans to remain outdoors until September 26, 1982, at 2 PM, without entering a single building, car, train, or ship. He is equipped with only a sleeping bag and a specially designed outfit to keep him warm during the winter. "Most people spend eighty percent of their time inside buildings," Hsieh says. "This piece will be about feeling at home outside. Really it's about freedom." ∞

THE ARTS

By Sal Manna

Physics professors do it. Optical technicians do it. College students do it. *Anyone* can do it for the price of a good 35mm camera. Even a twelve-year-old can do it.

In a laboratory in Lake Forest, Illinois, an eighth-grader turns on a green light. Illuminated on a table in front of her is a low-power helium neon laser, a lens, a photographic plate, and her favorite possession, a silver Darth Vader doll. She aims the laser through the lens to diverge the beam so that it covers the fallen Jedi warrior. She carefully lifts a piece of black cardboard that shields the plate in front of the doll. A moment later she replaces it. The special plate is immersed in a photographic developer and, *voilà*, a hologram made by a twelve-year-old! The finished product is a three-dimensional Darth Vader visible in ordinary white light.

Tung H. Jeong says that within our lifetime holography will be as common as photography is today. The guru of holography for the masses, Jeong admits that his "secret goal is to make holography as popular as taking snapshots. It's certainly just as simple, if not simpler. That's why more and more artists are getting into it. They're less afraid of the technology now."

A graduate in physics from Yale with a Ph.D. in nuclear physics from the University of Minnesota, the forty-five-year-old Lake Forest College professor has been conducting holography workshops for a decade. In the early days, however, the process required thousands of dollars for lasers, slate tables needed for stability, and elaborate beam splitters. Jeong has changed all that with his popularization of a technique first employed in the Soviet Union, known as the white-light reflection hologram.

"In our workshops everybody who comes in does a hologram their first afternoon," Jeong says. "They do it even before I explain it. It's like walking and talking as a child. You're doing it before you understand how you're doing it. You don't have to know the scientific analyses of lenses to be able to make a photograph. You don't have to be a scientist anymore to make a hologram."

Within our lifetimes," says Dr. Jeong, "holography will be as common as photography.

For approximately $400, you can set up your own holography studio, according to Jeong. The essential components are a helium neon laser (useful for its low cost and high safety level) of under 5 000 milliwatts, a vibration-isolated table (constructed of a steel plate or a sturdy sandbox resting on inner tubes), a negative lens or a 10x microscope lens, a holographic film plate, and processing chemicals. Since the laser accounts for three quarters of the cost, this method compares very favorably with the cost of a still-camera system. Besides, Jeong adds, there's no problem with focusing, *f*-stops, adjusting lenses, or even exposure. You can under- or overexpose grossly and still come out with a reasonable hologram.

The safety factor has even been improved recently with the production by Kodak of a nontoxic, noncaustic bleach that is required in the developing phase.

Among the sciences, holography is a child in swaddling clothes, having been applied only in the last 20 years. When Jeong first heard of it, he was curious, "but just from reading about it, a hologram is hard to appreciate." So Jeong asked a fellow scientist for one and received a flat hologram of some chess pieces. Though excited, Jeong felt there was much more that could be accomplished.

"The pioneers in photography tried to copy painters when they started, and the early holographers tried to imitate photography. But," he says with glee, "I thought that if you're delving into three-D, you might as well go all the way. Why not a three-hundred-sixty-degree hologram?"

With the help of two enthusiastic freshman students, Jeong made his first hologram in 1965—the first one ever that you could walk around and see all sides of. He had placed a beautiful Chinese ivory carving of a camel inside a cylinder, wrapped with holographic film, and aimed a laser at it from above. The idea, even in holography, that pictures are necessarily flat was found to be false.

In the middle of a coffee table in Jeong's living room are two American-made pistols used by Russian officers in the war

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GALILEO'S ITALY

EXPLORATIONS

By Norvell Brasch

The journey from Rome to Florence ranks among the gems of European travel. Up the Mediterranean coast of Italy and through the exquisite hill towns of Tuscany the route is famed for its wine, cuisine, and scenic splendors.

Galileo Galilei, a native of Pisa, had made the trip many times, but this was to be his last and most difficult. After a five-month trial in Rome, the Inquisition had found him guilty of heresy, a heinous offense against the Catholic Church. His crime: belief that the sun, not Earth, is the center of our planetary system. The Pope's tribunal finally extracted a confession, and on June 22, 1633, the aged scientist knelt before the court. A prison sentence was later commuted to house arrest for life, and Galileo returned under guard to his home near Florence.

The vision of an orbiting Earth soon gained broad acceptance, but the trial of Galileo remains a symbol of the unresolved conflict between science and faith. Recently Pope John Paul II used the occasion of Einstein's centenary to suggest a reconsideration of the harsh verdict against Galileo, which has stood for nearly 350 years.

Whatever the outcome, the reappraisal of Galileo's case has renewed interest in the Renaissance scientist, who stands as one of the most controversial figures in history. For his stubborn refusal to accept the assertions of others without verification, and for the clever methods he devised to prove his own theories, Galileo has been immortalized as the father of experimental science.

Galileo's early work on motion is a case in point. In the great cathedral of Pisa, he used his pulse to time the motion of a massive, swinging chandelier. He concluded that the period of this pendulum was constant, no matter how great or small its arc. This simple test eventually paved the way for more accurate clocks.

Next to the cathedral is Pisa's celebrated Leaning Tower. Legend has it that Galileo climbed the tower with a large iron ball in one hand and a small one in the other. He intended to prove that the acceleration of gravity is independent of the mass of falling objects. Dropped simultaneously from the top gallery, the balls landed at the same instant, demonstrating a law of motion that Newton's theory of gravitation would later explain. Both cathedral and tower remain open to the public, and only fear of arrest and a shortage of cannonballs prevent visitors from repeating the experiment.

An offer of a professorship at the University of Padua prompted Galileo's move to northeastern Italy in 1592. Padua was then within the realm of the progressive Venetian Republic, and Galileo enjoyed total academic freedom. A popular lecturer, he often drew crowds of more than 1,000 people.

In the summer of 1609 Galileo caught wind of a Dutch invention "by means of which visible objects, though very distant from the eye, were distinctly seen as if nearby." As dexterous mechanically as he was intellectually, Galileo wasted no time in constructing his own telescope, gradually improving the lenses until he reached a magnification of 33×. The telescope was an instant hit, and in a dramatic demonstration for the Venetian Senate Galileo touted its ability to sight hostile warships approaching nearly two hours before their arrival.

Galileo experimented at Pisa's Leaning Tower

But Galileo had grander plans for his instrument. Fixing his telescope on the moon, he observed vast craters and imposing mountains, destroying the notion of a smooth lunar surface. He damaged his eyes by viewing the sun and its mysterious spots. He discovered that Jupiter, like Earth, possesses orbiting moons, circumstantial evidence that our planet is not the center of the universe. Galileo announced this discovery in *The Starry Messenger*, describing the four moons that he observed in 1610 as "bodies that belong not to the inconspicuous multitude of fixed stars, but to the bright ranks of planets." In a rare act of political savvy, he dubbed these moons the "Medici Planets," to honor his powerful Florentine patrons.

The gesture apparently paid off. Grand Duke Cosimo de' Medici, his former pupil, engaged Galileo as court philosopher and mathematician. The move to Florence in 1610 marked the end of his teaching duties and the beginning of his career as a full-time scientist.

A devout Catholic, Galileo journeyed to Rome in 1624 to pay his respects to the Florentine cardinal Maffeo Barberini on his election as Pope Urban VIII. The scientist had reason to be encouraged by this event. The new Pope respected Galileo and was said to be more open-minded than his predecessor Paul V. On the strength of this improved climate, Galileo decided to go on record with his theory of a heliocentric system.

His masterpiece, *Dialogue on the Two Chief World Systems*, was printed in February 1632. The Pope's censors, who may have missed the full import of Galileo's message, initially approved the text for publication.

Galileo had been admonished to present the two theories, the geocentric and the heliocentric, as equally valid. He kept to the letter of this command, but the

CONTINUED ON PAGE 147

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Rate Chart To find the rate between two cities, trace down the vertical column of one city to its intersection with the horizontal column of the other city, as illustrated.

	ATLANTA	BOSTON	CHICAGO	CLEVELAND	DALLAS	DENVER	DETROIT	INDIANAPOLIS	MEMPHIS	MILWAUKEE	NEW HAVEN	NEW YORK	OMAHA	PHILADELPHIA	SAN FRANCISCO	SEATTLE
ATLANTA	3.67	3.50	3.50	3.67	3.67	3.67	3.50	3.50	3.67	3.50	3.50	3.50	3.67	3.50	3.84	3.50
BOSTON	3.50	3.49	3.67	3.67	3.67	3.67	3.50	3.50	3.67	3.50	3.50	3.50	3.67	3.50	3.84	3.67
CHICAGO	3.50	3.67	3.67	3.67	3.67	3.67	3.50	3.50	3.67	3.50	3.50	3.50	3.67	3.50	3.84	3.67
CLEVELAND	3.67	3.67	3.67	3.67	3.67	3.67	3.50	3.50	3.67	3.50	3.50	3.50	3.67	3.50	3.84	3.67
DALLAS	3.50	3.67	3.67	3.67	3.67	3.67	3.50	3.50	3.67	3.50	3.50	3.50	3.67	3.50	3.84	3.67
DENVER	3.67	3.67	3.67	3.67	3.67	3.67	3.50	3.50	3.67	3.50	3.50	3.50	3.67	3.50	3.84	3.67
DETROIT	3.50	3.67	3.67	3.67	3.67	3.67	3.50	3.50	3.67	3.50	3.50	3.50	3.67	3.50	3.84	3.67
INDIANAPOLIS	3.50	3.67	3.67	3.67	3.67	3.67	3.50	3.50	3.67	3.50	3.50	3.50	3.67	3.50	3.84	3.67
MEMPHIS	3.67	3.67	3.67	3.67	3.67	3.67	3.50	3.50	3.67	3.50	3.50	3.50	3.67	3.50	3.84	3.67
MILWAUKEE	3.50	3.67	3.67	3.67	3.67	3.67	3.50	3.50	3.67	3.50	3.50	3.50	3.67	3.50	3.84	3.67
NEW HAVEN	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.67	3.50	3.84	3.67
NEW YORK	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.67	3.50	3.84	3.67
OMAHA	3.67	3.67	3.67	3.67	3.67	3.67	3.50	3.50	3.67	3.50	3.50	3.50	3.67	3.50	3.84	3.67
PHILADELPHIA	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.67	3.50	3.84	3.67
SAN FRANCISCO	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84
SEATTLE	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.84	3.84

Bell System

CONTINUUM

Edited by Dick Teresi

GRASS-ROOTS TELECOMMUNICATIONS

Time was you could tell the difference between telegram, letter, newspaper, television program, phone call, and book. But today's marriage of satellites and computers has given birth to the communication hybrid: the voicegram, electronic mail, the videobook, the teletext.

In the good old days the provider was as distinctive as the service. Western Union typed telegrams, the Post Office delivered mail, the New York Times Company published the daily paper, CBS, ABC, NBC, and PBS broadcast television shows, Ma Bell sent the phone bill, and reading a best seller meant a trip to the library or the bookstore.

Now with Dial-a-Bird, Dial-a-Prayer, and even bedtime stories just a few digits away, it's hard to tell who's responsible for what. The *New York Times* arrives via a computer terminal, movies sell at the corner video market, and Federal Express brings the mail.

The profusion of services has caused some confusion among purveyors. During the Seventies the Federal Communications Commission dismantled the Communications Act of 1934, unbundling the nationwide telephone network and keeping the Postal Service out of the electronic marketplace. In 1981 Congress seems ready to approve the process. The result: a breed of new telecommunications, deceptively called "enhanced services." These pay-as-you-go services will be brought to us by just about every kind of communications company. (The exception: the Postal Service, which must stick with delivering the mail.) And while the competition in this new marketplace will offer several advantages, the hitch may be a loss of broad accessibility and universal service.

Take our democratic Postal Service, for example. Letters can be sent at a nationally uniform rate. Often the rate for newspapers, books, and mass mailings is subsidized, too. The private, but regulated, telephone monopoly gives local service for a flat monthly fee. These rates are usually low enough that virtually anyone can take advantage of the services.

Not so with these enhanced services. Because of the cost and complexities of the hardware, an electronic elite has emerged. Giant antennas reach from rooftop to rooftop of major international corporations, transferring electronic messages in voice, video, or facsimile to their far-flung enterprises around the globe. Citibank and BankAmerica have their own international private networks. Computers chitchat round the clock. Indeed, IBM calls its internal communications system Sunnet, because the sun never sets upon it.

But there do not seem to be any plans to install a computer terminal at the corner store for use by the great unwashed electorate. Has anyone been able to borrow videotapes or video discs from his or her public library? Unless each of us has the money to hook into the various telecommunication systems, we won't be granted access to them.

If we look back upon the "information infrastructure" that our forefathers built in a nationwide, flat-rate mail service, and that the Bell System ensured with local, flat-rate service, we may understand the consequences of allowing a pay-as-you-go marketplace to prevail. No longer will public lobbies be able to mobilize massive mail campaigns without incurring paralyzing costs. Charities will be unable to use these expensive systems when they solicit contributions.

The telephone and the mail are democratic instruments. There's a mailbox for every citizen, and a public switched network through which any one telephone can be connected with any other telephone. This isn't true of more authoritarian media—radio and television—where those controlling the microphone control the message. Besides, it's virtually impossible to talk back to a TV set. While enhanced services may permit instant polls and video shopping, they'll benefit only those wealthy enough to buy their way into the "enhancement."

If the public is to benefit from this era of telecommunications, then the public better demand more responsive government representation. If we're to render obsolete the postal system and the public switched network of POTS (plain old telephone service), we'd better take care not to throw out the sense of democracy upon which the government survives and the economy thrives. The nationwide grass-roots telecommunication system—now available to all—is a concept worth reconsidering.

Where shall we find a street corner computer terminal to send out our electronic mail if can't afford our very own Apple, Atari, or TRS-80? What public institutions will keep our electronic history books when parchment and paper are outmoded?

Who will tend our grass-roots telecommunication gardens?

—ANNE W. BRANSCOMB

CONTINUUM

SPORTING VIOLENCE

Every month or so John Chefters lugs a pair of video cameras to his car and drives to Boston Garden to see the Bruins in action While he s watching the game he flicks on his cameras pointing one at the hockey players and the other at the people in the stands

Chefters a psychologist at Boston University for the past few years has been studying the violence that erupts among spectators at sporting events, anything from hockey to football Using data gleaned from video recordings and firsthand observations of more than 700 college and professional games Chefters has concluded that violence on the field or in the arena almost always provokes violence among the fans At the Bruins games for instance fans become rowdy whenever a brawl breaks out on the ice

Because hockey players are especially violent followers of that sport become more disorderly than any other sort of fan Yet other sports also provoke rage Soccer fans for example do not go to a game expecting players to slug it out, but when there's a brawl the spectators often break into a slugfest themselves Indeed, some 65 percent of all the fights among soccer players are matched by disturbances in the stands

To keep peace among spectators Cheffers would have TV scanners that can predict outbreaks He would like to see fans grouped in smaller less anonymous ' seating sections If the chairs were more comfortable the herd instinct that normally prevails in crowded stadiums could be subdued And Cheffers suggests that arenas resemble parks with flower boxes in the stands Banning the sale of alcoholic beverages at athletic events however, is one measure Cheffers does not recommend Most imbibers, he says are well behaved

—Eric Mishara

Violence in the game often leads to violence in the stands

The only time politics will not interfere with the quality of a scientist's work is when he happens to be a political scientist

—Anonymous

$3 MILLION TOILET

Astronauts have been complaining for years Without gravity, they say answering nature s call is a messy totally distasteful chore

That s why NASA just spent $3 million on the new Waste Collector System a high-tech space commode that simulates a gravity field so that it can be used like a toilet on Earth by both males and females aboard the space shuttle The two-phase disposal system which processes liquid and solid wastes separately connects to a unit that resembles a regular toilet—except that crew members strap themselves onto the seat so they won't float away

When an astronaut defecates spinning blades beneath the seat create a powerful suction which draws the waste down to where it literally hits the fan ' according to Frank DiSanto, the project manager for General Electric Space Systems who refined the device over a three year period The blades shred the waste and hurl it against the sides of a huge collector tank

To ' flush astronauts pull a handle that slides a lid over the toilet, creating a vacuum that causes the waste material to vaporize through a filter and out into space

You have to strap yourself in

Zero gravity poses a special problem during urination as well since liquid released from the body does not flow in the expected stream Instead it separates into free floating "spheroids Astronauts find this circumstance disconcerting

To get the stream flowing engineers devised an air suction tube that draws the liquid in through a funnel Because people can use the toilet while standing or sitting it works equally well for male or female astronauts The liquid waste is stored in tanks in the belly of the spacecraft

According to DiSanto the system passed muster on *Columbia* s shakedown cruise with flying colors sparing the grateful crew the unsavory task of using and storing waste bags which he said, were really a mess during previous space-flights —Irving Lieberman

With regard to the electric light much has been said for and against it, but I think I may say without fear of contradiction that when the Paris Exhibition closes electric light will close with it and no more will be heard of it

—Erasmus Wilson
professor at
Oxford University 1878

NOISY VEGETABLES

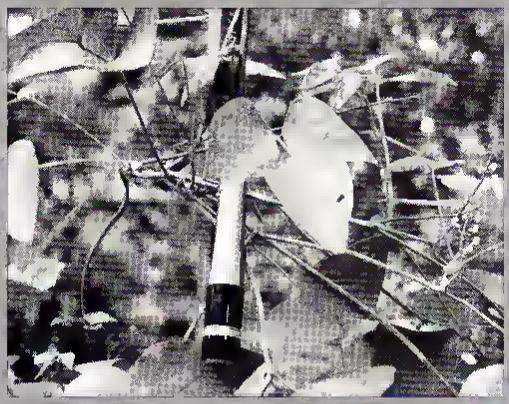
An Australian scientist has revealed that plants whisper Water me

As St Francis preached to birds John Milburn of the University of New England at Armidale New South Wales has picked up the language of plants according to the *New South Wales Business Review* Eavesdropping on the castor bean plant—by means of a tiny microphone implanted in its stem—Milburn has heard thirsty plants *click*

The clicking noises reportedly come from the vibration of the plant's minute water pipelines His method, Milburn says, could tell farmers which seeds to plant in arid soil and identify which new breeds of plants are drought resistant

Other plant fanciers are underwhelmed by the breakthrough however It's certainly plausible that the columns of water might snap after a while says University of Chicago biologist Edward Garber But so what?

What of Milburn's claim that the method could identify drought defying plants? 'He's out of his gourd says Garber Say you came up with five hundred ways to tell whether someone is dead That wouldn't bring him back to life —Judith Hooper



Listening carefully to plants An Australian scientist claims that plants in need of water make detectable clicking noises

I would like to volunteer for your next space trip I can go anytime but Wednesday afternoons I have my hair done on Wednesday afternoons

—Child's letter to NASA

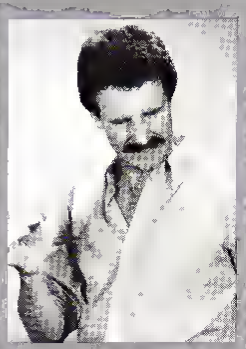
Medicine makes people ill, mathematics makes them sad and theology makes them sinful

—Martin Luther

FOUL MOUTHWASH

A new mouthwash makes smokers as objectionable to themselves as they often are to nonsmokers According to the inventor Dr William Najjar a Montreal physician the mouthwash has a fresh, minty taste that makes the mouth feel extraordinarily clean—until the smoker lights up Then the mouth tastes 'as if it has chewed on fifty cigars and the smoker is instantly in hell

Dr Najjar reports an 85 to 90 percent cure rate for smokers who use the mouthwash in a ten day regimen A smoker merely rinses twice daily with one teaspoon of the mouthwash in an ounce of water, the devastating effects last up to 18 hours Dosing the mouth with silver nitrate and glycerine the mouthwash produces a bracing sensation drying and tightening the gums and activating the salivary glands When the smoker takes a drag, the tar and nicotine absorbed by the gums react with the mouthwash and saliva forming a bilious yellow liquid After one or two puffs the smoker spits spits, spits " and the mouth feels like a garbage dump



A repulsive shock for smokers

Trained in neuropsychiatry, Najjar got sick of treating patients with smoking ailments Finding rational arguments useless, he resolved to cure them with a "shock therapy" Without warning Najjar gave the mouthwash to a few patients and let them go their merry way It made their breath unbearable Knowing he'd hit on something the doctor spent the next seven years testing the rinse on thousands of subjects

Najjar has begun to sell the mouthwash in Quebec and Ontario provinces under the name of Tabanil (a French portmanteau word for "tobacco-nil") He is seeking FDA approval so he can sell it in the United States When and if it gets here potheads should be alerted as well The mouthwash has the same effect on people who smoke marijuana and hashish —Mark Teich

The past is not dead history it is living material out of which man makes himself and builds the future '

—Rene Dubos

CONTINUUM

SPACE AGE BRA

You wouldn't have to be an astronaut to benefit from a Space Age bra designed by a NASA engineer the manufacturer contends

Designed by NASA's Lawrence Kuznetz the Support-Her bra suggested for jogging, employs the

Running presents problems similar to space travel

same theory of compression (rather than uplift) used in the design of astronauts' clothing For spaceflight it is important to ensure that bodies and clothing move in the same direction to prevent chafing

Manufactured by Protogs, a Long Island firm the bra combines Spandex Velcro carefully placed adjustable straps, and bottom ventilation to provide comfort to active women as they 'shuttle around.'

A product of an apparel analysis course that NASA conducted at the University of Houston, the bra is only the first of numerous articles Kuznetz wants to design Other ideas suggested include garments containing packets of heat-absorbing gel strategically placed to keep athletes cool children's clothing that grows as they do and sleeping bags that can be converted into hiking suits —Allan Maurer

PRESCRIPTION ERRORS

If a physician writes an illegible prescription, his patient may receive a deadly dose of the wrong medicine For instance one doctor's order for Ethatabs—a muscle relaxant—was misread as Estratabs, which is a female hormone Before the mistake was discovered the male patient took Estratabs for over a year and developed large breasts as well as psychological problems

According to Neil Davis and Michael Cohen of the Temple University School of Pharmacy in Philadelphia, not all doctors write sloppily and medication errors are caused by more than just poor handwriting The pharmacists who recently published a book titled *Medication Errors Causes and Prevention*, say a breakdown in communication within hospital staffs is also at fault

Abbreviations for instructions have sometimes caused the correct medicine to end up in the wrong place The letters OD stand for the Latin *oculus dexter*, or right eye Doctors occasionally use OD to mean once daily Nurses uncertain of the abbreviation have administered irritating oral liquid medications to the right eye

Davis says that a patient can protect himself by using common sense He should question the administration of eye drops, for example, if he is hospitalized for a condition unrelated to his eyes To match drug and disease accurately Davis and Cohen recommend that pharmacists maintain a patient's medication record, which would include a description of problems and previous therapy They also advocate the use of the unit-dose system, in which the pharmacy provides the patient with daily medication in a labeled package

—Madeleine Lebwohl

TALKING THERMOMETER

If you have trouble reading the red line on thermometers, Electromedics, Inc a Colorado company has just the thing for you a talking instrument that actually tells you your body temperature It's also realistic, it has a speech impediment

Don Nicholson of Electromedics, says, "We developed the instrument for the blind but it is being used primarily in biofeedback work Once the probe is attached to an extremity a finger or a toe the thermometer gives continuous readouts in a male voice ' Oral and rectal probes are also available The talking instrument, which Nicholson said lisps the numeral 3 saying "thwee " retails for about $270

A less expensive, non-talking model that gives a continuous digital readout of temperature is more popular priced at about $100, Nicholson says

'Both are useful in biofeedback because they tell the user how he's doing As you relax, for example, the temperature in the extremities goes up "

—Allan Maurer

Verbal thermometer Available orally or rectally and it lisps

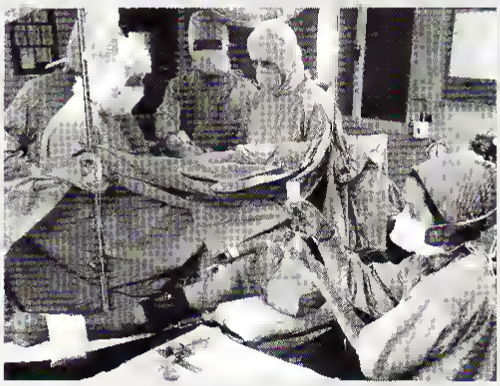
COMPUTER SURGERY

An automated setup now in the works may eventually enable surgeons to cut tissue and stop bleeding in delicate operations with more speed, precision, ease, and safety than ever.

The system, mainly consisting of a solid-state generator controlled by an 8080 microprocessor, is designed only for electrosurgery performed through an endoscope.

In electrosurgery, rapidly vibrating blades, powered by high-frequency electrical currents, blast rapid-fire voltage in a fraction of a second to sever tissue or to cause blood to coagulate. An endoscope is a tube that can snake through the throat and other body openings, and slide into a hard-to-reach spot to convey fiber optic images back to surgeons watching a TV monitor. Then surgical tools slipped through a cable are manipulated like marionettes for the procedure.

Computerized electrosurgery done by endoscope—without actually opening up a patient—shows potential value against ulcers, polyps, other stomach disorders and, possibly, such cancerous growths as melanomas.



Conventional surgery can result in unnecessary cutting and poor incisions. Computerized surgery can be precisely controlled.

The advantage here is that a surgeon can program the computer to control the intensity, frequency, duration, and rhythm of the electrical currents for each operation, preventing extra cutting or poor incisions.

"You can program an operation almost the way you compose music," says Otto H. Schmitt, biophysics-bioengineering professor at the University of Minnesota, who developed the computer surgeon with support from the National Institutes of Health and the Veterans Administration. "It makes the whole process faster and smoother because it has a program-it-yourself keyboard for the virtuoso operator."

After further experiments on dogs with ulcers, he says, the next step will be to test the device on humans within a year or two. —Robert Brody

"No organism can afford to be conscious of matters with which it could deal at unconscious levels."
—Gregory Bateson

CAR FINDER

For the absentminded driver who can't recall where he's left his car, there's hope at last.

A Torrance, California, firm is marketing an antitheft device, called Pulsafe, which—at the press of a button—will make your car beep its horn and flash its headlights.

Perfect for those mammoth parking lots at the airport after a weekend trip, or at a sports complex after a beered-up afternoon, Pulsafe uses a radio transmitter and operates on the same principle as an automatic garage-door opener. Just flip a switch, and your car springs into action. The optimal signal radius is 100 feet.

"The device is also useful in unsavory neighborhoods for scaring off young people who have selected your vehicle as a backstop for stickball," says Marvin Lazansky, president of TMX, Inc., the distributor. When the car goes crazy with no one in it, the kids just scatter. The suggested retail price is $495, not including installation. —Al Furst

"It is always the best policy to speak the truth, unless of course you are an exceptionally good liar."
—Jerome K. Jerome

"Smoking kills. If you're killed, you've lost a very important part of your life."
—Brooke Shields

Nightmarish parking lot. A new device brings your car to life.

CONTINUUM

DUSTY NUNS

Household dust, collected by nuns is being turned to good use in modern medicine

The dust comes in en velopes parcels and car trunks to Holy Cross Priory in Sussex, England where the Sisters of Our Lady of Grace and Compassion gather it into large plastic sacks These then go off in regular batches to Beecham Pharmaceuticals a drug manufacturer based at Brentford in Greater London

The eventual beneficiaries of this bizarre trade (Beecham pays 10 cents a pound for the dust) are people who suffer from allergic asthmas Many asthmatics are hypersensitive to antigens present in house mites, which are found in astronomical numbers in household dust Beecham's task is to use the purified dust to produce a vaccine—exactly as it would with measles virus or diphtheria toxin

All sides benefit Allergy sufferers are relieved of their runny noses and sneezes Beecham makes a nice profit from its ton of house dust collected each year And the Sisters of Our Lady of Grace and Compassion have already used *their* profits to help run interdenominational housing for old people —Bernard Dixon

Collecting that dusty stuff. The dusty variety collect extra money

MOVABLE MAILBOX

When mailman Raymond Vanis crossed the sprawling lawns of David City Nebraska he invariably slipped on ice tripped over toys, or provoked dogs to attack After more than 15 years of jangled nerves and mounting injuries he decided to tackle the problem The result? The Curb to Door Mail Retriever a robotlike arm that will help letter carriers transport mail across a yard

According to Vanis his new device consists of a folding mechanical arm with a portable mailbox at the end The arm stands in the middle of a yard Vanis explains and is hooked to a pulley system that extends from the curb to the front door of the house By tugging the pulley cord, the postman and the receiver of the mail can move the arm and the mailbox back and forth without braving the hazards of the lawn

An end to postal agony is near

Vanis expects that if his system is implemented one mail carrier could do more work than is now done by two thus reducing manpower costs Moreover the carriers who remain would require far less time off to nurse their bruises An additional incentive to homeowners The device doubles as a support for a flag yard light, or basketball hoop —Margaret Sachs

Time does not become sacred until we have lived it
—John Burroughs

NAUSEA STRAPS

Ancient Chinese acupuncturists relieved nausea by pressing tiny points on the inside of the wrists Now oncologist Daniel Choy of Columbia University Medical School has developed a pair of plastic straps that do the same thing By suppressing those tiny wrist points (called nei-kuans by acupuncturists) the straps can alleviate nausea within one minute

Worn like watchbands the elasticized straps exert constant pressure on the tendons inside each wrist Dr Choy believes that they inhibit nausea by triggering a direct electrical impulse to the brain

Choy conceived of the straps a year ago in a storm-tossed yacht race between Newport Rhode Island and Bermuda When a wave washed the ship's pill supply overboard, he had to come up with a treatment for the seasick crew He taught them how to suppress the nei-kuans with the thumb It worked, but only if the pressure was continuously applied

Choy realized there had to be a better way So he built the wrist straps when he reached land

The straps were tested on 100 seasick cruise passengers and according to him helped 85 of them The straps also had a high success rate with postoperative and chemotherapy patients With the patent pending on his invention Choy says the wrist strap will soon be on the market —Eric Mishara

SPACE VAN

By 1987 we may have two choices of travel to space the space shuttle and Len Cormier s compact alterna tive, which he calls the Space Van Orbiter

Cormier believes it is possible to build a small fleet of long-nosed stubby-winged space planes that can be piggybacked on a 747 high into the atmosphere Somewhere above 40 000 feet they would be released to rocket off into low-Earth orbit

Cormier an aerospace engineer with 23 years of experience has established Transpace Inc to design and launch that fleet

The Space Vans will be about half the size of the shuttle and consequently will carry smaller payloads Their big advantages over the shuttle will be in cost and convenience At the peak of operation Cormier says the Space Vans could be making as many as 1 500 flights to low orbit a year ferrying cargo and people for roughly one fifth of what the shuttle would cost

—Douglas Colligan

SURVIVAL CONDO

People determined to survive anything from nuclear war to social collapse have created a market for everything from crossbows to radiation suits Now they can survive in style—if they have $80 000 for an underground condominium

Survive Tomorrow Inc a Utah-based firm has built an underground condo project in the Utah town of LaVerne (population 1 200) Located far from cities or military installations and protected by mountains, the condos are designed to withstand anything except a direct nuclear hit Above each condo are eight inches of reinforced concrete and three feet of earth An independent utility system safeguarded air- and water-filtration systems a decontamination center and medical facilities are part of the package

While the base price of each unit is $39 000 each comes with a four year supply of freeze dried and air dried food for four persons with storage space above the shower and in other out-of-the way spots This raises the price of the condos to nearly $80,000

STI president Ron Boutwell says Unlike gun nuts and other kooks organized survivalists are not a threat to anyone What they're trying to do is preserve society and its laws —Allan Maurer

Survivalist Not a threat just trying to preserve socie y

SNORING CURE

Laugh and the world laughs with you snore and you sleep alone goes an old saying Snoring can be a noxious interpersonal problem says Raymond Rosen a clinical psychologist at Rutgers University Medical School, in New Jersey and he and his wife Linda an experimental psychologist have patented a device that s designed to stop it

The idea is fairly simple

When the patient snores too loudly the machine jus' wakes her up

When snoring exceeds a certain volume, the device wakes the patient up It also counts snoring episodes during the night, to help make the patient aware that he really was snoring During the two week treatment period the device is set to respond to progressively lower snoring volumes

So far over 80 percent of people using the device have reduced their snoring considerably and many continue to improve even after the treatment is finished, claims Rosen (who says by the way that neither he nor his wife snores) The device isn t on the market yet but Rosen is talking with possible manufacturers who could market it for less than $100 —Jeff Hecht

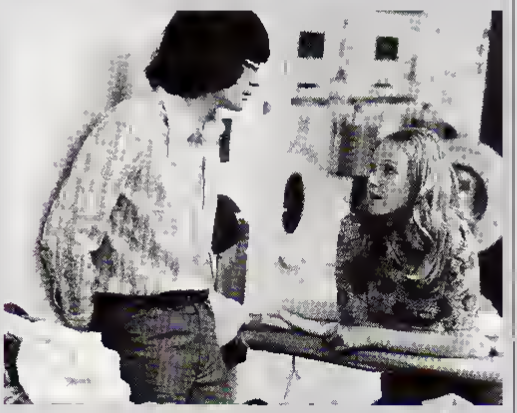
CONTINUUM

OPENING LINES

What do you say to an alluring stranger? Well, if you're a man and the stranger is a woman, lines like "I bet the cherry jubilee isn't as sweet as you are" won't get you very far in Singlesland.

Men have underestimated just how much women *hate* a little embarrassed about this, but I'd like to meet you" and innocuous queries like "What do you think of the band?"

The no-no's ranged from "Bet I can outdrink you" (bar) and "Is your bread fresh?" (supermarket) to such laundromat banter as "Those are some nice undies you have there."



Ineffective line: "Those are some nice undies you have there."

cute, flippant opening lines, says psychologist Chris L. Kleinke of Edith Nourse Rogers Veterans Hospital in Bedford, Massachusetts. In his study, both sexes—but particularly women—preferred either a "direct approach" or an "innocuous question" as a prelude to further acquaintance.

Kleinke had college students rate a potpourri of opening lines appropriate to bars, restaurants, supermarkets, laundromats, beaches, and general situations. Highly rated lines included direct ones like "I feel

Men employ such cutesy, macho come-ons out of fear of rejection, Kleinke theorizes. Indeed, a few women *liked* phrases like "Your place or mine?" (advocated in pickup manuals). But Kleinke recommends the ingenuous question as a more productive ego saver.

If you can't think of anything to say, at least say *something*. But don't talk too much, either. This advice comes from another Kleinke study, in which college students listened to tapes of a purported first encounter between a man and a woman and then rated the speakers on likability and dominance.

Whether male or female, the person who spoke 80 percent of the time was judged domineering, cold and impolite, while the one who got in only 20 percent of the words came across as submissive. When the conversation was equally shared, both speakers scored high on likability, warmth, and politeness.

—Judith Hooper

ELECTRIC ROADS

And now, electric freeways.

Led by Carl Walter and Steve Wilson, a team of researchers at the Lawrence Livermore National Laboratory (LLNL), near San Francisco, has built a 220-meter-long powered roadway that provides energy to a 1969 Volkswagen.

Buried in the roadway is a steel magnetic core, its top flush with the surface of the road. Inside the core are six insulated aluminum cables carrying from 500 to 1,000 amps of alternating current. An electrical pickup in the car's bottom collects the electricity from the cables by induction, without ever touching the surface, and turns the alternating current into direct current for the car and its batteries. The vehicle runs on battery power on "unpowered" roads.

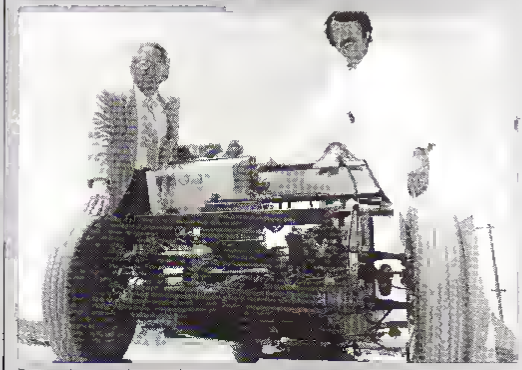
This isn't the first time someone has thought of using inductive energy transfer; the first patents were issued in 1891. This modern version may find use in Santa Barbara, California, for an electric-bus system.

LLNL engineers estimate running a roadway-powered electric car should cost between 1.2 cents and 2.4 cents per kilometer. The cost of turning regular freeways into powered roadways could be from $217,000 to $373,000 per kilometer.

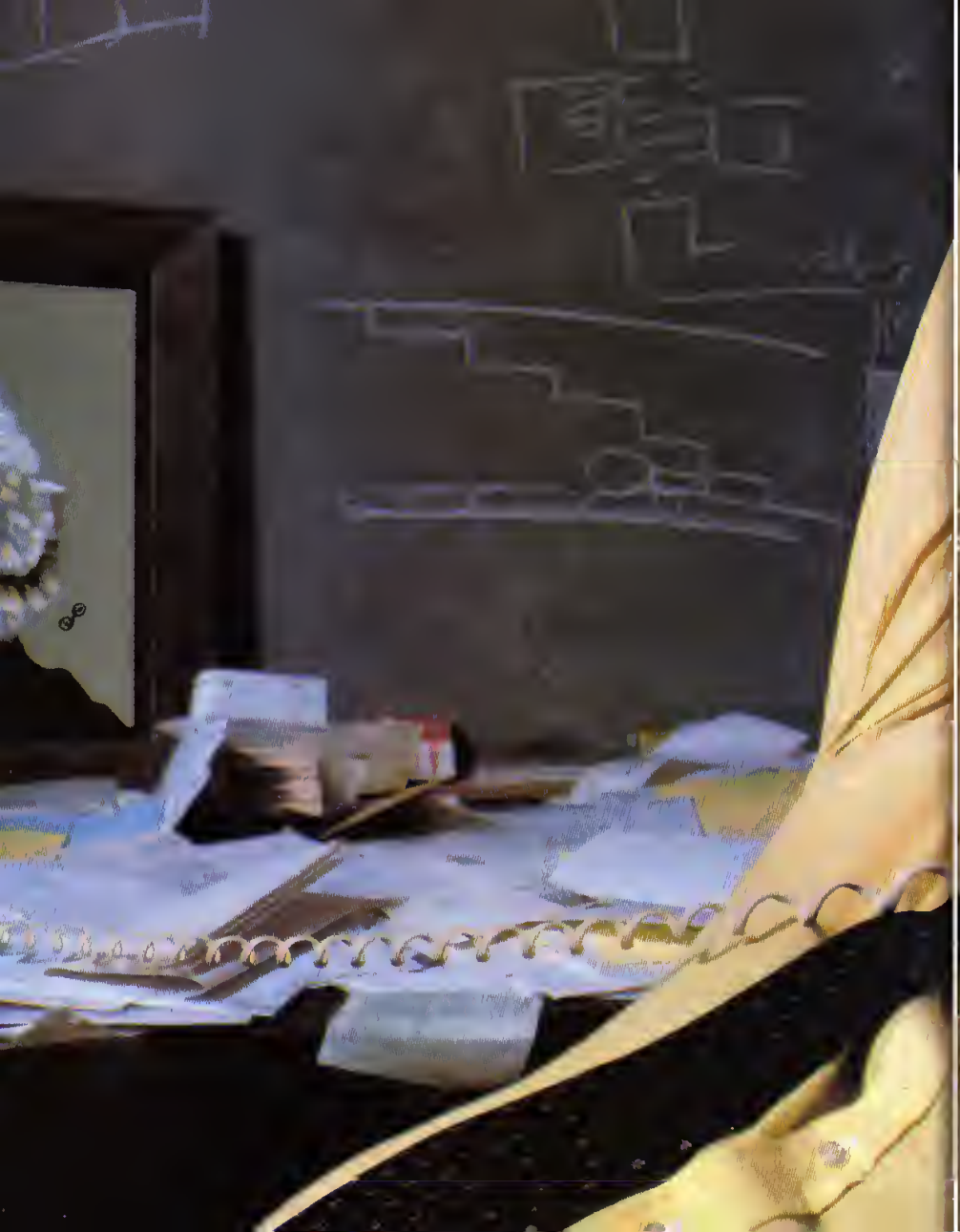
—Joel Davis

"Your head is your house, furnish it."

—Arabian proverb



Special car picks up electricity from a steel core in the road



This new computer doesn't just crunch numbers, it feeds on them

BIOCHIP REVOLUTION

BY KATHLEEN McAULIFFE

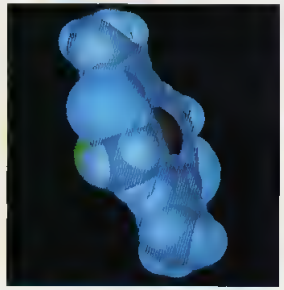
While microchip architects race to squeeze more and more information onto wafer-thin silicon, a few pioneering biochemists are plotting a computer revolution that could make obsolete the most advanced circuits dreamed up in the back rooms at Intel and Motorola. Almost unnoticed, the ultimate biological computer has reached the drawing boards.

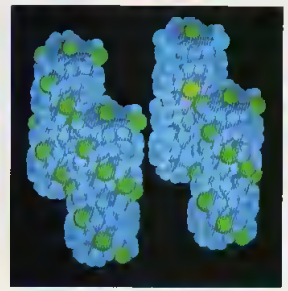
The bioprocessor will be a molecular latticework that can grow and reproduce. Capable of logic, reason, perhaps even feeling, its three-dimensional organic circuitry will not process data in the rigid, linear style of earlier computers, but network-fashion, like the living brain. Small enough to mesh directly with the human nervous system, biochip implants may restore sight to the blind and hearing to the deaf, replace damaged spinal nerves, and give the human brain memory and number-crunching power to rival today's mightiest computers.

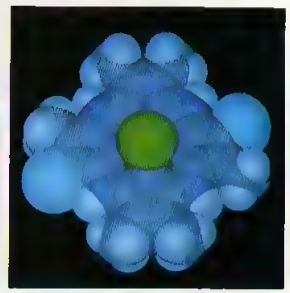
The prototype is taking shape not in the high-tech labs of IBM or Bell, where researchers have focused on such hardware as optical disk memories and Josephson junctions,

PHOTOGRAPHS BY ANTHONY WOLFF

"The plan is to develop a symbiote that will grow into the brain, communicate with the nerves, and learn from them"







but at EMV Associates Inc , an obscure six-employee outfit in Rockville Maryland where corporate gene splicers seem to be proliferating as quickly as their bacteria EMV s president and cofounder has high hopes for his company. Our aim is to build a computer that can design and assemble itself by using the same mechanism common to all living things This mechanism is the coding of genetic information in the self-replicating DNA double helix and the translation of this chemical code into the structure of protein '

A tall burly Irishman with a hearty laugh and a Billy Carter smile, James McAlear manages to be both a shrewd businessman and a highly imaginative inventor with several patents to his name He is both an idealist bent on expanding the human intellect and a pragmatist concerned with the nuts and bolts of how things work Among his colleagues Dr McAlear is known for his eccentric and electrifying ideas and an irreverent wit born of childhood rebellion against a strict Catholic upbringing

'It's easy to build a whole religion around this artificial-intelligence work ' he says with a mischievous twinkle in his eyes 'After all we are looking at conductive velocities about a million times faster than nerve cells, circuit switches one hundred million times faster than neuronal junctions or synapses and packing densities of the functional circuit elements a million times greater than are formed in the brain

"This factor of ten to the twentieth power is truly incomprehensible in terms of any present concept of intelligence It would be expected that the being' of an individual so equipped would live in the computer part, not in the central nervous system It is also possible that when the corpus perishes, its implant would survive and could be transmitted to a fresh host Well, that pretty much fits the specifications for an immortal soul And if you have something that has intelligence and the ability to communicate at high speed it might well become a single consciousness—a superior an omnipotent being '

It all this sounds like the next sequel to *2001*, it is a fantasy that big business takes seriously Bethesda Research Laboratories has just bought 30 percent of the company's shares McAlear reports that DNA Science, Inc the venture-capital arm of E F Hutton, and Paribas a large French financial firm are also keen to invest The Japanese, too are hot on the trail of molecular electronics EMV is now arranging a deal with Mitsui Corporation a Tokyo-based trading company that already has acquired a large stake in both biotechnology and microelectronics

EMV has also been awarded a grant from the National Science Foundation to test the first living interface between an electrode-studded chip and the brain If successful, the experiment could restore sight to the blind Its success would also reassure McAlear and many other bioengineers that embryonic nerve cells can serve as a living bridge between the mind and the computer It is here that the new technology may pay off first

A little over a decade ago British scientists reported that a blind woman could see phosphenes bright flashes of light, when they touched her exposed brain with an electrified wire Since then, blind patients with electrodes implanted in their visual cortex have been able to recognize simple shapes letters and even short sentences in Braille Impressive as it is, this vision is crude like a cartoon sketched out in flickering light bulbs Building on this work McAlear hopes to

Previous page James McAlear Above Computer graphics molecules from which chemists may build biocomputer s wires and switches far left McAlear and John Wehrung study protein chip on a microscope TV display

produce an image with roughly the resolution of a staticky black-and-white TV.

The major stumbling block has been making the electrodes. Even hair-thin wires are too thick to link with only a single neuron, each stimulates a bundle of neurons to create a phosphene. McAlear intends to cover his electrodes with a layer of protein, drilling thousands of holes through the coating with an electron beam. The holes will be covered with polylysine, a cellular glue, and be attached to embryonic brain neurons. According to plan, the nerves on the implanted electrode will then grow into the visual cortex of the brain, forming links with individual neurons in the patient's cortex. Each electrode, McAlear projects, will produce up to 100,000 phosphenes, 6 million in all.

"The idea is to mount a tiny video camera on the glasses of a blind person," he explains. "The wires leading from the camera will be inserted through a tiny plug in the scalp and connected to the protein chip and its electrodes. The computer will then process visual data and convert them into a pattern of phosphenes that will duplicate the camera's image."

If all goes well, EMV expects to have a prototype ready for testing in ten years.

At this point, however, the company is clearly a gamble for its eager investors. McAlear's organic circuits will measure less than one hundredth of a micron across. (For comparison, a human hair is about 62 microns wide, a red blood cell, 7 microns.) Building them will not be easy.

When approaching the limits of smallness, solid-state physicists enter a world as alien and uncharted as the universe. Just as black holes warp space and time, the infinitesimal distorts reality as we know it. Here traditional notions about the nature of solids are turned upside down. Electrons pool at discrete energy levels, turning conductors into insulators. Here a stray cosmic ray can knock an electron off course, causing malfunctions in software or, worse, damaging the molecular hardware. Computer scientists, genetic engineers, organic chemists, and a host of other specialists will be needed to make the biocomputer work. McAlear has managed to attract these diverse talents—probably, he thinks, because of his eclecticism.

This "eclecticism" is reflected in his lifestyle as well as his professional creativity. His office resembles a baby's playpen. The coffee-stained papers on his desk might have been blown there by a tornado. A file drawer opens to reveal balls of crumpled paper. Underneath this apparent chaos lies not a hint of order.

Yet this inability to compartmentalize may well explain his knack for seeing relationships in seemingly unrelated findings. In the junk shop of his mind, ideas mingle freely, coming together in unexpected combinations. "The inspiration for a molecular computer," McAlear comments, "would have occurred to anyone who had bothered to think about the ways in which biological principles might be applied to the manufacture of integrated circuits."

It started with the notion of building a conventional chip out of protein. Proteins organize the vast array of biochemicals and assemble them into living organisms. And if they could create order from that incredible complexity, McAlear reasoned, surely they could serve as a simple matrix for microcircuits.

To test this idea, EMV's pilot study coated a glass slide with a monolayer of protein, which was in turn covered with a thin protective material called a resist. Then an electron beam was used to dig trenches in the resist about half the width of a red blood cell. Dipped into a silver solution, the protein exposed by the beam organized the metal into fine streaks—microscopic wires. The research, carried out with Professor Jacob Hanker, of the University of North Carolina, in Chapel Hill, produced the basic pattern of a functioning microchip.

Dr. Hanker believes that proteins can arrange nearly any metal into useful circuits, including many materials that cannot be used by conventional methods. And protein can be coated with protective layers thinner than silicon. This makes it possible to etch much finer lines than those used in today's chips. Small-enough conductors could pack onto biochips more than 100,000 times the power of present computers. Gentronix, EMV's holding company, intends to test such a "very small device" (VSD) within three years.

"We think we are evolution's crowning glory, but we are merely the beginning of life, a potential for limitless growth once we take control of our biological destiny."

The VSD could soon stand the computer industry on its ear. But in McAlear's grand scheme it is merely the first step in the development of an ideal biocomputer—one modeled entirely after living systems.

Living organisms are treasure houses of molecular conductors and switching circuits. Poorly understood, their components are far smaller and more densely packed than the electronic components of the most sophisticated computers. Take, for example, the electron transport chain responsible for photosynthesis. The leaf of a green plant contains 10 million more electronic elements per square millimeter than a silicon chip. Without high-powered electron beams, nature has succeeded in building a microdevice that rivals man's most prized inventions. What is her secret?

As one scientist explains: "Nature uses a bottom-up, bricks-and-mortar method of building up microstructures atomic layer by atomic layer." This is how McAlear plans to build his biocomputer. Like many natural proteins, the molecular computer will be grown from the DNA templates of genetically engineered bacteria. The result will be radically different from the VSD, where protein merely supports traditional metal circuits. McAlear's brainchild is a three-dimensional protein lattice, including its densely packed circuitry.

"This microscopic gem will contain the collective consciousness of mankind," he envisions, ticking off the advantages of molecular computers. "They open up the possibility of three-dimensional circuits, increased speeds, reduced energy consumption, and ultraminiaturization that can reach a million billion elements per cubic centimeter. On this scale, all the memory elements of every computer manufactured to this day could be contained in a cube one centimeter on a side."

Since the biochemical organization of living cells is very different from what would be desirable in a molecular electronic device, an obvious question arises. Where in nature will genetic engineers find the genes that code for these proteins?

Very simply, they won't. Biotechnologists need not make do with the hand-me-downs of evolution. Scientists have already begun to design synthetic proteins unlike any found in living cells. Computer graphics allow them to study the three-dimensional structure of molecules that exist only in theory. Soon these computer techniques will be coupled with recombinant DNA technology to make the genetic blueprints for make-believe proteins.

"The ultimate scenario," says geneticist Kevin Ulmer, of Genex Corporation, "is to develop a complete genetic code for the computer that would function as a virus does, but instead of producing more virus, it would assemble a fully operational computer inside a cell." Eventually, he thinks, this will be a large market for the gene-tampering industry.

Biobuilding microcircuits would be largely a self-correcting process. Ulmer notes: "One component could not assemble out of place or out of turn, because it would lack the necessary binding sites required of the correct molecule. The yield of perfect devices could approach one hundred percent." And every time the cell divided, a new assembly line would be born. Conventional factories will have a hard time competing with microbes.

It will be a long time before working computers roll out of their cellular factories. "Ulmer's scenario is at least thirty years off," predicts Dr. Zsolt Harsanyi, vice president of DNA Science. "Computer graphics are very useful, but we will need a far greater knowledge than we have now to

design proteins that will automatically self-assemble the way a virus does.

Given these challenges, Dr Forrest Carter, of the Naval Research Laboratory in Maryland, has begun to look for solutions today instead of, as he puts it, "waiting for the rope to run out in the semiconduction field." A tall, bearded man who would look at home in the British Admiralty, Dr Carter is designing molecular switches to record the on-off binary code used in computers. "One possibility" he says, "is to use long chain molecules with alternating double and single bonds. When an electron is transported down the chain, all the single bonds will switch to double bonds, and vice versa. This, in turn, will determine whether intersecting chemical chains are switched on or off."

A computer built with Carter's molecules would be so small that an electron traveling from switch to switch would have almost no chance of colliding with an atom or another electron. So it would produce almost none of the waste heat that sometimes causes today's computers to fail. Its speed of operation would closely approach that of the superconducting Josephson junction, on which IBM has pinned its hopes for a supercomputer, spending an estimated $100 million. And its power needs would be so low that the computer could run on the chemical energy of the cells around it.

The gemlike biocomputer of McAlear's dreams, implanted in the brain, will sprout nerve projections from its tiny protein facets. The host's neurons will link up with these spindly outgrowths, sending out electrochemical pulses in the brain's own language. Inside the molecular lattice, electrons will dance at the speed of light. Only at its periphery where the implant's tentacles sense the neighboring nerve cells will the flow of electronic information slow to the gentle pace of the brain.

Suddenly the old distinctions begin to fade, the rigid line between life and nonlife wavers. How do we classify a human invention that derives its materials and energy from the living cells around it and can grow, reproduce, and think?

"By definition," says McAlear, a Harvard-trained biologist, "this is a form of life, but its potential will be realized through research and development by human beings rather than the trial and error of natural selection." The biocomputer is not just another implant, he feels, but a symbiote, living from the cells it inhabits and giving them, in turn, the chance to evolve into a higher intelligence.

Evolution set the precedent for this symbiogenesis some 3 billion years ago, McAlear says, when microorganisms assimilated even more primitive creatures that now survive as the chloroplasts, mitochondria, and other organelles of modern cells. "This alliance," he says, "paved the way for all plant and animal life. But the next time around, symbiogenesis may lead to intelligent beings that would be superlife by present standards."

The implant McAlear envisions would ideally combine the brain's ability to relate incoming data—to reason—with electronic speed and efficiency. "Computer and human intelligence are not antagonistic," McAlear asserts. "They complement each other beautifully. You might consider it a marriage made in heaven."

McAlear and John Wehrung, EMV's cofounder, admit that so far they have no idea how to achieve such a marriage here on Earth. "First and foremost," says Wehrung, a computer specialist, "we have to figure out how the brain works and then strive to duplicate its mode of operation."

In sharp contrast to McAlear, Wehrung is neat and athletic, fair-haired, with boyish good looks. But, like his partner, he loves to contemplate the bizarre. "The next plan of action," he says in hushed tones that sound almost intentionally theatrical, "is to develop a compatible symbiote that will literally grow into the brain, establish communication with individual neurons, and thus learn from them in a biological sense."

Farfetched as it sounds, Wehrung's idea might require only slight changes in the electrodes designed to simulate sight in the blind. Instead of sending signals into the brain, the device would eavesdrop on the electrical dialogue between cells.

"It would infiltrate the tissue," Wehrung says, "live with the tissue, sense the tissue, and keep detailed records of its interaction. After all, how do you learn how the natives live in Africa? You can take pictures of them. You can climb a tree with binoculars and gaze at their activities from afar. You can study the artifacts of their culture. But the best method is to send an anthropologist into the jungle to befriend them, live in their huts for a year, take part in their rituals, and report back. A symbiote would serve an analogous function."

McAlear, for his part, is not one to downplay the importance of the biocomputer he and Wehrung will build once they have the symbiote's report. "We are so accustomed to thinking of ourselves as the crowning glory of evolution," he says, "that it is difficult even to consider the possibility that we are merely the beginning of life—a potential for intellectual development that is limitless once we take control of our biological destiny."

His voice rises slightly to penetrate the din of the bar in which he is speaking. "One Sunday about four years ago," he begins, "I was parked in front of the Swedish Covenant Church, waiting for my wife, Anna, who was inside. The minister, it seems, had gotten into this tiff of singing a hymn and then praying that I'd come in and be saved. Finally my wife came out. 'Why don't you come in,' she implored. 'They've asked me to ask you, don't you believe in God?'

"'You go back,' I said, 'and tell them that not only do I believe in an almighty God, but I'm probably the only one here that has any idea how to build it.'" ☒

Ho, ho, ho, or a reasonable facsimile thereof.

FICTION

Blackmail is always a dirty business, but sometimes it's downright fun

RINGTIME

BY THOMAS M. DISCH

One day (my story begins) I found myself on the shady side of Memory Lane, which is a place, like Wall Street, that can be anywhere the sellers and the sold chance to collide. In this case, in the IRT Antique Arcade, between Twenty-third and Twenty-eighth, where I had come with four hundred in over-the-counter unregistered cash and a need to spend it all immediately. I knew where. At the downtown end of the Ar

PAINTING BY RUDOLF HAUSNER

cade was a dealer ostensibly dealing in old paperbacks most of them just powder sealed in cellophane but who was in fact a fence for hot rings

Morton Shure had the pale skin and opossum eyes common to the denizens of the IRT Arcade and a straggly beard that looked like acne that had undergone a sea change With browsers who stopped to inspect his baggies of powdered prose he affected the tranked-down speech of a zombie in custodial care With real customers he revved up to a laconic mumble Not a candidate for Salesman of the Month but Morton's merchandise sold itself I told him what I was after and we stepped to the back of the booth Morton drew the curtain and brought out his black velvet tray of lost silver souls Most of the rings on the tray were familiar to me from earlier shopping expeditions One or two I'd tried on for size and resold to Morton The selection was as varied, and as tempting, as the index of a sex manual It is my opinion that anyone who buys a ring as an alternative to getting laid in the phenomenological flesh has his ass screwed on backwards Orgasm is like the sunrise, another will be along soon Most collectors of any affluence agree and so raw sex is a buyer's market on Memory Lane Four hundred dollars would have bought up half the rings on Morton's tray and left me change for a doughnut and coffee On the other hand I knew that four hundred dollars wasn't going to buy me the bluebird of happiness A felony was as much as I could hope for

How about a life of crime? I hinted

Morton blinked his opossum eyes "You uh, wouldn't want me to break any laws?"

"Laws? Morton, we're grown-ups Grown-ups can distinguish between entertainment and real life If I can put on a ring I can take it off Right? At my age, with my blood pressure, do you think I can be corrupted by *The Adventures of Robin Hood*?" I continued babbling in this vein until Morton had been soothed sufficiently for his greed to get the better of his distrust

"There's one item I personally know nothing about it"

"Right, right Show me"

He unlocked a metal file and took out a cassette He plugged the cassette into a pair of video specs and handed them to me "Personally" he began again

"You know nothing about it"

I turned on the spectacles They bubbled with blue blips and then a man in a facemold of the aged Woody Allen told me what to expect from the ring he was pawning I will not anticipate the ring's spinning of its own tale except to say that the masker (who was not the ring's maker, only its third owner) admitted candidly (and a little nervously) that it recorded the commission of a felony To be found in possession of such a ring brings a mandatory sentence of a year's imprisonment—longer if the nature of the crime is particularly nasty It's odd but when you know a ring is hot it starts to look different Evil has its own glitter

On the whole, I am a law-abiding citizen I understand the reasoning behind outlawing the merchandising of murder, rape or any other actionable offense Surely it will not do for honest citizens to subsidize the corrupt elements in crimes they have committed in order to market their transcription Surely to traffic in such wares is irresponsible and deserves reprobation and punishment Even so consider how common it was in the days before micromemory transfer for the public to be offered as "entertainment" lurid fantasies of criminal behavior True in the movies and novels of the pre-now era law and order usually wound up winning but you don't have to be Diogenes to suppose that the prime fascination of all those criminous heroes otherwise known as villains was the possibility of the audience sharing vicariously in their wickedness I'm a guilty wretch I don't deny it for buying that ring but am I any guiltier than the wretches who flocked to see *Little Caesar* or *Death Row Studs* or *How to Dismember a Body*? (Or than the readers of this confession?)

The long and short of it was that I gave in to the temptation I'd come looking for Morton, with a merchant's mysterious sixth sense for any pocket's exact depth would not budge from a price of four hundred dollars The only concession I could pry out of him was to throw in a couple of blank

Well, I'd like still another opinion, Doctor

rings, which came with the proviso that he be allowed first refusal on anything I recorded.

"And if you think you might do anything um, undignified or —" he twiddled the four-hundred-dollar ring thoughtfully— "devious, stay away from mirrors, hear? You'd be amazed how many guys get busted cause they get careless about that."

"Just call me Dracula."

Morton smiled a pallid smile. "And don't rob any cradles, either. I got principles."

The deal was sealed, and I left Memory Lane fizzing with a sense of personal dignity. It had been quite a while since anyone had suggested that I make a recording. I went up the stairs like they were an escalator, whistling the theme from *The Myth of Progress*.

Arriving home cured me of those delusions. Home is where the heart breaks. Home is what's left when all the collectibles have gone to the auction block. Home is a plasterboard box fourteen feet long, twelve feet wide, and eight feet high, the largest of ten spaces sliced up from what had once been a dentist's office. I still have Dr. Moss's chair, back sprung and vinyl patched, bolted to the center of the floor. Beside it, where once the drill was mounted, is a rented Ringmaster, my central and sustaining self-indulgence. Twenty years ago, when my recording career began to flounder, I had the foresight to sign a long lease for both the office and the Ringmaster. Now the rent from the space I sublet is all that keeps me afloat financially.

The Ringmaster is a metered, not a monthly charge, and since, alas, I so rarely use it, my bill is less than I'd pay for a phone if I had one. I have a small stock of rings, but they are either crude mass-market simulations or my own botched jobs of later years. The day a picnic didn't pan out and I, undaunted, recorded eight hours spaced out in a laundromat. The day I bused upstate to view the autumn leaves and sprained my ankle leaving the bus. Those failures were, at least, vivid. Most of my unmarketable memories are just dull—so many soft, tasteless noodles in the soup of the past.

The fun past, the yummy past, the past one sings of on New Year's Eve—all that is unrecapturable, sold off in weekly and monthly lots. There is one entire year, my twenty-ninth, wiped from the slate of memory. What seas of pleasure I cruised that year, what wine cellars were plundered on my behalf, what dainties ravished my tongue, only the directors and patrons of the Albright-Know Museum are privileged to know, since the public, which includes me, is denied access to the documentation (never mind the use) of those three hundred sixty-five rings. But even unremembered pipers must be paid. One cannot gourmandize through the day and into the night and then, just by turning the lights low, summon Romance or even Raunch. Eventually there is an energy crisis. Instead of resisting that eventuality when it came upon me, I began unwisely to live higher off the hog and, at the same time, to sample my own tapes (with the excuse that I would do my own documentation and thus save gallery fees). Alas, pleasures that are remembered cannot be repeated with equal pleasure. I went through cycles of hunger and satiety, excess and disillusion. Instead of living for my public, I began to live for myself, with predictable results. My life fell apart, and my recordings got so bad that even I was bored by them. Bye, bye career.

All that was Auld Lang Syne. To return to the present, there I was in my humble (one-hundred-sixty-eight-square-foot) home with my own recent acquisition around my finger itching to be unveiled. I climbed into the antique dentist's chair, fastened the seatbelt, and stuck my ring hand into the Ringmaster's maw. I thumbed the switch and felt the prick of the recall needle as it passed through the center of the ring and pierced my finger. The filament began to revolve, and then, poof, *nada*, night and fog.

I thought (that much of me that could still think independently), *I've been had!* But no, the ring was functioning, and I—the other "I" of the recording—was walking through a foggy night, heart speeding, muscles tense, ears alert to the traffic noises. I was conscious, too, in an amateurish way, of the energy belt that powered my ring.

A city street, but what city I couldn't tell, for my eyes avoided all telltale specifics—street signs, shop fronts, the license plates of cars. The mind of the woman behind the ring was almost as featureless as the pavement underfoot, a blur of anxiety and fear with some black purpose locked in its back room. As the ring's previous owner had warned, this was a rather unprofessional recording, but in a way the very lack of definition added to the fun, if you count suspense as fun.

My temporary self stepped into the recessed entrance to a narrow brick building and reached into her pocket for the simple tools of her trade. Even numbed with cold, her fingers were quick in solving the riddle of the lock. After taping over the tumblers so the door would not lock behind her, she set off in deeper darkness, down a corridor, up two flights of stairs, and along a longer corridor until her flashlight's beam picked out, stenciled on a gray steel door, the number *33*. Here her task was more delicate, her workmanship more ingenious, but on that first viewing it was the thrills more than the skills of the burglary that I took note of. What clarity there can be in a fear defied! What pleasure (impossible to describe except that it is intensely specifically visceral) in the slow winning to the forbidden goal! What triumph when at last the till was open and the money in our hands! And (for it would be dishonest to edit out this final act) what a blast—of panic, horror, and guilt—when she shot the guard returning with his takeout order of pie.

and coffee! After the murder (if it amounted to that: she didn't stop to find out) she walked (resisted running) four blocks (I counted them) to a public park, where she sat on a bench and wolfed down the pie and coffee. A cherry pie, and never have I taken greater pleasure in a meal than in that one slice of pie. (And I am accounted something of a gourmet by those who've collected the rings I've made.)

After she'd wiped her fingers on a napkin, she counted her take—eighty-seven dollars. She seemed quite satisfied. At that point she stopped recording.

To speak in greater detail of what the ring revealed would be to betray the teacher to whom I was to owe so much. (As it is, I have had to disguise the more incriminating facts. *33* is simply the number I favor at roulette, eighty-seven dollars the going price for a blank ring.) Through her I learned not only (on later viewings) effective methods of picking locks and disabling alarms but, more critically, the *tao* of criminality. Just so a student learns from the ring of a virtuoso musician not only the feel of his fingerings but whatever of elan, judgment, and sublimity his artistry can bring to bear. Let me lay a wreath, therefore, on the grave of that Unknown Felon and pass on to my own malefactions.

As much, at least, as I know of them.

My own criminal career was, from its inception, undertaken less for the sake of immediate gain (that eighty-seven dollars was no great incitement) than for the sake of art. Once I had practiced lockpicking on my own and my tenants' locks (some of surprisingly good quality), I determined to profit from my new skill by recording burglaries that would be, like virtue, their own reward. My objective: not loot but luminescence. I have an abiding faith, which no amount of experience has ever been able to shake, in professionalism and quality. From an aesthetic point of view the ring I'd bought from Morton Shure was rankly unprofessional—hasty, unstructured, and fuzzy. While, even at their most minimal, on days when I had accomplished little more than tying my shoelaces, my own recordings had been clean, clear, and well-paced. "A born recorder," *Art Scene* called me, back in my golden youth, "with a knack for making something miraculous out of the most obvious materials."

Now that the gun of present purpose was loaded, all I lacked was a target. It didn't take long to decide what I wanted for Christmas. What else but rings? I wheedled a back issue of *Ringtimes* from Morton Shure and compiled a list, from its classified pages, of Manhattan dealers whose offerings were modest enough to suggest that their security systems would not be beyond my still-untested capabilities. List in hand, I began to scout the land and found, like Goldilocks, that most candidates were either too big or too piffling, too posh or too drear.

Until I came to, lucky number 33 New Soho Square. One look at its degentrified facade of sagging black iron and flaking rose-painted brick, another look at the lock on the door in the foyer and instinct told me that here was my target and now was the hour. As Shakespeare says, present mirth hath present laughter. I wired ring to belt and started to record.

I woke the next morning in my own room, finger ringless and memory's *tabula* entirely *rasa*. No memory even of having come home. Which meant that, as so often in the past, I'd been brought home and put to bed by friendly elves. The elves had left behind, in exchange for yesterday, two rings, a sealed eight-hour blank and a second, fully recorded and set to replay, molded in a lion's-head design. Beneath the rings was a note in my own handwriting:

Once more, with feeling. Come at 6.
Meanwhile enjoy your plunder.

After breakfast, for which I lacked my usual appetite, I decided to try out the new ring. Like an informer's hand slipping a secret accusation into the stone jaws of the Bocca del Leone, the needle of the Ringmaster entered the lion's-head ring, and I found myself at the bottom of a well. The water was up to my knees and rising. Rats squeaked nearby while far above a witch cackled with glee. Things quickly got worse.

I was lucky to have grown up before the entertainment industry had made cradle robbing a temptation available to the working class. The equipment needed to make recordings was still too bulky and expensive then, and Memory Lane was a county fair compared to the bustling bazaar it's since become. It's no credit to my parents, therefore, that my lousy childhood belongs to me and not to a collector hungry for wonder and innocence.

There was a case in the news lately of parents who had been restaging Baby's first Christmas every day of Baby's young life from age four through age seven, when the IRS finally caught them. (They got ten years for tax evasion. In Utah there's no law against robbing your own children's cradle.) This recording was more like Baby's first Halloween. The hours I spent trapped in rapport with that child's terror were the supreme bad trip of my life. My own adult knowledge that I was being tormented not by literal witches and ghosts but by everyday human monsters was no proof against panic terror. When the ordeal was over and the needle retracted from the ring, I lay a long time inert, reeling with the aftershock. Slowly my heart's roller coaster eased to a stop, and I got off.

I swore revenge and washed my pants at the sink in the hallway.

It was dusk when I returned to New Soho Square. The painted brick of Number 33 had dulled from rose to sepia. The metal gates of the shops about the square had been drawn down, giving the neighborhood a battered, embattled look. Pigeons fluttered to their roosts in the junked cars stacked monumentally in the basin of the defunct fountain at the center of the

square. It seemed as though nothing had changed for a hundred years. Machu Picchu has nothing on Manhattan, if you catch it on the right day.

I loitered in the square some minutes, circling the stacked cars in the fountain, establishing mood. Who knew but that this would be my last recording? So it had better be good. My eyes, cameras panned across the concrete stumps of benches toward the doorway of Number 33 and then, feet assisting, zoomed in to the shallow foyer and the laminated plastic nameplate of the Happenings Gallery, M. Ruyk, Proprietor. A ringed finger rang the bell. Silence.

The door was locked. With the ease of borrowed expertise, I entered. The gallery on the third-floor landing was double-locked. I entered again. The place was an ice palace carved from white light—no walls for miles, no furniture, just a pure and tasteful void. M. Ruyk didn't worry much about the electric bill. Illusions like this cost money. The cinematographer in me was delighted, but the thief was taken aback. Feeling less and less like an avenging angel, I inched forward through the mirage until my hand encountered vertical solidity.

"Mr. Whelan, we're so glad you've decided to return." The voice came from the four corners of the void, a flat, throat-miked contralto like the voice announcing time on the telephone.

In the white glare behind me, where the door should have been, two images formed, his and hers, both young, both dressed in icy shades of blue, both upside-down.

"You're inverted," I told them.

"One moment." The man's hand disappeared to the left, and the image righted itself and then sank through the white glow to just below floor level. "Better?"

"You need some vertical adjustment, but that's okay."

The sofa on which they were seated sank another two feet.

The woman leaned forward—seen right side up, she came across as expensive rather than young—and addressed my midriff with an earnest, placating smile. "Excuse us for keeping at such an unfriendly distance, Mr. Whelan, but the metal indicator suggested you might be armed."

"Excuse me for breaking and entering. And no need to worry about the gun. It's only imitation. Look." I took it from my pocket and fired off a blank.

"Oh, my!" She fluttered her hands expressively. They were white and bony and roped with veins and about fifty years older than her face. "How violent! Let me say at once, Mr. Whelan, that I am a great admirer of your work. You have such *Flair*. scarcely does justice. Regrettably, I can't claim to possess any of your more notable recordings, but I have been allowed glimpses. *Such* glimpses!" She cocked her head and squinted at my knees. (The image had continued sinking, and now their feet were coming into view in the air above their

heads.) "Rudy can't we get better focus?"

Rudy gave a martyred sigh. His hand vanished to fiddle a dial.

"Ah, that's better. No doubt you're impatient, Mr. Whelan. There's so much to explain. And I'm so bad at explanations. The loss of short-term memory is the price one pays for a lifetime of vicarious experience. It does something to the synapses." (Now only their heads were left in the lower image. Slowly they sank from sight and were reunited with their bodies in the image above.) "Consequently *my* memory of yesterday is very little better than yours. Though I do have the advantage over you in having just sampled this." She touched the ring on her left forefinger. "Exquisite! You have not lost your touch, Mr. Whelan. Your palette may be darker so to speak, but your palate is unchanged. Forgive the pun. I was saying?"

"You were explaining to Mr. Whelan," said Rudy, "why he's here."

"Oh, yes. Oh, dear. Why *is* he here, Rudy? I remember, from the ring, how he got in yesterday. That was fascinating, all that business with the locks. But then, after the guards had got him and he was handcuffed—which in its own way was most absorbing—after that I'm afraid I rather lose the thread. Mr. Whelan himself became confused, and I stopped paying attention. Until dinner. The dinner was superb, as I believe I've said already. You explain, Rudy. You do it better."

"Maybe you could begin with introductions," I suggested.

"Of course. Excuse me. This is my mother, Muriel Ruyk, who founded, and owns, this gallery. I'm Rudolph Ruyk. Fortunately for yourself, you do not need an introduction. Muriel recognized you at once from your recordings. Her short-term memory may be poor, but her recall for the more vivid stretches of her past—any time before the last ten to fifteen years—is often proportionally acute. You, Mr. Whelan, are one of my mother's most vivid memories."

"Aruba!" she exclaimed. "And the oysters on Belle Ile! I'll never forget those oysters."

"You were there with me?"

"Goodness, no. *You* were there. Isn't that enough? The way the waves pounded on the cliffs. And *you* on those slippery rocks! Oh, my! We did meet once, in passing, at Dar es Salaam, but nothing came of it. I am proud to say though, that I was one of your first collectors. So long as I could afford your prices. Once you'd moved up to Knoedler, you zoomed out of my range."

"All that was quite a while back. I'm surprised you recognized me."

"Your hair is thinner now, certainly, and you've put on weight, but the indescribable something is still there. If I *hadn't* recognized you, I'm afraid Rudy would have turned you over to the police directly, and that would have been a shame."

"Mmm, yes, it would."

"Such a daring, such a *desperate* thing to do! I've always said, haven't I, Rudy, that there is a deep affinity between artistry and criminality?"

"Yes, Mother. But crime is crime, for all that."

"Yes, of course, one must take precautions. But I can't help admiring those like you, Mr. Whelan, who are headstrong and act out of impulse. I *do* hope we'll work something out."

"We already have, Mother. We have his agreement on videotape. And as a pledge that he'll honor that agreement, we have his own recording of how he broke into the gallery. In fact, with the recording he's making now, we have two such recordings. He can scarcely refuse to cooperate."

"That sounds like blackmail to me."

"It is, Mr. Whelan," Muriel said pleasantly, "but I'd like to think that our arrangement would appeal to you on its own merits. You've been leading a rather *mean* sort of life. We're offering you a new chance at the good life. We're offering you, in fact, a comeback."

Despite myself, the word worked its magic: a comeback! I resisted the bait long enough to ask, "On what terms?"

"On *our* terms," said Rudy. "Five nights a week you'll record for us. The recordings will be the property of the gallery. All recording expenses will be approved in advance and charged to the gallery."

"It all sounds rather... unilateral."

Muriel touched her ingenue smile with a

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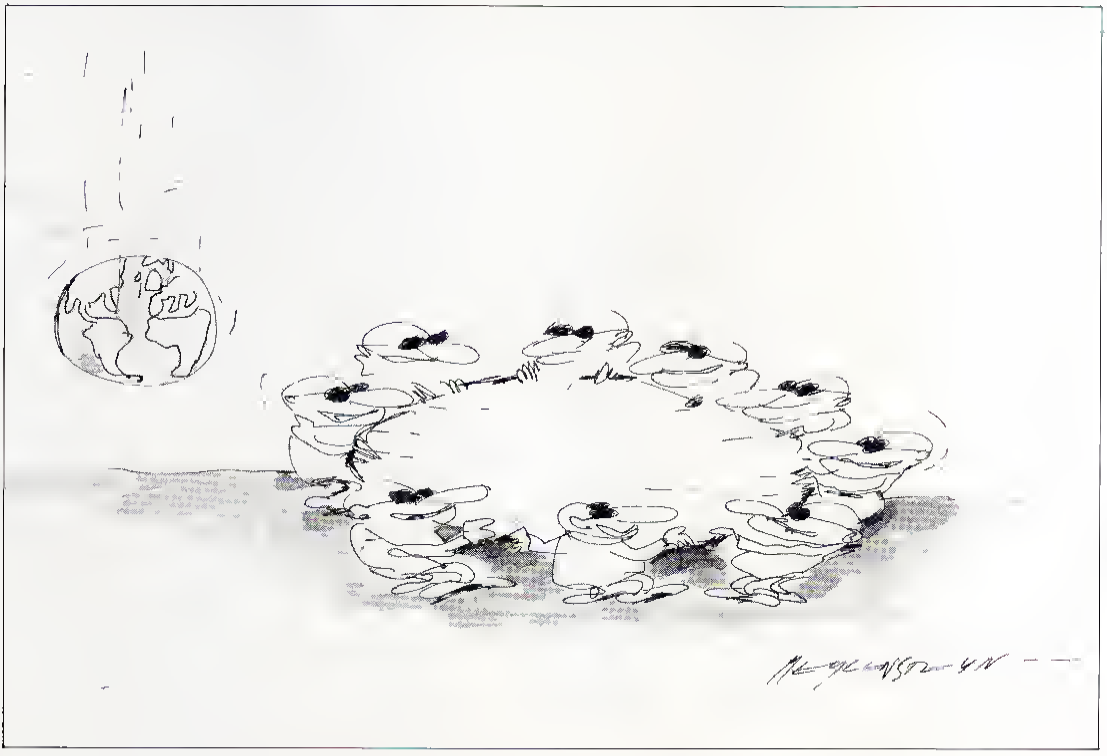

HERE'S TO THOSE WHO'VE TAUGHT US THE TRUE SPIRIT OF CHRISTMAS.

In 1843, Charles Dickens wrote A Christmas Carol to "awaken some loving and forbearing thoughts, never out of season."

The book was an immediate success. And since then it has become as much a part of the holiday season as mistletoe and stockings hung by the fireplace.

Ebenezer Scrooge, Bob Cratchit and Tiny Tim have shown generation after generation that Christmas isn't just a day of getting but a season of giving.

We at Cutty Sark toast the spirit of Christmas and those who keep it alive. And hope that you, too, will raise a glass to everyone who's shown you what Christmas is all about.

Charles Dickens

The Scotch with a following of leaders.

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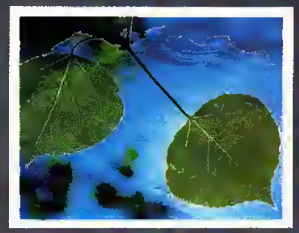
SURVIVAL

A handful of soil can guide society from the brink of catastrophe

BY RENE DUBOS



The most distressing aspect of the modern world is not the gravity of its problems; there have been worse problems in the past. It is the dampening of the human spirit that causes many people, especially in the countries of Western civilization, to lose their pride in being human and to doubt that we will be able to cope with our problems and those of the future. At a meeting on "Ethics in an Age of Pervasive Technology," held in Israel a few years ago, the American philosopher Max Black went so far as to state, "I happen to think that the problems raised by technological advance are probably insolvable [*sic*]." Such a feeling of hopelessness has historical precedents. In *Five Stages of Greek Religions* (1953) Gilbert Murray traced the fall of the Greco-Roman civilization to a "failure of nerve." History shows, however, that other societies have experienced dark days, yet have managed to recover, as illustrated in our time by Germany and Japan.

I am as much disturbed as anyone by the thousand devils of the present social, technological, and environmental crises. In fact, I am inclined to believe that we shall remain on the brink of catastrophe for at least two or three decades, if only because

PHOTOGRAPHS BY DAN MORRILL

of the likelihood of acute, even if temporary, shortages of energy and other resources. I also realize that several aspects of present world problems make them quantitatively and qualitatively different from those of the past. For example:

- Today's problems are no longer isolated and confined to small population groups scattered throughout the world.
- Many deleterious agents are spread over most of the globe, for instance, radioactive substances and acid rain.
- Useful technological innovations tend to have unexpected consequences, as when the widespread use of pesticides to control insects brings about dangerous changes in the food chains of birds, fish and eventually humans.
- There is an unprecedented interconnectedness of effects, the political conflicts in the Middle East influence petroleum production and thereby American living patterns as well as the attempts of poor nations to develop more productive agriculture and industry.

There are great tragedies in the world today. Paradoxically, however, much of contemporary gloom originates not from the difficulties we are actually experiencing but from disasters that have not yet happened and may never happen. We are profoundly disturbed by the possibility of nuclear warfare and of serious accidents in nuclear reactors. We are disturbed by the unproven hypothesis that the widespread use of fluorocarbons from spray cans will damage the ozone layer and thereby expose us to dangerous levels of ultraviolet radiation. We are collectively worried because we expect that world conditions will deteriorate if population and technology continue growing at the present rate. The earth will soon be overpopulated and its resources depleted; there will be catastrophic food shortages; pollutants will rot our lungs, dim our vision, poison us, alter the climate, and spoil the environment. The spread of income between the have and have-not nations will widen even further. This will certainly increase terrorism and may eventually lead to the use of nuclear weapons, if only as a form of blackmail.

During the past few decades most writings by sociologists, economists, and environmentalists have expressed a pessimistic mood about the future. The volumes on *Limits to Growth*, published by the Club of Rome in 1972, deserve special mention because they were the first to provide a seemingly scientific basis for the atmosphere of gloom that now prevails over much of the world. They have been read, or at least quoted, as gospel truth by millions of people who have accepted the doomsday forecasts of mass starvation, depletion of resources, overwhelming pollution and political chaos sometime during the next century. Many similar publications have recently appeared. All of them take the form of computer models of what the future will be, predicated on existing data concerning population, resources, pollution, and the present trends in these and other demographic, social, economic, and technological categories.

The last and most monumental contribution to this kind of world game is an 800-page *Global 2000 Report to the President*, prepared in the United States by the Council on Environmental Quality and the State Department in collaboration with 13 federal agencies. The purpose of the *Global 2000 Report* is to determine the "probable changes in the world's population, natural resources, and environment through the end of the century" and serve as a foundation for long-range planning. At the very beginning of the report its authors acknowledge the difficulty of obtaining reliable information for such an ambitious endeavor. In their own words: "The executive agencies of the U.S. government are not now capable of presenting the President with internally consistent projections of world trends in population, resources, and environment for the next two decades." A few examples will suffice to illustrate the unreliability of the information that serves as a basis for quantitative studies about the present state and the future of the world.

> *"Our form of technical civilization will eventually collapse if present trends continue. But what a big if this is. Humans aren't likely to stay passive in dangerous situations."*

According to official statistics issued by the British Ministry of Agriculture, Fisheries and Food, the total amount of foodstuffs recorded for 1976 in Great Britain was so low as to make it appear that the British people eat on the average much less than the minimum recommended by the U.N. Food and Agricultural Organization. Yet virtually all the British people were well nourished at that time and not a few of them were in fact overweight. In Great Britain, as in other parts of the world, people use in their diets and in most of their activities many items not entered in official documents. Since the statistical records in Great Britain are vastly better than those in most if not all other parts of the world, the *Global 2000 Report* probably justifies the phrase "Garbage In, Garbage Out," which was coined to criticize the use of unreliable information for the design of world models.

The lack of convincing information concerning Earth's reserves of fossil fuels such as petroleum, natural gas, coal and peat is obvious from even the most casual reading of newspapers or magazines. And there is uncertainty concerning the prospects for so-called renewable forms of fuel directly or indirectly derived from the sun.

One can assume with the authors of the report that the consumption of nonfuel minerals will continue to increase and that shortages of some of the rarer ones may occur. But it was shown during a recent international convention of geologists that new techniques—from remote sensing to geochemical methods—are substantiating the existence of vast reserves of essential minerals in many parts of the American continents.

There is nothing new in the general conclusion of the report that "if present trends continue, the world in 2000 will be more crowded, more polluted, less stable ecologically and more vulnerable to disruption than the world we live in now. Despite greater material output, the world's poor will be poorer in many ways than they are today." Such grim warnings have been repeated ad nauseam since the doomsday forecasts of the Club of Rome's *Limits to Growth*. Like many others, I also believe that our present form of technological civilization will eventually collapse *if* present trends continue, but what a big *if* this is.

Human beings are not likely to remain passive witnesses to situations that they regard as dangerous or unpleasant. Their interventions may often be unwise, but they always alter the course of events and make a mockery of attempts to predict the future from the extrapolation of existing trends. Industrial societies have a good chance of surviving and even of remaining prosperous because they are learning to adapt to the future and overcome crises.

We adapt to heat, cold, crowding and poverty and we minimize their effects by appropriate changes in our physiological mechanisms and our way of life. The phrase *social adaptations to the future* therefore sounds nonsensical since societies have not experienced the conditions, largely unpredictable, to which they will have to adapt in years to come. Our personal biological adaptations, however, are more subtle. In ordinary life our minds and our bodies make adaptive responses to situations that have not yet occurred, but that we anticipate. For example, our heart starts beating faster at the mere thought of having to run in order to catch a train at some time in the near future; our secretion of various hormones is increased when we know that we shall soon have to face a special situation, even one as mild as delivering a lecture to an unknown audience. In a similar way human societies can adapt to the future, even a distant one. By anticipating the probable effects of situations they are likely to encounter in times to come and by taking adequate measures in advance, societies can prepare themselves.

Until now important changes took the world by surprise Consequently there was no possibility of affecting their occurrence and it was difficult to control their manifestations Now, in contrast. the possible effects of technological and social innovations are discussed long before they become manifest. especially if they are likely to be dangerous It is only during recent decades that a significant number of important anticipations can be based on a wide range of reliable information and on precise scientific knowledge

Anticipating the likely consequences of natural processes and of human activities is quite different from predicting the future The future cannot be predicted for two different reasons One is that prediction would require complete knowledge of the past as well as of the present which is impossible The other is that human beings nearly always impose a pattern of their own choice on the natural course of events Admittedly there are aspects of the future that are largely predictable because they follow logically and inevitably from antecedent conditions and events

Thus the "logical future imposes constraints on human activities but there is a "willed ' future that is first imagined and that then comes into being only through systematic planning and effort The optimists—and I think I am one—are those who believe that the willed future based on humanistic values can be successfully integrated with the effects of natural forces and with the social structures emerging from scientific technology The willed future is bringing about desirable changes based on anticipations of effects and events that have not yet occurred In other words social adaptations to the future are taking place now

For example, environmental degradation became a lively public issue only two decades ago and most antipollution programs are less than ten years old Yet certain aspects of environmental quality have already been vastly improved as a result of control measures initiated during the 1960s and 1970s especially in Europe and North America The levels of social pollutants have decreased in many large American and European cities indeed even in Tokyo Several streams and lakes that were so grossly polluted as to be qualified "dead" during the 1960s have been brought back to a level of purity compatible with a rich and desirable aquatic life

Forests that had been devastated are being allowed to recover and massive programs of reforestation are being carried out in several parts of Africa and Asia. especially in China Areas that had become desertic are being protected against goats and other animals and can thus reacquire a diversified flora and fauna for example. in Israel and even in some parts of the Sahara and the Sahel While environmental degradation is still increasing in many parts of the world, particularly in the form of desertification and of the destruction of the tropical rain forest, there are signs that several modern societies are learning to work with nature

An interesting aspect of environmental improvement is that, in all cases measures against environmental degradation were taken long before the situation had become desperate The air of cities had not become poisonous to a significantly dangerous level before legislation was formulated and applied to control urban air pollution Lakes and rivers were far from being dead at the time when control of water pollution was begun It was anticipated. however that air and water pollution would reach unacceptable levels if the emission of pollutants was allowed to continue at the past rates for one or two more decades These measures to improve the environment were therefore taken not as a response to *actual* emergencies but rather *in anticipation of* emergencies

Besides its preventive aspects against anticipated dangers adaptation to the future has begun to take a more *creative* character For example the phrase *good environment* is no longer taken to mean only freedom from noxious influences it implies also the creation of surroundings having aesthetic and emotional values City planners used to be concerned almost exclusively with public health facilities transportation systems. and the efficient use of money and manpower in solving problems They are now beginning to emphasize in addition the role of neighborhood parks of pedestrian streets. and of "city centers" in the furtherance of social and cultural activities The fear of urban agglomerations is encouraging attempts to divide them into smaller communities that are easier to apprehend and to manage Creative adaptations to the future are the chief mechanisms by which human beings can invent new social structures on a rational basis

The ability to anticipate long-range consequences does not mean that modern societies will necessarily be able or willing to act early and vigorously enough to prevent deleterious effects Pessimists have good reasons to believe that someday somewhere a social or technological innovation will be carried so far so fast that it will cause irreversible damage to the human species or to global ecology However while a catastrophe following overshoot cannot be ruled out there is reason for hope in the wonderful resiliency of natural systems and of human beings Advances in knowledge will facilitate anticipating the long-range consequences of technological and social innovations and may thus enable us to undo the inevitability

A biological problem that has recently produced a great deal of public alarm will serve as a last example. and perhaps as a caricature, of the social process denoted by the phrase *adapting to the future* The new scientific techniques of so-called genetic engineering make it possible to mod-

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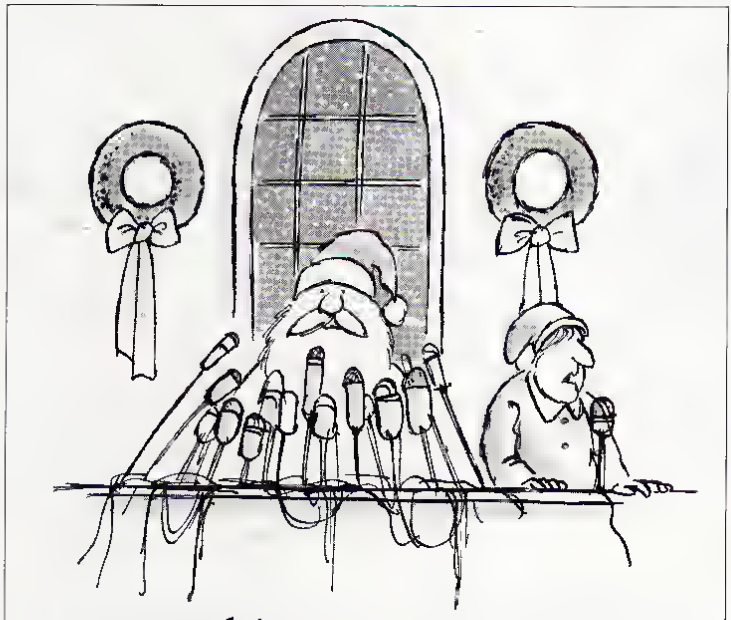

From the pressroom at the North Pole this has been a major policy address by Saint Nicholas touching on such issues as the world economy the population explosion travel problems in certain troubled areas world weather flying conditions

FICTION

ASHES

A man is haunted by an elusive memory

BY IAN STEWART

Anton Brachvogel lay sleepless on the bunk and listened to the fungus moaning *Chorisande*. The room was comfortably warm, but if he listened carefully, he could hear the distant dripping of meltwater from the evening frost. It was cold on Chorisande. When the sun warmed the ice fields, there was a slickness to the surface and free moisture in the air, but the only appreciable quantities of liquid water were those created by the artificial warmth of the installation. The average temperature was just below freezing and had been so for half a billion years.

He remembered skating with his father on the frozen oceans, silver blades slicing the soft, just-damp surface. Anton was a boy no longer, and Walter Brachvogel was dead. His legacy would not survive him by many more years. Tarkona-Chorisande Associates was on the verge of bankruptcy.

Anton blamed Chorisande. He knew it wasn't rational, but he blamed her just the same. *You bloody-minded, beautiful, deadly bitch of a planet.*

He went to the window and looked out. To the left, the ice field...

PAINTING BY
EVELYN TAYLOR

To the right, fifty-foot tree ferns, amber-edged in the moonlight. Night breezes rustled the brittle fronds, muting the moans of the fungus. The wind died, and the moaning resumed.

Why does the wind stop the fungus singing? So much about Chorisande was unknown. Tarkona-Chorisande had explored only the ice. That held riches enough. The forests, which covered entire continents, were a mystery.

Within a mile of the Installation—and that was as far into them as he or anyone else had ventured—there were the tree ferns; another plant with huge, fragile leaves, blue and skeletal; translucent, slow-moving insects, segmented, ice-sucking worms. A kind of dragonfly that could glide on rigid wings whether clicked into a flight configuration or folded flat beneath its body. Slugs the size of a cucumber that ate deep grooves in the fibrous trunks of the ferns, depositing clumps of crimson eggs like cherries. And a creeping fungus that spread over the forest floor and out onto the ice and sang mournful songs when the wind died.

Chorisande. I would give my soul to know your deepest secrets.

A short way into the forest, in a band around the coastline, where the moisture balance was at some critical level of equilibrium, were huge, shapeless growths of ice: convoluted towers and parapets and cornices, and hanging drapery, built by centuries of frost, delicate and deadly until they collapsed under their accumulated weight.

An ice tower had fallen on Walter Brachvogel while he took a walk in the forest with his son. Young Anton was found some hours later, cowering under a bush, babbling incoherently. And they had taken him away from Chorisande, until the memories dimmed and he no longer knew what he had seen or thought he had seen. All he could remember was that Chorisande had killed his father.

Anton had loved Chorisande. It was a difficult thing for a child to understand. He never quite succeeded.

And nobody had ever understood why Walter, usually such a careful man, had risked going so close to an ice tower.

Chorisande. The irony struck him. Now she was his, and he was losing her. *She's a planet, not a lover.*

She's both.

She's a murderess.

Tarkona-Chorisande Associates knew only the ice fields: the precious mineral-rich deposits laid down when there was rain enough on Chorisande to erode the mountains. To the company, the ice was no more than profit figures in a computer file. But to Anton, it was the ice that had killed his father and was now devouring Tarkona-Chorisande Associates, and Anton with it.

He returned to his bunk.

Eventually he slept.

The following morning, soon after daybreak, he took a company skitter and a pilot and began a brief inspection. The gray-blue ice, six hundred feet below, swirled inscrutable patterns like merged paint blobs on a much-used palette.

George Hazel, the pilot, turned his head for an instant. "Crawler B44 just coming up on the horizon," he said. "Shall I take her down, Mr Brachvogel?"

Ahead and to one side, Anton could see the crawler: a yellow dot on a sea of gray, attached to a taut black thread. He nodded, and the skitter's nose dropped. Now more yellow dots and black threads came into view, the threads radiating from an oddly shaped multicolored structure that, even from that distance, looked three-dimensional.

Process Plant B.

It deployed a total of seventy four crawlers, each using laser knives and rotary cutters to gouge the ancient ice a hundred thousand cubic yards every working shift. The wet slurry of smashed ice flowed along flexible pipelines to the plant, over a distance of up to two miles. TCA had fourteen plants operating on Chorisande, between them they processed three hundred fifty million cubic yards of ice per day. TCA's logo was a rectangular box transfixed by a wavy line. Its slogan: WE MINE THE OCEANS.

Slugs the size of cucumbers ate deep grooves in the trunks of ferns. And a creeping fungus spread out onto the ice and sang mournful songs when the winds died.

Intellectually Anton knew that these figures were puny by comparison with the bulk of Chorisande herself. The ice fields would last ten million years. It would take forty thousand years just to scrape off the top twenty feet. But numbers that big were meaningless.

Walter Brachvogel had commissioned the first plant when his son was one year old; the others had followed hard on its heels. Anton had visited Chorisande regularly, but to him the visits were just exciting vacations. After his father's death he had avoided the place until, on reaching majority, he had joined TCA's board of directors. Not only did Patience Monteith and Gilles duFeu own two thirds of Tarkona-Chorisande Associates, but they had been running it between them for more than a decade. The newcomer had a hard time. But Anton had learned quickly and relatively easily. Chorisande was in his blood.

The skitter circled low, its motor whining stridently. George Hazel settled it delicately on the ice.

The crawler was close by, and the noise was almost deafening. Hazel produced two phase-cancellation helmets from a compartment in the skitter's side: combination ear muffs, hard hats, and communicators. "Noisy animal, ain't she, Mr Brachvogel?" Anton nodded.

The crawler was a simple box shape, resting on four enormous caterpillar tracks, and fully automated. Its creeping forward motion was barely perceptible. It dragged its tail, a twelve-foot pipeline, behind it, adding sections in a spiral as it advanced. Brachvogel ran a gloved hand along its flank, and yellow paint flaked off beneath his fingers.

"Just normal corrosion, Mr Brachvogel. The salts. Not like—"

"G19. I know, George," Brachvogel said irritably.

"Yes, sir. Sorry. But Chorisande sure is a tiresome lady. Listen to that ice screaming. She don't want to part with it."

Too true.

They made their way to the observation bubble. The interior of the crawler was a jumble of machinery, which Brachvogel's practiced eye resolved into some semblance of order. Computation. Modulated infrasound scenners. Maintenance robots. At the front, the business end, rotating banks of cutters wreathed in clouds of steam. At the back, the pipeline's black mouth. The whole machine shuddered continually. If corrosion was the main engineering problem, vibration couldn't be far behind.

"This'n's fine," Hazel said unnecessarily. "Still on the top layer of course. You wanna see G19 now?"

"I guess." It would complete the comparison.

Hazel and Brachvogel made a rapid exit. A few minutes later the skitter was in the air again.

From the crawlers, the ice slurry went to the nearest plant—a system of desiccators and purifiers, powered by a fusion reactor, which extracted the minerals locked within it. There were phosphates, chlorides, sulfates—enough to feed the chemical industries of entire planets. Sodium, potassium, magnesium, manganese, rare earths—even uranium and thorium. Chorisande's gelid seas were a chemical El Dorado, which TCA plundered. Until G19 hit a snag. It started to wear out.

The designers had allowed for wear, of course. The trouble was that they seemed not to have allowed enough.

G19 was the first crawler to strip away the entire surface layer within its allocated area. When it started on the next one down, its cutters began to wear out faster than they could be economically replaced, and it didn't take long to discover why. Suspended in the ice, just below the surface, Brachvogel could see a thick layer of abrasive particles as fine as dust.

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RELIGION IN THE TWENTY-FIRST CENTURY

BY JAMES RESTON, JR.

PAINTING BY
SALVADOR DALI

Billy Graham, the Dalai Lama, Robert H. Schuller, Alison Cheek, Madalyn Murray O'Hair, Daniel Berrigan, William Sloan Coffin, Jr., Desmond Tutu, Truman G. Madsen, and Robert F. Drinan on the Gods of the Future

Editor's note *In planning this holiday issue Omni asked James Reston Jr to report on what will happen to religion in the future Reston whose remarkable book* Our Father Who Art in Hell *on the jungle disintegration of the Reverend Jim Jones, has received wide literary acclaim, searched out and interviewed prominent religious figures throughout the world From this research emerged Reston's following analysis of "the new religion" as well as the accompanying interviews with William Sloan Coffin Jr, Daniel Berrigan Billy Graham Madalyn Murray O'Hair, Desmond Tutu the Dalai Lama Robert Drinan Alison Cheek, Truman Madsen and Robert Schuller*

In the waning days of the summer of 1981 religion seemed to dominate almost every aspect of world news In Iran the chief of police and the chief prosecutor were assassinated leaving only the charisma of the Ayatollah Ruhollah Khomeini to hold the Iranian theocracy together In Egypt President Anwar el Sadat raged at the militant Islamic faction while at the same time deposing the Christian Coptic Pope In Poland the new Roman Catholic primate Jozef Glemp made overtures to the rebellious Polish workers' union And in the United States the Jewish lobby vowed to fight the sale of sophisticated aircraft to Saudi Arabia while Israeli Prime Minister Menachem Begin journeyed to America and met with Jerry Falwell the founder and leader of the Moral Majority

Was it simply coincidental that all these religiously influenced events were clustered together at one time? Had religion come to intrude more significantly into contemporary life or was it simply reasserting its former power and influence? Will the trend intensify in the twenty-first century? Will the collective religious voice of man grow louder or softer? How will the churches themselves change in form and ritual and how adaptable are the churches to the new technology and the new family of the future?

Together with these questions and with interviews of prominent religious figures, I tried to weave a tapestry of future religion The dimensions emerge as follows

There will be a far broader ministry responsive to life-styles other than the nuclear family with rituals more sensitive to divorced people and modern sexual mores and the special spiritual needs of women There will be church divorces for all and church marriages for homosexuals who want them

The new religion will shift away from the community church to the television church with spiritual persuasion based less on doctrine than on the television performance of electronic preachers But the effective television ministry will also depend on follow-up missionary work by the established church organization The business skills of a church will determine its growth The church of the future will have a more local look with local and national customs affecting priestly vestments, local insights determining the manner of prayer The authority of Rome Canterbury Geneva and Istanbul will diminish

Future religion will ally itself far more with the poor and the oppressed looking with greater shame on its past associations with the rich and the elite and the colonizers It will look back with pride at its pivotal role in the liberation of Nicaragua and South Africa The future church will retain its central imagery of God the Father but it will place God the Mother on a throne of equal power and mutual submission

But the most startling theme to emerge from these interviews perhaps is this The sturdiest thread throughout this tapestry is the rising anxiety about nuclear holocaust And this anxiety will create an ecumenical movement that will force the world's political leaders to address the ethics of nuclear armament At the core of this nuclear-arms debate within the Christian community will be the question of whether to fight on against the rising probability of nuclear conflict or to resign oneself to the fact that Armageddon and the fiery return of Jesus Christ will finally be at hand

"What's new with the Moral Majority is that they're all merged together These people believe in God, Adam Smith, and George Patton, but not necessarily in that order"

Let us go now to hear the words of our modern prophets

WILLIAM SLOAN COFFIN, JR

Senior minister at Riverside Church, in New York City and former chaplain at Yale University Dr Coffin is one of America's most outspoken religious activists and one of the few clergymen chosen to visit the U S hostages in Iran

He is a great jolly bear of a man who sparkles with zest for this life and excitement about the future He presides over a church that has always been in the vanguard, always deeply engaged in social struggle For him there are two images of the future church between which there should always be "creative tension" the light on the hill versus the arch of salvation The church on the hill like Riverside Church itself whose Gothic tower looks one way to the palisaded shore of the Hudson River and the other across the steaming, turbulent rooftops of Harlem, can be seen as representing great purity and enlightenment its danger being that it can be so pure that it reaches no one and becomes a monument to irrelevance But the arch of salvation also has its own problems With all welcome no dues to pay there can only be darkness Coffin's preference is clear The twenty-first century needs the light on the hill The church is at its best and most useful as a "faithful remnant, a "prophetic minority

Does that not foretell a church only of elected purified monks? I ask

That would be okay he replies provided their influence radiates provided biblical insights illuminate public life as well as personal private life and the recognition that salvation is for everyone including us few monks

Coffin is preparing a long attack on the Moral Majority whose influence he deplores and whose very title he finds ludicrous There has never been a moral majority he declares Morality never captivates the masses The majority usually stone the prophets among us

Predictably he does not argue against having spiritual men engaged in society's issues He has always been as engaged as any and he has contempt for "the gospel of private salvation "Just me and Thee O Lord" he says with a shake of his head Yet if politicians would only move to the creative edge of their profession ministers would not have to become involved for they could attend only to the soul and let justice roll down as mighty waters

Jerry Falwell and his crowd cannot live with uncertainty" Coffin says beginning to hit his stride The faith is what makes it possible to live with uncertainty including intellectual uncertainty So you can face a future that is open not clarified That is always scary particularly in times like ours when the currents of history are churning into rapids Fundamentalists would rather have a God that is cruel than have a world that is out of control They invariably subordinate God's love to God's power

We have always had conservative religion conservative economics intense nationalism What's new [with the Moral Majority] is that they're all merged together These people believe in God Adam Smith and George Patton, but not necessarily in that order But if God is a God of history then God is ahead of us or within us as much as He is above us The history of Christianity is characterized by an exodus that proclaims a New Testament which in turn announces new wine, new song a new Jerusalem a new heaven a new earth and we'll all become new beings So it is a very future-oriented religion "

With the threat of extinction hovering over mankind, Coffin sees a hopeful process at work forcing men to accept the original prophetic view of the planet as one The survival of the human race he insists has always meant the survival of the entire human race and its environment

There is a process at work in the world

that affirms and protects more and more of life. God must have been pleased when our moral awareness reached sufficient sensitivity for us to abolish slavery. God will be pleased now with the long-overdue recognition of women's rights, the rights of the handicapped, of the poor, the rights of the unborn, even the rights of whales. Nature is included in the process. It is not just a toolbox. So it is not a question of creating human unity but one of affirming it. It used to be that this part of the globe could not protect itself against the other parts. The whole is the target of future war now. The whole world lives on the target. So we are forced to affirm the ancient religious belief that we all belong to one another."

DANIEL BERRIGAN

A Jesuit priest, Berrigan, along with his brother Philip, has become identified with civil disobedience and dramatic protest against the U.S. military machine. Convicted at Catonsville, Maryland, of destroying draft records during the Vietnam War and again at King of Prussia, Pennsylvania, in 1981, for protesting against nuclear armaments, Father Berrigan awaits an answer to his appeal of his latest conviction.

In the early darkness a man stirs in nightmare. Indistinctly in the mist he sees the image of a man—perhaps it is he!—walking upon some unknown path. Underfoot a rug rolls out before him at a steady pace. He plods on. Then he dares to look behind and sees, to his terror, that the rug is rolling up. He begins to jog—an action he has always taken before to try to forget. But glancing backward again, he notices that the rolling rug is gaining upon him, and so he begins to run, faster and faster. But the rug ahead of him continues to unfold only at a walking pace! It will not unfold fast enough. He tries. He strains. But there is no escape. He is tripped up and flattened into the swirl.

This is Daniel Berrigan's image of the current nightmare that besets America. The United States has lost its past. It is speeding up the present, but there is nowhere to speed to. America, rolled into the process of time, ceases to be the master of time and becomes its victim. Berrigan's image is for the mass of Americans who have acceded to the "insane" nonfuture of nuclear armament. Each nuclear weapon, be it ordered, manufactured, or acceded to, further jeopardizes the human race. With each weapon the ante is raised.

What Reagan pushes ahead of him psychologically and spiritually is what Dr. Robert J. Lifton calls psychic numbing, induced by the weaponry itself. As the weaponry touches individuals, they are really touched with madness, with a death of feeling and of compassion. We become a nation touched with moral leprosy. That's Hiroshima before the fact."

Reagan's image is not accepted by everyone. There are many, like Daniel Berrigan and his friends, who refuse to consort with the Beast. To accept the arms race is

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CHAGALL'S BIBLE

BY GINI KOPECKY

The style is unmistakable. Only the subject matter is surprising. Not since the Renaissance has an artist attempted a work as monumental in theme or execution as Marc Chagall's 105 hand-colored etchings of stories from the Old Testament—stories intertwined, for the ninety-two-year-old artist, with memories of his Jewish upbringing in the Russian city of Vitebsk. Like the Old Testament itself, Chagall's pictures depict mortal beings engaged in every aspect of human existence—in reverie and

Left: God, whose name appears in Hebrew letters, creates man and gives him the breath of life. Above: After the great flood, God sends a rainbow to Noah, a sign of His covenant with mankind.

despair in love and war, in prayer and celebration. It is to the patriarchs and prophets, however that he is especially drawn. Noah, Moses, Ezekiel, Elijah—men of passion and vision who were as often ridiculed as they were revered by their own people for being harbingers of new epochs and a greater destiny. Chagall reinterprets these familiar stories, imbuing them with a quality of the miraculous and the fantastic. Commissioned in 1930 by French art dealer and publisher Ambroise Vollard, the project was not completed until 1956, after the unfinished plates had been retrieved from their World War II

Above, clockwise from top left: Moses before the burning bush; the Angel of Death passes over Egypt; Moses on Mount Sinai, the parting of the Red Sea. Right: Jacob wrestles with the angel on the eve of his reunion with Esau

hiding place and Chagall had resumed nurturing each illustration through multiple revisions His total devotion to the project—a devotion that extended to the handcoloring of each individual print—seems to have drawn from him a mastery of style beyond his younger years

Of the 100 sets of etchings originally printed, as few as 5 are believed to have survived intact One set was recently acquired and photographed before being sold to individual collectors by San Francisco's Harcourts Gallery by whom these reproductions were made available ∞

Left the vision of Ezekiel Above clockwise from top left Elijah's sacrifice the Lord reveals Himself to Elijah one of the seraphim purifies the lips of the prophet Isaiah with a live coal, Elijah ascends to Heaven in a chariot of fire

Photograph by Michael Somoroff

With a budget of only a fistful of dollars, NASA's new administrator prepares to make businessmen an offer they can't refuse

INTERVIEW

JAMES M. BEGGS

From those to whom much is given much is expected. The man named administrator of the National Aeronautics and Space Administration (NASA) is handed an awesome responsibility. His domain is the entire solar system and beyond. His tasks include research into and development of all facets of aerospace technology, exploration of other worlds, creation of new industrial capabilities in space, searching for extraterrestrial intelligence, promoting scientific research, and dealing with the Washington political apparatus. His budget for accomplishing all these objectives is considerably less than 5 percent of the budget for the Defense Department.

James M. Beggs brings to this daunting assignment a lifetime of experience in industry and government and an enthusiastic activist's view of aerospace technology's importance to the strength and well-being of the United States.

Born in Pittsburgh, in 1926, the fifty-five-year-old Beggs is a graduate of the U.S. Naval Academy. He served in the Navy until 1954, performing submarine duty. He received a master's degree in 1955 from the Harvard Graduate School of Business Administration and holds honorary doctorates from Washington and Jefferson College, in Washington, Pennsylvania, and from Embry Riddle Aeronautical University, in Daytona Beach, Florida.

Beggs spent 13 years in technical positions with Westinghouse Electric Corporation, rising to the post of vice-president of the Defense and Space Center. In 1968 and 1969 he served as NASA's associate administrator of the Office of Advanced Research and Technology. From 1969 to 1973 he was under secretary of transportation. In 1974 he joined General Dynamics Corporation, becoming a corporate director and executive vice-president in charge of aerospace operations. He was responsible for four of the corporation's operating divisions, including Convair and Electronics.

Beggs is a member of the Board of Governors of the National Space Club, the National Security Industrial Association, and the American Astronautical Society. He is also a member of the Na-

tional Academy of Public Administration the American Institute of Aeronautics and Astronautics, the American Society of Naval Engineers, and Tau Beta Pi the honorary society for engineers. He is also a director of the Consolidated Rail Corporation and of EMC, Inc.

A businessman who flies his own plane, an engineer who worries about the quality of American education, a space enthusiast who understands the role NASA must play in basic research, Beggs is still enough of a realist to know that reconciling NASA's many goals with the budget strictures of the Reagan White House and the Office of Management and Budget is no enviable task.

Beggs is a crisply articulate man who seems equally at home discussing the role of scientific research in strengthening the national economy or the role of grass-roots space-advocacy groups in promoting a stronger space program. He is clearly a "big-picture" thinker who foresees NASA assisting private industries to develop new technologies in space.

Shortly after his appointment was confirmed by the Senate in July, Beggs publicly suggested that President Reagan set a new goal for the U.S. space program: the establishment of the Space Operations Center, a permanent manned space station in orbit.

Beggs was interviewed a few weeks before his Senate confirmation by *Omni* Editorial Director Ben Bova at NASA headquarters in Washington, D.C. Also present during the interview were Drs. Hans Mark, NASA's deputy administrator, and Jerry Pournelle, writer and space activist.

Omni: Congratulations on your appointment. Or maybe I should say welcome to the hot seat.

Beggs: Thanks. This is, I think, a very interesting time—a difficult time. Budgets are likely to remain tight for the foreseeable future. At the same time, I think the pendulum has swung in the direction of renewed recognition on the part of the public that the space program is important.

Omni: Do you think the shuttle has played an important role in making people realize the space program is here to stay?

Beggs: Yes. The real importance of the shuttle is that in a few years we are not going to conduct any spaceflights without people going along; that transcends everything else. But ever since the manned space program began, there's been a very strong and vocal body that says that anything we want to do in space can be done more easily and cheaply without people. Unmanned space research is really where it's at.

If you have the experiments you want to do clearly in mind, then that statement is correct. But that's not the name of the game. The name of the game is flexibility, judgment, intelligence, and imagination. Those are much more valuable.

Omni: But there is still this drive to push manned spaceflights into one corner.

Beggs: I don't think so. I think that battle was fought back in 1969. The ideas on which the shuttle is based were hashed out then. The fact is that people are going to be there, and the real question right now is, 'Who should fly?'

Omni: Will there be shuttle flights with celebrities aboard?

Beggs: Sure. I think so.

Omni: For the promotional value of it, or because people want to go?

Beggs: Everything in this world has an element of promotion in it. When Jim Webb was running NASA, it was his view that we ought to get a very large spectrum of society involved in the program. And, as you know, he got everybody involved—everybody that he could. Some people he dragged in kicking and screaming, but they came. And when they got here, they found they liked it. I think the same thing applies to the future. If this program is going to be what we hope it will be, we want a very broad spectrum of people involved in it. We don't want just scientists and engineers.

> *"To maintain NASA's thrust, we must have new programs. My priority is a permanent space station in low geosynchronous orbit—a platform for planetary exploration."*

Omni: We've had suggestions from *Omni* readers that there be a national lottery so that ordinary citizens can have a chance to ride the shuttle.

Beggs: The big thing, to me, is to get kids involved. If we can get them thinking about the potential and the possibilities, the ideas will come from them.

We must try to capture the minds of the kids. You know, the aerospace industry is growing old. In fact, the average age of the twenty-two thousand engineers I had under my responsibility at General Dynamics was over forty-five. I spent seven years just trying to move that average down a few years, to start bringing in fresh blood.

Omni: What about funding for the next couple of years? It's going to be tight—we all know that. But, on the other hand, some of the R and D expenses of the shuttle should be declining. Will there be room for new starts?

Beggs: Two years is a very short time. I think the first thing we must do is make the shuttle operational.

Omni: That's your first priority then?

Beggs: Yes. The media have proclaimed the shuttle operational. It is not. We had a first flight. We'll have a second one, we hope, in the September–October [1981] time frame. Then we'll go from there. Assuming everything goes well—and we all hope and pray it will, and I believe it will—then, as we progress toward the time when it is operational, it clearly becomes time to think about what we can do with whatever resources have become available. I hope that we could get several new starts going. Maybe not in two years, but certainly in the next three or four years.

Omni: What would be your personal preference for a new program?

Beggs: The thing mentioned most often is a permanent station in low-Earth orbit, or ultimately a permanent station in geosynchronous orbit. That appeals to me.

Omni: That's a major commitment.

Beggs: A long-term commitment—a commitment of the size we made when we started the shuttle. But it would provide us the basis for doing a lot of other things, like more sophisticated planetary exploration. The ability to do the science from a permanent station would be of greater significance than anything we're thinking about today. The potential of eventually developing some commercial payoff certainly would be enhanced if we had a permanent station.

Omni: What are NASA's plans for getting more industrial participation in space programs?

Beggs: I don't really know that there is a plan other than trying to tell people. Here is a great potential, why don't you all come and explore that potential with us? I believe that after we have been flying the shuttle for a year or so, we will start to see some commercial fallout. Once we get some of that, I think there will be a lot of folks who will look at that and say, 'Gee whizz, there is a potential there. Let's explore it and see what we can develop.' Then you get the most creative minds in industry starting to think about it. I don't really think that there has been a lot of sound entrepreneurial thinking devoted to space. I think as a beginning you've got to get up there and do it.

It's like a favorite story of mine. Michael Faraday was guiding the king [of England] through his laboratory, and the king stopped before something that Faraday was doing and asked, "What's that?" Faraday proceeded to describe it to him, and the king said, "What good is it?" Faraday thought for a moment, then said, "What good is a baby?"

Omni: There's another version of that story. The king asked, "What good is it?" And Faraday answered, "I don't know, but someday you'll put a tax on it."

Beggs: But I like the first version, because this particular thing is in its infancy. Space has great potential. There is immense scientific fallout and scientific benefit from this. But beyond that, there undoubtedly will be some substantial commercial bene-

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It chews up the brain
It kills suddenly And nobody
knows what it is

AGENT X

BY FRANKLYNN PETERSON
AND JUDI KESSELMAN-TURKEL

Restless and ravenously hungry the killers fanned out in search of living food. Their goal: to invade the body of any healthy organism, capturing its life-force for the production of still more lethal agents.

Conceived by science-fiction writer Ralph Milne Farley in a 1936 story entitled "Liquid Life," the gelatinous monsters were minuscule, virus-like mutants that matched humans in intelligence. They were able to pass through filters fine enough to trap all known viruses. And the only chemical that could destroy them was carbolic acid.

Today 200 researchers throughout the world are racing to unravel the mysteries of a *thing* that could have stepped right out of Farley's fantasy. This thing is also a deadly mutant that passes through filters fine enough to trap all known viruses, it appears to be vulnerable only to carbolic acid. Scientists call it

PAINTING BY GOTTFRIED HELNWEIN

viroid viruslike agent scrapie agent and other names just as vague. We'll call it Agent X.

A brutal but insidious murderer Agent X enters living organisms, settling happily in and causing no trouble for years. Then suddenly it strikes with a vengeance that has jarred medical science. Victims first become too dizzy to walk, then too ill to stand. Their thought processes gradually slow until they seem senile or demented. In a year they are dead.

So far Agent X has been detected in nature only in sheep, minks and humans—particularly one New Guinea cannibal tribe. Because it has been so elusive, scientists suspect it might be the cause of a wide range of unexplained debilitating diseases: multiple sclerosis, rheumatoid arthritis, and even diabetes. It cannot be cured by interferon, radiation, or any of the virus and bacteria killers devised by man.

Until the discovery of Agent X, the ordinary virus was the tiniest known organism. Smaller than a single human cell, it consists merely of a strand of nucleic acid (a gene) surrounded by a protein shell. Without the protein-synthesizing machinery found in other living cells, the virus can neither grow nor reproduce. So, like Farley's fantastic little particle, it perpetuates by invading other living organisms, using their cellular machinery to manufacture more virus.

Agent X *seems* to reproduce in much the same way. However, scientists scrutinizing its structure can find no protein shell and no trace of nucleic acid, the building block of genes in every other form of life. Agent X cannot be classified. It is not really a virus, but rather a bizarre mutant that changes form from one generation to the next. Almost impossible to defect, it is so tiny that 1 billion particles could fit on the head of a pin one millimeter in diameter. The same pin could hold a third as many polio viruses. Researchers on the track of this ruthless scavenger expect they will eventually have to broaden, or even redefine, terms like *virus* and *gene*. When they do, they may have to draw up a new definition of life.

Agent X can be traced back to 1755, when English sheep farmers petitioned Parliament for relief after massive numbers of sheep died from scrapie, so called because the sheep first showed signs of the illness by scraping against posts and rocks, apparently to relieve itching. Later they lost the ability to walk, and still later their sense of balance was so disrupted they couldn't even stand. Scrapie symptoms appeared most often in the third year of a sheep's life and usually killed the animal before it was four years old. Today scrapie is known to be caused by Agent X.

A nineteenth-century scrapie epidemic in Germany was considered the agricultural equivalent of the black plague. By the early 1950s scrapie had become too costly a killer to be ignored, taking 1 sheep out of about every 100. So in several countries agriculture departments began eradication campaigns.

To wipe out a disease, you generally must know what's causing it. But by 1954 scientists knew only that scrapie was transmitted from animal to animal *somehow*, by *something*. Because sheep didn't show scrapie symptoms until the third year, scientists named the causative "thing" *slow virus*. Later it was pointed out that minks with a disease called transmissible mink encephalopathy (TME) showed similar symptoms. TME, too, was attributed to slow virus, again pretty much on the basis of a scientific hunch.

Back then scientists were relatively certain that scrapie couldn't spread through the air, in water, or by chance contacts, which are normal routes for viral infections. They suspected that scrapie got around only by direct, intimate contact, for example when a healthy sheep ate a placenta left behind by a diseased sheep. This was effectively confirmed when Richard Marsh, a veterinarian at the University of Wisconsin, demonstrated that TME and scrapie were one and the same disease and that minks caught it by eating scraps of scrapie-infected sheep.

"Victims become too dizzy to walk, then too ill to stand. They sink into a world of madness and confusion as their brains are chewed to a spongy pulp. Within about a year they are dead."

Then, in 1957, an American pediatrician named Carleton Gajdusek stumbled onto the trail of Agent X while visiting a friend in New Guinea. Gajdusek, an intense young man with piercing brown eyes and a rapid clip to his speech, met a district medical officer who told him about a strange neurological disorder. It was found only among the Fores, a group of cannibals, the officer said. The disease, called kuru, killed about 1 in every 100 Fore people, mostly women and children. The stricken were first unable to walk, then unable to talk or even see. They sank into a world of madness and confusion, and inside of a year they were dead.

So fascinated was Gajdusek that he stayed in New Guinea for a year, trading axes and tobacco for the tissue remains of kuru victims. He was able to prove that kuru chewed the brain to a spongy pulp, especially the cerebellum, which controls motor function. But nowhere could he find the elusive particle of destruction. In 1958 he accepted a post as visiting scientist at the National Institutes of Health (NIH), in Bethesda, Maryland, and started publishing his findings.

One of Gajdusek's papers was read by William Hadlow, a veterinary scientist who had spent most of his career tracking down scrapie. Hadlow, with NIH's Rocky Mountain Laboratory in Montana, quickly recognized the extraordinary similarity between kuru and scrapie. In a letter to *The Lancet*, he made the brave leap to the theory that both diseases were caused by the same mysterious agent.

Following Hadlow's suggestions, Gajdusek spent years observing the lab chimpanzees he had inoculated with homogenized brain tissue from kuru victims. In 1963, a few years after the inoculations began, the first chimps developed kuru, and Gajdusek concluded that the disease could be transmitted from one animal or person to another. Convinced that the Fores passed along Agent X via cannibalism, Gajdusek persuaded them to end the practice. Now the disease no longer strikes members of the tribe.

Because kuru was a cannibals' disease, it received more attention than the sheer number of victims would have warranted. But Gajdusek soon learned that another far less publicized neurological disorder—Creutzfeldt-Jakob disease (CJD)—had markedly kurulike symptoms. Victims lost the ability to walk or talk, finally relinquishing even the will to live. In every case the brain had been literally eaten alive.

Following his hunch, Gajdusek inoculated chimps with tissue taken from CJD victims and found that after years of incubation the monkeys came down with kuru. Obviously CJD and kuru were caused by the same villain, Agent X. Kuru, Gajdusek hypothesized, might have begun when the Fores ate a relative who had spontaneously developed CJD. More important, Gajdusek realized that Agent X was probably at the root of other debilitating disorders of the central nervous system—Parkinson's disease, for example, or Pick's disease, and even Huntington's chorea.

When Gajdusek won the Nobel Prize in 1976 for his work, he used his prize money to help educate Fore youngsters. Relatively little was known about Agent X at the time. The shadowy substance had eluded all scientists' efforts to catch a glimpse of it under electron microscopes, to define its chemical structure, or to explain how it could wreak such havoc. Total knowledge was limited to a few startling facts:

- Agent X caused scrapie, TME, kuru and CJD.
- Agent X had a slower incubation period than any microorganism known to science.
- Unlike bacteria, viruses, and even tumors, Agent X did not spark the body's immune system into action. It caused no fever, no interferon production, and no identifiable antibodies, only—eventually—death.

For years the investigation of Agent X was drastically limited by the enormous

time that it took to do a single experiment Marsh studied Agent X by injecting lab animals with scrapie, then watching for results For each experiment he had to obtain diseased tissue "brew" an extract of Agent X and then inject it into a variety of animals The animals were observed as they slowly incubated the substance—for up to three years Then, and only then could they be killed and their tissues be examined for evidence of disease Because it sometimes took as long as five years to get a single result it's small wonder that Marsh is eager to abandon his approach in favor of the newer "biochemical techniques" developed by such scientists as Stanley Prusiner of the University of California at San Francisco

Prusiner, thirty-nine, is roundish and mild-mannered, a bit like a complacent carpet salesman He was first fired with curiosity over the mysteries of Agent X while he worked as a medical resident in San Francisco There his case load included a patient with CJD So amazed was Prusiner by the woman's rapid neurological debilitation that he stayed in California to track down the substance that was making her ill Among the most brilliant and energetic newcomers in search of Agent X—he frequently puts in seven days a week at his lab—he assembled a team of ten researchers from such diverse fields as neurochemistry, cell biology, enzymology, and immunology "to have an expert on hand, no matter what direction our research might lead us in"

At the outset Prusiner was disturbed because no one had yet isolated a pure sample of Agent X Without such a sample he knew, it would be virtually impossible to learn much more about the deadly particle So he set out to isolate the agent, hoping to produce an uncontaminated sample that could be analyzed—and eventually destroyed

To make large batches of the agent for his first experiments, Prusiner injected mice with brain material from sheep that had scrapie When the mice died, Prusiner removed their brains and ground them into a pasty liquid

Prusiner reckoned that out of the entire paste sample, only 1 particle in 1 million was Agent X To separate that minute quantity from the mass of brain cell material, he put the paste in a centrifuge and spun it at successively greater speeds When the centrifuge whirled slowly, the heaviest particles spun out of the paste, when it whirled quickly lighter particles flew away Prusiner learned that Agent X was a middleweight particle, removed when the centrifuge turned at 50,000 revolutions per minute By spinning batches of his paste at just that speed, he was able to produce the most concentrated solution of Agent X ever

But while this sample was stronger than before, Prusiner knew that to produce pure X, he would have to remove many other contaminants So he subjected the purified paste to hundreds of chemicals, boiled it, and even bombarded it with radiation In this way he gathered enough information to remove one contaminant after the next After each procedure, he simply injected the resulting solution into healthy mice If contaminants were removed and the solution was purified, mice exposed to a more powerful dose of Agent X would become sick more rapidly with less inoculant than before

Each time a method worked, Prusiner would use it to make batches of a new more refined solution The purification went rapidly because Prusiner used a method that enabled him to measure the strength of the agent in a fraction of the time taken by other researchers Each time he removed a contaminant, he learned something new about the chemical and the physical properties of the agent

The remarkable outcome is that he and his colleague Frank Masiarz have made batches of Agent X that are 1,000 times as powerful as any found in nature This lethal

"An American doctor stumbled onto the deadly path of Agent X while vacationing in New Guinea, where he learned of a bizarre neurological disease found in a small, isolated tribe of cannibals."

Super X has allowed Prusiner to go further than anyone in characterizing slow virus For instance, he has established that it contains protein, though it does not seem to coat the organism as it does in viruses He's also established that if the protein is removed, Agent X loses its infectivity Once the nature of the protein is determined, physicians will be able to test for infection efficiently This is a prerequisite for any form of treatment

Prusiner has also documented that the agent is hydrophobic, that is, that it dislikes watery materials and feels most at home around fatty substances, such as membranes It also means that Agent X particles probably gather together in well-organized clumps for mutual protection against water

When challenged, Prusiner recently learned, Agent X particles are defended by a coating of membranelike fat from the body of the stricken person or animal Thus hidden they are enormously difficult to identify or destroy

Prusiner and others are now trying to find out whether Agent X contains nucleic acid such as DNA In every form of life discovered on Earth until now, it's been nucleic acid that controlled the transmission of genetic information from one organism to the next All living cells discovered so far—healthy human cells, bacteria, viruses, tumors—require nucleic acid to reproduce

Because Agent X does replicate, something must be supervising the process But so far Prusiner's intensive search for nucleic acid has proved fruitless And that's the most fascinating part of all If nobody finds nucleic acid, we may have to revise all previous concepts of how genetic information is passed along Someday soon one of these hypotheses may be proved true

- Nucleic acid, such as DNA, is not needed to sustain life in spite of what scientists have thought If Agent X can transmit genetic information *without* nucleic acid, it will force the scientists back to the drawing board for a new explanation of reproduction
- Agent X replicates with the aid of nucleic acid from the cells of the organism it has invaded Thus, it works like a biological switch, turning on systems that cause the body to produce lethal chemicals
- A tiny bit of nucleic acid may yet be found in Agent X If it is, it would probably contain one fourth as much information as the smallest virus That would create a dilemma Agent X is enormously sophisticated and its many "behavior patterns" suggest the presence of a large mass of nucleic acid
- We may never find one answer Instead, Agent X might be mutating constantly, always one step ahead of body defenses—and researchers If it has the ability as well to repair itself quickly, it may be vulnerable to radiation and life destroying chemicals, it may only appear to be invulnerable This might explain why it can lie dormant for so many years, and then cannibalize the brain in just a few months

These hypotheses have added new excitement to Agent X research In its last heyday the drama of a cannibal disease brought new people and new money into the field This is about to happen again Scientists struggling to comprehend this bizarre form of life are sure to shake things up, casting serious doubt on some of molecular biology's iron tenets and obliterating others In the process they could gain enough insight to cure diseases that have plagued man for centuries

Prusiner recently jet-hopped to three conferences in less than a week "When I used to run around the world giving papers, my fellow scientists wanted to know what I was wasting my time for," he says "But this trip was different Wherever I went, people kept saying to me 'Boy Stan, are you lucky you got in when you did!'" ◻◻

For Further Reading

The Cellular Basis of the Immune Response Golub, Edward S Sinauer Associates, Inc Sunderland, Mass 1977

Kuru Early Letters and Field Notes from the Collection of D Carleton Gajdusek Gajdusek, D. Carleton, and Farquhar, Judith Raven Press New York, N.Y. 1980

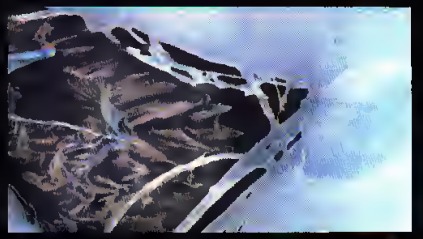
Unique photographs born of fire — and a touch of alchemy

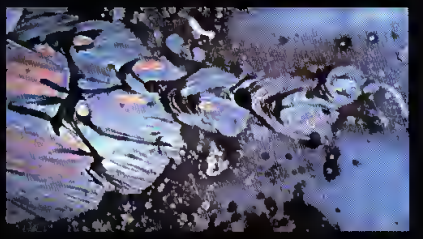
VISIONS OF THE OCCULT

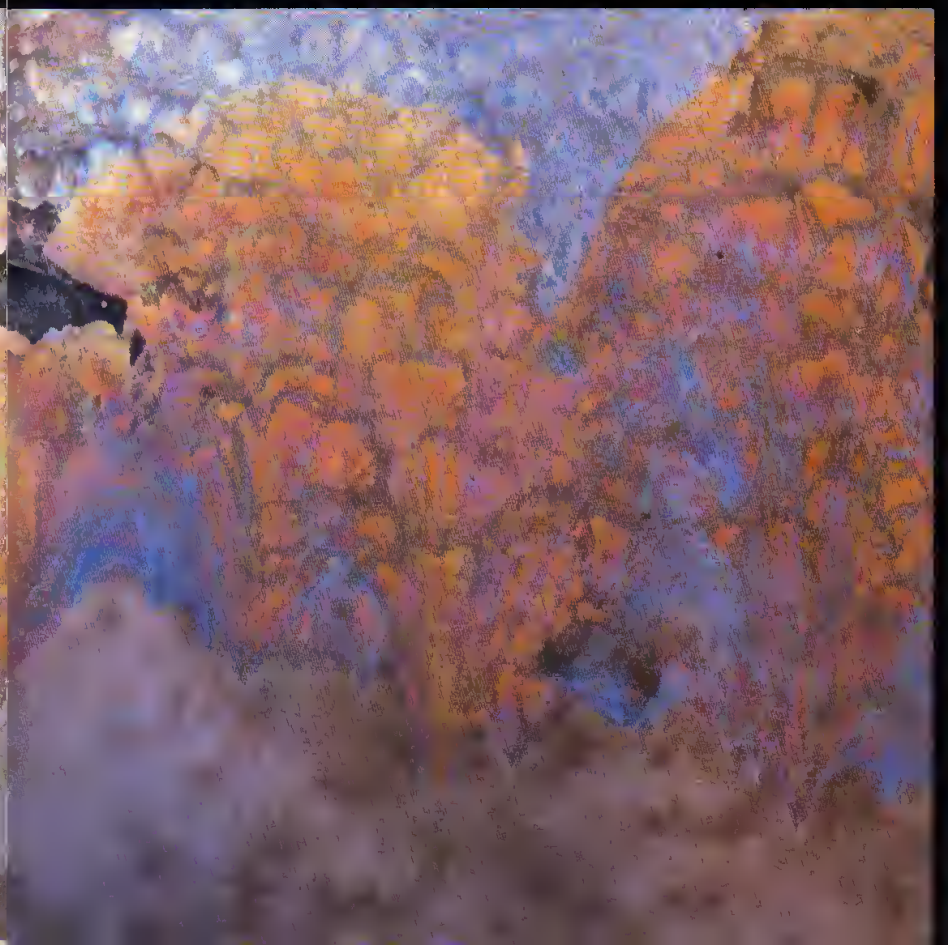
BY DOUGLAS COLLIGAN

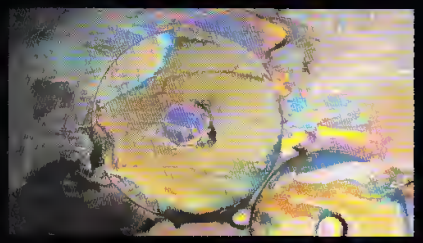
No one, not even the photographer who took these pictures, can determine their genesis. "I've worked in darkrooms since the age of seven, but I'm totally baffled by what happens on the sheet of film," says Robert Monroe of his camera-free process. The kaleidoscope patterns are obtained by laying various objects—

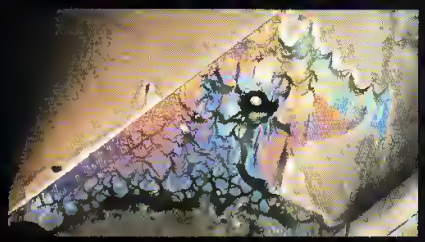
PHOTOGRAPHS BY ROBERT MONROE











coins, wispy feathers—directly on top of the film. The mysterious part is the unexpected galaxy of iridescent colors that appears on the emulsion. Monroe stumbled on these effects while experimenting with some chemicals that were supposed to improve the clarity of photographs. Suddenly figures came alive in icy silvers, electric blues, and shimmering reds. He got his next surprise when he tried to duplicate these dazzling images. He followed the same steps, used the same materials, yet got totally different results. He's reached one conclusion. The process seems to have a life of its own. His only clue to this phenomenon comes from *A Treatise on Cosmic Fire*, by occultist Alice Bailey, that refers to alchemy: "going from one state to another through the agency of fire." Monroe views the chemicals in his process as a form of fire. In fact, their volatility has forced him to wear a gas mask when he's in the darkroom. "Maybe it's a case of chemistry doing its own thing," he says, "but I always get something beautiful." ∞

FICTION

An adolescent journeys to hear the majestic last rites for a long-dead Earth

VOX OLYMPICA

BY MICHAEL BISHOP

My father had been tuning the volcano for the past year. His work was in preparation for the decennial Day of Diapason, when we who have made a home of the once-desolate mojaves and himalayas of Mars salute the long-dead planet where our species was born.

I had just turned eight, but our patriot population observes a double year, counting by the six hundred eighty-seven-day period in which Mars revolves around the sun. A colonist on Titan or Ganymede, harking back to Earth-style dating, would say I was fifteen and a half.

Though fast approaching adulthood, I had never heard my father or anyone else play the mountain. The Vox Olympica (as devout Krystic Harmonists generally call it) is not truly duplicable by any human-scale recording system, and I was eager for firsthand experience of the ancient volcano's voice. I was also eager to see my father again.

While supervising the tuning of the several hundred painstakingly cored-out calderas and vents of Olympus Mons, my father had come home for only brief visits. These obligatory "rests," mandated by the church, he had spent poring over computer diagrams of the great mountain's bowels, collating and memorizing the chromatic readouts of its glassy flues. As a result, he had made no real fuss over my improving grades in history and hydraulic science, he had shown only polite interest in my collection of preadapted insects from the Tharsis Steppe, and, although he had listened dutifully to three of my melodeon compositions (at my mother's dogged bidding) afterwards he had dispensed rote praise rather than incisive criticism. His mind had been elsewhere.

Vanora, my mother, resented the Day of Diapason as much as Theon, my father, revered it. To her it represented not only a disaster for the continuity of our family life but also a perverse wallowing in the fabled destruction of Earth. Why must we carry on so about what was lost forever? Beginning only a year after their bond covenant, my

PAINTING BY MATI KLARWEIN

father's first stint as Memorialist had almost destroyed their marriage. Somehow, though, they had survived the separations, the misunderstandings, the arguments. Finally my birth in Spaulding, West Tithonia, where Vanora headed one of the Northern Hemisphere's ground-based divisions of OSAS (Orbital Solar Amplification System), had confirmed their faith in the benefits of reconciliation. I was the tie that binds.

Seven years later the church had again selected my father to oversee the preparations at Olympus Mons, and Theon, despite his many intervening promises to my mother, had accepted the commission.

I was on my father's side, and I told Vanora so.

To me Theon's selection by the Harmonists seemed a signal honor, and I was prepared to forgive him a hundred humiliating slights if only I could sit beside him in the mountain organ room on the day he made even distant Helias ring. When he played, the whole planet was supposed to teeter in its orbit. I wanted to be with him, booming out a diapasonal lament for long-dead Earth. He had hinted that this might be possible. Perhaps he would even let the volcano give prodigious voice to one of my melodeon sonatinas. I had written an especially good one since his last visit to Spaulding.

"Gayle," my mother said, after listening to this feverish recitation of my hopes, "you shame yourself with every word."

"Why do you say that?"

"Because you're older now, child, but scarcely any wiser."

I was sitting at my melodeon, a gift from Theon on my seventh birthday. I had been filling our bunker with frisky runs and grace notes. Now I turned the melodeon off and covered its keyboard.

"Listen, Gayle, the ceremony's tradition-bound. The Memorialist plays what every other Memorialist since Zivu, the first, has played. Zivu established the program. Your father isn't going to squeeze in a little Gaylean ditty as a sop to your vanity."

"I know that, Mother. I was only talking."

"Well, your talk of joining him under the mountain is nonsense, too."

"He said I might."

"Gayle, he probably wasn't even listening." Vanora's voice conveyed her concern as well as her exasperation. "Did you know that the Memorialist hears only the ghost of his own performance?"

"The ghost?"

"It's true. The keyboard room is soundproofed. Everyone entering it—traditionally, the Memorialist and a single technician—must wear absorbent plugs and a pair of padded earphones. Zivu went deaf hymning Earth's lost glory. Knowing full well what the result would be, he performed the entire day's program without protection."

"Father's not deaf."

"No, but his hearing's impaired. Sometimes I think he accepted this second commission not for the honor of it but because he wants to be able to hear music again in the only way he really can—through his bones."

"Then why do you begrudge him?"

Stung, Vanora leveled an appraising glance at me. Then her expression softened. "First, because he told me this would never happen again. And, second, Gayle, because the Day of Diapason's a Harmonist anachronism. It's disruptive of the new order we've established, and it's morbid in its celebration of the poisoning and death of our home world."

"It doesn't celebrate, Mother. If memorializes."

Vanora dismissed my view of the matter by picking a thread from her tunic and dropping it to the floor. I was lucky that she was talking at all. Ordinarily, except when arguing with Theon and allowing her feelings to run away with her, she avoided discussing the topic in my presence. That she had *initiated* a conversation about the Day of Diapason with me—well, that was a breakthrough akin to faster-than-light travel. I tried to press my advantage before it fled at that speed.

"What was Father's first performance like?"

My mother looked at me, then let her gaze swing past the redwood statue of Ares guarding the corridor to her night chamber. "I'm afraid I didn't hear it, Gayle. I didn't want to hear it."

"You didn't hear it?"

"I *felt* it," Vanora said, intercepting my stare. "Or at least I think I did. OSAS held a training program for executive candidates in Stanleyville, Northwest Hellas, two weeks before the Day, and I stayed there, using my leave time, even after our training sessions were over. I was in the bunker of a government hospice in the Southern Hemisphere when your father played the mountain. I felt the music he was making, and an officer at the nearby OSAS facility recorded it on a seismograph."

"You could have got back in time to hear him, and you didn't even make the effort?"

"That's right."

I shook my head. "That's astonishing, Mother." Vanora did not reply. "Are you going to listen to him this time?"

"Spaulding's much closer to Olympus than Stanleyville is. I suppose I'll hear your father's performance. I'm going to spend the day down here, though, with our sound units turned up and my ears plugged."

"That's spiteful, Mother! Sheer irreligious spite!"

"Your father's the religionist in this family, Gayle, though he's pulled you that way, too. I just don't have any desire to hear the music he makes for a foolish memorial ceremony."

Controlling my outrage, I said, "I do."

"I know you do. Step aboveground on the Day of Diapason and you'll hear it everywhere—hour upon hour of merciless, unending bombast. But legislation in the Parliament at Chryse promises to make this

"I am the ghost of Christmas Past, providing, of course, that you accept Einstein's theory of relativity."

year's ceremony the Harmonists' swan song, at least so far as that ogreish mountain is concerned. So listen well, Gayle, and remember what you hear."

"Goodnight, Vanora." I stood up, brushed the wrinkles from my clothes, and strode past the tutelary statue of Ares to my tiny room. My own mother was a skeptic and an enemy.

"Goodnight, child," she said, resigned to my sharpness. "Sleep well."

A week before the Day of Diapason I ran away from home. I carried with me an Isidian silver harmonica, a printout of my sonatina "If I Forget Thee, O Elysian Earth of Yore," an enameled box in which to house captured insects, and a satchel for my clothes. I left at night, when the OSAS veils throw a bronze dusk over Tithonia's giant redwood groves, for then a brown-clad figure among the trees blends with the antique shadows like an otter or a deer.

As for Spaulding, a government town where the door to every buried house resembles an upright marble grave marker—well, no one there saw me take my leave.

My destination, of course, was Olympus Mons, the enormous shield volcano in the Martian province informally known as Blackshale. The mountain's chief city is a well-to-do vacation community incongruously called Hardscrabble on the eastern flank, high above the Olympus Palisades, which front the Tharsis Steppe. My father received mail and occasionally slept in Hardscrabble, which lay more than twenty-one hundred kilometers northwest of our home in Spaulding.

To get there I was going to have to pass through several government redwood groves, dairy farms, winter-wheat collectives, and mining hamlets. My course pointed me straight through the famous Wilder Plains, separating the two northernmost volcanoes of the Tharsis Ridge, Ascra and Pavo. If I made it through that pass by my second day of travel, I would be doing well. Everything depended on my catching rides in only a week, not even a towering, three-legged war machine could walk to Olympus.

That first night, though, I deliberately avoided people. I ran through the oxygen-exhaling redwoods like a two-year-old, my heart bursting with unwritten melodeon music. I was free. If anyone stopped me, I could show him my birth card, which showed me to be old enough for freelancing, and explain that I was a Harmonist novitiate on my first solo pilgrimage to the Holy Mountain. That was true, pretty much. It fell short of total truthfulness only in that I had not registered my intentions with the church.

Toward dawn I sat down beneath a redwood, emptied my pockets, and played "If I Forget Thee" on my harmonica. It sounded tinny and pitiful there in the woods, despite the sterling quality of my instrument, another gift from Theon, and I stopped before finishing the sonatina and returned both the mouth organ and my clumsy score to my satchel. I ate a dried beef cake and a seedless tangerine from Coprates, then stretched out to sleep. Around noon I was awakened by cricket song.

Instantly alert, I searched for my self-appointed alarm clock. Most crickets do not chirp during the day, but perpetual dusk has superseded night on Mars, and a few cricket species have so far accommodated to this pattern that even full daylight does not inhibit them. I found my minstrel in a patch of white moss on the south side of a nearby redwood, caught it between my cupped palms, and eased it into my perforated box. If was white, my cricket—not a pink-eyed albino, but an emerald-eyed mutant of a species I had never seen before. I took it with me.

Early that afternoon I left the forest and labored to a hilltop overlooking the Wilder Valley. Beneath me was a kilometer-wide tributary of the Canal Irrigation System (CIS), carrying water from the northern polar cap to Blackshale, Tithonia, Isidis, and other equatorial regions. This particular canal was the Wilder Interprovincial Tributary, CIS-WIT, to acronym lovers.

Gazing down, I was stunned by the amount of activity, both mercantile and recreational, along the broad concrete aprons of the locks. Like an immense liquid python, a strip of silver water curled away to the northwest and into a forest of dark green conifers. Up and down the middle of the canal moved colorful barges, while bathers and holiday anglers made use of the peripheral areas specifically set aside for them. Dock workers and freight vehicles labored noisily on the quays, and hundreds of gaily dressed people from nearby townships mingled among the wooden booths and striped canvas tents of the canalside markets. Spaulding, by comparison, was a drowsy memorial garden. I ran down the hill. If seemed unlikely that anyone in this busy festive place would know or care that I was a runaway.

After buying a cup of milk and a shell sandwich with some of last year's emergency scrip (it was worthless at home, but negotiable on the canals), I sauntered along the quays, looking for up-channel transportation. No one paid me any mind. I spilled most of the granulated beef from my shell sandwich, but a black dog and a pair of cheeky fulmars cleaned up after me. No reprimand from angry authority figures.

But no advice about how to catch a ride into Blackshale, either. It seemed that three quarters of the water traffic was coming *down* the canal. I despaired of reaching my father before D-Day. Surely though, there had to be other pilgrims journeying up the CIS-WIT to hear the Holy Mountain hymn the planet of our origins. I would join them.

Unfortunately, I could not find them. Everyone along this lock of the Wilder Tribu-

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"It looks as if someone spilled ink on a piece of paper and then folded it in half."

RINGTIME

CONTINUED FROM PAGE 88

crone's finger. "Isn't that always the way of it with galleries, though? But is self-advantage that important to you as an artist? What does money matter if you enjoy abundantly the pleasures it can buy?"

"Yeah, but you'll enjoy the reruns. You and your customers."

"I wouldn't deny that. But what better defense against satiety than to awake each day to a present unshadowed by the past? Candidly, I consider the loss of short-term memory a great blessing. It allows me to live for the moment."

"In any case," said Rudy, "you'll get a quid pro quo. After each recording session you'll be allowed to check out a ring from the gallery's current collection, excepting some few rare recordings that have only one or two replays left. I assume that's what you were after when you broke in here."

"If the ring you left with me last night is any sample of your collection, I'm not enticed."

"What ring was that, Rudy?" Muriel asked.

"One of my nightmares, from when I was four. I did warn you, Mr. Whelan, that it might be too strong for your taste, but you flipped for the price tag."

"I don't believe that was a nightmare. That was real."

"Oh, Rudy had the most vivid nightmares imaginable as a child. Everyone accepts them quite literally. Of course, as Rudy says, they're not to every taste. One sample was enough for me. But people go to horror movies, don't they? It's the same principle."

"Cradle robbing is not the same as anything. It's a crime in this state, and that ring is evidence."

"There was nothing illegal in any of Rudy's recordings. They were undertaken with a grant from the National Endowment and conducted under the strictest psychiatric supervision. Every ring is fully documented. And from a strictly ethical point of view, surely it was a kindness to the dear boy to exorcise the memory of such terrible dreams."

"Except, Mother, that as a result I went on having the nightmares."

"That's only a theory, Rudy," Muriel scolded. "All children have nightmares. It's a stage they go through. You just had a special talent. Why in the world are we discussing this? I thought we'd settled this years ago."

"Because Mr. Whelan didn't enjoy his private viewing."

"Oh, yes. Well, Mr. Whelan, you must choose more wisely next time. Try athletics. It picks you up wonderfully, and we've got a fine stock. Rudy takes a group of young men skiing every year, and they all have a lovely time. You can have the same lovely time, and I can have my own collection of Whelans! One comes to the gallery business after all, because one lacks the means to be a collector. I'm *sure* I explained all this yesterday."

"You did, Mother. But you also insisted—if you'll remember—that Mr. Whelan should not stop recording till he was back home and put to sleep. You wanted there to be an element of surprise in today's recording. But as I pointed out then, we would have to explain this all over."

"And so we are. It's good of you, Rudy, to be so patient with us. You won't have to tomorrow. We'll stop recording in a moment, and then, while you put the finishing touches on dinner—how long has it been, by the way, Mr. Whelan, since you've eaten tournedos Rossini?—*he* can audit the ring he's making now."

"You're assuming that I've agreed to all this," I pointed out.

"And so you did—yesterday."

"Yesterday I hadn't just gone through purgatory."

"Oh, pish, Mr. Whelan, pish. Tomorrow today will be yesterday. We must live for the present. Even the Bible says so, somewhere. Mr. Whelan, I implore you. Try it for one week. You see — she leaned forward confidentially and went out of focus — "I have been put on this *merciless* diet. No cholesterol, which means, in effect, no sauces. Virtually no desserts but fresh fruit. No *beef* in any form. Think of it! And no salt, Mr. Whelan! What kind of life is that?"

"So what you want me to do is—"

"To eat for me, Mr. Whelan. Rudy is a wonderful cook, and when he's not in the mood, the city's full of restaurants. My resources are limited, but I can still afford a table at La Pentola."

"But surely you don't need me for such a—a—"

"A bit part?" Rudy asked sarcastically.

"If you mean to say," Muriel said, "that someone else could make such recordings for me, you don't do justice to your own artistry, Mr. Whelan. Believe me, my dinner table has auditioned hundreds of would-be artists. None of them had your taste, your gusto, your concentration."

"Well?" Rudy demanded.

"Well," I replied, "why not? Like Shakespeare says, the best revenge is living well."

While Rudy went off to the kitchen and Muriel replayed our dinner of the night before, I let the gallery's two guards set up a Ringmaster so that I could audit—and thus be able to recall—the recording I'd just been making. There was a flash of discontinuity as the ring was rewound; subjectively, no time had intervened since I'd started recording out in the square. But soon the ring was ready, and I started to relive the last hour of my own life.

By the time the ring had finished playing, dinner was waiting in the upstairs dining room, to which the guards had escorted me. At the first whiff of the lobster bisque, I snapped to attention and started to record.

The rest is art history.

"Will you stop saluting everything that moves?"

OMNI THE NEW FRONTIER
STATION LISTINGS

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

SURVIVAL

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ify the hereditary constitution of microbes From this scientific fact many persons have concluded that it will eventually be possible to modify also the genetic constitution of all other living organisms including the human species

The genetic engineering of human beings is not scientifically possible now and many are the biologists who share my view that it will never be possible to a significant degree because the complexity of higher organisms implies a high level of integration which would be protoundly disturbed by an important change in any one of their constituents Yet several institutes of bioethics have been created in which physicians biologists sociologists jurists and theologians are assembled to discuss the medical, ethical legal, and theological aspects of changing human nature that might be brought about by methods of genetic engineering—yet to be imagined Thus, we try to adapt not only to the future which is being created by the enormous strides of scientific technology but also to the future imagined by science-fiction writers

CREATIVE ADAPTATIONS

Though biologically the same human beings have been able to create an immense diversity of cultures and ways of life through adaptive mechanisms The word *adaptation* however has several different meanings because fitness can be achieved in many different ways

On the one hand adaptation can be brought about through Darwinian evolution and therefore result from specific changes in the genetic DNA molecules—a process that usually requires many generations On the other hand adaptation can be achieved much more rapidly both through physiological responses and through sociocultural manipulations that do not require any change in the genetic constitution We humans are most likely to be comfortable and successful if we make conscious individual efforts to achieve physiological and social fitness to the places where we live, work and play and especially to the people with whom we deal The physiological and sociocultural mechanisms of adaptation are of far greater practical importance than the Darwinian genetic mechanisms

There is more to adaptation than the achievement of fitness In the majority of cases the successful interplay between people and the physical and social environments in which they develop and function involves the emergence of attitudes qualities, and structures that amount to a true creative process For example we become adapted to dangerous environments or to difficult tasks by developing greater resistance or new skills These creative effects of adaptive processes have been greatly neglected and I consider them of extreme importance for the history of life

Consider a handful of garden soil The general assumption is that soil is made up exclusively of the inanimate inorganic constituents of the earth except for the worms and insects it harbors However every grain of soil contains billions of various types of microbes I know this from having been a soil microbiologist early in my scientific life during the 1920s and 1930s In fact it was my experience as a soil microbiologist that first made me look at the problems of fitness and adaptation from an ecological point of view I learned for example that the kinds of microbes in a good rich garden soil would do poorly or die altogether in a sandy acidic soil or in any soil placed underwater The adaptive relationships between any particular type of soil and its microbial life are extremely complex and of great importance because they involve the very creation of the earth's surface

There would be no real soil on the surface of the earth if it were not for the presence of microbial life There would be only the inanimate chemical constituents of the planet as is now the case for the surface of Mars and the moon The humus that converts the chemical constituents of the earth surface into fertile soil and that covers the bedrock is produced by microbial life

How it all began is a mystery but we know that humus is constantly being produced by the soil microbes as they decompose the dead bodies and products of plants animals and other forms of life The characteristics and amounts of humus in a particular place furthermore depend upon the chemical composition of the local soil's constituents and upon other local environmental factors that determine the kinds of microbes that grow in that particular place Each type of soil in other words results from the creation of a system in which fitness is achieved between the total environment and its microbial population—a fitness that determines in turn what species of animals and plants are most successful on it in a particular climate The genetic DNA determines the potentialities and constraints of each species living in and on the earth's surface but all manifestations of life are the expressions of relationships conditioned not by the DNA molecules but by the creative interplay between microbes and their soil environment

I shall illustrate these relationships with an example also taken from my own work as a medical scientist—an example that has in fact conditioned my interest in biological adaptation especially in human life In the late 1920s I worked as a microbiologist on lobar pneumonia in the hospital of the Rockefeller Institute for Medical Research We knew that the pneumococci responsible for lobar pneumonia are covered with a mucous layer a capsule that protects them against the natural defense mechanisms of the human body This mucous layer is made up of a complex sugar which we called capsular polysaccharide

There was then no known way of destroying the capsular polysaccharide except by treatment with strong acid which of course could not be used in the body Being familiar with the potentialities of the soil microbial population and with its ability to decompose even the most esoteric kinds of substances I postulated that there probably existed somewhere in nature a kind of microbe that could feed on the polysaccharide by digesting it with a particular enzyme The word *enzyme* is the generic term for proteins that enable all living things including microbes to utilize food In 1929 I succeeded indeed in separating from the soil a certain type of microbe that could feed on the capsular polysaccharide, and from it I separated the enzyme that digested this substance Animals infected with pneumococci could then be completely cured by injection of the enzyme, which destroyed the capsular polysaccharide of the pneumococci in their bodies

The anticapsular enzyme I prepared in 1929 is the first antibiotic produced by a rational scientific method in the laboratory. But although highly active against pneumococcal infections in animals it was never tested in human beings because of the difficulty of producing it in a pure form on a large scale and the discovery in the early 1930s that sulfa drugs could be used against a great variety of bacterial diseases, including lobar pneumonia

Having established the antiinfectious activity of the microbial enzyme I tried to develop methods for its production on a large scale, and this led me to an unexpected discovery that has influenced all my subsequent life I had no difficulty in producing huge amounts of the soil microbe by cultivating it in a rich bouillon, but to my surprise and disappointment, the microbial mass thus obtained did not contain the anticapsular enzyme I was interested in I eventually recognized that this enzyme was produced only when the soil microbe was deprived of other nutrients and forced to feed on the capsular polysaccharide itself or on a related substance. The *adaptive* response to the necessity of using the polysaccharide as food was thus a creative one namely the production of an enzyme For good scientific reasons biochemists and geneticists who later collaborated on related problems of enzyme production coined the phrase *induced enzyme*, but for reasons of biological philosophy I still prefer the phrase *adaptive enzyme*

I was naturally excited by my finding, in part because of its scientific originality but even more because I immediately realized its relevance to other forms of life and especially to human life The fact that the enzyme was produced in a very short time as an adaptive response to a certain necessity proved that microscopic organisms possess potentialities that are expressed only under certain conditions I postulated that this biological law was applicable to other forms of life including human life and human behavior This was a mechanism of adaptation very different from that achieved by Darwinian genetic processes which in higher forms of life take place slowly over many generations I subsequently developed other examples of adaptive enzyme production and ever since that time—more than half a century ago!—I have been obsessed by the conviction that all of us are born with the potential capabilities for many different lifestyles, but develop only those that can be evoked into activity by the proper conditions and for which we make the proper kind of effort, more often than not out of necessity

In nature, creative adaptations can also commonly result from the fact that the various forms of life exist in intimate associations with other forms not genetically related to them Such biological associations involve animals plants and microbes in all sorts of combinations They depend for their survival on changes that make the associated species better adapted to one another usually with creative effects Indeed many types of organisms long

thought to be well-defined biological species have turned out to be associations of several different species. For example the sea animal called the Portuguese man-of-war consists in reality of at least three different species that have banded together in the course of evolution. One species constitutes the float, a second makes up the fishing tentacles that capture plankton, a third carries out the digestive functions. The various organisms constituting the Portuguese man-of-war are so interdependent that they do not live long after being separated from one another.

The word *symbiosis* was coined more than a century ago to designate the biological associations between algae and fungi that produce lichens, and it has now been extended to many other types of associations between genetically unrelated organisms. Etymologically *symbiosis* simply means living together, but it is now used almost exclusively in its initial historical sense, namely with the added meaning that each organism contributes to the welfare of its associates.

A new and even more subtle phenomenon of biological association came to light in the 1940s, when it was shown that some genes of a given bacterial type can be incorporated into another type and thus make the recipient acquire some hereditary characteristics of the donor. Gene transfer can be achieved by different techniques, but the one commonly known as the recombinant DNA technique (one of the procedures of genetic engineering) has been most extensively studied and applied. With this technique genes from many different kinds of creatures—microbes, plants, animals, and even human beings—have been incorporated into bacterial species, which then acquire some properties of the creature from which the gene has been obtained, for example, the ability to produce insulin or some other hormone. It was believed at first that gene transfer was only a laboratory artifact, but it has now been proved that the phenomenon takes place spontaneously in nature. Gene transfer certainly plays a role in the adaptation of living things to their environments.

Creative adaptations and associations may thus have been significant factors in the evolution of life on our planet. Darwinian evolution postulates that, in the competition for survival, the reward goes to the fittest. But the meek may also inherit the earth through the creativeness of their adaptations and associations.

This is not the best of times, but it is nevertheless a time for celebration because, even though we realize our insignificance as parts of the cosmos and as individual members of the human family, we know that each one of us can develop a persona that is unique, yet remains part of the cosmic and human order of things. Human beings have been and remain uniquely creative because they are able to integrate the pessimism of *intelligence* with the optimism of *will*. ∞

VOX OLYMPICA

CONTINUED FROM PAGE 110

tary was pursuing secular matters—trade water games, day labor, holiday courtships, and eating. A haggard veteran of the expedition against the Argyre Separatist Army was hawking tickets for the Recompense Lottery from her powered wheelchair. I bought a ticket with five pieces of my tattered scrip.

"Isn't there any way to get up-channel, Sergeant?"

She folded the scrip into a deerskin sporran in her lap, then pointed into the crowd north of me. "Go to Quay Number Twelve, ask for Harbin, and tell him old Oona's calling in a favor."

"I don't need a favor. I need a ride."

"If all you have is scrip, child, you need a favor. Go on. Find Harbin and tell him what I've said."

Backing away, I thanked the crippled sergeant repeatedly. She waved me on. I reoriented myself among the streaming pedestrians and counted off every quay until I had found Number Twelve. There, beside a ladder, sat a short, burly man in a dirty blue pea jacket. Older than my father, he was also wearing stained coveralls and boots. I approached and told him what the sergeant had instructed me to tell him. Out of the corner of my eye I saw a dilapidated airboat gently breasting the swells that broke against the canal wall.

"I'll give you a ride," Harbin said. "What's it for, pay?"

"Wait a minute. Oona said she was calling in a favor, remember?"

"The favor's letting you aboard, upstart. What's it for, pay?"

My heart sinking, I showed Harbin the last of my scrip.

"That won't do. What else have you got?"

I searched my pockets. My harmonica came into my hand. I turned it out so that the airboat owner could see it.

"Silver?"

"From Isidis," I boasted. "The best."

"It's small, though." He took the harmonica from me and examined it closely. "All right, Gayle, here's your fare. I'm assuming you play this thing. You do? Good. All right, then. You play for me whenever I ask you to, and when we get to WIT's End—you know the beginning of the Blackshale Tributary—you give up the harmonica and go your own way. Agreed?"

Although I thought about it for a minute, I finally agreed.

Harbin's airboat sprinted northwest on a cushion of downblasting air. Water spewed up beside us from the vessel's sculpted hydrofoils, and the battery-powered fans roared like miniature cyclones. So long as we were on the move, there was no question of my playing the mouth organ, nor could we really talk.

Holding the sides of my chair, I watched the lethargic barges and canal tugs flash by us in the glitter of the airboat's ceaseless spray. Harbin slowed down only when we had arrived at another lock level.

Here, as if piloting a helicraft rather than a water vessel, he would adjust the controls to power us up and over the wall. This stunning maneuver, he later told me, would have been impossible on Earth, where gravity had exerted a significantly stronger force.

The sky turned bronze, and the lights of the other mercantile craft looked like gems floating in amber syrup. We continued to skim along. In fact, we traveled for nearly ten hours, with only two brief breaks, neither of which gave me enough time to serenade Harbin on the harmonica. The conifer forests on our left gave way to the sprawling irrigated pastures of government dairy farms as we passed through the Wilder Plains. On the far horizon, the peak of Olympus Mons, where even native Martians dare not venture without oxygen gear, grew dimly visible.

The peak was naked, wavery brown in the twilight, for several weeks ago the Harmonists had paid OSAS to melt the summit snow. The runoff, I knew, would have turned the mountain's lower skirts a stunning, deep green and replenished most of the minor tributaries of the local canal system. But we were still not close enough to see below the mountain's timberline.

Around midnight we docked at an out-

post called Parkhill, a trading center built of logs and sod with latex caulking in the chinks and prefabricated plastic shutters on the double-paned windows.

The owner, who knew Harbin, gave us a late supper of beer and fried squirrel which we consumed on a wooded hillside overlooking both the trading post and the canal. My body was vibrating from the long, noisy ride, and I ate greedily to overcome my fatigue. When I had finished, Harbin demanded that I play. Willingly enough, my hands shaking. I complied. Bittersweet ballads, lively jigs and familiar Harmonist hymns—music that I accurately surmised would appeal to an uneducated but independent soul like my airboat pilot.

Not too shoddy for an upstart, he commented afterward.

My father's Theon the Memorialist.

Ah, so *that's* why you're heading for the mountain. (It had not occurred to him to doubt my story.) Well, maybe you'd better not tell *every* traveler along the way who your daddy is.

Why not?"

Harmonists—mouthy ones, anyhow—are none too popular in Blackshale this year. The hospice keepers in Hardscrabble would like to send Theon on a half-round trip to the bottom of the CIS-BIT.

Why?"

Because the government's ordered a three-day evacuation of the communities around the volcano. Everyone's got to withdraw at least two hundred kilometers from the Olympus Palisades. Some have already started pulling out. That's a dandy fuss for those folks, just so the church can turn the tallest mountain in the solar system into a wind-spittin' calliope. Me, I'm rapstatic this is probably the last decennial it's ever gonna blow.

Bitterly I pointed out that Harbin would not be alive for the next Day of Diapason, anyway.

"Don't be so sure. My mother, without genetic reconditioning or the usual butt-minded immortalist diets—my mother lived to be sixty-one. Why on Earth, she would have been well over a century old. These days lots of folks get older than she did."

Most of the ones who do are Harmonists.

Maybe.

I nodded at the trading post below us. 'Ask Parkhill's terminal for an actuarial readout. What I say is true, Harbin.'

Well, upstart, I've never understood that.

Whosoever is harmonically composed delights in harmony, I quoted.

Nor that, either.

I explained that the basic ordering of the physical universe is essentially crystalline. Because music also has a crystalline structure, it constitutes an important *seam* between the spiritual and the material worlds. Spiritually hungry human beings (I lectured the old man) have a deep-seated urge to bridge the two realities through music, and talented adepts like my father must mediate between these realms for the many people who lack his gift. Through either their own devout efforts or the salvific talent of a mediator like Theon, a longer or a more vital life comes to those who search for and find the crystalline harmonies undergirding the *whole* of Nature. Such is my credo, and I outlined it enthusiastically.

"You talk even fancier than you play," Harbin noted.

I was not finished yet. 'The volcanoes surrounding us—Olympus ahead, Ascra behind, Pavo and Ars to the south—they're *frozen music,* Harbin. The entire physical universe is God's dream of creation inscribed as a secret crystalline music. You and I are parts of the dream that have awakened. We must awaken the rest. We must draw the music of God's thought out of the physical substances embodying it. That's what the colonizing—the warming, the watering, the seeding—of half-frozen planets like precolonial Mars is all about, Pilot. That's why we're here.'

"Harbin's airboat sprinted northwest on a cushion of downblasting air. Water spewed up beside us, and the battery-powered fans roared like miniature cyclones."

Theology's never been my strong suit, upstart. I'm here because after the Punitive Expedition to the Argyre I saved enough to buy an airboat. Beats doing butt work in a government bunker, wouldn't you say?"

Operating an airboat is what you do to accommodate to physical reality, Harbin. Too often we let that side of Nature get the upper hand. Earth was blooming, unfreezing, awakening, but people unaware or uncaring that the implicit harmonies of God's thought were finally manifesting themselves killed the planet before its music was fully audible. We betrayed ourselves. The result was not simply death for our world but a lingering—I searched for a word—'a lingering *dissonance* in the lives of those who escaped the catastrophe. At all costs, we must save Mars from that kind of betrayal, in order to save ourselves, too.'

I was preaching. Although the look on Harbin's face conveyed a wry regard for my precocious eloquence, he obviously thought it both misplaced and haughty. I promptly shut up.

The pilot reached over and rumpled my hair. 'Go ahead. Get it all out, upstart. I've got plenty of time. Just don't expect a contribution when you've wound down for good.'

Pulling away, I drained a last drop of beer from my stein.

"Surely you must have a *moral,* upstart. Most preachers—Harmonists, Syncretists, whatever other mouthy kind—most of 'em end up with a moral."

I stared at the pilot defiantly. "Just this, Harbin. The entire universe, the whole staff of God's harmonic thought, sings through the consciousness of every human being, but few of us train ourselves to hear the melodies. And some of us," I added pointedly, "are more deaf than others."

Well, I'm not deaf to that singing in your pocket. What have you got there, upstart?'

Stunned, I realized that the cricket in my box had begun, quite faintly, to chirp. I had forgotten about the creature. Folding back my pocket, I turned the perforated box out onto the hillside. Then I picked it up and began stuffing grass blades and sprigs of clover through the tiny holes. It was a wonder the insect had not suffocated. As soon as the box had fallen from my pocket, of course, the cricket had stopped singing, but it appeared little the worse for close confinement, and I was relieved.

You're not planning to keep it, are you?"

"Well, I found it this morning when—"

Let it go.'

I looked uncertainly at the airboat pilot.

"Let it go," he repeated more forcibly. "What do you want to keep the little fiddler for, anyway?"

I collect singing insects. Cicadas, crickets, grasshoppers. It's a hobby of mine. I've been doing it since—

Collect 'em! Caterwauling Krystos, upstart, *what for?* Are you afraid you're missing a note or two of God's great hidden symphony? Do you think you have to pick 'em up secondhand? Where's your faith, upstart? *Where's your faith?*'

Listen, it's not—

'If you want a ride to WIT's End with me, upstart, you're going to have to let that pale little fiddler loose."

I tried to stare Harbin down, but that was impossible. Finally I pulled the top from the capture box and bumped the white cricket gently into a patch of clover, where it was conspicuous against the green.

Now give me the box," Harbin said.

What for?

To pay for your ride."

I thought you wanted the harmonica.

'I do. I want the box, too. I always charge more for well-tuned hypocrites than for live and let live folks with tin ears.'

Oh. I see. You've found out my father's Theon the Memorialist, and you're going to gouge me for having a well-known father.

You don't see anything. And you don't hear so good, either, even if it's not because you're deaf."

He strode down the slope to Parkhill's trading post, to surrender his stein and wooden bowl and to scribble a farewell to the owner on the slate hanging beside the door. After seeing to our provisioning, Park-

hill had gone back to bed. I followed Harbin around like a puppy, for without his airboat I would never reach Olympus.

We reached the end of the Wilder Interprovincial Tributary a little before dawn. Traffic here was nonexistent, we had the canal locks and the countryside all to ourselves.

Harbin made me disembark on a lock apron from which the volcanic surface of the ancient Tharsis Steppe was visible. Unredeemed basalt and jumbled rocks rich in iron oxide. A primeval desert in the midst of irrigated pastures and lovely evergreen groves. In fact, the naked area—known today as the Tharsis Precolonial Preserve—had been set aside by the government as a commemorative park. Because few latter-day Martians care to remember what our world looked like before the Warming, however, no one was about to give me transportation farther west into Blackshale Province. I saw no prospect of continuing my journey other than by foot.

"What am I supposed to do now?" I asked Harbin.

"Take a hike through the park" — the desert he meant — "and if you keep bearing toward the mountain, you'll soon run up on Volcano Flats. It's too big to miss. You should be able to get help there. Just don't tell 'em you're a caterwauling Harmonist."

Harbin had dry goods from New Tithonia to deliver to a crater community called Lower Alba. He saluted me, leaped his airboat over the lock wall, and sprinted off north over the water. His was still the only vessel on the canal, and I stood on the vast, blank apron of the automated lock and watched it go cyclonng out of my life.

Then I turned and walked westward into the antique desolation of the Tharsis Precolonial Preserve.

Lizards, birds, and rodents live among the rocks of this prehistoric landscape. They do not contribute to the precolonial authenticity of the park, but they made my passage through its barrens less lonely and therefore more endurable.

I hiked for nearly six hours along a well-marked trail and at last emerged into the stony sprawl of Volcano Flats, a lively city with an aerodrome, dozens of wide pedestrian thoroughfares, and a host of carven-looking beige buildings whose windows winked in the sunlight like murals of hammered copper. The city was full of people. Many of them, it became clear, were affluent evacuees from Olympus Mons, tourists who had come out well ahead of D-Day.

I told no one on the streets that my father was Theon the Memorialist. Nor did I say that I was a pilgrim to the Holy Mountain. Instead, after asking directions to the aerodrome, I swung along past the Volcano Flats Carnival Grounds and the Blackshale Livestock Emporia as if frivolity and commerce were my birthrights and I a native of this boisterous frontier town. No one looked at me twice.

At the aerodrome I engaged in some imaginative haggling and suffered several discouraging setbacks. However, I finally connived my way aboard one of the skyliner dirigibles that cruised back and forth between Volcano Flats and the East Olympus Palisades. My story was that my parents, trade representatives from Epur, on the Jovian satellite Ganymede, had left me in town in order to take a three-day holiday by themselves in Hardscrabble. But they had been gone a week now, the money they had given me to get by in Volcano Flats had run out, and I feared that some terrible mishap had befallen them. The manager at the hospice where they had planned to stay had recently told me by tellaser transmission that they had never even arrived. Frantic, almost weeping, I begged the agents of the dirigible service to give me passage to Olympus Mons to find out what had happened. Although these people tried to refer me to local government authorities for help, a woman going back to Hardscrabble for an entertainment contractor overheard my pitiful tale and bought me a ticket for the next flight.

The woman's name was Ardath. She sat beside me in the dirigible's passenger gondola and plied me with questions that made me stammer, blush, and finally full of remorse, confess my true identity. The surprising upshot of my confession was that Ardath found the truth harder to swallow than the lie I had told at the aerodrome. Disappointed, she patted my knee and folded several pieces of planetary currency into my hand, not scrip but money, nearly a hundred legitimate marsnotes.

"Gayle, maybe you won't feel compelled to counterfeit identities for yourself if you have a little money ready to hand."

"Please, Elder, it's not—"

"I don't know what it is, Gayle. Never mind, though. I think I understand. I was young once, too."

Ardath rose and went aft into the dirigible's library. Miserable, I looked out the window at the deep green landscape rolling by beneath us. Because of the impending Diapason, the gondola was virtually empty, and Ardath did not return to her seat beside me.

At dusk we tethered at an aerodrome below the Olympus Palisades, above which lighter-than-air craft may not venture without special permit. I disembarked on a marshy pasture below the great volcano. The iodine of twilight bronzed the entire world. Beneath the cliffs, two kilometers high, you could see neither the mountain's cloud-ringed summit nor its lava-coated skirts, but the distant din of running water attested to the success of the snowcap's carefully channeled melt.

While the other dirigible passengers straggled across the landing field to a village of A-frame lodges, I made for the cog-lift depot. There I used a little of Ardath's

"The following changes of address are effective as of December 24."

money to purchase a ride to the top of the Palisades.

An hour later I was in Hardscrabble, a ghost town of glass chalets and pueblo-style apartments built of rock and extruded foam. I sought out the Harmonist cloister above the village. My knowledge of *The Lore of Krystos* got me past the cenobite guards stationed outside the gate, and when I showed them my birth card, I suddenly became an honored guest.

Inside, I told a youthful cenobite named Doloro what I had come for. Like Ardath, he did not believe my father was Theon. In spite of my birth card and my facile grasp of Harmonist dogma. However, his training and his natural courtesy did not permit him to dispute my claim. He merely mentioned that most of those at the Olympus Cloister had abandoned the mountain last week. They would not return until after the Diapason. He and the other cenobites still present would depart in another three days. Meanwhile they were carrying out their traditional duties and guarding the cloister against vandalism. Theon might or might not be my father, Doloro's remarks implied, but I would not be permitted to remain on the Holy Mountain any longer than bona fide servants of the church.

'I want to hear my father play.'

"Very well, but you don't warm your hands by sticking them into the fire."

Wind chimes hung in the red-glass towers of the cloister and the quiet sawings of stringed instruments knitted its various rooms together as surely as did the crystal statues lining its corridors. In the communication center Doloro put through a tellase to my father in the keyboard room deep in the bowels of the mountain. On the third try one of Theon's technicians answered, and a few minutes later an image of my father's face was floating in the projection cylinder.

"Gayle!"

'You said I could come.'

Vanora was through to me yesterday. She was afraid something terrible had happened to you. Gayle, you can't stay. You just can't!'

We argued, and Doloro discreetly left the communication center. Theon adduced reasons for my returning to Spaulding, and I either countered these or attacked the general thrust of my father's argument, whichever seemed the more promising course. Finally, weary of our exchange, my father threatened to abdicate the responsibilities of Memorialist in order to discipline me. Someone else—Eldora, say, or Kiernan—could earn the glory for which he had spent the last six hundred days laying the groundwork. This threat frightened me, and even in his air-conditioned cage under the mountain he could see the cold fear in my eyes.

'I wrote a sonatina for you,' I pleaded.

'For me?'

'For Earth, Father.'

'Leave it with Doloro, and go back to Spaulding. Tellase your mother, and let her know you're coming. Otherwise, Gayle, I'll inform the Ecclesiarchal Council I'm resigning and take you home myself.'

"In Spaulding I'll hear nothing!"

'What is loud and cacophonous close to hand acquires, with distance, a mellow harmony.'

I parried the epigram: 'I'll retreat to Volcano Flats with the other evacuees, but I'll remain there until after the Diapason. I want to hear it, Father! I want to hear it!'

For some minutes Theon's face floated expressionless in the translucent cylinder. Then it said, 'Leave your sonatina with Doloro,' and it faded from view. By making a concession, I had called my father's bluff.

Doloro returned and helped me reach my mother in Spaulding. We awakened her, and she spent a few minutes trying to shake the sleep from her head. I explained what had passed between Theon and me, then told her that I would meet her not in Volcano Flats but on an artificial hill several kilometers north of the city. This was a Harmonist retreat, where many cenobites and pilgrims, according to Doloro, would gather to hear my father's performance.

Vanora protested. She wanted me to come home at once, and she had no intention of meeting me at a Harmonist gathering place.

But I had just learned a deceitful debating technique from Theon, and I explained that if she wished to see me again, she

'Magenheim, I'd like to tap your fertile imagination.'

must make the journey to Harmony Knoll and meet me there on Diapason Eve. Otherwise I would ride the canals to some faraway plain or canyon and never again set foot in West Tithonia except by a vagrant whim. Unlike my father's, this threat was one that the threatener felt capable of carrying out.

"I'll be there, Gayle, but I'll remember this.'

Doloro led me to a night chamber. Later, dreaming, I heard several harsh thudding sounds, and in the morning a cenobite named Talitha told me that a small gang of adolescents from Hardscrabble had come up to the cloister and stoned its unbreakable towers of rose glass. Doloro, Risa and two constables from the village had routed the troublemakers. The protests this decennial were mild, primarily because everyone understood that there would never be another.

The church could no longer afford to finance the attendant evacuation, and local law-enforcement units no longer wanted to organize and police the withdrawal. Those who opposed the Day of Diapason were finally inclined to be tolerant of those who cherished it. The Parliament had written their objections into law.

Two days before D-Day I accompanied most of the Hardscrabble cenobites to Harmony Knoll. We floated back across the volcanic plains in the gondola of the same dirigible that I had boarded with Ardath. We spent the entire flight playing ceramic flutes and singing Harmonist rounds.

My reunion with Vanora was chilly. An old ecclesiarch had given us a tent in the city of tents facing Olympus Mons, and my mother and I shared this diaphanous chapel—it seemed to have been made of lavender scarves and oiled rice paper—like strangers who do not understand each other's language. I slept on one side, she on the other, and when I tried to apologize for my blackmail by bringing her tea or apples from the fellowship center she accepted these gifts without speaking.

Are you sure you still want me to come home with you?'

Vanora smiled, for the first time. Of course I do. It's going to be lonely without your father.

'He'll come home, too, Mother.'

That remains to be seen.'

Whose fault will it be if he doesn't?'

'His. Mine. Who knows, Gayle?'

We did not talk about the matter again, and on Diapason Eve every cenobite and pilgrim on Harmony Knoll stood on the hillside keeping vigil with chants and musical prayer candles. Vanora and I kept vigil, too, gazing westward at the colossal blue-black silhouette of Olympus Mons. Near dawn she allowed her hand to creep into mine, and we waited together. There were more than a thousand of us waiting for the universe to sing through our individual consciousnesses, a chorus of sympathetically vibrating minds, each brain a crystal.

The sun rose at our backs, and the first deep utterance of the Vox Olympica sounded across the land.

Our feet trembled. A murmur of awe ran through our ranks like a ripple of wind over a field of wheat. A second note sounded, and the sky seemed to scintillate the way a spill of whiskey enlivens a shallow pan of water. A third, a fourth, a fifth, a dozen more notes boomed out over the plains of Blackshale, and the power of this stately melody forced people to their knees. The ground was quaking. The solar-amplification veils high above the planet seemed to ricochet sound as well as light.

It went on for twenty minutes, this first ringing hymn. The silence after the polyphonic caroling of the mountain was like a drought, a famine, an extinction. I was afraid to look up. If I did, I would find that the atmosphere of Mars had peeled back to reveal a blackness in which the crystalline arrangements of the stars shadowed forth God's primal thought. If I looked up, I would hear as well as see that thought.

So I did not look up, and no one on the hillside moved. Then my father began playing the second movement of the requiem. The sun continued to rise and our adoptive planet to stagger in its orbit.

Or so I imagined.

Later the manifold vents and calderas of the volcano gave out recognizable paraphrases of 'If I Forget Thee, O Elysian Earth of Yore.' Theon worked them into the various movements of Zivu's original program and played them back and forth through the laments, the paeans and the hallelujahs. On the winds howling so sweetly from the mountain, clouds broke apart, and like a mantle of audible fallout my sonatina traveled ever outward.

I looked at Vanora. Her face was wet, radiant. She squeezed my hand, and we stood together in the ocean of sound, listening to its cunning surges and imagining unknown or half-forgotten referents for its themes. Neither of us had ever heard the sea before, not really, but now, thanks to Theon and the Vox Olympica, we had.

Three evenings later, after Vanora and I had returned to Spaulding, a flickering of household lights indicated that visitors stood outside the upright cenotaph of our door. Expecting only the evening post or perhaps one of my mother's OSAS colleagues, I rode the entry platform to ground level and opened to our callers.

Father!

Supported by a young believer unfamiliar to me, Theon gave me a wan smile and touched my lower lip with a trembling finger. His face was horribly bruised. A gash in his right cheek had not reacted well to its first subcutaneous treatments, for the lips of the wound were livid.

'This is Corydon,' my father said, nodding in the direction of the young man. 'He's brought me home.'

Too shocked to speak, I wrapped my arm

about my father's waist and led him onto the platform. He was strong enough to stand without my help, but I insisted on lending my hip and shoulder. Meanwhile, wearing a half-angry, half-bereft expression, Corydon remained outside.

"A small band of anti-Harmonist fanatics met our dirigible at the Volcano Flats aerodrome," he explained, his voice deliberately loud. "Had several of us not fought back fiercely, they might have killed your father."

"The authorities intervened," Theon reminded Corydon.

"Only when they saw that we might inflict a few injuries, too. I have only contempt for the so-called authorities, Master Theon."

My father invited the young man in, urging him to rest a little before journeying back to Harmony Knoll.

"Now is a time to be with believers," Corydon said pointedly. "For an entire day, Master Theon, you knitted all the patterns together, revealed the latticework behind Creation. You did this magnificently, sir, but the deaf and the indifferent have pulled the patterns asunder again, and today—forgive me, sir—today I am unable to face even one more such person."

Before my father could reply, Corydon turned and strode off down the green hillside toward the silver tracking discs and relay towers of the OSAS facility.

Theon and I descended into the house. A moment later, in the center of the music room, he and Vanora were silently embracing. They seemed to take no notice of me.

"I thought you wouldn't come home," my mother whispered.

Theon stepped back and tugged on one earlobe to suggest that he had not really heard her, and Vanora repeated her last words aloud.

"Why would you think that?" he asked her, still gripping her shoulders.

"Years of argument, years of hostility, years of trying to accommodate ourselves to each other's belief." Though on the edge of tears, my mother did not ease herself back into Theon's arms. "Or lack of belief. I should probably add. Finally the connectives snap, and everything disintegrates."

Theon shook his head. "And years of loving each other, Vanora. You can't leave that out. It's unheard music—sweeter, far sweeter, than all the desperate clangor of those other things. You know that, don't you?"

This response appeared to embarrass my mother. She glanced at me, then pulled gently away from Theon's hands.

A moment later she said, "Everyone at the OSAS facility—everyone old enough to have heard the Vox Olympica two or three times before—well, they're all convinced that no performance in memory can rival this last one. They're sorry there's never going to be another. They're *genuinely* sorry, Theon, and I suppose I am, too."

"After people have succeeded in murdering something important," I blurted, "it becomes fashionable to mourn what they've killed. That's the way it always is."

"Hush," my father admonished me.

It makes me sick—angry and sick.

"Just as it does Corydon and all the other young ones," Theon replied. "Go above ground, Gayle. Give your mother and me a chance to lay our ghosts to rest without—"

"Without my interference," I bitterly concluded.

But Theon merely looked me toward the entry well, and I followed his meaning, look onto the platform and from there upward and into the lonely memorial gardens of the dusk. Here, cursing both my parents, I wandered about among the tombstone doorways like a spirit seeking its body's grave. Predictably, I soon tired of this game and sat down in the grass bordering an orchard of flowering apple trees.

Somewhat later Theon emerged from our doorway and climbed the vast communal lawn to the orchard. He took up a sentry position only a couple of meters away. Lifting his bruised face to the sky, he surveyed the dim, almost invisible scatter of stars beyond the canted solar veils. Although I tried not to, I found myself sneaking glimpses of his dark, heavy-jowled profile.

"There's Phobos," he said presently.

I looked up and saw the inner moon come floating by. It always reminds me of a pitted hominid skull, and so of Earth, and I shuddered to see that tiny lunar death's-head passing over our township. Another emblem, it seemed that night, of our failure to deflect Martian institutions and mores from the self-destructive course taken by the majority of our home-world forebears. Another word for fear. Phobos, another word for failure.

"I'm not going to let it end this way," I told my father, loudly enough to penetrate his incipient deafness.

"Let what end this way?"

"What we believe in. I'm a Harmonist. Three days ago you played the mountain, but tonight you seem to have given up."

Theon turned toward me. "I've given up trying to badger a good woman into putting on a belief system that doesn't fit her."

"But everyone's got to—"

"Everyone's got to nothing, Gayle. For anyone past puberty intolerance is an unaffordable luxury. I'm not giving up. I'm merely passing the baton to you. If you don't try to beat everybody over the head with it, you may be able to coax some singular music from your own spiritual resources. Do you understand me? Your *own*, not this or that other poor beggar's."

Suddenly, as if palsy-stricken, my hands were shaking.

"That's where it starts, Gayle. Do you understand what I'm telling you?"

"Yes, sir." A chorus of crickets had begun singing in the grass beneath the apple trees. Weeping, I went to Theon for warmth and reassurance. I was weeping, I realized, not merely in filial gratitude but in the painful knowledge that Theon could no longer hear the crickets' faint, stridulous music. My heirloom. And my charge. ∞

"Ever have the feeling that the whole thing's getting out of hand?"

"Star Flight disks will add untold chapters to the notorious history of the UFO hoax"

ANTI MATTER

UFO UPDATE

UFO investigators have had a slow year but things should pick up once Terry Gudgel starts selling his illuminated frisbee. Gudgel, president of Heatherland Inc. in Rochester, New York, designed the Star Flight disk so that people can play frisbee at night. The disk's resemblance to a flying saucer he adds, is just a happy coincidence.

Gudgel says that any observer watching his spinning disk from the ground will see trails of light that connect three glowing centerpoints to nine glowing spots at the rim. Tiny batteries at the center of the disk power three red diodes that are far brighter than those found on watch faces and calculator displays. Optical fibers transmit the red light to the rim of the disk, where it emerges from nine small portholes.

With the disk's striking appearance, it's no wonder that people can be fooled. Last year, when Gudgel demonstrated a six-foot-diameter version of his disk at the New York State Fair, its resemblance to a UFO was remarkable. On a clear night the standard 9.5-inch-diameter model should be just as convincing, particularly if the Star Flight is launched away from trees and other objects that could aid observers in gauging its true size. Right now a few Star Flight disks are available in the Miami and Rochester areas, but once Gudgel expands his efforts nationwide, many new chapters will be added to the already-long, if not particularly honorable, history of UFO hoaxes.

Successful launching of home-made UFOs has generally required technical skill. During the Sixties and Seventies, for example, savvy teen-agers filled garment bags with hot air and generated hundreds of reported sightings. (Gudgel himself attempted to launch hot-air UFOs when he was a teen-ager, but they always bombed out at about fifty feet.) Sophisticated students at Caltech launched UFO-weather balloons, including one with four highway flares rotating beneath.

Gudgel's new disk, however, will make it simple for any technical ignoramus to perpetrate a UFO hoax with a flick of the wrist. A fleet of Star Flight disks, at $9.95 apiece, might cause as much havoc as the Caltech effort.

According to UFO skeptic Philip J. Klass, many of the sightings might never even be traced to Gudgel's disk because observers may fail to get the details straight. For example, when the Caltech students launched their flaring weather balloon, reports attracted widespread attention until the hoax was revealed. Even so, there were no consistent observations of the balloon or of its four rotating lights. According to Robert D. Parker, one of the Caltech hoaxers, "Some people even said the UFO played strange music and emitted some kind of perfume."

In his book *UFOs Explained*, Klass labeled the problem "Ufological Principle Number 1." "Basically, honest and intelligent persons who are suddenly exposed to a brief, unexpected event ... may be grossly inaccurate in trying to describe precisely what they have seen." If the Star Flight disks soar aloft, we may have a chance to learn exactly *how* inaccurate. —*JEFF HECHT*

PREMATURE THAW

When the Cryonics Society of California in Berkeley was founded in 1965, it offered to freeze the newly dead in liquid nitrogen for the sum of $20,000. Sustained at −350°F, the corpses would be too cold to decay, the society said, and in the future, if a cure were to be found for the disease that the deceased died of, the body could be reanimated and healed.

Just recently, however, the booming cryonics enterprise, which claimed more than 1,000 members and had offices in five cities, was dealt a deathblow. A California Superior Court this past June awarded three families nearly $1 million in damages against the Cryonics Society for gross negligence and fraud. The families involved sued after finding that the bodies of relatives in cryonic suspension had thawed and decomposed. The California company no longer exists, but the other branches of the Cryonics Society continue doing business, at least for a while.

Public opinion varies regarding the future of cryonics in this country. Robert Ettinger, known as the father of cryonics, considers the incident a typical accident that could have happened in any industry. Others disagree and consider the cryonics business a ripoff. John Gill, secretary of the California Cemetery Board, says, 'Cryonics is obviously consumer fraud. They can't do what they promise—that is, bring you back from the dead.' In summing up, he says, 'There is no known technology available today to prove that cryonics works and is a viable method of preservation.' — Harry Lebelson

'I don't want to achieve immortality through my work. I want to achieve immortality through not dying.'
— Woody Allen

FRENCH FLYING SAUCER

Jean-Claude Ladrat, foreman at a small timber firm in southwestern France, has spent the past ten years building a flying saucer in his backyard.

It all began one evening in 1969 as Ladraf, then a merchant seaman on a Scandinavian oil tanker, sailed through the infamous Bermuda Triangle. Ladrat, who had been staring at the stars, was struck with the vision of a magnificent flying saucer. Every detail of the craft's design was revealed, Ladrat says, and the course of his life was clear; he would have to get to work.

Nine months later Ladrat moved to the farmhouse that would become the base for his activities. It took him seven years to build the craft's motor. Situated under the pilot's seat, this cone-shaped engine is made up of 11 panels, each containing 49 electromagnetic circuits. It works, says Ladrat, by magnifying the pilot's willpower, thereby generating a force field powerful enough to counteract the earth's gravitational pull.

By 1978, with the motor complete, it was time to start work on the hull—several layers of plywood, plastic sheeting, lead, and aluminum to protect the craft from magnetic and gravitational forces.

Today the Ladratan One is almost complete, and the date for its maiden flight is drawing near. Whether or not one shares Ladrat's 'minor doubts about the final success of the venture,' one thing is sure. For once photographs of a flying saucer are clear, distinct, and in focus. — Philip Black

'He had only one idea, and that was wrong.'
— Benjamin Disraeli

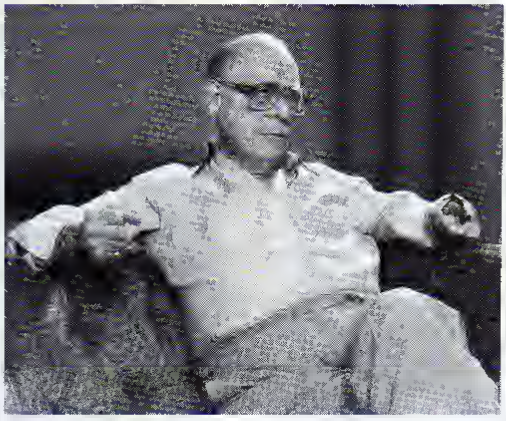
ESP BELIEVERS

Parapsychologists—the folks who test clairvoyance and telepathy in the laboratory—believe in ESP. That's the not-very-surprising conclusion of two recent surveys of parapsychologists across the country.

According to the first study, conducted by the Parapsychological Association, 88 percent of those who belong to the association believe that ESP has been either "positively" or "probably" demonstrated. The younger members of the organization are less certain, however, with a mere 74 per-

cent professing overwhelming faith. In the second survey, conducted by two professors at the University of Pittsburgh, 68 percent of the parapsychologists questioned said they had "complete" faith in ESP, and 22 percent said their belief in ESP was "strong."

Which professional group is most skeptical when it comes to ESP? Ordinary psychologists. Indeed, according to yet another survey, only 5.5 percent of all psychologists believe in ESP.—Kendrick Frazier



HUMAN COMBUSTION

Jack Angel, a traveling salesman on business in Savannah, Georgia, reportedly burst into flames while asleep in his mobile trailer. Believed by some to be the only survivor of spontaneous human combustion, Angel was left with a hole in his chest, fused vertebrae, and an arm so charred it had to be amputated.

According to David Fern, a Savannah physician summoned to the scene of Angel's accident, his patient was obviously a victim of spontaneous combustion (a bizarre molecular reaction Dr. Fern says that causes people to burn up inside). There is no other plausible explanation, he contends, because objects in the trailer were not the least bit singed. Thus, they could not have set Jack Angel on fire.

Others disagree. Dr. Marion Jordan, of the burn unit at Washington Hospital Center in Washington, D.C., for one, says that Angel may have taken an antibiotic containing sulfur. One adverse reaction to such a drug is shrinkage of skin and blood vessels, creating the appearance of a burn.

Before his experience, Angel earned $70,000 a year and was in peak physical condition. Now collecting Social Security checks, he is a mere shadow of himself, confined to his Atlanta home. Though he has no memory of the incident, Angel clings to the belief that his injuries resulted from spontaneous combustion.—Harry Lebelson

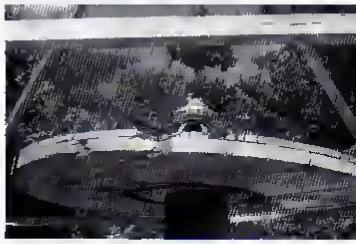
"The Kentucky meat shower which attracted so much attention recently has now been supplanted by a rain of live snakes in Memphis, Tennessee."

—Anonymous report in Scientific American, *1877*

UFO PORTS

For years UFO buffs have tried to build a landing port for extraterrestrial astronauts. In 1973, for example, a retired Marine major planned to make dummy flying saucers to attract alien pilots, but his funds ran out. Now, however, the dream is coming true.

Last summer a 15-acre plot at the foot of Mount Rainier in Washington State was dedicated Spaceport Earth by the New Age Foundation. According to its mayor, the Reverend Harold R. Price of Tacoma, the site may soon warrant its own



Post Office designation.

If the Rainier site is too difficult for the aliens to find, they may still reach a saucerport recently built in Lawson Valley near San Diego. Port owner Ruth Norman, of the Unarius Educational Foundation, believes that a landing will occur there before January 1, 1982. Norman is so sure that she has added another $1,000 to her wager with Ladbroke Investors, a London betting agency. Ladbroke will pay her $1 million if the landing occurs.—Margaret Sachs

RUSSIAN SLEEPTALK

Wilma Sutherland, of Mesa, Arizona, was roused from her dreams whenever her husband, Gene, talked in his sleep. Groggily perking her ears, she would make out words and phrases and, satisfied that nothing was amiss, immediately fall asleep again.

One night recently, though, the babbling that woke her was different—more excited and agitated, and rife with sounds like "ski" and "vich" repeated in a thick, unfamiliar accent. None of it was intelligible.

Somewhat unnerved, Wilma got a tape recorder to capture the gibberish. When she played the tape back to Gene, he had no idea what the sounds meant or what had triggered them. Nonetheless, because they reminded her of Russian, she called the foreign language department at Arizona State.

Hearing the 40-minute tape, Professor Lee Croft recognized eight or nine Russian terms, including *pjanj*, which means "a drunk," and *prostvidno*, or "excuse me, it's evident."

Croft learned that Gene Sutherland's one previous experience with the Russian language had occurred during World War II, when the U.S. Army united with the Red Army at the Elbe River. As far as Sutherland remembered, none of the Russians he met taught him any Russian words. Croft surmised, however, that the experience had left a deep impression on Sutherland, etching the phrases into his subconscious.

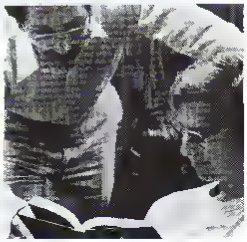
Finally, the local newspaper got wind of the Russian dreams and ran an article with a photo showing Gene under the covers. Suddenly, droves of reporters, religious zealots, and even "parapsychological authorities" were beating a path to the Sutherlands' door. They urged the couple to try hypnosis and pseudo-psychological ploys to find out Gene's secret and told them that his ability to talk Russian was caused by everything from reincarnation to demonic possession. Gene was even accused of being an unwitting Soviet tool, contacted—and manipulated—by the Russians through telepathy.

Whatever the explanation, the Sutherlands don't care much anymore. Hounded and exhausted, they have gotten an unlisted telephone number and cannot be reached. —Mark Teich

HYPNOREADING

High school students in a darkened Los Angeles classroom shut their eyes and listen to the lulling voice of a hypnotist. He reassures them that they will learn to read faster with each passing day, and as he speaks they visualize the words of an imaginary book gliding past their field of vision. When the session is finished, they are given homework: daily self-hypnosis sessions in which they repeat the instructor's suggestions again and again.

The students are learning hypnoreading, an off-beat speed-reading method developed by Live and Learn, a nonprofit educational foundation in Sherman Oaks, California. According to program directors Michael Lilienfeld and Steven Snyder, successful students must practice under hypnotic trance daily for several weeks. While the program requires a strict regimen, it



does not take the pleasure out of reading—a complaint often leveled at more conventional speed-reading systems. "Improved skills acquired during practice sessions are automatically used during the normal waking state," Lilienfeld says.

The Los Angeles School District has taught hypnoreading to students and school counselors since 1978. Participants say they read three to five times faster than they did before. —Margaret Sachs

"The stuff of the world is mind stuff."
—Sir Arthur Eddington

RELIGION

CONTINUED FROM PAGE 83

to partake of an anti-Eucharist a feast of cannibals I ask him about the MX missile What should be the appropriate Christian response?

Any Christian worth his or her salt refuses to enter into a discussion of the insane It's like joining the cast of *Marat/Sade* All that frenzy nonsense babel is suicidal One must close that debate open the New Testament and take the real news the good news

I put his own question to him posed in his latest book *Ten Commandments for the Long Haul* What if the good news remains only in the past and the bad news awaits us in the future?

We are sleepwalking he says The disease hits our people in several ways Temporally it wipes out the past and makes a future less likely The two things go together If you don't know the past you are really writing off the future

As dangerous as Father Berrigan feels the world has become as close as the earth may be to the situation where these silk suited characters with their manicured hands on their children can reach over the child's shoulder and press a button to kill children thousands of miles away the priest does not see Armageddon quite like say Billy Graham For starters Berrigan believes Christ has already come, he has seen this in his own work and the work of his friends More important the evil signs in the world may not be the indication of the end time at all but mere seismic shiftings shadowy reminders of the possible

"If we lie around weeping about the state of the world and waiting on Christ that's magic It is not enough not human We were called upon to do more in the world than weep about the state of affairs With that stance there is no impulse to resist the Armageddon

In short, Armageddon is overrated

It is just one image out of many in the Bible that deal with the end of time It is a waste of human energy to concentrate on one biblical image to the exclusion of many many others So many beautiful images! The bridal image the image of the great feast the Eucharist, which is eternity itself We tend toward the image of the bloody battle and all that stuff because we are so bloody and violent ourselves There's something in us about that image as much as about God We deeply want things to end that way

BILLY GRAHAM

A spiritual adviser to presidents and a minister whose crusades are attended by millions and whose television programs are viewed by tens of millions the Reverend Billy Graham is the world's best-known evangelist

Evangelist Billy Graham instructs me from his home in Montreat North Carolina derives from the ancient Greek word for announcer In the Greek city-states the announcer traveled about proclaiming the news As applied to the writers of the four gospels the word *evangelist* means the announcer of the good news of salvation and the personification of the Holy Spirit Graham sees his mission as essentially that of an announcer the clarifier of the Word of God in areas generally not accustomed to hearing the Word

The success and power of the Graham sermon are attributed in an authorized biography to its almost artless simplicity its breadth of elementary exposition about Jesus from His birth to the Cross and Resurrection and coming judgment But Graham thinks of himself more in the tradition of the roving preachers such as George Whitefield leader of America's Great Awakening and John Wesley whose methods Graham has studied carefully

In the modern world the evangelist has the freedom to address controversial problems Graham believes where the traditional church experiences difficulty

"The Bible mentions a total of 22 signs signaling the onset of Armageddon, and Billy Graham discerns them all converging now for the first time in history"

[The traditional church] is on the horns of a dilemma he says his voice fading in and out across the telephone from his mountain retreat It would like to adapt but it's held back by the teachings of the Scriptures There's only so much flexibility They have to say for example that homosexuality as taught in the Bible is a sin But it's only one of maybe a hundred or two hundred sins—I've never counted them—and no greater a sin than a lie or jealousy or greed or prejudice or lust In this generation it's been pulled out It's been so publicized that almost everywhere you go if you're a clergyman you're asked about it

On two aspects of twenty-first-century religion Graham is already a special witness the power of television and the shape of Armageddon He speaks pointedly to me about both

The revolution that television has fomented goes far beyond the parachurch preachers of the Sunday morning airwaves Graham thinks It has now reached the most conservative elements of the traditional church Even the Southern Baptists, once so scornful of television because of its use as an entertainment medium are now purchasing prime time The advent of cable television and the deregulation of the airwaves will make more than 100 channels available before the year 2000 available equally Graham notes to religion and smut The tube consequently will make the forces of Christ and those of Satan both stronger at the same time

Inevitably the emphasis on the performance of the television minister will grow and competition for ratings will follow While Graham denies that he is part of the electronic ministry he is comfortable with entertainment parlance By appearing on television every Sunday one builds a narrow and limited audience he believes and he is careful not to be overexposed

If I come on periodically in prime-time television the audience is much greater" he says Our Nielsen rating will go up to thirteen or sixteen percent

He is resolved not to compete with the village church however for he thinks that if television were to replace local parishes the whole concept of the church would be lost Television should be viewed solely as an adjunct of the church to stir up religious feelings especially in those who don't normally attend church services But the real problem of the future will arise when a television preacher announces the gospel one way and the parish preacher announces it another

In the proliferation of cults and in the words of self-proclaimed prophets—400 people in Los Angeles now claim to be God he says—Graham sees the mark of the Devil How then is a television viewer to know the sincere from the insincere religious performer?

"The Bible teaches that we are to learn to discern the Spirit," he tells me When we are walking with the Lord He gives us the power as Christians to discern between good and evil The believer should not be fooled The person who is not a believer and who does not know the Lord can easily be fooled and easily be misled

You don't think the believer can be misled? I ask

He can be misled for a while but he'll soon wake up if he's a true believer My wife was sitting beside the head of the counterfeiting division of Scotland Yard some time ago at a dinner and she said I suppose you spend a great deal of time studying counterfeit bills and coins He replied No I never look at them I study the real thing constantly If you know the real thing you'll be able to detect a counterfeit

Of all the participants in this inquiry Graham was the most certain about how the impending Armageddon will unfold The time of reckoning is relatively near he observes The Bible mentions some 22 signs signaling the end time, and Graham discerns them all converging now for the first time in history The signs are international (wars and the rumors of war) cultural (movies like *The Exorcist*) satanic (devil

worship in this country and elsewhere) natural (starvation in many parts of Africa, Asia, and Latin America), and mysterious (UFOs). When Armageddon is upon us, the world will pass through terrifying events, which will involve much killing, but not enough to annihilate mankind. Or Armageddon may involve interplanetary warfare, but not sufficient to destroy the solar system. Christ will intervene at the last minute, to save mankind from itself.

"Does that not make it simply a matter of degree?" I ask. "To quality as Armageddon, doesn't the cataclysm have to be great, with much killing, but not so much that knowledge and mankind would be wholly eliminated?"

"I can only speculate, like anyone else," he says. "My own judgment would be that [Armageddon] will involve a great many armies and peoples from north, east, south, and west, gathered in the Middle East to war against one another. They will have the power to destroy a substantial portion of the human race, but God is not going to permit it."

But Graham sees beyond these terrifying events. His is a glorious vision, a world of true justice and permanent peace, without soldiers and police, where the lion lies down with the lamb, where there will be no weeping and no suffering. In short, the world created for Adam and Eve.

Why, then, should the believer not rejoice at the prospect of the cataclysm, or at least accept its inevitability?

"We're to live pure lives as though Christ were not coming for ten thousand years, and yet we're to watch for Him and have this hope in our hearts. If man does reach Armageddon, God has a plan for the human race. This gives great incentive to all kinds of good works. To attempt to bring about as much of a heaven on Earth as we possibly can, as Christians. We're to be the salt of the earth, and we're to be the light of the world."

MADALYN MURRAY O'HAIR

America's most famous atheist, Madalyn Murray O'Hair is best known for her successful lawsuit to remove Bible reading and prayer recitation from the public schools.

Were Madalyn Murray O'Hair's philosophy to be adopted by our society gradually, this examination of future religion would be quaint indeed. The influence of theology would diminish so significantly that religion would become only a mild curiosity.

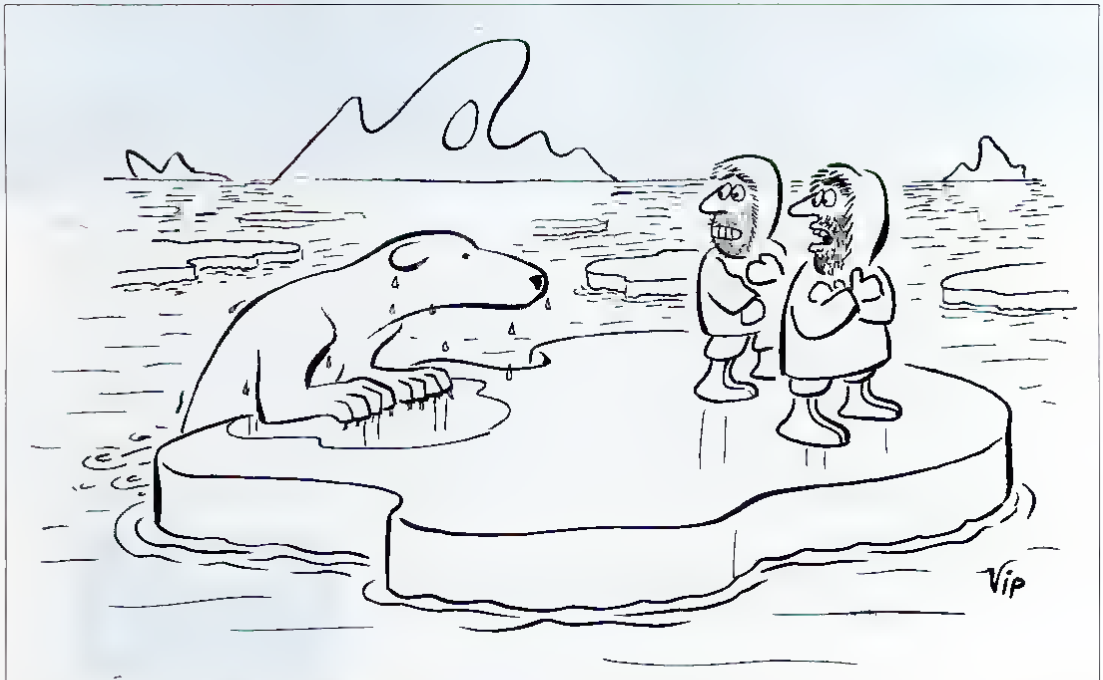
Atheism is still accepted by only a small minority of Americans. Billy Graham contends that more people attend religious services in America every Sunday than attend all the sporting events held in this country combined in an entire year.

Madalyn Murray O'Hair might respond: But which do Americans care about more, their religion or their sports? If people were only honest with themselves, if they would recognize their religious mouthings as insincere and destructive, she says, they would see that America and the world are now already in a post-Christian era. O'Hair thinks religion is more a stimulant than an opiate. Like sports, it is only one of a number of means Americans employ to kill their boredom.

O'Hair proposes to puncture the hypocrisy and sanctimony of the churches and to remind Americans that church and state were separated in our Constitution for very good reasons. Her refrain is constant: More killing and wickedness have been perpetrated in the name of God and religion than for any other cause. Unabashedly elitist, she cites her upper-middle-class roots and pitches her message to the intellectual elite, while ascribing the rising influence of fundamental Christianity and the Moral Majority to the lowest social classes. She scoffs at a country that could now peg Billy Graham as a liberal.

It is hard to talk to this abrasive Texas lawyer and social psychologist without debating with her. Her contentiousness comes across naturally. She is more comfortable in criticizing the nonsense of contemporary religion than in expounding on the future of atheism. Still, I press the point with her. I ask about the perfect atheistic world of the future.

There are five insane ideas that should be outlawed, she declares. 'First, violence between individuals and nations; second, slavery; third, racism; fourth, sexism; and



"One thing's for sure. He's got the home ice advantage."

fifth, God—a god that gives punishments or rewards in the afterlife, so that you remove yourself from everyday life or abdicate the use of human reason."

Might these be called the five atheist commandments? I ask.

"Oh, no," she objects. "Atheism has no commandments. Well, only one commandment. Thou shalt use thy mind, use reason in everything that thou doest, and never stop the process of learning."

"But religion exists as much as anything to address the *meaning* of life," I parry.

"The meaning of life is simply to live," she replies, "not to prepare to enter a heaven or elude a hell, but to actualize your potential and to ameliorate the human condition. All other forms of life help their own pack. The human community alone fights within its own species for the elimination of that species."

What is the perfect atheistic world of the future? O'Hair sees it as a world without hypocrisy with the greatest possible individual freedom, free universal education, sensitivity to the health of the race and the preservation of the environment, equal justice as a reality with an emphasis on the uniqueness of the individual. In short, a worldwide Jeffersonian democracy.

It sounds good. I think, but will the atheists in the Soviet Union and China espouse it?

DESMOND TUTU

Black Anglican bishop and head of the South African Council of Churches, Desmond Tutu is an eloquent figure in African Christianity.

Because Bishop Tutu is often kept under house arrest for statements and actions that advocate the liberation of his people, I thought it best that we speak first about Christianity in black Africa as a whole.

Clearly, the bishop is excited by what is happening in the African churches. With the liberation of most African nations, one might have thought that the Christian churches would suffer, associated as they had been with the colonial masters. Instead, church growth since liberation has been dramatic. Soon, Bishop Tutu asserts, Africa may be the most Christian continent in the world. The rapid growth of Christianity there is due to the essential spirituality of the black African, he suggests.

"An unspiritual, irreligious African is almost a contradiction in terms," he says.

Bishop Tutu applauds the great energy obvious in the Africanization of Christianity now taking place. Black theologians are busily at work in adapting Christian thought to local circumstances and argue intently that God was present in Africa long before Western missionaries arrived. In 1975 a new Anglican liturgy was devised containing many new prayers drawn from African insights and harmonious with the African's exuberance. African vestments are replacing Western ones. Incense and candlelight fill the churches, lending a luminous quality to worship. Dancing, clapping, and sing-

ing lustily" accent the new services.

"I was thrilled to attend Roman Catholic services in places like Cameroon and Ghana, seeing how they use the things of the soil, preaching that the Incarnation [the doctrine that God took on human form] sanctified the whole of our life. We don't need to be circumcised, as it were, into Western Christianity first. We come to God as who we are, where we are, with our gifts and our insights, in order to enrich the total church of God in the world."

Step by step we inch closer to the issue at hand. How will the black churches deal with anger? When the cataclysm comes, will the churches be in the middle of the fray? Or will they, like Gandhi, be proponents of nonviolence?

"In South Africa race is never very far from our consciousness. Virtually anything we do, say, or think is affected by the obsession with race. The main hope for a new, more just, more open society lies with the churches. They demonstrate, as their chief consideration that there is no Jew or Greek, no male or female, no slave or master, no rich or poor, but all one in Christ," he says, quoting St. Paul.

This idea can be quite explosive. The church must concern itself with the marginalized ones: the oppressed, the downtrodden. It must be the voice of the voiceless, be the prophetic church, declaring itself against injustice. The very credibility of the gospel of Jesus Christ is always at risk when the church aligns itself with the rich and the powerful.

"It is very difficult to see how other leadership [outside the church] can operate reasonably freely. I would say our society is hopeless without the church."

What about anger?

"I'm not sure we're handling that adequately. Some try to compartmentalize life, by saying that anger, which is obviously a highly volatile and political thing, does not quite belong in the realm of the religious. That's one way. The other is to stress that biblical tradition takes all of life seriously. There is nowhere where the writ of God does not run. We have a gospel that speaks about grace for sinners, but that also challenges the social and economic system, not merely providing palliatives, preaching that things will be okay upstairs, giving them a kind of prophet of the post-mortem pie. 'God is a God of grace and truth, but also one of justice.'

"The issue of nonviolence, as it is perceived in the American experience, is a luxury for the South African black. The bishop asserts. 'Quite a few of us on the inside feel the peaceful, nonviolent options have not *yet* been exhausted. Massive resistance may still turn the trick. But the authorities will act against any resistance. We are running out of peaceful options.'

Although Bishop Tutu is anxious to be off to his next appointment, I ask him one more question. Spiritual leaders in the West perceive nuclear holocaust as the central moral challenge of the future, but surely the black in South Africa, facing a white remnant in possession of nuclear weapons, must view this problem in a special way.

"It is not being melodramatic to say that we could have a scorched-earth policy if the whites thought they had had it. They could do a Samson on us. Since they would be destroyed, they could very well say, 'Well, let's all be destroyed together or take away as many of them as possible.'

"But nuclear weapons can be packaged small," I insist, so that they wouldn't have to take away whole cities, but only neighborhoods, such as Soweto.

They could do that," he admits. "But I suspect it would be such an act of desperation, such an extreme situation, they would fear the reaction of the world. That would spell curtains for them. If the West didn't do anything about it, I'm just as certain as I can be that the Socialist world wouldn't just look on. However you look at it, the use of nuclear weapons, no matter where or how limited, would trigger World War III."

"Though in the past the church associated itself with the upper class, it is now identifying with the poor. The poor and the powerless are the people of the future."

THE DALAI LAMA XIV

The pontiff of Tibetan Tantric Buddhism and the spiritual and temporal leader of the Tibetan people, His Holiness was forced into exile by the Chinese Communists in 1959. He now lives in northern India and awaits the day when he can return to Tibet.

To have an audience with the Dalai Lama is to be in the presence of considerable, gentle power. William Sloan Coffin remarked that he could never quite tell with Buddhist priests whether their simplicity was on this or the other side of complexity. With His Holiness, there can be no question. Yet as he held my hand at length after our conversation and smiled and joked, he might have been a jovial, disingenuous village priest, not the spiritual and temporal leader of 100,000 refugees, the symbolic leader in exile of faraway Tibet.

He was in the United States for his second major visit, and we met in a stately mansion down a remote, deer-traveled dirt road in New York's Catskill Mountains. He rested there after bestowing the Kalachakra Initiation upon the faithful in Madison, Wisconsin—a ceremony that lasted three days and that can be conferred only by a scholar lama after 20 years' study—and before he gave a series of lectures at Harvard Divinity School on "Emptiness and Great Compassion."

To speak of the future with this personage is to speak of the present and the past. The currents of history are like the currents at the bottom of the sea, where the moiling of sand is insignificant and constantly changing. Everything changes, perhaps even the institution of the Dalai Lama. Perhaps this fourteenth incarnation is the last. It does not matter. If the institution is useful, it will be retained. If not, it will be discarded.

"Despite external program, basic human suffering remains eternal," he says in his staccato bursts of broken English. "Old age, disease—these will always be with us. In order to face suffering, mental development is necessary and helpful. To utilize material progress in the *proper* way, to maintain *human* value above *material* progress, one must think inwardly and have a clear awareness of the human itself."

In the present day the Dalai Lama and his fellow Tibetans in exile are often considered an esoteric curiosity. But a Dalai Lama reestablished in his Potala in Lhasa, Tibet would provide the world of the twenty-first century one more powerful moral voice. No longer could that Buddhist pontiff, even in the remoteness of Tibet, represent the purity and safety of isolation.

What are the chances for his return? In the last two years discussions between the Dalai Lama and the Chinese leaders have begun. An invitation to return has been extended, but His Holiness is in no hurry. What happens to him personally "is not important."

"We must reach a certain stage where the majority of the Tibetan people are happy. That is the main condition [for return]," he says. "Then we will see. In the future a new attitude may come. The Buddhist faith cannot be replaced. But I believe there is common ground between Marxism and particularly the higher form of Buddhist practice."

"What is your dream?" I ask. At first he seems not to understand and, when he finally does, not to be much interested in the question.

"More harmony. A more friendly attitude. Less suspicion. Not living with a hostile attitude toward one another. If we develop the proper attitude that all human beings are the same, crises can be handled coolly, with more patience, more understanding. Not using weapons. With that, we may have a better world. That is what I believe. And you see that is the only alternative."

If religion is kept simple, without complicated theology, he believes, people will not argue over unimportant differences.

"How can universal religion become a more powerful force?" I try.

"It is complicated, difficult," he answers.

"What do you see as the greatest moral challenge of the future?"

He turns to his interpreter, Professor Jef-

frey Hopkins, of the University of Virginia, for a translation. They talk back and forth in Tibetan for what seems like an eternity. Finally His Holiness turns back to me.

"The question is not very clear," he says.

ROBERT F. DRINAN

A Jesuit priest, Father Robert Drinan was elected to Congress from Massachusetts in 1970, then withdrew from elective politics in 1980 after receiving a papal decree forbidding further elective political activity. Drinan, who is president of Americans for Democratic Action, teaches law at Georgetown University in Washington, D.C.

Father Drinan's departure from elective politics on orders from Pope John Paul II posed dilemmas for himself, for the Roman Catholic Church, and for the United States. He accepted the Vatican decree with "pain and regret," not "pretending to understand why the Holy See had chosen to silence the one priestly voice in Congress while it permitted priests to continue in top administrative posts in other nations."

Obedient to church authority, Drinan stands in sharp contrast to the Reverend Alison Cheek, an Episcopalian. Together they draw an issue for the future: Can ecclesiastical authority keep pace with a turbulent and ever-changing world? Will its laws and practices remain relevant to moral problems in the future? When the established church ceases to speak to the modern world, must the priest accept his superiors' orders? Or should he reject them dramatically?

I had heard speculation that two reasons lay behind Pope John Paul's decision: that the pontiff had become increasingly disturbed about the political involvement of priests in Latin American revolutions, particularly in Nicaragua, and wished to send a symbolic warning to all priests by silencing Drinan; and that by representing a liberal constituency that favored abortion, Drinan as a Catholic priest/politician had become a liability.

In his disheveled office at the Georgetown Law Center, Drinan addresses both problems. "With Latin America having a population of more than 350 million and representing half of those in the world who adhere to the Roman Catholic faith, Drinan sees a significant moral shift. Whereas in the past the church had associated itself with the upper class, now it is identifying with the poor. The poor and the powerless, he says, are the people of the future.

"There will be more situations like Nicaragua where the church will promote political liberty and economic freedom. The Catholic Church does not stand aside. . . . For the first time Christianity presents itself as a religion that favors the poor. . . . Inevitably you're going to have political revolutions."

If Rome knew more about it, it would say Nicaragua is a very interesting experiment. Drinan continues. "Many Catholics believe that Nicaragua could be a model of what could happen in all Latin America if there is no relief. . . . That's okay if the Nicaraguan model is followed. Nobody wants a Communist state or heavy Cuban influence. There is no one model for the future. But all over the continent priests are telling people, 'Cry out for justice!'"

Drinan sees abortion more as a question for now than for the future. He cites the statistic that there are 40 million abortions worldwide in a year. In the Third World 80 million infants are born annually, but 25 million will die before the age of five. Still, Drinan is opposed to abortion on moral grounds and thinks the U.S. government should not be involved in the question.

Drinan, like Father Daniel Berrigan, believes that nuclear holocaust will be the chief moral problem of the late twentieth and twenty-first centuries. At the Vatican II ecumenical council, in 1965, 2,200 Catholic prelates proclaimed that nuclear weapons should never be used for any purpose, offensive or defensive. As far as Drinan is concerned, the council waffled on the issues of manufacture and possession for deterrence. Again, his horrifying statistics: 50,000 nuclear devices extant now, 30,000 in this country and 3 more manufactured every day. At Vatican III, Drinan asserts, the church should declare their very possession immoral.

"The world is sick and getting sicker. 'Sodom and Gomorrah were mini-San Franciscos. There is a tendency toward radical individualism,' says Madsen."

The possibilities [of nuclear warfare] seemingly grow more possible every day. The proclivities of mankind to do evil are always present. We have to prevent that from happening." But how? "Through the collective religious voice of mankind. It will require a huge moral force that we can't even estimate."

But when Ronald Reagan's defense budget comes in the next session to the House floor, there will be no bony finger to punctuate the air filled with hot talk about the vulnerability of our 30,000 atomic devices. To make his arguments effectively, Drinan must hope for a certifiable political appointment, presumably in another administration.

ALISON CHEEK

Episcopal priesthood was conferred on Alison Cheek and ten other women on July 29, 1974, in Philadelphia, in an "irregular" ordination, conducted by three retired bishops over the objections of the Presiding Bishop. For two and a half years the ordination was generally considered "illegal" and led to ecclesiastical trials of ministers who allowed the 11 to perform priestly functions. In 1977 the Episcopal House of Bishops finally approved the ordination of women and recognized the ordinations of the original 11. Cheek is now the director of the Well Woman Project in Philadelphia.

Cheek saw her ordination in 1974 as a metaphor. It was as if she were standing upon a great cliff, perhaps in her native Australia, looking out to the sea, watching a wave in the far distance form, swell as it drew inevitably nearer, crest frighteningly powerfully and then crash upon the beach. The year 1974 was the time for the Episcopal Church to face up to women's equality, the time for the church's slowly receding patriarchy to yield.

Yet Cheek approached her ordination as a sad event of the spirit. It was the end, she feared, a spiritual death, for she fully expected to be deposed afterward, not simply branded as a bogus priest, but removed as an Episcopal deacon as well.

Not only in her investiture as a deacon of the church, but also in the Philadelphia ordination itself, she had sworn to obey any "godly admonition" of her bishop. "I knew jolly well I was not going to obey godly admonitions [on women's issues], and I thought of Martin Luther. 'If you must sin, sin boldly.' So I took that vow sinning boldly."

Looking back now on her original disobedience, Cheek hesitates to say that the success of her action validated a technique for updating canon law. "For most of us there was no technique involved. We were doing what we had to do. It was powerful because we weren't playing politics."

Cheek is part of the Episcopalian clergy with the church's blessing. Yet she feels autonomous, almost longing for the old public image of disobedience, rather than the new subtle discrimination of the church.

Cheek focuses on the "whole woman" of the future. To that new woman, a rich spiritual life is central. Its shape begins with discarding the outmoded practices of a patriarchal Christianity. "Humility is woman's sin," she quotes.

The "problem text" in the Scriptures about woman's submission to man must mean in the future mutual submission. The spiritual difficulty for women will be "to claim the whole of themselves and not feel guilty about it." By so doing, women "grow to full maturity in Christ."

Much in the traditional church is not suited to the condition of today's women, but that will change. The wife in the nuclear family represents only one life-style. What about the single woman, the divorced woman, the gay woman, the adolescent? The new whole church must have a place for them all. And she says with passion,

this split between the spirit and the body—so solid in the traditional church's attitude toward women—must go. Women want to be able to come to church as whole people, and not have to leave a part of them behind. In the church, women should be able to talk about *anything*."

Even the central image of God the Father will change radically. God the Father will give up power to "God the Mother." The early, feminine interpretations of Christianity lost after the first century will reenter: the Old Testament image of God as a mother dangling Her child on Her knee and the words of Jesus, wishing He could gather the Jews of Jerusalem to Him "as a hen doth her brood."

Yet women ironically will not want to give up "father language" or "father symbolism" lightly. In fact, Cheek says, with a touch of wryness, the father image may even strengthen, because many modern women find a scarcity of reliable earthly fathers in the temporal world today and thus they long even more for the heavenly Father.

DR. TRUMAN G. MADSEN

The Richard L. Evans Professor of Religious Studies at Brigham Young University in Provo, Utah, Dr. Madsen is a noted Mormon scholar and a theologian of the Church of Jesus Christ of Latter-day Saints.

The vision of the future Dr. Madsen propounds is both hopeful and apocalyptic. His enthusiasm stems from the certainty of the Mormon view and the joy of sainthood; his gloom comes from his surety that discord can only grow worse.

Mormonism is the fastest-growing religious persuasion in the United States. By the year 2000, it expects to attain 20 million members, a figure exceeding worldwide Jewry. Soon a tower will rise outside Salt Lake City that will beam a television signal around the world. It will enable a peasant outside Calcutta to get on a bicycle and generate the energy to tune in a concert from the Mormon Tabernacle. But this would only aid, not replace, the missionary zeal of the church. Mormons rely on the one-on-one approach. At Brigham Young University missionaries are trained by the battalion. Thirty thousand of them are out in the field, all over the world. The hope is that each will log in a new convert every month.

Madsen thinks the challenge of the future is not so much to adapt to modern reality as to restore traditional verity: the family as the core of love, the body as a temple, God as the Father.

"The world is sick and getting sicker. Sodom and Gomorrah was a mini-San Francisco. . . . There is a tendency toward radical individualism."

The irony of 1981 is that this, the most politically conservative of America's major religious sects, has done more to affect the central moral concern for the future than any other. On May 5, 1981, the eighty-two-year-old President of the Mormon Church, the living oracle as he is called, Spencer W. Kimball, made a major pronouncement on the seemingly temporal matter of MX missiles. Whenever this prophet speaks, he reveals God's will for the Mormon faithful.

Our fathers came to this western area to establish a base from which to carry the gospel of peace to the peoples of the world," the statement read. "It is ironic, and a denial of the very essence of that gospel, that in this same general area should be constructed a mammoth weapons system potentially capable of destroying much of civilization. . . . We plead with our national leaders to marshal the genius of the nation to find viable alternatives." From the point of this statement, the Reagan Administration began to reconsider whether the proposed MX system was feasible. A region closest to anything resembling a theocracy in America had profoundly challenged the nuclear-arms race.

Why is the MX a moral problem for the Mormon Church? I ask. After all, the Mormon stance wherever the church exists has been to support civil and military authority.

"People were meant to live in a garden, with the sounds of water, the whisper of wind, the fragrance of grass. Later Schuller will say the Santa Ana Freeway adds a touch of realism to the mix."

Conscientious objection, even in this broad sense, is something new to Mormons.

"[The destruction of innocent life] is part of it, but it is more the impact on the community itself. So complex a system would involve a revision of the very nature of life in the two states [Utah and Nevada]. It would bring in massive industrial components, severely affect our meager water resources, build heavy-duty roads throughout our region, introduce great numbers of people indifferent to our community life. We would pay a price, a moral price, for a missile system that may or may not demonstrate itself as a proper mode [of national defense]."

Perhaps the Mormons would succeed in stopping the MX, at least its deployment in their gardens and parking lots, but this was only a fleeting moment in a wider, grimmer process.

"Discord is not going to decrease," Madsen declares. "Time will come when you have to take up the sword against your neighbor or flee to a few havens in the world where there are solid communities designed to promote peace."

Zion is the name he applies to this safe refuge to which the wounded would return. This is only one of a number of identifications with Israel. Mormon Utah is America's Israel. The river that flows from Utah Lake (their Sea of Galilee) through the desert to the Great Salt Lake (their Dead Sea) is the Jordan River. In a century and a half, Madsen says, Mormonism has recapitulated a minihistory of the Jews, with its genesis, exodus, struggles, persecution and even occasional destruction.

So in these latter days the Mormon must seek to live a saintly life in the midst of turmoil and with the expectation of war.

"No one should rejoice in war, but it is part of the prophetic future. We must be sturdy and peaceloving even in the midst of war, but that is the test. If we welcome it in a bloodthirsty spirit, we are not Christians and not Mormons. It is a matter of faith and of attitude."

ROBERT H. SCHULLER

Pastor of the Crystal Cathedral in Garden Grove, California, and creator of the television program *Hour of Power*, which is seen by 3 million viewers in the United States and Australia, Dr. Robert Schuller claims that he is the most widely known churchman in America.

"I had this big dream of a dynamic ministry with a beautiful church," Dr. Schuller writes. "I dreamed of a staff of eight ministers of a thousand lay people doing the teaching, the counseling, the work. But my dream was stalled. All the 'Possibility Thinking' I could muster left me trapped in a corner. For two years God tested me, to make sure He could trust me, before He began to give me the success He was planning. That was easy for God to do: to keep me humble. His biggest task was to keep me believing bigger and better and more beautifully than I had ever thought before. There are: I had to learn, no mammoth tasks, only small minds."

One fruit of Schuller's big dream is the magnificent Crystal Cathedral. Designed by architect Philip Johnson, set amid glass office buildings and aesthetic shopping malls just off the Santa Ana Freeway in Orange County, it is an extraordinarily impressive symbol of the future, an architectural concept Schuller calls "biorealism."

"The human being was meant to live in a garden," Schuller tells me, "where the sounds of water, the whisper of the wind, the fragrance of the growing grass, the touch of the sun on the skin are all a part of us." Later he will say that the sound of the Santa Ana Freeway adds a touch of realism to the mixture.

The other fruit of his big dream is the *Hour of Power*, deemed by many the perfect marriage of religion and Hollywood.

An autographed photograph of John Wayne decorates the backdrop of Schuller's desk near one of Billy Graham and the snapshot of Schuller with the Pope.

Sitting in his office atop his Tower of Hope across from the Crystal Cathedral "campus," gazing out on the freeways and

office buildings and the hot plain where Schuller says 500,000 *hurting* people hunger for spiritual upliftment. I feel as if I am with the hotel magnate who started out with a simple root-beer stand. Schuller began his California ministry preaching in a drive-in movie theater. The marquee once announced the Sunday feature: "Someday Is Today, Featuring Robert Schuller with a Supporting Cast of Thousands."

As a communicator to small minds, as a packager of salvation, Schuller is unparalleled. "Losers can be winners." "Bloom where you are." "God has no wastebaskets." "Attitude has no latitude." "No gain without pain."

It is as if he is saying, "I'm okay. You can be too, and make a tidy fortune as well if you will only dare to begin." Schuller confers upon this message the imposing title of his theology of self-esteem. And it sells.

"In the latter part of the twentieth century we are experiencing nothing less than a theological reformation as deep and abiding as the event in the sixteenth century," he says enthusiastically, alluding to the Protestant Reformation.

Religion at present, particularly evangelical Protestantism, he believes, rests upon embarrassing the sinner by fostering shame and fear as the lash of redemption. He means to accent the positive.

"Self-esteem is the central verity, the north star, the central mark of the emotionally healthy person. That is why I talk against failure so much. Failure is an ego blowout in heavy traffic in the public eye."

Health, not sin, is the standard to gauge the upright life. As for divorce, for example, he says, "We would ask the question, What is the healthy decision? There is no doubt that many marriages are a terrible mistake." He agrees with William Sloan Coffin that the church should be involved in the dissolution, as well as in the making, of marriage. He has even conducted a church divorce.

All right, this marriage is terminated," he recalls telling the couple. "There is no way you can go through this process without wounds. I will not excommunicate you from the church, provided you come back to me after the judge has ruled, and we'll have a time of healing and prayer." Still, Schuller contends, the phrase *Till death do us part* should remain in the marriage vows as the goal of the couple.

High over Orange County, Schuller knows he's effective. He is excited about "what I have going here." After 30 years of preaching, he says, "I have my act together."

"If there's one thing I hear over and over in the United States and Australia, it is, 'Dr. Schuller, you saved my life.' It's always the same words. We're trying to give hurting people a look, a word, a touch, a healing touch that makes them think, 'Maybe I'm lovable after all.' So that's why I use my little phrase, 'God loves you.' So do I."

"It must be hard to be humble," I say.

"Oh, no," he replies. "It's the easiest thing in the world." ☐

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reader could easily discern the author's bias. The *Dialogue* cast three characters in a heated debate. Salviati, the learned scientist, was clearly Galileo himself. Sagredo, the intelligent layman, hung on Salviati's every word, and Simplicio, as simpleminded as his name implied, naively and unconvincingly defended the ancient Earth-centered system. Galileo had stacked the cards in his own favor, and, not surprisingly, the sun-centered system emerged victorious at Simplicio's expense.

In relying on the backing of the Pope, Galileo had made a serious miscalculation. Writing the book in straightforward Italian rather than Latin, he forced church authorities to view it as a revolutionary exposition instead of as an abstruse academic exercise. The heliocentric system it cleverly advocated seemed to violate intuition; even today we speak of the sun as rising and setting, as if we were watching from a fixed point in space. Worst of all, Galileo's enemies convinced Urban VIII that Simplicio, the half-wit, was a scarcely subtle substitute for the Pope himself.

Shortly after the publication of the *Dialogue*, the Inquisition banned the book and charged Galileo with heresy. Though seventy and in poor health, Galileo was unable to avoid another trip to Rome. At the trial he presented a defense of the theory, parts of which have since been shown logically false. But not even irrefutable logic could have defeated the dogma of the Catholic Church, and Galileo ultimately succumbed to the pressure and recanted his views. "I, Galileo Galilei, . . . abandon the false opinion that the sun is the center of the universe and immovable, and that the earth is not the center."

Back at his villa in Arcetri, now a suburb of Florence, Galileo was ordered not to publish and not to entertain visitors. He was granted one brief release from house arrest and visited at his son's home in Florence across the Arno River. Though his villa is now in a woeful state of disrepair, the Museum of the History of Science, in Florence, elegantly displays what remains of the scientist's instruments, including two of his telescopes.

Confined, going blind, Galileo dictated his *Dialogue on the Two New Sciences* to a student, reviving his three fictitious debaters in a discussion of motion and vibration. Through a friend, he arranged to have the manuscript smuggled to Holland for publication in 1638, later feigning surprise when the edition showed up in Italy.

Even at his trial, Galileo had the last word. After his humiliating recantation, he is said to have mumbled a last defense of an orbiting Earth: "Nevertheless, it moves."

Norvell Brasch is the author of a newly released book, The Birthplaces of European Science, *published by United Technologies Corporation, Hartford, Connecticut.*

INTERVIEW

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fits just as there have been since we entered the era of aeronautics and astronautics. What it is, is not very clear right now. But in another ten years, I suspect, there will be a new administrator sitting at this table discussing how the nation is going to deal with an explosion of commercial activity in space.

Omni: Do you see NASA taking a more active role in trying to persuade industrialists to get on board early in the game?

Beggs: Well, my experience with the business community—in which I have operated for twenty-five years—has been that, unless you can show business people in hard cold numbers what the earnings of a venture will be, you're not going to get them interested.

Just waving your arms and talking about potential is not going to get them coming in here with money. We've got to show them some payoff. Now, as I say, I am thoroughly convinced that the future payoff is there. But the way to attract the business community is to find out what is possible and then work it out in a business plan and present it to them as a commercial opportunity. As time goes on, and if we do indeed uncover those opportunities, my intention is to make that kind of business analysis and present it to them.

I hope that they will also do it themselves. I think that if we continue to fly frequently as we learn, and as we publicize what we learn, we will find the more creative minds in industry will say, "Hey, here's a possibility of making some money." They will do their own analyses. We've seen the beginnings of it in the communications area. When the first commercial fallout from space occurred—namely the communications satellite—it wasn't long until the financial community was most anxious to invest money. It was no trouble at all to sell shares of stock in Comsat. If memory serves, it was oversubscribed.

Omni: So you believe the business community will get actively involved in space operations once the shuttle becomes operational.

Beggs: If it becomes a commercial reality—maybe in ten years or so—a NASA administrator is going to be sitting here trying to figure out how to shuck off this large operational responsibility because it is dilutive of the basic reason for this agency's existence, which is research and technology. We're not an operating agency. We never have been one, and I hope we will never become one.

Omni: Do you think NASA should operate the shuttle as a transportation system, or hand it over to some other agency or company?

Beggs: I chaired a panel at the National Academy of Public Administration several years ago, when NASA had asked us to look at that. Our conclusion was that NASA ought to bring the shuttle through to a demonstrated capability, and then seek some way of transferring it to either another government agency, a quasi-government agency, or a private agency.

My personal predilection would be to try making it a commercial enterprise. But as long as the government is the major customer, that's going to be a hard sell. The next step would be a half-private, half-public agency. Transportation is a good example of partnership between government and private enterprise. The government took on the construction of the infrastructure, and the private sector runs on the infrastructure that the government creates. In a sense, the shuttle is a transportation system not unlike some of the things this country pioneered in its infancy. George Washington proposed the Chesapeake and Ohio Canal, and that was a means to provide access to the riches of the West. In a sense, this is a means of providing access to what we hope will be the riches of space, and therefore, the government ought to be the enabling hand.

But at some point the canal was turned over to a government-type corporation that levied tolls. Maybe this is the same kind of thing. I don't know. Surely there'll be a time when we'll have to invent a system for somebody other than NASA to operate. As I say, this agency should properly be a pioneering agency in research and technology.

My observation is that, once an agency becomes an operational entity, it tends to devote most of its energies to operating and too little of them to doing the research, because the operational problems are daily and the research activity can easily be put off until another day.

Omni: Ted Sturgeon once said that NASA's most astonishing achievement was to make mankind's greatest achievement look dull. In a sense, that's true. For years NASA told the public that *Apollo 14*, *15*, and *16* were exhibition games, that nothing important was going to happen, you don't have to watch. And nobody watched them, whereupon the television executives killed the coverage of our lunar missions because of their low ratings.

Beggs: The problem with this country is that the public has a fairly short attention span, and it is very difficult to keep putting on spectaculars that will keep people's attention. I will not argue whether NASA handled that well. Even if we had done it well, even if we had been superb in staging and publicizing what we were doing, I think it was inevitable that the American people would eventually lose interest. These are long-term programs. It takes ten years or longer from the time we start planning until we actually fly hardware. And it is tough to sustain public and political interest for that long a time.

Omni: What do you see as the main motivation behind the U.S. space program?

Beggs: It's the knowledge—the human knowledge. Carl Sagan says we live in an

age when people are intensely interested in the expansion of scientific knowledge. It's a very interesting, wonderful time to live, when you come right down to it, because I think the public is interested in knowing how the universe began and what the edges of the universe are. How does the whole thing fit together? That in itself, I think, is a wonderful motivation for continuing the space program.

With the space telescope in operation, we'll be able to peer out close to the edges of the universe, and we'll be able to find answers to some of the questions that astronomers have been asking for a long time. We will better understand the way our solar system operates, why it came into being the way it is, whether we are alone in the universe or not. We will begin to understand some of the processes that have taken place in the creation of the universe. And all of that, I think, is a very strong motivation, particularly for young people.

Omni: Do you see national prestige as an equally powerful motivation?

Beggs: The world is highly nationalistic, and one of the great motivations for our expenditures in space unquestionably has been competition with the Soviet Union, and now with the rest of the world. The Europeans are coming up fast in certain areas. They can see the benefits that will accrue from the program.

So do the Japanese. I think we're going to see some competition from the developed countries. It's a healthy thing. This is an area in which we can compete with our friends and our potential enemies in a fairly benign environment. There's relatively little chance that we're going to go up and shoot each other. It's easier to do that down here than it is to do it up there.

Omni: Yet the Soviet Union objected to the shuttle on the grounds that it's a military vehicle.

Beggs: Well, shucks, if you listened to Soviet leaders, you wouldn't do anything. Anything that enhances the capability of this country to do things that the USSR can't do is a threat as far as the Russians are concerned.

Omni: Well, there are military missions for the shuttle, and the U.S. Air Force is talking about developing its own shuttle.

Beggs: Well, of course there are many military applications in space, the most important of which is the reconnaissance that we've been able to conduct. It's made possible the negotiations of arms agreements that have succeeded because space reconnaissance has enabled us to verify and enforce those agreements. That, I think, is a great example of what can be done. If you're going to shoot someone, you don't have to go out into space to do it.

Omni: Unless you want to shoot down an ICBM.

Beggs: All right, there may be some military applications, but they are largely defensive in nature. I have studied the literature, and I have not seen anything proposed that is truly offensive in nature.

They're not dropping rocks on other people's heads. They're keeping others from dropping rocks on our heads.

Omni: How do you feel about the grass-roots movement that's developing—the L-5 Society, the National Space Institute, and other political-action groups that are pushing for a bigger and stronger space program?

Beggs: I think it's healthy and is typically American. We tend to be a people who form associations to promote common objectives. In a democratic or representative system such as ours, it's the only way to build political muscle. Politicians are much more impressed by the power of a group than they are by the power of an individual, unless an individual is extremely wealthy.

There are other desirable consequences from the formation of such groups. One is that they do, indeed, give us a voice to publicize what is happening, not only in NASA, but in the world at large. We can bring out in the open the various studies and the many scientific speculations about what the future might hold. All this is good. And everyone needs to get involved. I believe. Not getting involved in something that interests and stimulates you is not healthy for the human mind and body.

Omni: You recall how private citizens got together and donated money to the Viking Fund. Many of the same people are now trying to fund a probe to Halley's Comet.

Beggs: I'm afraid that the probability of a successful public subscription of that type is not very likely. I would welcome it if it were successful. Obviously, some things have more public pizzazz than others. Halley's Comet is very popular. There are probably more worthwhile scientific things in which people would not be as interested.

Omni: Is there any chance NASA will send out a probe to meet Halley's Comet? Some have said that if NASA could get twenty million dollars in the 1982 budget, it could be done.

Beggs: The money isn't there, and the mood of the administration and Congress is not to put it there. I think we've missed it. Personally, I should like to have seen a probe, because the Soviet, European and Japanese probes are not all that sophisticated. We would have done it better, and we might have found out some interesting and worthwhile things about comets. But on a list of priorities that doesn't rank very high.

Omni: Some people have talked about the possibility of sending nuclear wastes off the planet. Do you think that is feasible?

Beggs: It's feasible, but expensive. My friends in the nuclear power industry claim there are cheaper ways to dispose of wastes. Of course, this is something with which the environmentalists are intensely concerned, and I think rightfully so. Perhaps it is possible to do that when it looks more economically feasible than it does today. It's an interesting idea. But I put that into the same class with placing a solar power satellite in space, which is also a very interesting idea, but very expensive and a pretty tough thing to mechanize when power is still relatively cheap on Earth.

Omni: If Congress were to put discretionary money into the budget for a solar-power satellite, would you feel differently?

Beggs: If Congress were to say, "Let's explore some possibilities," yes, I think it's an interesting thing to do. Thinking of just the dollars and cents involved, we aren't there yet. We may be there someday. There may come a time when humankind is using so much power that power stations in space would become desirable, maybe not on economic grounds, but purely on the grounds of getting more energy without suffering any of the ill consequences of generating that energy.

Omni: Do you think that NASA ought to go for new capabilities and technologies rather than specific missions?

Beggs: We've always had a mission-oriented focus. Apollo or the shuttle, or some other program. And I think the tendency has been to say that within those broad programs we have developed the technology and the other things necessary to make the mission a success. Right now we've reached a point in the program where we have come to a new capability—the shuttle.

It is the fulfillment of what John F. Kennedy said twenty years ago about our becoming a spacefaring nation. Okay, we're about to become a spacefaring nation in the sense that we can fly routinely in space. Maybe what we do next is build the permanent space station. Maybe it's a more expansive scheme—one that says we go from a permanent station to replicating machines on the moon to the manned exploration of Mars. Maybe we start mining the resources of the moon and utilize those resources to expand the horizons of what we're doing in a permanent space station.

Omni: You don't see any of that as fantastic or nonsensical?

Beggs: No. One can raise questions—as Senator William Proxmire does all the time—about the cost-benefit tradeoffs, but not about the technical feasibility.

Omni: I wanted to ask you about international cooperation. The United Nations has enacted the Moon Treaty. How do you feel about it?

Beggs: About international cooperation or about the Moon Treaty?

Omni: I think everyone favors international cooperation.

Beggs: Well, I don't think that everybody's in favor of international cooperation. I think we're in favor of it. I don't know how much the rest of the world is. I think the Europeans have participated when they have felt it was to their advantage.

It's an attitude that has been fostered since World War II, when this country became a dispenser of largess, and other countries have picked and chosen what

they wanted from among our offerings.

The European community now has a greater economy than the United States has. They certainly don't spend near the money in advancing the frontiers of science that we do. I believe they could if they wanted to. I think they should spend more. Instead of picking and choosing only those things that they feel are to their benefit, they should also share in some of the things that cost money but don't look as if they have an immediate payoff. I don't know that we're going to drag them into a fuller cooperation without really giving them equal partnership, which they properly should have. Whether they would take it or not, I don't know. The French might still go off and do their own thing.

Omni: The Moon Treaty, to many people, seems to be aimed at preventing free enterprise in space.

Beggs: Well, the United Nations, I think, has had a policy of trying to develop resources for the benefit of humankind. My view is that the development of resources can be done more readily and efficiently if we open space to free enterprise. The facts are that people seem to work best when they work in an environment of enlightened self-interest. And sooner or later the United Nations will come around to this realization. I think it will probably be later rather than sooner because they still seem hell-bent on making sure everybody shares and shares alike, which is the division of zero by a large number.

Omni: What do you do if a shuttle crashes? What if there is a real failure in a test?

Beggs: I don't anticipate we will lose a spacecraft, but if we do ever lose one, well, we had the Apollo fire. It set our program back. It hurt, and it would hurt here, too. But we'd pull up our socks and go on from there.

When you're engaged in the operation of flying machines which fly statically unstable, you've got to worry. And you have to handle them very tenderly. We intend to do that. This is a good crew. They're very experienced. They've gone through a lot together, and they understand, I think, the risks we take. We don't fly unless we feel we're ready. We don't fly even if, at the last minute, we think something is not right. We will continue that policy.

My experience with flying machines has always been that you treat them gently, and you fly them as much as you can, and as you fly them, you learn, and the more you learn, the more you're able to improve them. Pretty soon the operation of them becomes routine.

Let's face it. Safe as commercial aviation is—and it's the safest form of transportation known to man—we unfortunately still experience an occasional catastrophe. And you have to worry about an occasional accident.

Omni: When the shuttle becomes operational, will you fly in it?

Beggs: I'd love to. I love to fly. Nothing would please me more. ◻◻

ASHES

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Now looking despondently at the dismantled carcass of crawler G19 Brachvogel's mind went back to the disastrous day when they had realized that this engineer's nightmare was more than just a local accident of topography

"You mean to say this junk covers the whole bloody planet?"

Ray Czerny technical coordinator nodded unhappily "All the evidence points that way Miss Monteith."

Patience Monteith was a tall forceful woman in her late seventies though she looked nearer forty thanks to expensive medical treatment Her close-cropped black hair and her flashing eyes were entirely her own, however So was her mouth and everyone knew it Czerny watched her face and waited for the explosion It came

"Then why wasn't it spotted years ago?"

In front of Czerny was a pile of yellow-bound reports He pushed them to the center of the table "It was, but its significance wasn't understood when the original survey's samples were analyzed and nobody followed it up I've been asking for funds to do a new survey for three years now, but Finance vetoes the idea every time I—"

"Keep to the point," said Monteith

"The main purpose of the original cores was to assess the mineral potential of Chorisande, for the benefit of the Asterope Bank's accountants Chemically this stuff is harmless and unimportant The abrasion problem just wasn't appreciated by the chemists who—"

"And the engineers?" Monteith interrupted menacingly

"They needed more than the cores could tell them Bulk samples for stress-strain analysis and so forth So they dug themselves a nice big deep pit—at the edge of the ice field near the installation—to keep transport costs down And they managed to pick one of the few places on Chorisande where the particle layer wasn't Some kind of shielding effect of the coastline."

Gilles duFeu was five years younger than Patience but he looked twenty years older He leaned forward in his chair with the tentative movements of a man whose joints were no longer supple "What caused it?"

"Geology says it was planetwide vulcanism That's why it's spread so evenly over the whole surface Round about the time the oceans started to freeze there was a lot of volcanic activity The ocean surface froze and unfroze repeatedly in cycles and the dust settled in bands below the ice They think that a near-miss with an asteroid perturbed Chorisande's orbit and triggered the—"

"Damn Geology's theories," Patience said "The question is, What in the hell can we do about it now?"

"Can we relocate the crawlers?" Brachvogel asked "Skim a bigger area?"

"No You can't extend those pipelines indefinitely It shaves too much off the profit margins."

They all nodded They also all knew that there was no way to relocate the Plants Those were permanent The economics of the project were predicated on ice miles deep, not twenty feet and every proposal made in the next twenty minutes foundered on that discrepancy

Brachvogel asked how much time was left

"We've already got forty-eight crawlers outside their planned zones," said Czerny "and another seventy on a slowed cutting schedule Within six months we'll have half the crawlers laid up That will reduce turnover severely The Asterope Bank isn't going to be happy."

"To hell with the bank!" Patience exclaimed "*I'm* not happy I want an answer to this, and I want it fast Develop abrasion-resistant cutters Change to an all-laser system Find new ways to strip the ice Find something better than pipelines to carry the slurry."

"I assure you we're pursuing all of those ideas, Miss Monteith But there isn't much room to maneuver For example, an obvious approach is to liquefy the ice completely filter out the abrasives, eliminate the cutters altogether But there isn't the spare energy The fusion generator doesn't have

"Do you get the feeling that Blitzen won't be with us much longer?"

the capacity for that much energy."

Bring in another one," Monteith said.

Patience." duFeu said. "do you remember how long it took to commission the existing one? And we're still paying off the loan."

"It's a pity though," said Anton. "With liquid water instead of slurry we could up production no end. Get rid of the crawlers, shorten the pipelines, cut channels for the melted ice to flow in. We could borrow pretty much anything we needed, on the strength of that kind of increase, and—"

"Yes, and if pigs had wings—"

"Okay. Patience, keep your hair on. We're all as upset about it as you are."

"I am not upset! I am merely trying to—"

"Patience, dear," said duFeu, "*do* try to live up to your name. We need cool heads."

"In that case," Patience replied, "you can stick them in a bucket of ice slurry."

About the only thing that came out of that meeting, apart from an ill-concealed air of panic, was a decision to send Anton to make an on-site investigation. And now he returned from Chorisande to the Asterope Distributor with a report that held little encouragement. The meeting at which he was due to present it turned out to be even more traumatic than the previous one, but for different reasons.

They never even asked to hear his report.

Instead, they talked about the greenhouse effect.

"The idea's as old as the hills," said Czerny. "Carbon dioxide in the atmosphere traps radiation, and up goes the temperature. Chorisande is so finely balanced that just a couple of degrees would do it."

"Great," said Brachvogel. "So where does all that carbon dioxide come from?"

"We take advantage of Chorisande's extensive forest cover."

"I thought vegetation absorbed carbon dioxide, not produced it," said duFeu.

"Ordinarily it does."

"So how are we to persuade the forests to give instead of take?"

"Burn them," Czerny said.

"*What?*"

"Burn them, Mr. duFeu. We calculate that—"

"Hold on," Brachvogel said. "Just how much of the forest do you propose to burn? That's a delicate ecology."

"Well, actually, the optimal—"

"Oh, for Christ's sake, Czerny!" Patience reverted to character. "We burn the lot, Anton! What's the point of half-measures? The more carbon dioxide, the quicker we get Chorisande warmed up!"

Oh, Chorisande, what have we come to? Out of the corner of his eye, Brachvogel saw duFeu's face. DuFeu looked stunned, Brachvogel said. "And how long will this take to get results, Patience?"

"To fire the forests, three to four months. To melt enough ice to get production going properly, five years."

It was obviously ridiculous, and Brachvogel said so.

Not with a loan from the AB," Patience reminded them. "Based on the production increase we'll get—"

"For God's sake, Patience!" duFeu protested. "You can't just go around setting fire to planets. It's immoral. Those forests are unique. Beautiful. Unexplored. We haven't any idea what's in there. We—"

"We are heading straight for the Asterope Bankruptcy Court, Gilles! Chorisande's no use to us if we can't extract its minerals. Immoral? So is poverty! What are a few dragonflies and some screeching fungi compared to what a warmer Chorisande will give us?"

"They don't screech," Patience," Brachvogel said. "They moan. It's a wonderful resonant sound, almost like a chant. I used to love listening to it when I was a child on Chorisande." *Chant? A threnody.* Anton was having trouble reconciling conflicting emotions. *For Chorisande, or my father? Both?* "Patience, how do we burn them anyway? The conditions don't strike me as being suitable for forest fires."

"Particle beams. Bring in an orbital projector and sweep the continental mass in short bursts. The bank will pay."

"No!" duFeu shouted. "It's a *world*, not an entry in a ledger. I won't permit it."

"Fair enough," said Patience. "But Anton and I outvote you. Don't we, Anton?"

"You're trying to rush me," Brachvogel answered. "I need time to think it through."

"We haven't got any time! The bank will call in our current loans soon."

"But—the government," Anton interposed. "We'd never get a license for action on this scale."

Patience shot him a look of disgust. "Honestly, Anton, do you think the government will interfere with a nice little terraforming operation?"

"Terraforming?"

"Of course. Chorisande would make a beautiful terratype world if the climate were milder. Warm oceans and forested continents. We replant, of course. Conifers, maybe."

"And the animals?" asked duFeu.

"Worms and insects! You call those animals? There's nothing worth speaking of on Chorisande except ice."

DuFeu clenched his fists in frustration. "We don't know that. We don't know anything."

Patience nodded. "Exactly. So there's nothing on central file to prevent our going ahead. If we move quickly, the project will be a *fait accompli*. The AB doesn't anticipate any trouble." She shot a glance at Anton. "Well? Are you capable of making a sensible commercial decision without getting sentimental?"

"That was too much for duFeu. "Sentiment be damned! Anton, she's asking us to kill a planet."

It was a mistake. It reminded Brachvogel of what Chorisande had done to his father. *Chorisande the murderess. How neatly*

symmetric to kill in return! And while part of him was thinking *It's stupid to wreak vengeance on a planet*, another part reached a decision.

"Okay, Patience. We'll play it your way. Bring on the incendiaries. It's an evil answer to an evil problem, but I don't see any choice." *You blackhearted bitch.* And he wasn't sure whether he meant Patience or Chorisande.

It was the director's job to decide policy, nothing more. With the decision taken, its implementation was in other hands. One of the benefits of a hierarchical structure is its moral insulation.

Brachvogel took an extended vacation away from the Asterope region. He told himself that he deserved it, but the truth was that he couldn't face the prospect of actually watching Chorisande's forests burn.

From time to time he got digest reports of the project's progress: financial arrangements, legal requirements, logistics, temporary evacuation of personnel and equipment. It was easy enough to begin with. The fine print on a bank loan seemed light-years away from the nasty fact of an orbital particle-beam projector. But the narrower that gap became, the greater the momentum of its closing. By the time Brachvogel's doubts had become painfully conscious, it was too late to stop.

When the report arrived saying that the burn-off had started, he tore it up, and he was in a black depression for a week. Patience was like a dog with two tails; duFeu seemed to have retreated within himself and hardly communicated at all. Anton's spirits rose and fell, depending on whom he talked to. After the burn-off had been completed, he tore up the next six reports unread. He was beginning to feel a little happier when duFeu contacted him with a person-to-person freewave call.

'Anton. I'd like you over here right away.'

"Oh, hello, Gilles. I haven't seen you in ages. What's the rush? And where's *here*? How is Patience?'

'It's urgent. Extremely urgent. I'm on Chorisande. So is Patience, but I'd rather not talk about that. Get on the next cruiser and come as quickly as you can.'

'But why? I thought everything was running smoothly. I'm not sure I—'

'For God's sake, Anton, *get over here*. Move.'

Anton felt his depression coming over him again. "All right, Gilles, if you insist. I'm on my way. But why damn it?"

Gilles looked anguished. "I can't say over the freewave, but Patience's *fait accompli* is looking a little sick,' he said. And he cut the connection.

Anton stopped feeling depressed and began to feel scared.

From space, Chorisande had always been a sparkling jewel, dashed with green and brown. Now it was just a featureless gray blob, like a ball of mud.

It wasn't much better from the ground. Mostly it was obscured by swirling fog. The air smelled wrong: damp ash and woodsmoke. Even now a month after the fires had died, even through a face mask, *I never realized it would be like this.* And there was another, indefinable smell—a smell of death.

DuFeu had met him when the shuttle landed and taken him to the Installation without saying a word. Something was horribly wrong.

'Where's Patience?'

"She's shut herself in her room and refuses to see anyone," duFeu said flatly.

'What? Patience? But she was so happy about this project.'

'Yes. She's not the kind you'd expect to crack up, is she? But I'm afraid she can't take the way her *fait accompli* has turned out. Neither can I, Anton. But at least it was never my idea.'

Cracked up? Gilles, what the hell has been happening? Has someone found out

> *It was a mistake. It reminded Brachvogel of what Chorisande had done to his father. Chorisande the murderess. How neatly symmetric it would be to kill in return!*

what we're doing here? Is that it?' He struggled to control his emotions.

'No. But they will. And then—' He saw Brachvogel's puzzled face and shrugged. "I'll show you." He tossed a pile of holographs onto the table. "Take a look at these."

The first appeared to have been taken on the ice field near the coastline, probably in infrared to pierce the fog. It was hard to tell for sure; everything had changed so much. The ice was littered with strange, shapeless humps.

The next was a close-up of one of the humps. It was blackened and crumpled, like a dirty rug thrown carelessly into a heap. But if you looked closely, it was possible to make out the bone structure.

It was an animal. Something like a bear, except that only the lower half bore fur. There were more holos. One showed the face. It was sunken and deformed. There were no bacteria on Chorisande, but tissues still undergo chemical decomposition. There was something familiar about it.

"Dear God," said Brachvogel. *I didn't know, I didn't know, I didn't know.* 'This is awful. What *are* they?'

"The clean-up team called them half-bears. Gallows humor, but it's appropriate. There must have been millions of them in the forests. Maybe more. We have no real idea, we—. The lucky ones near the edges made it to the ice. The rest—they burned, I guess. But the ones who escaped the flames didn't last long. Suffocation, lack of food, poisoned by gas—they were heaped up, in places. A dead continent bordered by corpses. I think I'm going mad. Anton. We did this to them. What do you think of the greenhouse effect now?'

Anton was feeling sick. He turned his eyes from the holo of the crumpled corpse. "Hell. They're only animals. We didn't mean to do it. But it's done now anyway, isn't it?'

'Yes. It's done.'

So nobody's going to worry about a bunch of animals.'

'I do, Patience, too. So will you. I think you do now.'

Yeah. But worrying won't bring the half-bears back, will it?'

'No.'

'So what's a bunch of animals compared to Chorisande's minerals?' *Revenge should be sweet. Why isn't it? Justice is—ugh! I can't speak the word.* 'She killed my father, Gilles. Why shouldn't we kill her?'

DuFeu wasn't really listening. "You tell me, Anton.'

"I don't know anymore, Gilles.' He paused. 'These—these half-bears—they're very familiar. I just can't quite place them.'

'We know so little about them,' said duFeu. 'Where they lived, how they lived. It's all gone forever. Were they solitary, or did they group into herds? What did they eat?"

'Fungus.'

'Eh?"

Brachvogel said, almost dreamily. 'We saw some eating the fungus. Daddy and me—we saw them. Just before he was killed. We were hurrying back to tell everyone.'

He was almost in a trance. For a second he seemed to shake it off. 'That must have been why he got careless and passed too near an ice tower.'

'I'd forgotten all about it, but now it's all coming back. I was too young to appreciate it, but I remember how excited Daddy was. Oh, God, I remember *everything*!' He stared blankly into space.

DuFeu put one hand on his shoulder. 'I'm sorry, Anton. Did you watch them long?'

'Quite—quite a long time. They were, kind of—*collecting* the fungus.'

"Grazing?"

'No, more like harvesting, I suppose. They were putting it into huge baskets, woven from some sort of reed—.' His voice trailed off, and his eyes stared.

'Anton,' said duFeu in a stricken voice, 'are you sure? Baskets?" His face was ashen.

No more than your dead fungus shall I sing again, O Chorisande. And I called you murderess. Brachvogel nodded once and held his head in his hands. ∞

PHOTO CONTEST

By Geoffrey Golson

We caught glimpses of the future in the photographs submitted in response to our request for images from A D 2000 Photographic foresight was best expressed by First Prize-winners Joan Hall and John Budde of New York City in their collaborative effort on a symbolic spaceship of the twenty-first century Hall constructed the mixed-media assemblage and Budde photographed it in multiple exposures with a Sinar 4" × 5" view camera and a 210mm Schneider Symmar f/5 6 lens Budde achieved the background star patterns by backlighting pinholes on a black field exposed separately through two star filters

Second Prize-winner Rick Ueda of Burbank, California, portrays a stark finality in his Year 2000 setting of a broken sculpture on rocks This photograph was also taken with a 4" × 5" view camera and multiple exposure techniques and was recorded on Ektachrome film

An update of Michelangelo's Sistine Chapel fresco depicting God creating Adam was produced by Third Prize winner Jan Hartley of New York City Here, man is the divine creator of a lesser being Hartley used a Pentax Spotmatic to shoot slides of the robot hand the human hand, the stars in the background, and the aura around the fingers The four separate slides were combined and photographed with a Forox SS camera loaded with Ektachrome film ∞

NEXT OMNI

FICTION

ARISMAN

GAMESMAN

MATHEMATICAL GAMES—After 25 years of writing his popular games column in *Scientific American* Martin Gardner is retiring—to work harder on other projects In a rare exclusive interview *Omni* senior editor Scot Morris talks to Gardner about *Alice in Wonderland* perpetual-motion machines Uri Geller ESP hoaxes (including Gardner's own) Fermat's Last Theorem, the fourth dimension calculators computers creativity, the 'aha!' experience, the consequences of the fundamentalist Christian explosion, and nearly a googol other topics Watch for the funny business when our games editor talks to their games editor in the January issue of *Omni*

WHERE FLESH AND STEEL MESH—An eerie mix of organic and man-made textures characterizes the art of Marshall Arisman, whose inspiration springs from the social unrest wrought by science and technology His paintings with their surreal aura and futuristic sheen, convey the trapped helpless feeling of men who have been reduced to cogs in a machine Don't miss Arisman's disturbing vision of mechanized man in January's *Omni*, timed to coincide with an exhibition of his work

MAGIC MIRRORS—Television technicians are about to turn passive watchers into active participants who can create images on the screen Like the mirror in Disney's *Snow White*, new video systems answer questions and extend our view behind closed doors They can also take people at their own pace on tours through the streets of villages the halls of an art gallery the fuel lines of a jeep, and the arteries of a human body Some have screens shaped like faces that nod to whispered secrets To get an advance look at future viewing, read *Omni* next month

MR. HYDROGEN—You can drink the exhaust of the mail trucks in Independence, Missouri That's because Roger Billings has converted the engines of these trucks to run on hydrogen Not only do engines that use hydrogen produce water as a by-product but they deliver more energy per pound than any other fuel synthetic or otherwise Billings leads the vanguard of the hydrogen-power movement, telling people all across America how to convert their car house, helicopter or boat to hydrogen There's even a town in Iowa that's using his ideas to become the first hydrogen-powered community Learn in the January issue of *Omni* how this abundant resource could make this country energy independent by the year 2000

SCIENCE FICTION—In January *Omni* presents an exclusive excerpt from Barry B Longyear's novel *Elephant Song* the latest installment of the continuing history of the interstellar circus ship *Baraboo* Longyear winner of the Hugo Nebula and Campbell awards, is the author of *City of Baraboo* and *Circus World*, the two popular forerunners of *Elephant Song* And an unusual detective is sent to sort out what seems to be a simple reincarnation mix-up in John Shirley's Triggering "

EARTH

CONTINUED FROM PAGE 16

have various kinds of cancer Although vinblastine and vincristine sales totaled $35 million worldwide in 1979 the actual value of these drugs—in terms of the economic productivity of the lives saved—may be more than fiftyfold that amount

"It is not uncommon for otherwise ordinary plants to produce invaluable medicines" says Norman Farnsworth professor of pharmacognosy (the science of medicines derived from nature) at the University of Illinois Medical Center in Chicago "Roughly twenty-five percent of all prescription drugs in the United States are derived from higher plants These medicines have an annual market value of about six billion dollars And yet the amazing thing is that today there is not a single drug company looking for new drugs in plants native to the United States

"The best way to get funds for drug research," Farnsworth asserts "is to find out who's sick in Congress or in the President's Cabinet They started looking at plants as antitumoral agents only when John Foster Dulles [then the secretary of State] was found to have terminal cancer More than fifteen hundred letters were sent in by people suggesting cures and a very large number of those letters mentioned plant remedies"

Farnsworth offers a preliminary strategy to estimate the total number of medicines that can be discovered in untested plants "Since fewer than five thousand species have been thoroughly investigated for drugs, and roughly fifty plants are used in the drugs now sold in pharmacies in this country, one can expect that about one percent of the plants will eventually prove to be of value for drug production If the total number of species remains constant, nine thousand new medicines might be discovered"

Farnsworth cautions that his analysis applies equally to all species of plants and cannot be used to select which individual plants should be preserved But if his estimate is accurate medicines found in rare and endangered U.S plants will someday have a yearly market value of about $1 billion in this country alone "There is a gold mine out there,' Farnsworth says, "and everybody is bypassing it"

Wild plant species are also essential for high agricultural productivity Since 90 percent of the world's food supply is obtained from plants, insects and blights can cause serious global consequences Genes that enable wild plants to resist insects and diseases must continually be transferred to food-producing species to prevent crop failures such as that which destroyed 15 percent of America's corn in 1970 at a cost of nearly $500 million

The race between plants and disease organisms runs uncomfortably close New strains of wheat for example, last an aver-

age of five years in the American Northwest before the ever-present pathogens close in. In *Extinction*, the Ehrlichs emphasize that the loss of genetic stocks in the wild increases the probability of large-scale agricultural failure, which could then lead to political turbulence and even nuclear war. Large crop failures can also be expected.

Despite the fundamental importance of plants, the U.S. Department of the Interior has recently decided that it is more important to protect any fish, amphibian, reptile, bird, or mammal than to protect an endangered plant. Alarmed by this newly formulated federal policy, several organizations are initiating preliminary cost-benefit assessments on their own. The New York Botanical Garden, for instance, has established a new Institute of Economic Botany, and California's Governor Jerry Brown has directed the California Gene Resource Program to prepare a list of plants that are of real and potential importance to the state and to outline procedures to save them.

But governmental and scientific programs are encumbered by red tape and a scarcity of funds and facilities. By the time important plant species are identified, it may be too late. That is why a group of concerned botanical gardens and societies has taken matters into its own hands by beginning a program of foster care for plants. Called the Rare and Endangered Native Plant Exchange, this plan calls for giving endangered plants to people who will provide homes for them and who will return seeds and cuttings at the end of each growing season. Records of all plant and seed exchanges will be maintained by participating botanical gardens and societies and in the computer system of the City University of New York.

Cost-benefit analysis is only a first step. It is a necessary tool to translate the value of plant species into terms that everyone can understand regardless of his or her political or economic interests. But economic analysis can assess only a portion of the value of plants and cannot in and of itself save any of them. Fortunately, the Ehrlichs write, the accelerating rate of extinctions can be arrested. This will not be easy and will require concerted action by millions of people. But no tasks are more important, because extinctions must be stopped before the living structure of our planet is so weakened that at a moment of stress it fails and civilization is permanently disabled.

"We can save our native endangered plants if we work quickly," says Bruce MacBryde, of the U.S. Fish and Wildlife Service. "And the chances for each species improve with everyone who volunteers to help." ☐☐

For information about how you can participate in the Rare and Endangered Native Plant Exchange, please send a self-addressed, stamped envelope to Plant Exchange, c/o New York Botanical Garden, Bronx, NY 10458. Please include $5 if you want an Endangered Wild Flower Calendar and information about endangered plants as it becomes available.

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SPACE

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was my philosophical phase," he says. "After that I became more and more convinced that the private sector should take over the exploitation of space."

He began knocking on doors in Houston and soon caught the ear of the Chamber of Commerce and its president, ex-Houston Mayor Louie Welch. Hannah was invited to a dinner early in 1980 to persuade local leaders of the need for private investment in space. "I thought it would ignite them and that we'd really get some interest up," he says. "But nothing happened."

The only thing to come out of the dinner was an introduction to Hudson, who had put together a slide presentation about the exploitation of space. Hudson was one of the growing number of people who make a living championing space exploration.

The two men began to talk. "I was impressed with Gary," Hannah says. Hudson said he could make a rocket for about $5 million. Hannah said it had to be less. Hudson came up with another figure, and eventually they decided it could be done for about $1.2 million.

"It took me about a year to get the money assembled," Hannah says. "Mostly it was people I'd done business with. I had all the funds in hand in March of 1981, and we incorporated in Austin under the name Percheron Joint Venture."

Hudson had the first rocket ready in about five months, but it was far from easy. "We ran into one dead end after another," Hannah says, "but Gary always worked us out of them. About once a month I thought this wasn't a good idea."

But soon the rocket was being loaded on a truck for transport to Texas. GCH had planned to launch from the tip of Matagorda Peninsula, but landowners there raised questions about the group's liability. It was decided to move to Matagorda Island and a farm run by one of the investors.

The plans were to test-fire the engine in a 5-second burst, then go for a longer, 25-second burn, with a launch to take place several days later. The tests were delayed several times, however, because of weather and technical problems. The Federal Aviation Administration also was slow in acting on the group's request to approve the launch, although the go-ahead was given the day the rocket blew up.

Hannah says his investors considered the entire venture of a gamble at first, without much chance of success. "It wasn't until we got the rocket up on the pad that they really thought it would work," he says.

Hannah believes the explosion is unlikely to deter investors. "We tried to break this into small chunks. What we're doing is a logical one-, two-, three-step approach. We'll keep going as long as we can. If I lose an investor, I'll see whether I can find someone else. When we run out of funds, we'll quit. That's free enterprise."

BOOKS

CONTINUED FROM PAGE 30

Ursula Le Guin's *The Left Hand of Darkness*, in which the alien world is simply a convenient place to situate an evolved androgynous version of the human race so as to dramatize a social message about sex roles. Le Guin's more recent book *The Dispossessed* employs the same technique, this time with political implications. So, too, do Norman Spinrad's *The World Between* and Joanna Russ's *And Chaos Died*.

Books of this kind are really no different from *Gulliver's Travels* or even *Lord of the Flies*. Each of these writers imagines a self-contained society cut off from everyday life. Swift and Golding chose isolated islands. Writers of science fiction reasoning that if Lilliput existed, it would long since have been mapped by satellite, feel that they have to resort to an unknown planet for the story to be feasible.

One problem in this sort of fiction is that such locales don't really work in stories less than novel length. When we all believed in the dry sands of Mars and the steamy swamps of Venus, a writer could evoke a setting with a few quick paragraphs and then get on with the story. Today the writer has to specify every detail of his chosen world, from the edibility of its vegetation to the color of its sky. It is not easy to convey so much detail in anything less than a novel, and this is one reason why more *Dune*-sized epics are now being written.

Another drawback of distant-system-planet stories is that, despite their often socially relevant themes, they may actually seem less relevant to our own lives than earlier types of science fiction. When *The War of the Worlds* was first published (1898)—and again when it was first dramatized on radio in the Thirties—people could take it seriously because anyone could look up and see Mars shining in the night sky. All the other planet stories through the Sixties, shared a similar power. The unfamiliar and frightening scenes they contained were set right here on our celestial front doorstep. Stories taking place on remote planets can never seem so immediate, and therefore can never be so threatening.

Not all writers have chosen to shift their stories far from home. Those who decided to deal with moons and man-made space environments are still working within the solar system. They have to be more careful about scientific facts and plausibility, and this in turn means that the stories are harder to write. But there's still room for adventure.

Gregory Benford's *Jupiter Project* is a classic example. The novel takes place on and around one of Jupiter's moons. It's not a very friendly habitat, so the characters have to be protected from it by various cumbersome man-made environments. By sticking meticulously within what is known and feasible, Benford builds a near-future scenario we can truly believe in.

Likewise, Poul Anderson (using the pseudonym Winston P. Saunders) has written a series of stories about life in a colonized asteroid belt. (These stories have been collected in a book entitled *Tales of the Flying Mountains*.) Anderson, like Benford, is scrupulous about his science; we can be sure that what we read is not only plausible but possible.

And then there are books about orbital space colonies, built according to the model proposed by Gerard K. O'Neill in his nonfiction book *The High Frontier*. This subject is one that authors have only just begun to exploit. Ben Bova's *Colony* was one of the first describing the political machinations involved in establishing a man-made environment in Earth orbit. More recent is *Worlds*, by Joe Haldeman, the first part of a trilogy that will furnish us a full tale of a society of space colonists whose lives, beliefs and morality evolved in ways unheard of on their home planet, Earth.

While distant-star-planet stories allow much more creative freedom, science fiction is most powerful when it tells about events that may come true within the reader's lifetime, instead of taking us away to lands of make-believe. This kind of science fiction has superseded the old-style planet stories, portraying the kind of tomorrow we want and alerting us to the unpleasant worlds we may inherit instead. ∞

FILM

CONTINUED FROM PAGE 26

man feels safe and comfortable on a walk through the woods, but Naoh always had to be poised for flight from danger."

Burgess, who had developed an argot for his London toughs in *A Clockwork Orange*, worked in a manner analogous to Morris's: by deductive rather than inductive leaps. Ultimately he contributed about 150 words to the Ulam vocabulary, but no grammar. There were to be no noteworthy Ulam orators. Burgess selected Indo-European roots. For example, because the most important Ulam concept is fire, Burgess reckoned that its real name, like that of God among the Jews, would be forbidden, unspoken. He therefore named fire *aitra*, from the French word *âtre* ('hearth'). *Atramon* (*atra* plus the root of the English word *monbund*) would mean "the fire dies": the most solemn proclamation an Ulam could make.

"We know in that period," Annaud explained, "that humans had small vocabularies." Burgess's vocabulary is for articulating exclamations but not for dialogue. He gave us *ri-mar-giom* ('come back') to shout, because "ugh, ugh, ugh" sounds absolutely ridiculous. Nevertheless, in *Quest for Fire* we understand from situations not from learning words. What could the Ulams possibly say? They have a cage containing embers. It's smoking. The smoke disappears. Do they have to say, "Oh, hell, the fire went out"?

So much of our image of prehistoric mankind, developed by just such deductive reasoning, is mired in aesthetic conventions. Is this the customary portrait of simian savages? They are conventional. Bare skeletons tell no such tales. With four tribes to distinguish in the film—the Ulam, the Ivaka, the fearsome Wagabu, and the cannibalistic Kzamm—you can imagine the scale of deductive reasoning required. A heavy burden fell on costuming.

John Hay, designer on location: "Animal bones found with human skeletons of this period indicate that the men were hunters, they got the best furs. Women got scraps."

The Ulam men are wearing bear and wolf. The Ulam women are wearing wallaby, cat, coyote, fox, and wild dog. The Neanderthal Wagabu are wearing hair suits with nylon body-suit bases, the hirsute Kzamm are wearing bones for ornaments, the desert Ivaka are wearing paint and masks. Hay purposefully selected third-quality furs from Hudson's Bay Company—stiffer, cheaper, and sparse of hair—then added dye, wax, soap, and rolled oafs. Each Ulam costume weighed 40 to 60 pounds—more when wet (and they were often wet).

The suffering endured by the actors, many of them mimes and athletes, contributed to the realism (and this was not limited to the wax dentures and latex prosthetic brows, which took several hours to apply each morning). "What people will do when they're freezing," Annaud hypothesized, "they cannot do in a studio. I needed more than talented actors. I needed talented actors in good physical condition. I told them it would be horrendous. I told them they would spend a week waist-deep in the freezing water of Ontario's Georgian Bay. They said, 'I can do it,' 'I'm a hiker.' 'Give me a chance.' I told them, 'If it gets too painful, don't come to me. I thought it would be more painful.' So they never came to me."

They went instead, after two days in the marsh, to the producers, complaining, "We are dirty. We are filthy. We are doing hard work fourteen to seventeen hours a day up to our necks in ice water with nothing on but our furs." They were given wet suits.

After three days in the marsh, they went to their union, crying, "We have chills and abrasions. Our skins are ravaged by old-age stipple, prosthetic glues, body paint, and the alcohol used to remove it all." They got no response.

On the fourth day in the marsh, the script called for Rouka, the tribal idiot (Gary Schwartz), to commit suicide. He dashed across the bog, seeking a hole deep enough for drowning. A dozen Ulams, shivering, shouted, "Die, die!" Rouka dived for the bottom. Clutching reeds, he remained submerged. Annaud was displeased. "You look like you're swimming." After three takes, he ordered a hole drilled in the marsh floor. Two takes later, Rouka deceased, Schwartz very nearly so: was rushed to a hospital. Legs numb, the soles of his feet turning blue, he was diagnosed as hypothermic. As one, the Ulam demanded, and received, up to $250 a day in stunt bonuses.

All of this to avoid *fantaisie imbécile*.

"I don't want to say that I'm accurate," Annaud declared. "Though I tried my best, that was not my purpose. My purpose was to show human feelings. My responsibility was to make a picture that works."

Does it? Except for some misgivings about the potential level of violence portrayed (he preferred to reserve judgment until a screening of the final print), Morris was willing to allow that *Quest for Fire* represents an adequate, even admirable, parable of modern life.

"In terms of basic social behavior," he said, "we've probably changed far less than most people imagine. A number of genetic suggestions—not genetic instructions—that makes it too fixed—tend to keep us at the same level of protecting our young, loving our mates, defending our territories, and caring for our group.

"Jean-Jacques is the first truly sensitive director to have tackled the problem. If you put Raquel Welch in a fur bikini, you've got the potential to make a bit of show biz razzmatazz hokum—and very entertaining, too, in its own silly way. But if you do what Jean-Jacques has set out to do, you have the potential for making a really major film contribution." ∞

SCULPTURE

CONTINUED FROM PAGE 28

transmitted instructions volunteers choreographed the lights moving them a bit east or west at certain times "I was conductor as well as creator" Mooney recalls

In July 1979 Mooney, along with 12 volunteers arranged 2,400 automobile headlights 2 miles of aluminum rods 30 miles of copper wire and 2,500 yards of fishing line to form *Chicago Light Lines* This quarter-mile-long light sculpture originated he says from "the stream of car headlights moving along Lake Shore Drive"

Mooney's first impulse was "to create light not as illumination but as form in space and to give a sense of colors and fluidity" Auto headlights are one of his favorite materials "They are common to our urban and industrial heritage yet once extracted from that they become merely lamps, raw materials So with them we can create objects with new life"

In *Chicago Light Lines* which cost $200,000 to assemble Mooney used vertical rows of car headlights standing six feet high Each row contained seven lights each sealed behind a gel The amber blue and white headlights were computer-controlled to dim and brighten in slowly changing patterns along the quarter-mile length of the piece as spectators walked among the lights

The Los Angeles piece *Starsteps* sprang from that Chicago work Though it doesn't employ any actual automobile parts in the piece itself it does incorporate the car as an instrument of the work Most people see *Starsteps* from their cars on the freeway just as they see the notorious HOLLYWOOD sign nearby The stepped form of the 133-foot-long sculpture also reflects Mooney's interest in early Celtic and ancient architectural monuments Some of these shapes called mastabas were used in *Chicago Light Lines* as well

Pelletier thirty has also been fascinated by the artistic potential of light in vacuums and light in darkness That and his vision of the urban postindustrial environment as canvas were the two basic elements of *Night/Light* The density of light from buildings situated close together along Wall Street and the reflections they made on the East River gave the scene as viewed from the Brooklyn shore a dreamlike quality

It took an entire year from the initial idea of *Night/Light* to the actual moment when Pelletier and his crew began to turn on the lights behind 3,691 windows The work began with a letter-writing campaign and hours of meetings Finally Pelletier who has worked with lights for eight years secured permission from the managements of 12 buildings including Chase Manhattan, American Express Manufacturers Hanover Trust and Citibank He gained the sponsorship of Consolidated Edison, the International Centennial of Light and the Public Light Fund Several building managements donated electricity and manpower The cost for planning and executing the three-hour event came to $10,000

After he had a list of participants Pelletier made blueprint grids of each building's windows He pored over the blueprints with building managers and electrical engineers locating places where constant light (machine and computer rooms) or the complete absence of it (air shafts) was of critical importance Then he designed each building's specific light pattern on the grid and composed an individual visual score for each

It all started Pelletier says with the moon "The moon is a form The sunlight that we see reflected from it creates a two-dimensional pattern on its three-dimensional form Lights from within buildings at night destroy the buildings' form My inspiration was the light pattern of the moon"

Since the success of *Night/Light* Pelletier with choreographer June Anderson helped found Moondance, an outdoor evening light dance and music performance by 15 light-bearing dancers Moondance uses chemical light tubes and fluorescent light wands held by the dancers who wave them to the accompaniment of music to form patterns punctuated by flashing emergency strobes The performance won Pelletier the 1981 Lumen Award the electric-light industry's highest honor This December Pelletier takes his night vision a step further Provided he raises the $25,000 necessary to produce his next nightscape he will play the World Trade Center in Manhattan Using a variety of colored gels he will cover 7,000 windows of the quarter-mile-high building creating a geometric stained-glass effect on the face of the twin towers

Pelletier's ultimate dream is to arrange up to 20 World War II General Electric arc aerial surveillance searchlights on the summit of Mount Monadnock near his hometown Jaffrey New Hampshire Then by varying the heights and lengths of each light he will synchronize them all to create geometric shapes on the night sky

Mooney likewise, is moving toward more conceptual light sculptures Beginning at Lake Michigan's Navy Pier he hopes to trace an axial light line around the earth and he's aiming to complete this global light wrap for the 1992 Chicago World's Fair Using light from multiple sources Mooney will draw a continuous plane of light perpendicular to the earth's surface Stationary searchlights will span landmasses, mobile searchlights mounted on moving barges will illuminate water areas—seas and rivers Inaccessible places such as jungles will be lighted by lasers or searchlights from airplanes flying eight miles above the earth The viewers will have to conceive of the piece conceptually Mooney explains "If you are in Burma you can see only what's there not what's on the other side of the world This piece will be similar to the imaginary tracing used to show the path of a satellite ∞

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HOLOGRAPHY

CONTINUED FROM PAGE 38

against Turkey in 1877 and 1878. The pearl handles sparkle with brilliance. Actually the pistols are a hologram of their real counterparts, permanently ensconced in the Military Museum in Sofia, Bulgaria, a country that's been taking the lead in holography for artistic purposes along with the Soviet Union. Both countries are embarked on an ambitious program of putting all their national art treasures onto holograms.

Jeong's own favorite hologram is one he did with a grant from the Veterans Administration. Large in terms of most holograms—18" x 24"—it depicts an actual human skeleton whose hands are seen holding the hologram. Looking at it, your own feeling is one of introspection, as if it is an X ray of your body only so much more lifelike. The hologram is on permanent exhibition at the Chicago Museum of Holography, America's second such museum and its largest. This country's first is located in New York City and was founded by Tracy Jackson, one of Jeong's first workshop students.

Making and understanding holograms are two separate things, he reiterates. An artist comes in and wants to make one and understand it later. I want to be known as a teacher, not as an innovator. So my major interest is in simplifying the procedure. Actually some of the best holograms are the simplest, and upgrading the equipment doesn't necessarily mean you'll make better ones.

Laser light is used to make holograms because, unlike ordinary light, it is *coherent*, that is, all the light coming out of the laser is of the same wavelength and the lightwaves are lined up in step with each other, trough to trough, crest to crest. Ordinary light, as from a light bulb, is a mishmash of different wavelengths and is totally disorganized.

So, in making a hologram, you aim the laser beam into a special mirror, called a beam splitter, which turns it into two smaller but identical beams. One beam, called the reference beam, travels unimpeded to a photographic plate. The other, the object beam, is aimed at the object to be holograminized—say a Darth Vader doll—then on to the same photographic plate. The reference beam arrives at the plate with all its waves still in step. The object beams, however, will have been distributed by Darth Vader. When the beams collide with each other at the plate, an interference pattern is formed.

"If creating a hologram seems difficult," Jeong suggests, "can you imagine how mysterious photography must have sounded to people who never heard of a lens before? But children in school today know what a laser and holography are. It's like playing with levers and pulleys when we were growing up."

Not one to be satisfied with his present accomplishments in a rapidly developing field, Jeong talks about 3-D television and movies as well. Invited to the Soviet Union in 1976, he viewed the latest advance there, a holographic movie screen for a 70mm 3-D film. "It was forty-five seconds long, and the screen was made out of elliptical mirrors that directed the image to each individual seat. It showed an actress walking at you with a bouquet of flowers covering her face. But if you moved around in your seat or stood up, you could actually look around the flowers and see her face. As is not so with a conventional movie screen, you could not focus on the screen at a fixed distance, because when she would come nearer to you, you'd have to focus your eyes to the closer distance."

Television, he says, is another story. "Holography gives you too much information when it comes to television. There aren't many people interested in looking under John Chancellor's chin, for example. Besides, we'd need an entirely different format and have to get away from the idea of a box with a screen on one of its sides. You'd probably have a cylinder in the middle of a room instead. You have to change the medium completely or not at all."

The development of holography, of course, has not been uniformly smooth. Early entrepreneurs tended to promise too much, take too much money and do very little. Holography started to get a bad name and was threatened with the dismal fate of quadraphonic stereo. What kept holography alive, according to Jeong, was its practical applications. Important in measurement, holography can reveal, for instance, how much teeth move when they bite or the movement created when a crankcase vibrates.

Now the artistic uses are coming to the fore, and Jeong claims there are more people in his workshops interested in the artistic end than in the technical. "It took one hundred fifty years for photography to evolve to its present state, and holography is following the same sequence of events. It takes patience. First we got an image, now we have motion. The next step is full color."

The interest in holography is worldwide. In September Jeong traveled to Peking (his native city) to set up a holography workshop at the request of the Chinese so they can train their own people.

Of course, holography continues to be misunderstood, too. The second hologram Jeong ever did, of a Chinese ivory horse, was purchased by Hugh Hefner for his large collection. An unknowing cleaning woman thought it looked dusty, sprayed some ammonia on the naked holographic plate, and wiped the image out. It won't be long, though, Jeong insists, before that cleaning woman's children will be bringing holograms home to show her as an earlier generation brought home scrawlings with crayons.

(Jeong offers a free instruction sheet on do-it-yourself holograms. Write him at Lake Forest College, Lake Forest, IL 60045.) OO

The ten best games of the year

GAMES

By Scot Morris

In just four years, games have gone from Simon to Milton to Space Invaders to Rubik's Cube. In 1981, a year that marked a retreat from the all-electronic gameshelf, the top product was easily the ingenious puzzle designed by Hungarian architect Erno Rubik. This year his cube was rightfully enshrined in the Museum of Modern Art in New York City, while just outside, Taiwanese knockoffs of the cube were being hawked on Manhattan street corners. In our September 1980 article on the cube—the first mass-media treatment to take this toy seriously—we concluded by saying, "We await the first divorce suit in which Rubik is named as corespondent." In March of this year Helga Martens, twenty-one, of Bottrot, Germany, filed for divorce from her husband, Carl. The grounds: Since she gave him a Rubik's Cube for Christmas, he has been paying more attention to it than to her.

In keeping with the electronic slowdown of 1981, our list of Ten Best this year includes only four action electronic games of the Simon and Space Invaders genre. Other electronic items are either novelties or hand-held versions of classic board games. Three winners are completely nonelectric.

The ten games below are listed not by order of preference but by price, from most expensive to least. Prices are approximate and tend to be on the high side. Shop around for discounts.

1 COMPUTER OTHELLO (Gabriel, $120)

Once upon a time there was a game called reversi, played on an eight-by-eight board, it had 64 reversible pieces, black on one side and white on the other. When, for example, black outflanked white on any line—vertical, horizontal, or diagonal—the surrounded white pieces were flipped over to black. With one move the board could alter drastically.

Recently Gabriel Toys reintroduced reversi under the name Othello and brought it renewed attention. Gabriel's slogan, "A minute to learn—a lifetime to master," accurately sums up the game's simplicity and unexpected depth.

Now there's a portable-computer opponent that flips all the pieces for you on a liquid crystal display (LCD). Other companies have reversi computers (they can't call them Othello, for copyright reasons) and may even have slightly stronger programs. But since we have yet to beat this Gabriel machine at skill level 3 (there are eight levels), we have a way to go before worrying about which machine beats which.

Just to be sure, we checked with the world's top-ranked player, Jonathan Cerf, son of the late Bennett Cerf, the first non-Japanese champion since tournaments began in 1977. "I think the Gabriel game is best for most people," he said. "It's portable, with no bagful of pieces, and it's sufficiently challenging to give a good game to almost any player."

Has it ever beaten him? "Yes. I have lost to all three machines—the Gabriel, the Fidelity, and the Great Game Machine—but only occasionally. I still think humans are better players."

2 COMPUTER BACKGAMMON (Mattel, $90)

Here's excellent solitaire backgammon for times when you can't find someone to play with or when you want to learn strategy at your own pace. Set any of six skill levels, use the computer's electronic dice to provide random rolls, or enter your own dice rolls. A built-in doubling cube adds realistic challenge. When you think you're ahead, offer to double the stakes, either the machine accepts your offer, or you win immediately.

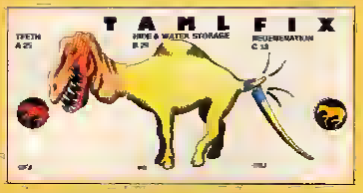
Stronger backgammon programs can be had, but not with the convenience of this hand-held, computer-controlled display. How good is the game? We decided to ask Lee Genud, thirty-seven year old mother of two from Long Island, New York, who last July in Monte Carlo beat all comers to become the first woman ever to win the World's Backgammon Championship. "I was very pleased with the Mattel program," she told us. "It was fast and made very few errors. The only thing I didn't like is that all the LCD pips look alike, and you have to check the arrows below each point to know which ones are yours. That takes some getting used to. Otherwise, I thought it played a very good game, and I love the automatic doubling cube."

3 PACMAN 2 (Entex, $60)

The latest craze at those family amusement centers is a silly "gobble or be

Above, from top: In a photo Ideal Toys said couldn't be taken, Sky Writer writes and moves on; Sky Writer hovers over two Rubik's Snakes; Air Traffic Control and PacMan, two of the year's best electronic action games, are unique in both their concept and their appeal.

gobbled game called PacMan What's the appeal of crescent-shaped heads racing around a maze chomping white dots fleeing deadly "ghosts" gobbling "power energizer" dots that temporarily make the ghosts quiver with vulnerability all for a few extra points? We don't know but the fact remains that



From top The vicious tamlfix, an unnatural selection from Quirks Board games come to the small screen in Computer Backgammon and Othello TV game Kaboom! shown with electric Dungeons and Dragons and nonelectronic Roaring 20s board games

PacMan is the most successful arcade game this year eclipsing even Asteroids and the venerable Space Invaders in the quest for quarters

PacMan is the first arcade game to attract large numbers of female players, too, perhaps because of its lack of violence and laser-zap weaponry

Now there are hand-held versions of PacMan, and we judge Entex's the best You can play against the machine, after deciding the number of ghosts you want to take on or against someone else who controls the attacking ghost This two-player capability is one feature even the arcade game doesn't offer another is a mute switch that silences the incessant beep-beep-beep Most important this game does away with that annoying sound of quarters hitting other quarters

4 AIR TRAFFIC CONTROL (Bandai $50)

This is a one-of-a-kind electronic game, there's nothing else like it on the market We found it to be the most difficult of this year's games—and also the most nerve-racking

The radar screen shows a six-mile radius around the airport You've got one plane heading east on the runway at 60 mph and accelerating 8 mph per second—still not fast enough for liftoff Another is approaching from the east three miles out at 280 mph and 1,000 feet, while decelerating 4 mph and dropping 20 feet in altitude every second What do you do now? You can adjust altitudes and air speeds but which plane should you control first? Hurry!

Plan on crashing a lot of planes before you get the hang of it, but then prepare for a very exciting game After 15 minutes you may be ready to go on strike

5 DUNGEONS AND DRAGONS COMPUTER LABYRINTH GAME (Mattel $45)

Gary Gygax has licensed this first electronic version of his popular fantasy game Dungeons and Dragons Imaginative role-playing is deemphasized here, but, Gygax says "the introduction of the computer as the Dragon Master adds an exciting new aspect to the game

Enter the winding labyrinth alone or race against another adventurous warrior Find the room containing the treasure and get it back to your own secret chamber without being attacked by the fire-breathing dragon or waylaid by the other warrior As you make your way down twisting tunnels, sound effects tell you whether you've bumped into a wall, stumbled onto the treasure, or awakened the dragon Place markers to indicate walls, or negotiate the passages from memory The computer creates a new labyrinth each game so that the passageways are never the same

6 SKY-WRITER (Ideal $30)

This is one of the strangest devices we've seen It's not really a game, not even a great toy We can't recommend it for repeat-play value Once you've tried it a few times you'll probably leave it on the shelf

What's it good for? It's good for showing to people who have never seen it before If your friends are like ours, the reactions will be unanimous "Incredible! I don't believe it! How does it work?

There are seven red lights on the front and a keyboard on the back on which you can enter your name or any message of up to 40 characters Wave the wand back and forth, and there in the sky is your name in lights With every sweep of the wand you see not only whole letters but whole words as in the photo at top left

If you come up with a use for this item let us know We're thinking of keeping one in the car, for sending nasty messages to tailgaters

7 KABOOM! (Activision $22.95)

It wasn't easy picking one TV-game cartridge for this list While Atari put out some excellent games this year—especially Missile Command and [illegible] and Mattel Intellivision introduced a delightful Auto Racing, we finally had to give the nod to Activision for such creative games as Skiing Tennis Freeway, and Kaboom!

Activision makes only software for the Atari game system Most Activision personnel are ex-Atari programmers who

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MARTIAN LASER STARS

By Jeff Hecht

There's a trillion-watt laser sitting in the sky, but don't panic. The USSR didn't put it there. Neither for that matter did the United States. Man-made lasers cannot yet produce more than a few million watts and only for a matter of seconds, and nobody on Earth has yet placed such a laser in orbit.

The laser is high in the Martian atmosphere, where nature produces conditions similar to those inside a man-made laser. It may have been operating continuously for millions of years, but it wasn't discovered until 20 years after Theodore H. Maiman built the first laser. Discovery of the Martian laser has earned recognition for NASA astronomer Michael J. Mumma, it's also earned him an invitation to testify in one of the most complex patent cases in history.

That's not the ordinary result of astronomical research, but then the Martian laser isn't exactly ordinary. For one thing, the light it produces isn't channeled into a beam like the light from a man-made laser. To extract energy in a beam from any laser, including the Martian atmosphere, you need a pair of mirrors, one on each side of the laser medium. To do that on Mars, Mumma suggests mounting huge mirrors on two satellites aligned so that part of the sunlit atmosphere always lies between them. He hasn't calculated how much power would be produced. The plan requires some formidable engineering, and Mumma admits it's "not likely in the foreseeable future."

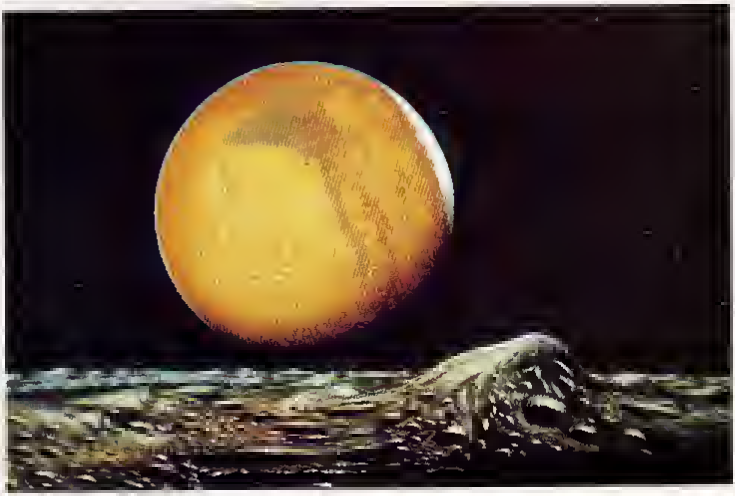
Natural masers (the microwave analogs of lasers) are abundant in interstellar clouds, but Mumma says that the Martian emission is the first *laser* for which there is definite evidence. He also suspects that ammonia molecules near the poles of Jupiter may produce laser light, but that emission is sporadic, and he has been unable to explain convincingly the underlying physics. Other planetary atmospheres may also produce stimulated emission, even Earth's atmosphere may do so. However, the process requires low pressures, which occur only high in the atmosphere, and Mumma says that we would never see laser light from our own atmosphere because it would be absorbed by molecules closer to the surface.

Charles Townes, who shared the Nobel Prize in physics in 1964 for the theoretical work behind the laser, has speculated that earlier discovery of cosmic masers might have helped ground-based physicists develop the laser. It might seem that discovery of a natural laser would have been even more effective. In reality, however, the scientists who found the Martian laser relied on the fact that it emits only a very narrow range of wavelengths. To detect it, in turn, requires a light source that emits a narrow range of wavelengths—a man-made carbon dioxide laser. In short, it takes a laser to find a laser.

The Martian laser turns out to be surprisingly efficient. About 0.003 percent of the sun's energy that reaches Mars is re-emitted as laser light, not bad for a fluke of nature. That's encouraging news for another NASA group trying to develop solar-powered lasers for spacecraft propulsion and power transmission. J. H. Lee, of Vanderbilt University, and W. R. Weaver, of NASA's Langley Research Center, now hope to better the 0.1 percent efficiency of their first solar-pumped laser.

Discovery of the Martian laser was also good news for people fighting a patent on light-powered lasers issued in 1977 to Gordon Gould. A natural phenomenon is generally considered unpatentable. Thus the Control Laser Corporation, of Orlando, Florida, accused of infringing Gould's patent, has asked Mumma to testify when its case goes to trial. Meanwhile, Gould's lawyers contend that the "natural phenomenon" criterion applies only to chemicals known and used in the United States before the patent application.

Like everything else in this tangled affair, the issue is complex. Gould's original patent application was filed in 1959, but it ran into a lengthy series of legal obstacles involving patents filed by Townes and others. It was not until 1973 that the Martian laser was detected on Earth—by Townes, of all people—and it was 1980 when Mumma's group identified the emission as being laser light. By then the patent had been granted. ∞



A laser on Mars, seen here from Deimos, might be a source of unimaginable electrical power

PHENOMENA

Lightning bolts pierce through thunderhead clouds above Nez Perce National Forest, Idaho. Perched atop a lookout tower, firefighter and photographer John E. Deeks stalks monster storms at eye level. They breed and explode during late August in the American West, where mountain ranges force warm, moist, and unstable air to rise and clash with the colder upper atmosphere. Deeks tracks lightning to spot possible forest fires. He has made a specialty of capturing thunderbolts on film. He leaves the shutter open on his camera to record several lightning strikes over a period of time. The exposure is controlled with the lens cap. Deeks takes the cap off when he suspects a strike and replaces it when the flash is over. He used a Nikon F-2 to photograph the electricity on Kodachrome 25 film.

GAMES

CONTINUED FROM PAGE 171

know the machines well

Kaboom! is a sleeper. The game itself is simplistic, with no variations. The graphic display is rather plain—a mad bomber at the top of the screen and three water buckets at the bottom that you move left and right. But when the bombs start dropping and we're madly sloshing buckets back and forth, miraculously catching more than we ever thought possible, we're hooked. When we have to catch them at 13 per second, we can even ignore the absurdity that gravity seems to be speeding up as the game goes on.

8. QUIRKS (Eon, $12)

Quirks is your chance to play God—or Darwin. Create thousands of weird-looking plants and animals, "quirks" of nature. Make them fit to survive in the changing climates of ocean, jungle, forest, plain, and desert, and adapt them well enough to withstand challenges from other Quirks.

An original and very clever idea from those original and clever people who created Cosmic Encounter. For information write to: Eon, 96 Stockton Street, Dorchester, MA 02124.

9. ROARING 20s (Yaquinto, $10)

Here's a board game that lets you be a mobster on one turn and a police commissioner on the next. As a crook, you pull a big job somewhere in the city, then high-tail your getaway car down narrow streets to your hideout. As PC, you control ten police cars and set up roadblocks to prevent the gangsters from reaching their hideouts. Of course, for a percentage of the take, you might be persuaded to have engine trouble. Dealing, bargaining, and treachery are allowed.

We found this to be easily learnable and enjoyed by people who aren't game nuts. Most games we checked had long, involved rule books and required some wargaming experience. Exceptions that are worth checking out include Amoeba Wars and Circus Maximus (Avalon Hill); Apocalypse (Games Workshop); Spies (SPI); and A House Divided (Game Designers Workshop).

10. THE MAGIC SNAKE (Hirsch Company, $10)

Can Professor Ernö Rubik do it again? Will his new creation, the Magic Snake, surpass the phenomenal success of 1981's Wonder Toy, Rubik's Cube?

Probably not. Don't expect this to be as challenging or as frustrating as the cube. It's more of a fiddling toy, something for the coffee table. It is made up of 24 half-cubes joined at their square surfaces into a long chain or snake. It comes packaged as a ball, but it can be twisted into a Scottie dog, a swan, a frog, a whole variety of shapes as yet unnamed. Don't expect the intellectual depth of the cube, but don't be surprised either if you find yourself playing with this one more often.

HONORABLE MENTIONS

In preparing this review we looked at many more games than could make the final list. Here are some of our favorite also-rans:

1. THE GREAT GAME MACHINE (Applied Concepts). A module with which a variety of game cartridges can be used. The module, with Morphy chess, is $295; additional cartridges cost about $100 apiece. Available now: reversi (Othello), blackjack, checkers, Kriegspiel. In the near future: backgammon, Scrabble, Monopoly. A unique feature is three chess programs for openings (Gruenfeld), middle games (Morphy), and end games (Capablanca). Individually these cartridges have memories of 12K, 8K, and 16K, respectively. Play them in sequence and you've got a 36K chess program, the most powerful on the market, able to solve all mate-in-eleven (!) problems. For information write to: Applied Concepts, 207 North Kirby Street, Garland, TX 75042.

2. LIGHT FIGHT (Milton Bradley). Even the manufacturer admits that this game is two years behind its time. The technology here is not exactly sophisticated. Still, this is a challenge to reaction time, eye-hand coordination, and visual memory. It's fun and deserves more success than it probably will get.

3. AMERICAN EAGLE SAILPLANE. Here's a rubber-band-launched radio-controlled glider, especially designed for first-timers. The styrofoam plane can withstand occasional crashes. For safekeeping we left ours in a tree in Hancock, New Hampshire. From Cox Hobbies (about $90).

4. STAR FLIGHT ELECTRONIC DISK. For nighttime frisbee flying. Uses three rechargeable nickel-cadmium batteries (included), which light three LEDs near the center; fiber optics carry light to nine spots on the rim. A little heavier than most disks, it is still a lot better than those luminescent fliers that lose their glow after a minute or two. (See Antimatter, page 131, for the full story on this gadget.) From Heatherland, Inc., 770 Emerson Street, Rochester, NY 19613.

5. ODDS-ON BASEBALL AND FOOTBALL (Low Voltage Games). If you like watching baseball or football on TV, here's an ingenious idea to increase your enjoyment. It's simply a piece of felt (imprinted with FOOTBALL on one side, BASEBALL on the other), a bag of poker chips, and a sheet of rules. When a player comes to bat, place your bet whether he will strike out (pays 4–1), fly out (3–2), walk (6–1), or hit a home run (9–1). If your prediction comes true, collect from the bank; otherwise lose your chips and place your next bet. There are similar betting opportunities for football. For information write to: Low Voltage Games, PO Box 136, Postal Station "T", Toronto, Ontario, M6B 3Z9, Canada.

FORUM

CONTINUED FROM PAGE 14

Asimov or Vomisa?

If Isaac Asimov's "collapsible universe" theory described in "The Very Large Lion and the Very Small Mouse" [August 1981] could ever be borne out, would not life, as we know it, also run backward?

To conceive of the universe expanding and contracting any number of times is easy enough, but to conceptualize the effect of this on our lives is not so easy. Picture this: A mother would have to "unborn" her child. What does Mr. Asimov think?

Elizabeth Behler
Chagrin Falls, Ohio

Isaac Asimov replies: *I don't think we ought to take the "running backward" of the universe quite as literally as Ms. Behler suggests. If, in a contracting universe, entropy spontaneously decreases, then life might still live "forward" as far as consciousness is concerned, but with different kinds of experiences as far as the outer world is concerned. Since we have never lived in a contracting universe, we can't be sure of the consequences.*

Balanced Mind

Now psychiatrists are under fire for misdiagnosis [Mind, September 1981].

No profession or science has reached perfection. Space launches abort, lawyers are disbarred, bones are misset, and some pills—with enormous research behind them—are not always free of flaws.

Psychiatrists are the only persons trained to deal with the mind and, as doctors, with the body too. It's disappointing that *Omni* didn't also mention some of the spectacular successes of psychiatry that occur every day.

Robert G. Bruce
Acting Director
Mental Health, Inc.
Los Angeles, Calif.

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LAST WORD

By Spider Robinson

"God created all the souls at once and placed them latent in the belly of Eve, set like so many trillions of timer ovens."

We commend before you today as a spokesperson for the Pious Plurality, a group dedicated to bring an end to the [illegible] slaughter of countless trillions.

And this group calling itself the Moral Majority (a name to which, admittedly, it has precisely as much right as we to ours) has been campaigning for the banning of abortions. The Creator, the Moral Majority assures us, ordained that the human soul which it refuses to define comes into existence at the moment of conception therefore, abortion in any trimester is murder. We will not question the evidence offered in support of this proposition—inasmuch as none is offered—but we believe it is not quite *God-fearing* enough.

Our own personal divine revelation was imparted to us while we were in meditation trying idly to understand God's purpose in toxic shock syndrome. What could He be trying to tell us? The answer suddenly smote us like a thunderbolt.

What's so special about fertilization? Why should that be the trigger for the creation of a soul? Is a flower not a flower until the bee arrives? Is a car not a car before the clutch is engaged? Can we really picture God waiting outside millions of bedroom windows with a satchelful of souls, deciding which conjugations receive a prize? It seems to us self evident that the soul inheres in the ovum. This yields a much neater theological structure in which God actually created all the souls at once and placed them latent in the belly of Eve, set like so many trillions of timer ovens to activate themselves down through the centuries.

The conclusion is obvious. We must stamp out menstruation.

The horror! The tragic waste of human lives entrusted to our care! How many billions, how many trillions of potential worshipers of the Almighty have come down the eons from the dawn of creation only to be lost in murderous devices with euphemistic names involving absorbency, convenience, comfort, and freedom. *No wonder He gives us cramps.*

The biological evidence is unmistakable. Alone of the animals, human females were ordained by God to be perpetually in season. And to human males He gave an absurd overabundance of sperm, billions of bullets for each salvo, together with a powerful urge to fire such salvos. Manifestly God's intent was to minimize the chance that a single egg would be wasted. For venal, selfish reasons, most of them deriving from simple pig laziness, men and women have conspired for centuries—with growing success—to frustrate His evident will. Contraceptive side effects and toxic shock syndrome are clear signs.

It is time to end the murder. We must harass, blackmail, and bribe our political leaders until we have forced the enactment of laws extending full civil rights to the unconceived.

The Census Bureau assesses a female as "of childbearing age" at fourteen. With some reservations, stemming from personal experience in the sixth grade, we will accept the Census Bureau's decision. The mandatory defloration of all females at age fourteen must be prescribed by law.

(Right there, we admit, we run up against a small contradiction. As of 1978 the United States had 87 million females over fourteen and only 80 million males over that age. We are not yet certain whether it would be better to permit polygamy—the Mormons providing a good precedent—or better to admit that no theocracy is perfect and simply let sin continue to take care of it.)

All females must be required by law either to marry or to become state-supported mothers within 28 days of menarche. The failure to accept an offer of sperm from any human male of less than second-degree consanguinity shall be a class A misdemeanor, unless it be proved to have occurred during the female's most fertile period, when it shall be a felony. If, despite all precautions, menstrual flow should accidentally occur, the ovum must be salvaged to be inseminated artificially. Proven failure to do so shall be deemed murder in the second degree.

Now that we come to think about it, we of the Pious Plurality have more right to our name than the Moral Majority has to its, for our constituency outnumbers all the people who now live, or have ever lived, put together. Just how many?

Let's see. Assume 87×10^6 breeding females. Keep it simple by ignoring exceptions. Each year some will die, but some will attain puberty, some will be ovulatorily incompetent, but some will experience multiple births, and so forth. We cannot realistically expect a female to reproduce any faster, on the average, than once every 11 months in the best of circumstances. By 1995, after 14 years, those valiant servants of God will have produced 1.32873×10^9 children. Of this 1.3 billion, roughly 52 percent will be female, 691 million new breeders. Of these, a little more than 45 million will be fourteen years old, and their output will begin at once, raising the breeding population to 132 million.

By the year 2000, the U.S. population should reach more than 2.65 billion, of whom about 1.3 billion will be female and more than 300 million will be pregnant. Thus, at the dawn of the third millennium, the time prophesied for the Second Coming of Jesus Christ, the population density of this country will have jumped 1,200 percent in 19 years (from about 62 people per square mile to about 750) to a level approximating that of present-day Japan and roughly half that of Monaco.

Fortunately for us all, He is said to be able to walk on water.

And meanwhile, of course, crash construction and expansion programs will immeasurably stimulate the economies of both Heaven and Hell. ∞