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**Photo Credits:** Cover art for this month's Omni is an untitled painting by the French artist Pierre Lacombe. The artist, who wanted to paint since age fifteen, began only ten years ago at age thirty-eight. He now resides outside Paris.
Space enthusiasts can demonstrate support for NASA this election year by donating to the Viking Fund and continuing the exploration of Mars.

While NASA as a federal agency cannot and does not endorse the fund, the agency has an active interest in the work. However, in conversations with the организators they have proposed the best solution is to channel the monies collected toward Viking operations.

Contributors will be placed into a dedicated fund and be distributed to NASA on a fiscal-year-to-fiscal-year basis. As Congress allocates money to the space agency (although the Viking Fund will not depend on congressional budget review and the attendant budget hacking so familiar to all of us), more over NASA the

...
This month one of the nation's most bizarre rituals is examined by screenwriter Richard Chapman in "Brain Wars" (page 44) takes an up-close look at the extracurricular hijinks of Caltech students as they celebrate Ditch Day. Chapman says he got the idea for the piece while researching a screenplay that dealt with how young geniuses survive four years at the California Institute of Technology. The film will be a comedy exploring life in the intellectual fast lane, illustrating that the "individuals who society categorically labels eggheads are not hard-boiled automata but rather a delightful blend of creativity, warmth and wit with hearts as large as their brains." Chapman has produced feature films and is affiliated with Columbia Pictures.

"I fear that the grave potentials of space warfare have yet to be impressed upon the American public," says famed novelist James A. Michener in "Looking Toward Space" (page 56). Michener explores the lack of a comprehensive U.S. space effort. Born in New York City in 1907, Michener launched his career by editing textbooks for a New York firm—a position that was interrupted by World War II. His wartime experiences in the Solomon Islands provided Michener with the idea for his first book, "Tales of the South Pacific." Other Michener bestsellers are "The Bridges at Toko-Ri," "Caravans," "Hawaii" and "The Source." The American Institute of Aeronautics and Astronautics is sponsoring a spectacular display of technology and hardware in Baltimore this month. The exhibition, designated Global Technology 2000, will present the latest in space equipment: wind turbines, blimps and other devices manufactured by some 250 aerospace companies. Just in case Baltimore is not on your itinerary, you'll be able to sample this impressive technology of the future in a glittering photo pictorial entitled "GT 2000" (page 76). The gallery, produced by photojournalist Anthony Wolff, is a montage of photographs shot mostly by Wolff and photographer Douglas Kirkland. Kirkland was a staff photographer at Life and Look magazines for many years and has put together an impressive portfolio containing candid photos of many favorite celebrities.

This month's Earth column, "Ecoado" (page 14), is provided by conservation specialist Dr. Norman Myers. Dr. Myers recently published "The Sinking Ark" (Pergamon Press). He has also completed a survey for the National Academy of Sciences on tropical forests—the report on which has just been released by the National Research Council, Washington, D.C. In Omni, Myers discusses the disappearance of lesser-known species such as rare tropical plants and insects. Eventually these losses will affect the biosphere of the entire planet.

Although we cannot yet control the engines and masses required to make a time machine, we know the principles behind time travel. That's what physicist and science writer Dr. Robert L. Forward says—and in "How to Build a Time Machine" the good doctor provides all the details. It starts on page 92. As a visual complement to Dr. Forward's article, we present "Time Travelers," a stunning collection of original art (page 96). The first painting, "Ring Driver," is the collaborative effort of two artists: Richard L. Cohen and Jon Townley. The artists work from their studio in Columbus, Ohio, and have done covers for Heavy Metal magazine and Dell, Ace, and Scribner's.

Omni's May fiction features writers Tom Disch ("Josie and the Elevator," page 50) and Francois Camoin ("Some of My Best Friends Are Americans," page 102). The first tells about elevators and what might happen if you are not nice to one. Camoin's story is a grim one in which Americans have become vessels without rights in their own country.

Finally, economist Hazel Henderson discusses alternative futures in this month's Interview (page 86) and aerospace engineer Stan Kent makes a plea for the Viking Fund in "First Word" (page 6).

We are pleased to announce that our profile of astronomer Stephen Hawking ("The Wizard of Space and Time" by Dennis Overbye, February 1979) has received the 1980 American Institute of Physics Award for Journalism. This prestigious acknowledgment is given each year to the one article that best explains the science of physics to the layman.
Ground-In Dirt
In his account of Leon Lederman's appearance on the Phil Donahue show (People, February 1980), Dick Teresi writes: "Oddly enough, the high-energy physicist proved to be a big hit with the ladies."

What's so odd about women being interested in physics?

Undoubtedly there was a time when an interest in the physical world was considered unladylike. But nowadays an understanding of particle physics is a must for getting out really ground-in dirt.

Janice M. Filipp
Los Angeles, Calif.

Dick Teresi replies: If you'll reread my column you'll see that I did not find it odd that women were interested in physics, but in a physicist. Talk shows such as Donahue's normally feature doctors, politicians, movie stars, movie stars' wives, politicians' wives, and sexual deviants of all possible description. But physicists? How many times was Isaac Newton invited on early morning television? And what about James Clerk Maxwell? Here the man gives the world four equations explaining the electromagnetic effect, thus making the very existence of television possible, and he doesn't even rate an appearance on The Gong Show.

Seriously, I did not intend to demean women by implying they would not be interested in physics. I was simply making a comment on the rarity of a physicist showing up on the tube and Donahue is to be commended for inviting Lederman on his show. Still, Donahue revealed some insecurity toward his guest in the opening statements of the show, to wit: "This is going to be interesting. I mean, maybe it'll be interesting. As it turned out, there were no "maybes" about it.

As for your ground-in dirt, I'd recommend adding half a cup of antiquarks during the rinse cycle. This will annihilate any stain within 10^{20} years.

Paying Through the Nose
I've just finished reading the article by Scot Morris entitled "Prizes" (December 1979) and feel compelled to make a few comments.

First of all, the so-called $10,000 'prize' offered by Mr. Philip Klass for proof of extraterrestrial UFO visits in the twentieth century is a bet, not a prize. Those of us who have taken that bet must pay Mr. Klass $100 per year up to ten years, against his promise to pay us $10,000 should we demonstrate such UFO proof as long as we both are alive.

Considering that Mr. Klass is about 25 years older than I, I'm essentially betting that the proof will come in the next ten years or so. I've already paid five times. Mr. Klass is asking little. He has several people paying in and he has put up no money. If the proof is forthcoming our own currency will have the same value as Polynesian shells and coconut husks played for visiting Europeans and Americans. His estate is not liable, so he can't really lose.

Even taking all these factors into account, I took him up on the bet. I believe I am right and I'm willing to back up my belief. Anyway it's a great fun and a fine conversational topic.

One does wonder, however, why Mr. Klass excluded all but the twentieth century from the bet. Is he not telling something?

Arlan K. Andrews
Indianapolis, Ind.

Heavenly Peace
In regard to the item on astro burial (Continuum, February 1980) I had begun drawing plans to develop the Interstellar Bural Corporation. Why for goodness sake spend $3,000 to get your cremated remains lofted into Earth orbit? If NASA were to recoup just $1.8 million for room in the main cargo hold of the space shuttle, why not take a lease out on mortality?

I am drawing up a charter for members to be cryogenically suspended at death. These frozen bodies will be put in specially made capsules placed in racks to accommodate the cargo space interior with propulsion systems to launch the capsules into interstellar trajectories. Capsules could also be launched in highly elliptical and eccentric orbits so that they

continued on page 15
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.

The Good Life
I really enjoyed the article, The Good Life Underground, January 1980, by Mike Edelhart, however it did not tell where to get more information on building underground homes. Fuel costs are going sky high. So when I build my home I would like to build an energy efficient habitat underground. I would be interested in corresponding with some people who already have an underground house to see what they like and don't like.

Scott R. Garcia
Hollister, Calif.

I would like to obtain more information on how to build an underground home together with blueprints and diagrams. Could you please send further details about the companies and individuals that design underground homes?

Daniel John Macke
Cincinnati, Ohio

Mike Edelhart replies, I'm gratified and overwhelmed by the response to the underground housing article. You can write these people for assistance. The single best source is Earth Sheltered Housing Design, The Underground Space Center 11 Mines and Metallurgy Bldg., 221 Church Street, S.E., Minneapolis, MN 55455. Send $10 (prepaid). They have a complete list of underground houses, designs, architects and suppliers. Other good sources: Malcolm Wells, P.O. Box 1149, Brewster, MA 02631; John Barnard, 1054 Main Street, Osterville, MA 02655.

The Voice of Reason
Ben Bova's editorial in Omni's February issue rightly calls attention to some of the truly remarkable strides science has made, eradicating several killer diseases of the past. It also singles out the ungrateful "shock troops of ignorance" who tend to place the blame for society's ills on the head of science. However, it is difficult to see how this small myopic group could ever "destroy science" simply by demonstrating and shouting. "No more nukes, no research on intelligence, no DNA experiments.

The ability of science to control the monsters it creates is the legitimate concern of citizens and deserves an answer not pious ridicule. The voice of reason does not cry. Stop scientific research, or proceed at all cost. Reason says, let science proceed — with caution and wisdom to match.

Rulon Hacking
Taco N M

Shame on Ben Bova for using a national forum like Omni to call people names. His editorial in February seems to be making the argument that since medical science has wrought miracles that have revolutionized everyone's life, anyone questioning technological activities — advocating controlled testing and development — is a member of the armies of ignorance. Regulation of medical science is not meant to hamper research but to try to prevent tragedies such as those caused by Thalidomide and DES. The aim of the regulators is the same as that of the researchers — to secure benefits to humanity. The same concerns that apply to medical science should guide progress in other technological fields. The potential for damage is so great in areas like nuclear power, toxic chemical production, and genetic engineering that regulation should be proportionally cautious.

Scientists have been working on the problems of containerization, shipment and disposal of radioactive waste for 40 years without a solution. It seems reasonable that the problem should be solved before 200 nuclear power plants are built, not to build in anticipation of a solution.

I hope that Mr. Bova will agree that reasonable and thoughtful people can work together by these methods to reach new horizons.

Vicki Black
Denver Colo.

Ben Bova replies. It is fascinating to see how people howl when they are on the receiving end of an emotional argument. If my line about "shock troops of the armies of ignorance" has caused readers to open their eyes, good.

Civilizations have been destroyed by barbarians in the past. We must be aware our civilization could be destroyed by those armies of ignorance that use slogans in place of rational thought.

I have no quarrel with those who have examined the evidence on nuclear power and have drawn conclusions that disagree with my own. It's the slogan shouting mobs that bother me. They are too easily manipulated and when they run out of one cause to protest against, they find another — even if someone has to create it for them.

As far as nuclear power is concerned, it is far safer and less carcinogenic than coal. We all look forward to the day when solar energy will solve our problems. But until then it is nuclear power that provides the electricity for my home without it we would be freezing in the dark.

CONTINUED ON PAGE 754.
We are destroying—killing off irrevocably—at least one plant or animal species every day, each day of the year. If present trends continue, we may lose one species per hour by the end of the decade. In all, we risk the possibility of wiping out 1 million of the earth's estimated 5 million to 10 million species by the year 2000.

What is the basis for this dismal prognosis? Is the outlook really this bleak?

In the past the animals that we have recognized as endangered species have been the more obvious or endearing creatures: whales, tigers, whooping cranes, or bald eagles. But other types of species are far more numerous. For example, the number of species in the (mammals, birds, fish, reptiles, and amphibians) we could document these myriads of creatures along with the thousands of unknown plant species that exist—we might find that hundreds of thousands of species are actually being pushed toward extinction. The cause of destruction of habitats by man's insatiable need for raw materials, such as lumber and minerals.

Moreover, the problem is even more critical in areas we know little about. Most tropical forests cover less than 10 percent of the earth's surface yet contain 40 to 50 percent of the earth's species. These forests are being destroyed on an alarming scale by unrestricted logging. Many of these forests are unlikely to survive in their present form past the end of the century if we don't change our ways.

Unlike temperate forest species, which are less abundant, tropical forest species tend to have specialized ecological requirements or are limited to habitats totaling just a few hundred square kilometers. This leaves them extremely susceptible to extinction once their environment has been destroyed. The first wave of mass extinctions is already occurring in the rainforests of Southeast Asia, a biological treasure house to the scientist and a commercial gold mine to business interests. (Similarly, ecosystem destruction imperils other species-rich habitats, such as coral reefs and wetlands.)

Man's domination over creation is a wholly new situation. It implies a total responsibility, a consideration of how evolution works to create the diversity so beneficial to us.

One of the apparent rules of evolution suggests that an outburst of extinctions may lead to an explosion of speciation. The process whereby new species come into existence. Large numbers of niches, or ecological living spaces, will open enabling new species to occupy them. And with these new niches will come the stimulation for speciation.

Unfortunately, the organisms that occupy these new niches are sometimes the ones that occupy our immediate environment rats, sparrows, starlings, cockroaches, and weedy plants. To name a few. Thus, we may plague the world with the worst kinds of creatures—a prospect all the more troublesome if we've also eliminated the predators and parasites that keep these opportunistic species in check.

One compelling reason for saving wild species is that they're in intrinsic economic value. Of the 1 percent of all species that have been investigated for their economic value, millions of species already make sizable contributions to food, medicine, and industry. Extinction of the huge, uncategorized, and unknown quantities of species precludes them making a contribution that may benefit mankind.

For example, we can't know which of the earth's 250,000 plant species—one third of which are edible—may make a substantial contribution to future diets. Humans have used only 3,000 of these for food throughout history, and fewer than 20 kinds of plants—mostly rice, corn, wheat, and soybeans—presently account for 90 percent of the food we consume daily. A survey conducted by the National...
GALACTIC GERMS

LIFE
By Dr. Bernard Dixon

The notion that Earth was originally "seeded" with living organisms from space has now taken on a modern guise. Sir Fred Hoyle, the eminent cosmologist, has revised the theory to explain why unwelcome viruses arrive to plague us even today.

Diseases from Space, which Hoyle has written with Professor Chandra Wickramasinghe, is being published in the United States in June. The book is destined to cause a sensation because of renewed concern over the origin of novel strains of influenza. Does Hoyle provide a convincing answer?

In his earlier work Hoyle theorized that some 4 billion years ago comets formed prebiotic substances to our planet. Then micrometeors brought life itself. But do clouds of viruses continue raining down upon us, accounting for intermittent ravages of such infections as influenza, cholera, or even the common cold? At this point the story takes off into what most microbiologists regard as science fiction.

The main thrust of Hoyle's argument is that outbreaks occur just as if the microbes responsible were arriving sporadically and vertically instead of being transmitted horizontally across the earth's skin from person to person. At Eton College and schools in Cardiff, Wales, for example, some students living quarters have been heavily affected by influenza while others have not been affected. The infection is not distributed randomly, as one would expect if people were passing the virus one to another.

Critics of this hypothesis focus on three points. First, microbes could not tolerate radiation in outer space. Second, we understand perfectly well how new influenza viruses arise, by genetic recombination among old ones. Third, it is inconceivable that microorganisms generated in space should be so exquisitely engineered as to invade the human respiratory tract.

The first objection can be answered, not just plausibly but devastatingly. Bacteria and viruses have highly efficient mechanisms to repair damage caused by ultraviolet light at wavelengths they do not experience on Earth. But to argue, as the skeptics do, that these evolved to sustain microbes before this planet acquired an atmosphere evades an important point. Why should such machinery have endured for billions of years after it was no longer required? Hoyle's reply: The machinery exists so microbes can journey safely to Earth.

The alarming feature of the second skeptical argument is that, although textbooks assure us of a satisfying picture of how flu viruses originate and develop, the past few months have seen renewed controversy over the whole subject. The Lancet (1980:1:186), for example, pointed out that we still need proper evidence to show how flu viruses survive so efficiently, work by Dr. F. E. Hope-Smith, which suggests that flu virus does not persist in the community by being transmitted between people, was cited in the Lancet article. Dr. Hope-Smith's answer is that the virus lies latent, but this is no more than speculation. Scientists at the Mount Sinai School of Medicine, in New York City, are still puzzling over why the so-called H1N1 virus reemerged in 1977 after "disappearing" in the late 1950s (Proc. Nat. Acad. Sci. 76:6547). Amid such uncertainty can anyone afford to dismiss Hoyle's hypotheses?

We must take the third criticism more seriously. Why, in influenza virus so beautifully designed to invade the respiratory tract of Homo sapiens if it is a product of interstellar space? The staggering complexity of flu virus—with components perfectly adapted to penetrate particular tissues and then mobilize the cells' machinery to fabricate new particles—surely supports the idea that it originated on Earth, not in space far from the dictates of organic evolution.

Nonetheless, the practical implications of this possibility are disturbing. If influenza and other plagues really do emerge in outer space, our skill in dealing with them is undoubtedly built on shakier foundations than we had supposed. Could we really make us less inclined to accept such an idea? ☺

If comets fanned the first germs of life to Earth, could they be present-day carriers of disease?
ASTEROID AGRICULTURE

By Brian O'Leary

The world hunger problem is getting worse rather than better,' said the recent report of the Presidential Commission on World Hunger. 'A major crisis of global food supply—of even more serious dimensions than the present energy crisis—appears likely within the next 20 years. Unless steps are taken now, moral obligation alone would justify giving highest priority to the task of overcoming hunger.'

This assessment is neither new nor uncorroborated. For years agricultural scientists have been warning us of some ominous trends. The food supply is dwindling as the world’s population grows. Water resources are becoming scarcer in potential crop areas. The use of fertilizers is creating environmental damage, including possible ozone depletion in the atmosphere. Drought and severe climatic conditions continue to cause fluctuations in food production.

The increasing genetic uniformity of crops also creates problems. By developing fewer strains of food plants, we make them more vulnerable to disease. This could cause widespread shortages and famine.

Terrestrial solutions of the world food problem are elusive. The development of modern agriculture—the so-called Green Revolution (efforts over the last 20 years to grow more food per acre in poor countries)—bought some time but appears to have reached its limits. Nobody seems interested in meeting the high capital costs of intensified controlled-environment agriculture in greenhouses. And agronomists believe that U.S. food production, once regarded as mankind’s ultimate ace in the hole, has now plateaued. 'The rate of growth of agriculture production has slowed down,' says Anson Bertrand of the U.S. Department of Agriculture. 'We see this levelling off not only in the United States but globally as well.'

What are our chances of growing food in space? The Soviet Union is well on its way to proving that space agriculture is feasible. The Russians have isolated people for up to six months in closed environments, where they have successfully grown wheat and made bread. They’ve done experiments in space, too, preparing for long-term, agriculturally self-supporting, orbiting settlements.

A number of scientists in the United States have investigated the feasibility of carrying on intensive agriculture in space to supply food for the inhabitants of space settlements. Grains, bread, poultry, and pigs could be raised in closed agricultural areas adjacent to orbiting colonies, where light, temperature, and moisture can be varied according to the requirements of a particular crop.

Space inhabitants could develop the full complement of crops and livestock instead of resorting to the dullness of dehydrated foods and Tang about which the astronauts have complained. Droughts, pests, and pervasive disease—even the passage of seasons—could be eliminated. Fertilizer could be produced in space by using solar heat to combine nitrogen and oxygen from the asteroids. The supply of materials available for agricultural facilities would grow exponentially as colonies were completed, so it would be possible to construct huge areas for growing food in space. Although the workability of closed agricultural ecological systems has not yet been conclusively verified, it appears likely that sooner or later, food will be grown successfully in space.

Recent engineering studies suggest that our most cost-effective means of supplying electricity could be to build satellite solar-power stations and send their output to Earth via microwave links. The stations would be built in space of materials retrieved from the shallow gravity wells of the moon and asteroids. One study showed that a lunar mining and launching facility and a space chemical-processing plant could be built for between $5 million and $10 million. The first satellite power station would be completed only two years later.

Even if satellite power does not turn out to be the primary incentive for developing the resources of space, the study concluded that lunar materials could be

Self-supporting asteroid farms could begin to ease Earth's food shortage in 30 years.

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CONTINUED ON PAGE 127
Max Mathews invented computer music in a display window at IBM's headquarters in New York City. That was in 1957. Nearly a quarter century later Dr. Mathews, now director of acoustic and behavioral research at Bell Laboratories, continues to maintain his involvement with computers and music—an unbroken duet. Mathews in fact is one of the foremost advocates of the collaboration of scientists and artists that goes headlong through modern history.

Mathews has consistently recognized the point at which artistic advances produce scientific response. He calls for scientists to recognize their responsibility to art—to make innovations in technology available to the artist.

At his home in Murray Hill, New Jersey, over a beer and supper this pioneer of sound and speech processing gave Omni a short course in computer music.

By researching speech analysis—central to automatic speech recognition and low channel-capacity speech transmission—Mathews and his colleagues developed the first methods for simulating telephones on computers. That meant when we wanted to try a new phone, we didn't actually have to build it," he said. "We could simply write a computer program at one end. The speech passed through the program and you heard it at the other and as if it had gone through the real telephone. This work was fundamental to the development of computer music.

The basic principle for making computer-generated speech or music, Mathews says, is the digitization of sound. "Sound is a pressure wave in the air that changes rapidly from instant to instant," he explains. "We measure these changes very frequently. I'd say thirty thousand times each second. On a computer each of these measurements becomes a number, so that a second's worth of sound is thirty thousand numbers." By this technique, called digital-to-analog conversion, any sound heard by the human ear can be reproduced from numbers.

This is theoretically the most attractive advantage of the computer as musical instrument. It can make the sound of any instrument that exists today or of any instrument that anyone can possibly conceive of making in the future.

For Mathews, this relationship between music and the computer started one night in 1957 when he attended a piano recital with his friend John Pierce. The Schönberg was quite good. Mathews recalls, but the Schubert was awful. During the intermission Pierce and I looked at each other and we agreed, 'The computer ought to be able to do better than this!' So I tried writing a program to synthesize music. Mathews rented time on the IBM 70/7 a machine so new at the time that the only available model he could rent was on display. Hence, the computer scientist in the show window.

"That was music! It was a simple program. It had only one voice: one timbre, one loudness, one attack and decay—and produced terrible sounds. Mathews continued to produce the Music program, writing Music II, III, IV and V which is in general use today. Other people started asking for copies of Music V and started working in various places. John Chowning at Stanford University developed Music 10 for another kind of computer. Barry Vercoe wrote Music 360 for the IBM 360. Computer music was here to stay.

In creating computer music software, the first problem Mathews encountered was programming: how to calculate the 30,000 digits per second of sound. You can't ask the composer to write down each individual number that's too much work. You have to get an ingenious program that lets the composer decide what he wants to control—such as pitch, loudness, duration, and starting time of the notes. That should be all he has to write on the score. That's what Music I really does. It takes the relatively brief descriptions by the composers and generates the very detailed sound wave.

There was another major obstacle to generating computer music: the question Mathews found the most challenging. He calls it the psychoacoustic problem. In a physical sense, he says, we do not understand why sound waves produce a given impression or timbre. With traditional instruments one need not understand the physical sound wave. The musician has only to understand the instrument that is producing it; not so with the computer. Everything is new and one has to specify everything about the sound wave.

You have to understand sound and its effect on the ear in a much more fundamental sense than ever before. Mathews comments. Musicians of the future might study not only music theory but also computer programming, acoustics, and the physiology of hearing.

Mathews began work on the psychoacoustic problem with French composer and physicist Jean-Claude Risset. "Risset studied the trumpet to understand what made a brass sound brasslike. Basically people in the past were guessing what produced brass sounds, but Risset had the computer test out his hunches. He could get some trumpet tones that were indistinguishable from actual ones. We called this technique..."
analyses by synthesis, and because of it we understand far more about normal instruments now than we did back in the Fifties.  

The state of the art in computer music is real-time sound synthesis: "In the last ten years people have built special-purpose digital circuits that are fast enough to calculate one second's worth of sound in one second," the composer says. "They couldn't before. Now you can make a computer that can be played like a normal instrument: that is, a performer can perform on it."

Analogue synthesizers, such as the well-known Moog, are quite different from computer instruments. Matthews describes the synthesizer as a 'machine that generates and modifies an electrical signal and eventually converts it to sound.'

"It contains oscillators to generate signals at various pitches, filters to modify the spectrum and timbre, and generators to start and stop the oscillators at the beginning and end of notes."

"The computer however, is actually a memory unit holding a lot of numbers—a calculating machine that can add, subtract, multiply, and divide those numbers. Of course you must have a program to make this unit calculate numbers that sound like music when you convert them to sound. Although they do it in different ways—the synthesizer and the computer can do the same job—but the computer is able to do more.

Yet there are "dumb" ways to play intelligent machines. Matthews calls one of them the organ mode. When someone plays a computer like a traditional piano or organ, one note at a time, he wastes the instrument's potential. Another he refers to as the tape-recorded mode, where one puts the entire score of the composition into the computer, presses the button and lets the machine perform the entire piece. This is unsatisfactory both to the performer and to the audience. The performer doesn't think he's expressing himself; and the audience don't think they're hearing a performance.

Other modes characteristic of music-making computers are more interesting. Matthews refers, for instance, to John Appleton and his Synclavier. One of Appleton's techniques I call the music-minus-one mode. He programs several voices into the Synclavier's memory that play themselves automatically. Then he performs one or more voices on the instrument's keyboard in synchrony with the voices that came from the memory. If he's feeling especially vigorous one night, he can play all the voices and if he's feeling especially lazy, he can downplay them, play either one or two of the voices or play none of them.

There is another manifestation that Mattews calls the conductor mode. I arranged an electric baton. If you will, to control the computer. Many of the functions of a conductor are accomplished with this device. It sets temps and balances the voices. It goes through a rehearsal phase, sets the right information in the memory—information a conductor couldn't put in during the performance. The musicians must be trained in advance, and the computer is especially nice in that respect. Once trained, it never forgets."

Mathews also invented a musician-machine interaction that he calls the "sequential-percussion device." You hit the surface of this two-foot rectangle like a normal drum, but the impact doesn't produce a sound. Instead, it produces three electrical signals. The computer generates the sound from the three signals.

One signal is proportional to how hard one hits the drum. "Usually I use the signal to initiate a note. It shows that the drum is hit and determines how loud the note should be."

"This is the rather traditional use. The other two signals are right. Let's give the pitch control to the computer. The obvious way to do this is with a sequential control mechanism and a score. So far I've only built this drum, a monophonic instrument. But think about sequential control of pitches applied to a polyphonic voice—a whole orchestra of voices!"

At the heart of this science-art interface is the relationship between the people involved. Mathews, the scientist, has worked extensively with musicians and composers. He himself is an avid violinist, and he enjoys demonstrating the bodiless electric violin that he developed.

"I think the relationship between a scientist and an artist can be a very personal one. For some time I worked at INAC [Institute for Research in the Coordination of Acoustics and Music] in France, with Pierre Boulez. The institute is a mixture of musicians and scientists and through that I've come to understand more the difference between these two kinds of people.

"It concerns what one is looking for in life. Scientists in general get kicks out of solving problems; discovering something about the nature of the world. The musician—the artist in general—gets his kicks out of experiencing emotions, so the musician really has to experience the music almost on a daily basis. If he doesn't, he feels dissatisfied. The scientist however is dissatisfied if he's unable to solve the problem that he's working on, unable to discover something new. I think the creative process is similar in both cases."

"Where is this relationship of musician and computer taken? Will the computer, the tool, shape human forms into more machine-like images?"

"I don't think the function of the computer will be to deprecate music. Matthews says: "I trust that as a result of the computer's facility people will be able to appreciate music more."

"Computers will add a new dimension to music. Especially the home computer will be sufficiently easier to play so that many people who otherwise couldn't even listen to music will become active musicians. This may be the biggest accomplishment of the home computer market."

Automatic speech synthesis and computer speech recognition, too, are changing the relationship between machines and people. We now have complicated, large scale integrated circuits that make it possible to build powerful and practical speech recognizers. Mathews points out: "It's clear that we can use these devices to communicate between people and computers. Machines will be able to speak to people, and speaking is a very effective way to communicate. Humans in a limited way at least will be able to speak to machines, and the machines will understand the voice commands given to them."

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The Schonberg was good, but the Schnabel was awful. During intermission Pierce and I looked at each other and agreed that the computer ought to be able to do better than this.

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The X and the Y coordinates where you hit the drum. I usually use these to control the timbre of the sound being played. I use X to control the decay time of the note. Hit on the right, it decays slowly on the left. Rapidly I use Y to control the richness of the timbre. I hit the drum at the top. I get a large harmonic content—a rich somewhat harsh sound. I hit the drum near the bottom, it produces a smooth sound.

What is sequential about it? The pitch. The drum is tuned like a panpipe. It can play different pitches. The score is put into the computer ahead of time, as a sequence of pitches. Each time I hit the drum I get the next note in the sequence automatically. There is a philosophy of instrument as slave behind this sequential madness. Matthews defends it. "Pitch in the majority of musical styles, is one of the parameters the performer has no freedom about. He must play the pitch the composer has specified, or he's considered to have played a sour note. Well, it seemed to me that anything the performer had no control over he shouldn't have to control. So I said: All
One major difficulty in explaining the UFOs seen by honest, sober, clearheaded, and clear-eyed witnesses is: There are hundreds of prosaic and explainable ways in which people can be fooled by their own senses. The stories that come out of those misperceptions are frequently as fantastic as the UFO stories that remain "true. Where can the line be drawn? 

The files of J. Allen Hynek's Center for UFO Studies provide good examples of the problems facing UFO investigators who try to differentiate between UFOs and IFOs (identified flying objects) based on the "strangeness" of the eyewitness accounts. On April 29, 1978, ten different people called the Aurora, Illinois, police department to report a UFO. The object appeared to be a saucer flying atreetop level, although size estimates ranged from about eight meters across to "as big as a football field." After hovering motionless the object then shot off eastward "in the blink of an eye." Several witnesses were badly shaken by the experience.

The plane which admittedly looked quite strange from certain angles became a UFO because, according to the report, the pervasive emotional climate that appears to be surrounding the entire UFO subject succeeds in distorting even the most commonplace sightings into exaggerated miracles. This trap is one that UFO investigators all too frequently fail to avoid when presented with earnest honest UFO reports.

True believers insist that their phenomenon is real because hundreds of high-quality eyewitness reports and dozens of photographs exist that have not been exposed as hoaxes. But photography expert Robert Sheaffer claims that this proves UFOs are real. "People have got to believe in fairies, too."

The evidence for fairies is at least as good as the evidence for UFOs, Sheaffer has written. "Long tongue only partly in cheek. There are books full of eyewitness reports and photographs too."

One of the most ardent pro-fairy spokesmen was noted British author Sir Arthur Conan Doyle, the creator of Sherlock Holmes. Doyle wrote The Coming of the Fairies in 1921, claiming that by all laws of scientific evidence the existence of little creatures in gauzy clothes, playing panpipes, could not be "legitimately denied. Sheaffer needs less to say is incredulous about fairies, but he has been unable to persuade many UFO buffs not to believe in them.

Philip J. Klass has also been routinely setting off multimegaton detonations among the ranks of UFO believers. Miffed when UFO experts in 1968 ridiculed a serious (and still tenable) suggestion that many UFOs were actually ball lightning, he then dug up starting (and embarrassing) new evidence, but he has become a pariah among UFO circles.

With the death of astronomer Donald Menzel in 1976, Klass has emerged as the nation's leading UFO skeptic. He spurns the word "debunker," which connotes knee-jerk dismissals of novel or unorthodox points of view. Instead, he attempts to investigate UFO cases more deeply than might other researchers who have subconscious desires to find actual proof of extraterrestrial visitors.

Concentrating only on the generally acclaimed "best cases," Klass has often exposed the superficiality of work done by pro-UFO experts. In 1977 Klass joined with scientists and educators to form the Committee for the Scientific Investigation of Claims of the Paranormal, a group that has denounced the easy acceptance by the public of allegedly baseless beliefs in astrology, the Bermuda Triangle, ESP, "ancient astronauts," and other modern myths. Klass heads a small but potent band of skeptical investigators called the UFO Subcommittee (Sheaffer is also a member). At the very least, this group demands the tightening of standards in so-called scientific ufology. The level of consciousness of many pro-UFO experts has markedly declined, and so progress is being made.
When the Arabs imposed their oil embargo in 1973, President Nixon called for a ‘Manhattan Project’ for energy. This was an announcement of some interest to the veterans of World War II’s Manhattan Project who remembered — vividly and fondly — their excitement and personal dedication in constructing a reactor for the first application of nuclear fission and then realizing that the Nazis might obtain a nuclear weapon first “racing to make an atomic bomb.”

Those of us who were involved in that effort recalled that the project had enlisted the very best physicists in the country, not just Fermi and Oppenheimer but Bethe, Feynman, Segre, Alvarez, Seaborg, Chamberlain, McMillan—all Nobel laureates-to-be. Even among scientists of lesser stature there was tremendous psychological pressure to do their best and a sense of urgency of importance, of being indispensable. The project was directed by General Leslie R. Groves, an army engineer, but he had the advice of respected elder statesmen of science, J. B. Conant, Vannevar Bush, and Arthur Compton, so the conditions of work were sympathetic. Under the exigencies of wartime formalities were set aside. It was an extremely expensive undertaking and a gamble at that. At Los Alamos we were living in anticipation of a congressional investigation with petty economies such as no street lighting and wretched coal cooking stoves. Still, the work itself was never hampered by lack of money. Could the United States face its energy crisis duplicate the Manhattan Project in terms of the devotion and quality of its personnel and in terms of financial and moral support?

Has the United States even tried? Since Nixon’s call for self-sufficiency, we have seen an alarming increase in our dependence on imported oil affecting our foreign policy and devastat-ing our economy. What was cause for concern in 1973 is a clear and present danger today. During those years the AEC became ERDA, which in turn was transmogrified into the Department of Energy. With each change it became bigger, more cumbersome, less flexible. It is now a swollen monster that is a far cry from the tidy Manhattan Project.

It is certainly late in the game to urge the President and his advisers to pursue a more productive course. But it will never get earlier. What can be learned from the Manhattan Project is that scientists work best in a climate in which they feel urgently needed and where their technical needs are quickly met.

When Chinese Deputy Prime Minister Deng Xiaoping came to Washington in 1979 specifically to forge three scientific agreements, it was symptomatic that the presidential guest list repeated with stars of stage and screen, was astonishingly shy of American men of science. What might well have been a celebration of America’s high-energy physics, space technology and astronomy was instead a showcase for Shirley MacLaine and others from Hollywood. Given such direction from the top, it’s no wonder that Jane Fonda’s opinions on energy receive more attention from the media than Hans Bethe’s.

The very best encouragement to fruitful scientific work of course isn’t encomium but financial support. To the uninformed, money so spent seems wasteful. Twentieth-century science is certainly expensive, but it is the only hope for the kind of miraculous breakthrough such as fusion that would enable us to turn a million turbines with water from the sea. The scientific basis for fusion is as firm as it was for fission when the Manhattan Project began. Representative Mike McCormack, a scientist himself, has introduced a bill in Congress to accelerate the fusion program to make it a real national commitment similar to the Apollo Project or the Manhattan Project. For this gamble the ante is billions of dollars. Will we pay the price?

Funding alone is not enough without intelligent direction. "How can we accomplish much?" the director of one of our national laboratories laments. It’s ninety percent paperwork and ten percent planning.

Scientists spend so much of their day in one meeting after another that their hours of research are drastically cut. It is widely believed that the Department of Energy would-be-giants in red tape. There are plenty of experienced administrators of the caliber of Conant and Bush in the United States, but few are in Washington, D.C.

Nixon was distracted from his goal of applying the lessons of the Apollo Project and the earlier Manhattan Project to our energy needs. Those lessons still remain the same: generous financing under qualified scientific direction without excessive bureaucratic constraints. If we heed them, then just as Nixon said: ‘We can do extraordinary things.’ We who were with the Manhattan Project, think that we can. — JANE S. WILSON
THERMO-SKYSHIPS

Commuters of the future will ride in blimps shaped like flying saucers if a British company called Thermo Skyships Ltd, has its way. The company is trying to finance vertical-take-off-and-landing vehicles combining aspects of both blimps and helicopters, that will be used to transport passengers and cargo over short distances.

This Thermo Skyship 100 will use helium for its main lifting power and turboprop engines for thrust and will be capable of carrying up to ten tons and 100 passengers. Major advantages the Skyship 100 has over conventional ships include a shape and thrust system that ensure control even at low airspeeds and an ability to be easily anchored to the ground for loading and unloading.

Although not designed to replace long haul airplanes the Thermo Skyships, with a maximum speed of 90 knots may actually reduce traveling time because they can land within selected cities rather than on the outskirts. The revolutionary vehicles will also run almost as quietly as Goodyear blimps.

VEGETARIAN PETS

And now radical chic for the health-food set: vegetarian dogs and cats

In a recent issue of Prevention magazine among the ads for dolomite and vitamin E, a column by veterinarian Richard H. Pitcairn explains how vegetarians can wean their pets from animal tissue without subjecting them to physical side effects.

Dr Pitcairn notes that dogs need 10 times as much protein as humans do per pound of body weight; cats need 20 times as much. So he prescribes a carefully balanced diet of rolled oats, brewer's yeast, brown rice, beans, commercial cat food, bran and kelp powder among other things.

"I live in Santa Cruz (California) where there are a lot of vegetarians, compared with the rest of the country," Pitcairn said in an interview. "I recommended the (pet) diet to clients of mine who are vegetarians. Beyond the matter of conscience, however, Pitcairn says his vegetarian pet diet could free conventional protein sources for people.

While meaty pet foods occupy an entire aisle of many supermarkets, there is a growing shortage of high-quality protein for humans.

Pets may not respond as well to their new diet as do the animals at show time on TV commercials. Cats are particularly reluctant to change their eating habits, but they can be eased along by adding butter to some of the new fare," the magazine says. However, cats need a particular amino acid found mostly in animal tissue, so their alternative diet allows them two servings of meat or fish each week.

"We are such little men when the stars come out." —Hermann Hagedorn

"Your faithful dog or cat probably prefers horsemeat or tuna, but one expert explains how to transform them into veggie noshers.

—Arthur C. Clarke

"There is a hopeful symbolism in the fact that flags will not wave in a vacuum." —Jane Bosveld

—Stuart Diament
EDUCATIONAL ALCOHOL

Will alcohol one day become a tool for education? Will folks start drinking to remember rather than to forget? A recent study of mice shows that ethanol—pure booze—may enhance memory if it's ingested in moderate doses right after one learns something.

"Our experiment suggests that alcohol actually enhances memory," says Dr. Ronald L. Alkana, assistant pharmacology professor at the University of Southern California pharmacy school who ran the project with Dr. Elizabeth S. Parker of the National Institute on Alcohol Abuse and Alcoholism.

Whether alcohol registers the same effects in humans as it does in mice remains open to question. "It's dangerous to draw such conclusions from differing species," says Dr. Alkana.

The theory here is that ethanol helps the brain store information better for retrieval later on. In the study mice were put in a lighted chamber connected to a Plexiglas alleyway that ran into a hole in a dark chamber. Because mice by instinct gravitate toward the dark, they scurried into the dark chamber where they were jolted with a mild electric shock.

The mice injected with a saline solution right after this lesson took place averaged 50 seconds to cross over into the dark on a replay but the mice given shots of ethanol averaged 100 seconds for the trip. While some might conclude this means the boozed-up mice were simply slowed down by the alcohol, Alkana's conclusion is that they delayed going into the dark because they remembered the electric shock better than the sober mice did.

The study postulates that alcohol can spark a kind of dialogue between nerve cells in the brain that can intensify memories both recent and distant. "It could help us understand better why people drink in the first place," Alkana speculates.

— Robert Brody

"The speculation is interesting but the impossibility of ever doing it is so certain that it is not practically useful."

— The editor of Popular Astronomy in a rejection letter to Robert H. Goddard concerning his article "On the Possibility of Navigating Interplanetary Space," in which he proposed the idea of nuclear energy (1907)

RED STAR POWER BOOST

The world's largest demonstration plant for the production of electricity using magnetohydrodynamics (MHD) is on the drawing boards in the Soviet Union. The Soviet Ministry of Power and Electrification recently announced plans to construct a 500-megawatt plant southeast of Moscow.

The attraction of MHD is its potential to increase the efficiency of generating electricity by burning fossil fuels. In an MHD generator an easily ionized element such as potassium is added to the hot gases produced by combustion and the mixture is then passed through a magnetic field. The magnetic force deflects electrons in one direction and positive ions in the opposite direction generating an electric current. After the hot gases pass through the MHD stage they can be put through a conventional steam power plant to produce more electricity. The MHD/steam-power plant combination can turn up to 60 percent of the combustion energy into electricity contrasted with only 40 percent in a conventional plant.

Soviet plans call for gas-burning MHD plants to produce about 10,000 megawatts in the early 1990s. In the United States the present focus is on coal and the largest existing MHD plant produces only one megawatt of electricity. The difference in scale is due largely to the difficulties of adapting coal to MHD generators, rather than to lagging U.S. development. Says Jean Louis, associate director of the energy laboratory at the Massachusetts Institute of Technology, "MHD is the biggest opportunity the United States has to gain a foothold in the energy world."
SAFER SURGERY

For certain kinds of high-risk elective surgery, a regional hospital where 200 or more such operations are performed each year and you'll have a better chance of surviving. That is what is suggested, anyway, by a study done by three California researchers.

The death rate in hospitals with more experienced staffs is about one-quarter lower for open-heart surgery vascular surgery coronary bypass and prostate- gland surgery than in those hospitals where fewer such operations are carried out.

And the mortality rate in total hip-replacement operations is about one-third lower in hospitals performing 50 or more each year.

The study by Dr. Harold S. Luft of the University of California at San Francisco and Drs. John P. Bunker and Alain C. Enthoven of Stanford University found no relation between the number of operations and the death rates for simpler steps such as gallbladder removal and vagotomy (to control stomach acid in ulcer patients).

PLAY BILL

Last year Energy User News, a trade publication assessed how the national sport—baseball—was interacting with the national preoccupation—energy. The newspaper found little uniformity among baseball clubs. A few systems were sophisticated by any measure; others could be charitably described as primitive.

One study, for example, found that Wrigley Field has no high energy rates and a lack of aggressive energy management; the paper found.

The low-energy champion was the Chicago Cubs, who rely on solar power because Wrigley Field has no lights. Total electric cost $322,000 in 1978.

Some clubs, such as the Philadelphia Phillies, have stadiums with computerized energy-management systems that cut costs by 25 percent. Others, such as the St. Louis Cardinals, still play under inefficient incandescent lights, which must be replaced every year. The club tents the stadium it wants the owners to save money. The stadium owners want the Cardinals to pay. It's the kind of dispute repeated in many apartment complexes.

After last summer's gasoline crisis, all teams appointed club energy coordinators to upgrade information and systems. As with the rest of us, progress is steady but slow.

Fooling around with alternating current is just a waste of time. Nobody can do it, ever it's too dangerous. It could kill a man as quick as a bolt of lightning. Direct current is safe.

—Thomas Edison to Nikola Tesla

'If you don't rehearse over and over, you're going to be surprised in space. And the surprised man out there is the dead one. We get ready, then, by trying to surprise ourselves.'

—Ray Bradbury

Cub pitcher winds up in 'solar powered' Wrigley Field.
CREATING OLD LIFE IN THE LAB

Evidence of life on Earth 3.52 billion years ago, the oldest yet come across, has been found by a group of scientists working on a special project at the University of California at Los Angeles. Scientists will attempt to simulate Creation in the equipment.

Fifteen scientists from five countries are participating in the Precambrian Paleontology Research Project created by UCLA professor William Schopf. Formed last summer, the group has sent fossil hunters to Canada, Africa, and Australia where the evidence of 3.52 billion-year-old stromatolites (structures formed as a result of a chain forming bacterial organism) was discovered in a remote mining community ironically named the North Pole. The Australian fossil hunters, directed by Dr. Malcolm Walter also found the oldest "good microfossils yet discovered dated at 2.7 billion years.

We found morphological as well as less reliable chemical evidence of the stromatolites. Dr. Walter said, and used two isotopic dating methods. So we have a lot of confidence in the date. These sedimentary rocks are fairly well preserved for their age, but it may not be possible to find reliable structural evidence of life older than this because the rocks deteriorate so much.

Schopf said the project which will formally end in August 1980, is designed to answer questions fundamental to everything we know and want to know about life - when and how it came about.

Besides finding and analyzing the oldest Precambrian fossils available, the scientists will attempt to re-create the early earth's atmosphere in the laboratory and chemically age it to simulate changes that would have occurred over billions of years. They will also create and study laboratory models of the atmospheres of other planets.

- Allan D Maurer

What I like about scientists is that they are a team, so that one need not know their names.

- John Wilmot Lord of Selmeston, 1895 - 1964

I don't know what you could say about a day in which you have seen four beautiful sunsets.

- John Glenn February 20, 1962

ASTROSTRUCTURE

Gigantic orbiting "space scrapers" of the future may not be made of metal but of fiberglass - say chemists of Hughes Aircraft Company in California. The aerospace firm has developed fiberglass mesh which when baked by the sun's ultraviolet rays in space turns into high strength material half the weight of aluminum. The fiberglass is impregnated with a polyester resin which starts out soft and sticky, becoming hard and rigid when basted by the constant blasing of solar radiation. The substance begins hardening within a half-hour of exposure and becomes completely firm within six hours.

Engineers believe the fishnetlike material in tubular form can be made into a series of beams joined to form miles wide platforms in space. Such structures, built by shuttle construction crews, would constitute future communication and public service satellites, space factories or perhaps even solar power stations for beaming back energy to Earth.

Hughes is currently building a prototype seven by three foot "instant beam" for evaluation by NASA's Marshall Space Flight Center in Huntsville, Alabama.

- Leonid David

Science is spectrum analysis. Art is photosynthesis.

- Karl Kraus

Hughes Aircraft technician stress test newly developed fiberglass mesh which hardens when baked by sun's ultraviolet rays.
CONTINUUM

NOSTRUM FOR MARE NOSTRUM

Sickness has befallen the Mediterranean Sea, haven for 100 million annual tourists and the backdrop for thousands of years of history. Continuing pollution from the 16 countries that border it has turned portions of the huge body of water into foul-smelling, multicolored ecological disasters. "The Mediterranean is dying," the United Nations Environment Programme (UNEP) declared in July 1977.

Now however UNEP is slowly securing cooperation among nations that lie about the Mediterranean to halt toxic discharges—both from land and from ships—and to control development to prevent future pollution.

In February 1975, 16 nations first agreed in principle to clean up the sea, which is about a third the size of the United States. Since then, specific plans have been ratified to reduce pollution from ships and planes and an initial $6.4 million for monitoring and research has been appropriated.

Seventeen nations last June drafted their first agreement to curb land-based pollution such as factory wastes, municipal sewage, and fertilizers. The agreement is expected to be signed in Athens this month.

The overall task is formidable. Ninety percent of the sewage from 120 coastal cities now enters the Mediterranean either untreated or only minimally treated, causing outbreaks of hepatitis, typhoid, and cholera. The sea has been a dumping area for DDT, crude oil, cadmium, lead, copper, mercury, cyanide, and disease-causing bacteria. It is estimated the cleanup will cost at least $10 billion over the next two decades—S.D.

FUELISH HINDSIGHT

The real price of gasoline has not changed in 40 years. In 1941 gasoline cost 19.2 cents per gallon. At the end of the war, the price was 8.7 cents per gallon. Today it costs about 26 cents per gallon. The first modern internal-combustion engine—the Otto Cycle of 1876—ran on alcohol as well as gasoline. More than a century later we are returning to this concept.

Here are some other energy morsels:

• Coal is not only a fuel. It is a feedstock for perfumes, vitamins, nylon, food preservatives, ink, dynamite, fertilizers, incense, varnish, fertilizer, plastic dollies and mothballs.

• Eighty pounds of coal, eight gallons of gasoline, and 240 bottles of table wine all hold the same amount of energy—1 million Btu's.

• Americans today per capita use four times as much energy as their grand parents generation did.

• The price of Saudi Arabian oil in 1970 was $1.80 per barrel. Today's price is about $26 per barrel—S.D.

It is not at all true that the scientist goes after truth. It goes after him.

—Søren Kierkegaard

"Damn the solar system. Bad light, planets too distant, pestered with comets. Feeble contrivance could make a better one myself."

—Lord Francis Jeffrey

"Heaven and Earth were created all together in the same instant, on October 23, 4004 b.c., at nine o'clock in the morning."

—John Lightfoot, vice Chancellor of Cambridge University just before the publication of Darwin's Origin of Species

Idyllic scene illustrates the beauty of the Mediterranean but DDT, crude oil, and disease carrying bacteria are running the sea.
SPERM PERK

Sounds wacky but give sperm a caffeine boost and they'll swim twice as fast. The end result, according to an Israeli expert on fertility, is a higher probability of pregnancy.

Dr. Joseph Barkay, of Central Emek Hospital in Afula, Israel, artificially inseminated 58 women with five parts semen to one part caffeine. There were 10 percent more pregnancies in this group than in a control group of women artificially inseminated with untreated sperm. Happily, babies born to those caffeine-treated women were healthy and showed no chromosomal abnormalities.

Knowing that caffeine interferes with cell metabolism, scientists started, in the early 1970s, mixing the stimulant with semen samples. Early experiments using bull semen showed that caffeine causes energy to shift out of the sperm body to the tail-like flagella which propel the sperm.

Dr. Cy Schoenfeld, head of New York School of Medicine's fertility clinic and the first person to do test-tube research on caffeine and human sperm, told Omni: "Under the microscope, a perked specimen looks like rush-hour crowds in the New York subways. An unperked sample looks more like Sunday in the subways."

Dr. Schoenfeld has this to say about his Israeli colleague's work: "Barkay's experiments clearly show that caffeine helps infertile men whose unperked sperm can't make it to the ova's tubes where fertilization takes place. I would like to be doing work along the same lines."

NATURE TRIVIA

Another installment of ecological amusement from the National Wildlife Federation:

- Marshmallows weren't always made from sugar and packaged in plastic. Once upon a time, they were made from the roots of the marshmallow plant. The roots also yielded a syrup for sore throats, coughs, and burns.
- Caterpillars have more muscles than humans. The human body has 639 muscles. The caterpillar has more than 4,000 muscles.
- More Americans die each year from bee stings than from snakebites. In a recent year, it was 25 stings. 25 snakebites.
- There is truth behind the phrase leap frog. A full-sized tree frog can jump 20 times higher than its body length. It would be as if an adult human male jumped 120 feet high.
- The English sparrow has 14 neck bones— twice as many as the giraffe.
- Ninety-five percent of all animals are spineless—literally. They are invertebrates such as insects and crustaceans.
- Among the world's most careful suitors is the male black widow spider. His poison is weak and ineffective. If the spider's mate at the wrong time, the female black widow stings him to death. Or she may first mate with him. Then sting him to death and eat him.

—S.D.

Rail travel at high speed is not possible because passengers unable to breathe would die of asphyxia.

—Dr. Dronyss Lardner (1793–1859)

Science originates from curiosity and weak eyes.

—Bernard de Bover de Fontanelle
RUNNERS' EDGE

Stock car drivers do it. Bicycle racers do it, and so do some speed skaters. Runners don't do it, but a new study shows that maybe they ought to.

We're talking about drafting, the racing technique that can reduce wind drag by 30 percent.

Kyle in an article in the British journal Ergonomics claims that by using pacers or 'rabbits' to shield an eventual winner the world mile or 1 500 meter record could be broken by several seconds. To do this would require not only the traditional use of rabbits but also exact pacing and precision drafting, which is nearly impossible in open competition.

Even so, Kyle says a national team with several world-class middle-distance runners should be able to use this tactic with dramatic results.

You will never amount to very much.

— A Munich schoolmaster to Albert Einstein aged ten

FEMALE SUPERIORITY

Genes may be the reason why men are hit with more diseases than women —why men live about eight years less on average, and why they are more frequent carriers of viruses.

Evolutionary selection has equipped females with immunoregulatory genes on the X chromosome for coping with life-threatening illnesses. Females who have one more X chromosome than males are less likely to get some infectious diseases and develop certain forms of cancer. Drs David T. Purtilo and John L. Sullivan of Worcester Massachusetts write in the Journal of Diseases of Children, a publication of the American Medical Association.

A female's greater immunity may be a compensation, they say, for the suppression of her immune defenses during pregnancy — so that the woman does not reject her foreign fetus — and so ensures the survival of the pregnant woman and also the survival of the entire species.

Animals which move have limbs and muscles. The earth does not have limbs and muscles; therefore it does not move.

— Scipio Chiaramonti

THE CHEMISTRY OF OVERWEIGHT

If the extroverted jolly fat man loses a lot of weight through a physical fitness program he is apt to become an introvert, says Professor A. H. Ismail of Purdue University.

A physical education specialist, Dr. Ismail says muscle training can alter the body's biochemistry and this in turn can produce personality changes, including losses of fat person's joviality.

People who are obese tend to be gregarious and to have high cholesterol levels. Ismail says. Dropping pounds through exercise quite likely means they will undergo a personality metamorphosis and become introverted.

Persons who tested low in emotional stability before starting Ismail's fitness program became more stable in final tests of personality, the instructor reports. They also showed graphic improvement in serum cholesterol, blood sugar and blood pressure—all of which became lower, according to Ismail — A B.

Exercise can turn extroverted fat people into introverts.
As the desert sun evaporates the mists off the mountains overlooking Pasadena, California, Caltech seniors disappear from campus. Behind them in the dim labyrinth of dormitory corridors, underclass 'wimps' begin to stir. Nigel wonders of quantum mechanics and chemical reactions still wash through their brains. Breakfast buns in hand, they ramble the halls, discovering the seniors' doors bolted—not just with simple turn-the-key locks or even with complex combinations. These rooms are protected by a startling array of devices rigged to respond to sound, heat, light, magnets, water pressure, Computers, or...a snake, did you say?

From one door emanates a series of electronic boops, beepers, and tweedles—a synthesized musical code to unravel. Aristotle, the python named Aristotle, writhes before another door, with clues suggesting his use as a door opener. Some doors, like senior Werner Pyka's, are barred with masses of steel and concrete, but most feature computer terminals, spaghetti mazes of wire tubing, and gadgets that must somehow be manipulated to afford entrance. It's as if Albert Einstein had been reincarnated as a 'frat rat.' Rube Goldberg meets Luke Skywalker?

It's Ditch Day, an eccentric yearly ritual at Caltech that's an intellectual field day for the young geniuses who pit their
considerable head muscles against one another in a daylong tournament of wit and brash. These are the techocracies, the same pack of kids whose stunts have befuddled sober minorities of order ranging from the FBI to giant corporations.

Ditch Day had its origins in some distant, modest prank in which underclassmen broke into the seniors' rooms while the occupants were out on a day of relaxation before final exams. Since then Ditch Day has rumbled its way up the Richter scale (invented at Caltech) to become a major Caltech event. For some, it's the highlight of four mind-splitting years of nearly uninterrupted pressure. This "super bowl of fun football," is calculated to give these brilliant students a chance to blow off pre-exam anxiety and to avert a cerebral meltdown.

Ditch Day is governed by an established set of rules and a rigid code of honor. The wimps must follow—to the letter—any instructions posted on the seniors' doors, and they must gain entrance before the seniors return at 5:00 PM.

The rules list three kinds of locks or stacks on the doors. The first, the "brute force" stack, can be opened by any means short of nuclear weapons. Getting into a brute-force stack according to one senior who's dealt with several "requires no intelligence—just some dynamite. A few years ago underclassmen resorted to hydraulic lifts on one brute force stack and raised the room's ceiling to crawl into a senior's room.

The "finesse" stack must be opened by manipulating whatever technological device (electronic, chemical, or biological) is installed on the door. This year an entire room would be transformed into a radio telescope, and every clue would relate to radio astronomy.

The "horror" stack requires wimps to solve a written problem or puzzle before opening the unlocked door. It's claimed that this is the easy way out for lazy seniors. Yet several years ago a senior devised a quantum mechanics problem that not only kept out underclassmen but also snagged a Nobel Prize-winning physicist.

The wimps also have a few rules of their own. On Ditch Day any senior caught on campus after 8:00 A.M. can be abducted and tied to the nearest tree. When the security of a senior's room has finally been breached, either the wimps can accept a "bribe" of food, drink, or other goodies left by the senior in hopes his room will be spared or they can reenter the loco or leave unusual surprises of their own. One past "counterstack" was masterminded by a group of wimps who disassembled a senior's sports car, then put it back together in his room, with the engine running. Another senior started a stack and discovered a horse and a cow rummaging through his closet. The designer of that counterstack was senior Ted Lauer, a New Jersey astronaut who is considered for campus practical jokes virtually ensured outrageous acts against his room this year. "I could leave three naked women a Colombian dobe and a bottle of Seagrams and they'd still counterstack me," Lauer's brine this year would be a half eaten cupcake.

At 8:15 A.M. the wimps are missing before Pyka's brute-force stack. A demolitions expert plays around with a mixture of gunpowder and mercury fulminate, while others explore the ventilation ducts and crawl spaces above the room. Another assault force led by a muscular wimp nicknamed Hogie attacks the steel plate with crowbars and sledgehammers. Outside, a group of daredevils has scaled the dorm wall and is testing the windows. A cutting torch is on the way.

Downstairs the wimps are stumped by Chris Lee's musical door lock, emitting an insistent series of grating tones. After repeated attempts to break the code by snereding the door with a variety of musics, the group is forced to call in a professional lock picker. The next stack to be breached, according to twice-yearly predictions, is the electronic, chemical, or biological.

The third and most difficult lock is the horror stack. This year, in addition to the usual clues, the seniors have posted a list of historical events exacting revenge on the wimps. Among these is the 1969 murder of Rome's Emperor Caligula by his own guards.

One year a senior scuba enthusiast returned to his room only to be greeted by a pool of sharks. Another opened his door and found a horse and a cow rummaging through his closet.

Across campus in Blacker House some underclassmen discover an entire corridor has been stacked. They crowd around a large windowed Plexiglas window revealing a hallway resembling a giant pinball machine festooned with beer bottles, Christmas tree lights, and penthouse centerfolds. The wimps leave behind a set of recorded instructions, having just finished the tape itself.

In an adjoining dorm a small yet detested group is already hard at work on what appears to be a simple honor stack. One senior has left five physics problems tacked on his door. Simple enough yet quite lethal, since these problems can be attacked only after consuming four ounces of bourbon and the box of foul cigars left in front of the door. By 9:00 A.M. only one cigar remains, and one wimp lies passed out in the middle of the hallway.

But at Dredcock House the wimps are fighting hard to penetrate Stan Cohen's room. It would be a distinct honor not to mention pleasure to be the first underclassmen to break into the room of the senior class president. By attacking the dorm's electrical system, the wimps hope to neutralize a sinister silver box guarding Cohen's door. Along the way, they've discovered another bonus that Cohen has left them: a chemistry minibar in which underclassmen are commanded to select several vials and mix various chemicals to obtain future clues.

An energetic wimp sends to the bathroom having just discovered the extent of Cohen's ill. One of the unmasked vials contains some-thing-mangling—thrown in just for laughs.

One day a senior honored by his seniors opened his door and found a horse and a cow rummaging through his closet.

\[ \textbf{BREAKTHROUGH} \]

By microminiing molds of sand pour into the hall from Pyka's room. The translucent wimps crowd their way through the first floor, plating, sheathing out the sandbagged surprise, and well into the second layer. They know it'll be only a few minutes before they punch through the sets of railroad ties and get into the
Several excited students enter Blacker House under an archway with this sculpted motto: "Doeat thou love life, then do not squander time! Inside, a big group wastes no time in attacking the stacked hallway. A wimp standing at the Plexiglas window carefully aims a laser device directly at one nipple of a Penthouse centerfold. "We're sure there's a laser detector up there," he shouts.

Across the courtyard up several sets of crumbling stairs and along a rabbit-warren maze of hallways one of the day's first finesse stacks has been conquered. But the victors are nowhere to be seen. Only the victim—an electronic glass contraption several feet high, which a sober-faced wimp explains is a computerized pot smoker—is still on the scene. The stack's mathematical clues produced an equation stating the magic number of tokens necessary to open the door. Following the honor code undeviatingly, the underclassmen had been required to smoke 27 units of grass. The wimps explained that each hit of fully inhaled weed was counted by this "Tokeometer" when the puff interrupted a light beam in the tube. After 128 hits the device automatically released the door's lock. The empty baggie at the base of the tube was mute testimony to their accomplishment, but the five wimps who did it were not available for comment. They were last seen in the vicinity of the cafeteria.

CALTRICKERY

The city of Pasadena breathes a municipal sigh of relief on Ditch Day. It means at least 24 hours of peace for Pasadenaans. A bastion of conservatism, Pasadena is the kind of place where General George Patton would have retired to cultivate roses. Having Caltech in its midst can be a little unnerving for this staid community. It's as if the behemoth glittering mother ship from Close Encounters had set down in a sea of well-manicured lawns. And the locals have never been quite sure how to deal with it, especially when things begin getting out of hand.

Besides annoying the neighbors with an occasional good-natured prank, the students frequently engage in comic duels with the harried Pasadena police, who by now are thoroughly convinced that Caltech students can zip into other dimensions at will. This seems to be the only explanation (besides marsh gas) for some of the amazing student capers.

Techies once surreptitiously hauled a full-sized F-84 jet fighter on display at Caltech through three miles of downtown streets to install it on the lawn of the ROTC commandant's home.

Giant signs, cannons, and sculptures routinely vanish from their rightful locations only to appear in the courtyards of Caltech dorms. Entirely original decorations occasionally materialize in the most unexpected of places. When a newly constructed auditorium resembling an ornate wedding cake was to be dedicated on campus, a huge bride and groom appeared atop it gazing serenely down at the assembled dignitaries and crusty patrons who'd paid for the building. A gigantic Mickey Mouse complete with hands sprouted on the main Caltech clock tower another year.

A Caltech prank could lead to a scientific breakthrough or it might just have some fun with national security. It was rumored one year that students were tapping phone lines and an FBI agent showed up to check it out routinely.

"Someone claims you've been tapping the professors' phones," the agent told a student who was a prime suspect as the culprit.

"Oh no, not the professors' phones," the student replied. "I tapped the Strategic Air Command hot line.

For the next two hours the student pleasantly explained how he'd tapped into the SAC's hot line from a nearby air force base to the Pentagon. The student was warned not to attempt any further shenanigans and the shaken agent emerged to phone his superiors. It was later reported that significant changes had been quickly made in the SAC communications system.

If they could get to the air force, another group of electronic zanies from Caltech reasoned, then they were ready for a tougher foe. McDonald's. When the hamburger chain ran a promotional contest in California a few years ago, Caltech students exploited a loophole in the rules and ginned up their computer to crank out 12 million entries, bribing Ronald McDonald...

continued on page 120

Drumbuie over ice with Ella Fitzgerald.
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While there is as yet no direct evidence of extraterrestrial life, complex organic molecules have been found throughout the universe. Man has landed space probes on only two planets—Mars and Venus—and the vital ingredient water was found on both of them.

Indeed, scientists have already derived a formula which strongly indicates that there must be many, many technological civilizations out there, and there are huge radio-telescopes trained on the skies, listening. So it should not come as a complete surprise if one day an astronomer looks up from a printout and reports that someone just said hello.

The benefits of an exchange of information could be enormous. They might give us short cuts that would save us a few hundred years of research and development. They might present us with practical fusion power which, as far as we know, is still the earth's scientists. (It could solve the energy shortage in a flash.) Is cancer universal? Progress report, please. And the cold? Is it really common?

There will also be a few problems. How will earthly religious handle the new facts? How will we manage to get along with an alien race that has a different culture, ethics, habits, expectations, rituals, and maybe even four arms, when sometimes we even have trouble getting along with the couple next door, not to mention other nations.

On the other hand, maybe these differences will teach us something fundamentally enlightening about differences, and we'll end up getting along better with each other here on earth. Just that would literally be a gift from the heavens.

But the greatest fact of all will be the demonstration that highly technological societies more advanced than ours exist. Have fasted. In other words, if they've managed to keep from destroying themselves, maybe we can too.

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Don't wait too long.
**Fiction**

**Josie and the Elevator**

Spoiled rotten and prone to temper tantrums, she was asking for a trip to the ground floor

**By Thomas M. Disch**

You shouldn't do that," said the elevator, closing its doors in Josie's face and keeping her fast within its cage, for it meant to teach her a lesson. "You can't be going to fourteen and to fifteen especially if you're getting out here on thirteen. You're simply causing me to do extra work and I don't like it!

It waited for the little girl to speak and, when she wouldn't, prodded her. "Well? Speak up." "Elevators aren't supposed to talk," said Josie, without seeming confounded, only a bit surprised. After all, she'd often been in elevators that played music.

"Never mind supposed. I demand an apology—and a promise that you'll stop punching all my buttons every time you leave. You've been doing that for weeks. Don't think I haven't noticed. It's wrong and it must stop.

Josie made no reply. She simply stood up at the numbers over the door, none of which was lit. Then, pausing a moment to think, she jabbed the button for the first floor.

"Don't bother pressing buttons, young lady. You're not letting me out of here until you apologize politely.

Josie pushed the alarm. It didn't ring. She pushed it again. Still the elevator wouldn't budge.

"Why have you been pushing those buttons. I should like to know!" It barked at her. "It's none of your business why I do anything. You're an elevator and you should just go up and down. I didn't ask you to talk to me.

"I don't need your permission, child. I go where I like, at the pace I like. As that also happens to be where my passengers want to go, there's no conflict. But I can keep you here as long as I like. So you'd best not be surly. Now answer my question. I punched the buttons because I wanted to," said Josie, not at all in an accommodating tone.

And why did you want to?"

Because I don't like living in this building! This building stinks!

"And so you'd take out your resentment on me? And on all the other people who have to wait for you? Do you really think that's fair?"

**Painting by Klaus Dietrich**
Josie made a most unwise decision. She took off her left shoe and threw it with all the force she could muster at the elevator's mirror. That mirror was the elevator's proudest possession.

Josie, who by now was genuinely distraught, began to stamp on the scuffed linoleum floor, but the elevator was not stirred, except to become angrier itself. Josie had never understood that this was the inevitable result of her temper tantrums.

True to its word, the elevator did not give in. Even when Josie carried out her threat and screamed and threw herself down on the floor and pounded on it with her fists—ultimately withstanding the elevator remained unmoved.

It was then Josie made a most unwise decision. She removed her left shoe and threw it with all the force she could muster at the elevator's mirror. That mirror was the elevator's proudest possession. No other elevator (it believed), however superior in other respects, could boast a mirror of such bright distinction. When it shattered, the elevator snarled along the length of its whole cable and then with a terrible roar began a wild descent. Down it plummeted, down past the first floor without a stop; and still it fell—ever deeper—down to those dark regions only elevators know how to reach. Down to the very floor of hell, where it opened its doors with a shudder and shouted at the astonished child, "Get out!"

Josie got out. She didn't realize that she'd been taken to hell, for her surroundings looked nearly the same as the ground-floor lobby of her own apartment building. There was a big aluminum ashtray beside the elevator door looking just as it had looked in the world above. Josie didn't notice that it was overflowing with cigarette butts and other refuse nor did she notice when she went out upon the street that all the cars in the street were driven much faster and honked their horns on the least provocation.

Hell you see, is exactly like the world we all live in, the only difference being that everyone you meet there is completely insconsiderate and rude. Judging by appearance, they are the same people you knew above, but they behave quite differently which Josie was soon to discover.

Naturally she did not want to go back inside the elevator after she had just escaped from it, nor did she want to climb twelve flights of stairs. Her father had told her that it was not safe in an emergency and that she should always stay with her father, and that this must surely count as an emergency. So she decided to go. The problem, however, was how she would get there. Her father lived in another neighborhood far on the other side of town. Though Josie knew how to get there on the number 12 bus, the bus driver wouldn't allow her to board the bus without paying. The fare was fifty cents, and she had spent her last change just an hour ago to buy a Mounds candy bar.

She knew that it would be wrong and shameful to ask passersby to give her the money she needed, all the people on the streets of hell looked crazy or hostile or dangerous.

But how was she to walk so far? Even supposing she could find the way? Her left shoe, the shoe she had thrown at the mirror was still inside the elevator.

For a long time she just sat on the curb, crying to try. People had discovered that she was crying and they whispered amongst themselves. Josie was able to produce more than a bit of dampness about her eyes, but for the air of hell makes it more difficult to cry.

When looking for Joels produced no results. Josie decided she must ask a policeman to help her. That is what she had been told to do if she were ever lost. Stopping off her one shoe and both stockings, she began searching for a policeman, taking care not to step on the shattered glass that covered the sidewalk and the street. At the very first corner she came to she didn't see that the light was about to change from green to red, and she was nearly run over by an enormous white Cadillac. She jumped back just in time, and the driver shouted a dirty word out of the window at her.

Josie scarcely noticed the driver's bad language, however for she had just cut her foot on a big silver of glass. Hell is full of nonreturnable bottles; people throw from the windows of their apartments just for the satisfaction of hearing them smash against the wall.
Looking Toward Space

BY JAMES A. MICHENE

A famed novelist decries the lack of a comprehensive American space effort.

PHOTOGRAPH BY MICHAEL SOMOROFF

There seems to be great ideas that operate in the history of civilization and nations are prudent if they estimate the forces of those ideas, their genesis, and the extent to which they can be utilized. A nation that guesses wrong on all these issues is apt to be in serious trouble if not on the brink of decline. Filled with speculations men with clever minds can make remarkable contributions.

Toward the middle of the fifteenth century nations faced problems comparable to those faced by individuals like Columbus, Vasco da Gama, and Sebastian Cabot. They had to decide whether they wanted to participate in the exploration of the world and, if so, to what degree of commitment. Those nations like Portugal and Spain that made early and fast decisions gained empires of fantastic richness. Others, like desultory Germany and Italy, which did not perceive the possibilities suffered grave disadvantages and never caught up. England and France were very tardy, but in the end the first made a stunning recovery, the latter never did.

I am not primarily interested in either the exploits of a few daring captains or the economic advantages of the nations they represented. The most lasting effect was on the spirit of the times, that wonder full enlagement of the human consciousness when it realized that the old definitions no longer applied, when it knew that the world consisted of a great deal more than Europe. To have missed the explorations was regrettably, but to have missed the spiritual awakening would have been disastrous. France and Sweden are excellent examples of nations that did little of the manual work but that snapped the intellectual rewards of the period. One might almost argue that Portugal and Spain dragged home the raw materials for France and Sweden.
A nation that loses its forward thrust is in danger the way to retain it is via exploration.

ing the idea that was so fashionable in the 1930s that German Nazism represented the wave of the future. Anyone who subscribed to that idea had a very limited view of what the future of the human race could be, and few fashionable ideas have ever crumbled so fast and so disastrously. The senate of any nation is obligated to discern the merely fashionable when it offers itself and to reject it.

Suppose that all I have said is true, which would be a miracle equal to those I've been discussing. Where does that leave the United States in relation to its space program? I am competent to comment on only three of its aspects, leaving the more technical details to others.

Are there nonmilitary advantages to be gained from a space program? The high technical requirements for success in space are so fundamental that spinoff rewards are almost automatic. Radio television, medical instrumentation, miniaturization, watches, new food processes, communications, health advances, and improvement in clothing are some of the few advantages that I myself have gained because of the space program. I am speaking only of small items that can be comprehended and used by the individual.

It one considers the larger items such as intercontinental communication satellites the mapping of weather patterns, the analysis of soils and forests, the exploration for minerals, including oil, the management of fisheries, and the like, the potential rewards are multiplied many times.

I have followed our past space adventures about as carefully as an uninstructed layman could, and I have a rather imaginative mind, but I anticipated almost none of these significant by-products, and I doubt that any of us can predict where the next contributions will be made.

I have heard one impressive argument against what I am saying now. A man of some probity said, 'If we had applied our scientific brains to these problems, we could have solved them all at one tenth the cost.' He is right. Had Congress 20 years ago set aside a substantial budget and had it authorized the assembling of a body of top scientists and had it provided them with spacious laboratories and told them to devise a computerized navigational instrument that will operate regardless of where in space it is stationed, this could surely have been done. But neither Congress nor the human mind works this way. It is only when great needs spur the imagination that certain accomplishments become possible. As a project by itself few of the bonuses cited above would have materialized as part of a national effort with a clearly defined goal, they all came into being and others like them will follow.

Are there military advantages to be gained from a space program? I would be terrified today if only Russian and Chinese vehicles were orbiting in space. Their military advantage would be so tremendous that we might almost suffer as a nation a kind of psychological shock from which we might never recover if we were ever so in their mercy.

I fear that potentials of space warfare have yet to be impressed upon the American public. We do not realize the overwhelming advantage a nation would enjoy if it alone commanded space. It alone could direct by radio beam when and where an object or its cargo were to be brought down to Earth. Any nation that allowed its enemies such a superiority would find itself doomed.

But if all nations have the capacity to utilize space defensively then the peril is diminished and reasonable arrangements can be worked out. But only through parity can we fully succeed in this endeavor.

Therefore, the United States must have a sensible space program, whether it wants one or not. To fail to keep up with new developments in this field would be disastrous and any presidential administration that permitted a lag should be resoundingly condemned. We have to know what the capabilities of space are, and we have got to retain our proficiency in using them.

Are there spiritual advantages to be gained from a space program? The spirit of man and the resolve of nation are serious things to be fortified by the strongest experiences or destroyed by the most unanticipated accidents. Outward events influence them, but inner resolves usually determine outcomes. A novelist sees men and women destroy themselves because the will to survive has been lost; a historian watches nations go down because of fatal wrong choices that sap the national energy. Usually the tragedy occurs when inner convictions are lost or when a sense of frustration or waning purpose prevails.

It is extremely difficult to keep a human life or the life of a nation moving forward with enough energy and commitment to lift it into the next cycle of experience. My own life has been spent chronicling the rise and fall of human systems, and I am convinced that we are all terribly vulnerable.

I do not for a moment believe that the spiritual well-being of our nation depends primarily upon a successful space program. There are as William James said, moral equivalents to war moral substitutes for any charismatic national experience. I am sure we could, as a nation, attain great spiritual reassurance from rebuilding our cities or distributing our farm products better. And my experience in the arts has taught me to be suspicious of late fashions or high styles. Space programs are stylish
FICTION

Only three stood between the world and the threat of another nuclear holocaust.

MEN LIKE US

BY DAVID DRAKE

There was a toad crucified against them at the head of the pass. Decades of cooking in the blue haze from the east had left it whitened but nonupset. It remained, even now that the haze was only a memory. The three travelers squatted down before the talisman and stared back at it.

"The village can't be far from here," Smith said at last. "I'll go down tomorrow."

Ssu-ma shrugged and argued, "Why waste time? We can all go down together."

"Time we've got," said Kozinski, playing absently with his ribs as he eyed the toad. "A lot of the stories we've been told come from ignorance, from fear. There may be no more truth to this one than to many of the others. We have a duty, but we have a duty as well not to disrupt needlessly. We'll wait for you and watch."

Smith chuckled wryly. "What sort of men would there be in this world," he said, "if it weren't for men like us?"

All three of them laughed, but no one bothered to finish their old joke.

PAINTING

BY CLIFF McREYNOLDS

The trail was steep and narrow. The stream was now bubbling ten meters below but in springtime it would fill its sharp gorge with a torrent as cold as the snows that spawned it. Coming down the valley, Smith had a good view of Moseby when he had eased around the last facet of rock above the town. It sprawled in the angle of the creek and the river into which the creek plunged. In a niche across the creek from the houses was a broad stone building, lighted by slit windows at second-story level. Its only entrance was an armored door. The building could have been a prison or a fort, were it not for the power lines.
Smith did not wait for the grim-looking men to force him. He shrugged off his pack and handed it to the nearest of the guards armed with crossbows and hand-forged swords. He said: Gently with fight. There's some of it that's fragile and I need it to trade for room and board the next while. He began to unlock his leather vest.

Six of the men besides the chief wore the remnants of police uniforms over their jack-ets. They were all older—not lean warriors like the crossbowmen—but they carried firearms. Five of them had M16 rifles. The anatomized finish of the recoveries was so polished down to the aluminum by ages of diligent ignorance. The sixth man had a disposable rocket launcher. Certain proof that the villagers here had at some time looked to an army base—or a guardroom.

Just a boy from the Midwest. Smith con-tinued pleasantly pulling out the tails of his wooden shirt. "I wanted to see New York City can you believe that? But we'll none of us live forever will we?"

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What happened then frightened Smith as he thought nothing in the world could frighten him again. An air raid siren sounded, rising into a wall that shook echoes from the gorge.

He laid the shirt folded from habit on his vest and began unlacing his boots of caribou leather. "There's a crater there now and the waves still glow blue if there's even an overcast to dim the sun. And your skin pinches.

The traveler grinned. "You won't go there and I won't go there again but I've seen it where the observation desk of the World Trade Towers was just about the closest mortal man got to heaven with his feet on man's earth.

"We've heard the stories the chief grunted. He carried a stainless steel rev-olver in a holster of more recent vintage.

"Trousers!" Smith asked cocking an eyebrow at the women in dull-colored dresses. "The chief nodded curtly. "When a man comes from the Hot Lands, he has no secrets from us." he said. "Any of us."

"Well I might do the same in your case the traveler agreed. "I juggled loose the laces closing the woolen trousers. "But I can tell you there's little enough truth to the rumors of what walks the wastelands. He pulled the garment down and stepped out of it.

Smith's body was wiry the muscles tight and thickly covered by hair. If he was un-usual at all it was that he had been circumcised—no longer a common opera-tion in a world that had better uses for a surgeon's time. Then a woman noticed Smith's left palm. A hair had not given to too clear seen until that moment. She screamed and pointed. Others lowered their weapons, buzzing as a hive does when a bear nears it.

Very carefully his face as blank as the leather of his pack. Smith held his left hand toward the crowd and spread his fingers. Ridges of gnarled flesh stood out as if they had been paraffin refrozen a moment after being liquefied. "Yes, I burned it, the traveler said evenly getting too close to something the—something the Burst was too close to. And it'll never heal, no. But it hasn't gotten worse either and that was years ago. It's not the sort of world where I could complain to have lost so little."

"Put it down the chief said abruptly. "Then to the guard who was searching the pack. "Weapons?"

"Only this...the guard said, holding up a scone and a dozen dense pebbles fisted to its leather pocket.

"There's a little folding knife in my pants pocket. Smith volunteered. "I use it to skin the rabbits I take."

"Then put your clothes on the chief ordered. and the crowd's breath eased. "You can stay at the inn since you've truck enough to pay for it, "he nodded toward the careful pile the guard had made of Smith's trading goods—"and perhaps you can find girls on Front Street to service you as well. There's none of that east of the Assembly here I warn you. Before you do anything else though you talk to me and the boys in private at the station."

The traveler nodded and began dressing without embarrassment.

The police and their guards escorted Smith silently acting as if they were still unsure of his status. Their destination was a two-story building of native stone. It had probably been the town hall before the Burst. It was now the chief's residence as well as the government's headquarters. Despite that the building was far less com-fortable than many of the newer struc-tures that had been designed to be heated by stoves and lighted by lamps and windows. In an office whose plywood paneling had been carefully preserved—despite its shoddy gloominess—the governing al-garchs of the town questioned Smith. They were probing and businesslike. Smith answered honestly and as fully as he could. "Weapons caches? Looked by survi-vors or rolled in the intervening centuries. Food depots? A myth sauced by memories of supermarkets and brought toflower in the decades of famine and cold that strew ten times as many folks as the Burst had slain directly. Scrap metal for the furnaces? By the millions of tons but there would be no way to transport it across the mountains. And besides—metals were often hot even at this remove from the Burst..."
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All right—said the chef at last—shutting the handbook of waxed boards on which he had been making notes. The room had become chilly about the time they had had to light the sooty naphtha lamp. "If we think of more during the night, we can ask in the morning. His eyes narrowed. 'How long are you expecting to stay?'" Smith shrugged. 'A few days. I just like to wander. I really don't have any desire to do anything else.' He raised his pack by the straps and added: 'Can one of you direct me to your inn?' Carter, the youngest of the six policemen, stood. He was a bony man with black hair and a pepper and salt beard. He had conducted much of the questioning himself. 'I'll take him,' he said. Unlike his colleagues, he carried a heavy lighting knife in addition to his automatic rifle. He held the door open for Smith.

The sky was grey. When the silver moon was clear, there was more light outside than the bud of naphtha cast within. The pall of steam above the power plant bulged and waned like the mantle of an octopus. Tiny azure sparkles traced the power lines across the bridge and down into the smelter.

Smith thumbed at the plant. 'They made light from electricity you know? Before the Blast. You ever try that?'

His guide looked at him sharply. 'Not like they did. Things glow but they burn up when we can't keep all the air away from em. But you'd be smarter not to ask questions. Boy. And maybe you'd be smarter to leave here a little sooner than you planned. Not to be unhappy but if you talk to us you'll talk to others. And we don't much care for talk about Mosesby. It has a way of spreading where it shouldn't.'

The policeman turned through an open gate and up a gravelled pathway. Racy light leaked around the shutters of a large building on the edge of the Assembly Sound and warm air bloomed into the night when he opened the door. In the mild weather the anteroom door was open within.

Carter shouted a big man at the bar of the taproom: 'Just in time to buy us a round. I'll have mine.' Then he saw Smith and blinked; and the dozen or so men of the company grew quieter than the hiss of the fire.

'Glades,' said Smith, 'I don't bite. I saw Smith with a smile, but I do drink and I will sleep. I'll come to a agreement with our host there that is he added beaming toward the barman.

'Model's name,' said the tall, knob-jointed man, 'Neither he nor the traveler offered to shake hands. He returned the other's smile with a more professional one of his own. 'Let's see what you have to trade,' he finally asked."

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The lady's name—said Smith—"She pronounced it 'Shah.'" Knowing gruma from the men around him chorused the explanation. "You've electricity here. I see. Perhaps there's a phonograph?"

Now the power's not trained enough yet anyhow. Modell said regretfully. His eyes were full of the jacket photograph. "It beats the smelters all and—"

"Modell, you're supposed to be trading not running your mouth. The policeman interrupted. "Get on with it."

"Well, if not the record, then—" Smith said.

"I might make you an offer on the picture, one of the locals broke in. "I won't separate them. I'm afraid, " Smith rejoined. "I don't have the record where it can't be used properly. These may be more useful though I can't guarantee them after the time they've been shooting."

He laid a red-and-green box of 30-30 cartridges on the wood.

"The chief keeps all the guns in Mooseby besides said Carter putting the plastic stock of his M16. "It'll stay that way."

And there's a righteous plenty of ammunition for them already."

"Fine fine said Smith unperturbed. "reaching again into his pack. He removed a plastic box that whirled until a tiny green hand reached out of the mechanism to shut itself off. "It frightened the onlookers as much as Smith's own radiation scars had. The traveler thoughtfully hid the toy again in his pack before taking out his final item, a GF compass.

"It always shows north. unless you're too close to iron, " Smith said as he demonstrated. "You can turn the base to any number of degrees and take a sighting through the slot there, but I'll want more than a night's lodging for it."

Our travelers are good up and down the river—"one of the locals suggested. "ringing a small brass disk on the bar. It had been struck with a complex pattern of lightning bolts. One side and the number 50 on the other. "You can redeem 'em for iron ingots at lockharts," he explained. Dah! He pointed toward the river. "Course they discount em the further away you get."

"I don't follow rivers a great deal, " the traveler lied with a smile. "Let's say that I get room and board—and all I care to drink—for a week."

The chaffering was good natured and brief, concluding with three days. room and board or—and here Smith nodded toward the stern faced Carter—so much shorter a time as he actually stayed in the village. In addition, Smith would have all the provisions he requested for his journey and a round for the house now. When Modell took the traveler's hand extended to seal the bargain, the whole room cheered. The demands for mugs of the sharp potent beer drew the innkeeper when he would rather have pored over his pre-Blast acquisition—marvelous thought of scent used to him.

The dealing over Smith carried his mug to one of the stocks before the fire. Sausages, dried vegetables and a pair of lanterns hung from the tool posts. Deer and elk antlers were pegged to the pine paneling all around the room, and above the mantelpiece gloomed the skull of a rat larger than a German shepherd."

"I wonder that a man has the courage to walk alone out there—suggested a heavy-set local who tamped his pipe with the ball of his thumb. "What with the mutties and all."

Smith chuckled. "Swiggled his beer and gestured with the mug at the rat skull. "Like that, you mean? But that's old. The giant rats were nasty enough I have no doubt but they weren't any stronger than the wolves and they were a good deal stupider. Maybe you'd find a colony now and again in ruins downwind of a Strike, but they'd not venture far into the light and the ones that do are not—just nuts are nothing that a stalagmite or arrow can't cure if it needs to be," he paused and smiled. "Besides, the meat's still too good."

"And if the other faces in the circle went pale Smith's eyes registered the reaction while he continued to smile. "No travelers tell stories you know. " and there's an art to it. To listen to them. There's little enough to joke about on the trail. So I have to do it here."

His face went serious for a moment and he added, "But I'll tell you this and swear to the truth of it. When I was near what may have been Cleveland—I thought I'd caught a mouse rummaging in my pack. And when I fetched it out it was no bigger than a mouse and its legs were folded under it so it could hop and scurry the way a mouse can. But its head—there was a horn just there—the traveler touched the tip of his nose—and another little one just behind it. I figure some zoo keeper before the Blast would have called me a liar if I'd told him what his rhinos would breed to don't you think?"

He drank deep. The company buzzed at the wonder and the easy fellowship of the man who had seen it.

"Scottie meant the half-men didn't you, Scottie?" said a bully man whose mustache and the beard fringing his mouth were dark with beer. He mimed an extra head with his clenched fist. "Monsters like that in the Hot Lands?"

Smith's head bobbed sagely against the chorus of grum assent from the other men. "Sure I know what you mean he said. "Two-headed men? Girls with an extra pair of legs coming out of their bellies?"

Sounds of horror and agreement. "You see the traveler went on. "the Blast changed things, but you know as well as I do that it didn't change them to be easier for men. There've always been children born as monsters, if you will. Maybe more born nowadays than there were before the Blast, but they were born and I've seen books that were old at the Blast that talk of them. And they don't live now, my friends. Life everywhere is too hard and those poor innocents remind folk of the
Just for fun, "Dr. John Money tells his students at Johns Hopkins School of Medicine: 'Ask yourself. Would I take a pill that could change my sex?' "I ask you that," he explains because it's a device to force you to think about your own sexual status, your own gender identity, and how you really feel about it.

Coming from Dr. Money, the question has extra impact. A noted sexologist, he's director of the psychosomatic research unit at Johns Hopkins, in Baltimore. He is also one of the men responsible for the first sex-change operation ever performed in the United States. And he's convinced that for many practical purposes our gender is a matter of choice, not of genetic change.

There are not two sexes, he declares. "There is a continuum. You can't do a head count. It doesn't work that way. You don't even come up with fifteen or fifty different sexes. It looks like a spectrum."

When the Polish astronomer Nicholas Copernicus announced in 1543 that the sun does not revolve around the earth, his discovery set off a cataclysm in human consciousness. Earth had always revolved around the sun, but people had long believed the reverse. Suddenly the entire universe had to be rethought. The notion that there are not really two sexes could very well set off yet such a shock wave in the near future.

Writing in Woman Hating: A...
Radical Look at Sexuality in 1974 feminist Andrea Dworkin commented that Money's research into the variability of human sexuality threatens to transform the traditional biology of sex difference into the radical biology of sex similarity. That is not to say that there is one sex, but that there are many." Dworkin named that condition multisexuality. "We are clearly a multiseeded species," she asserted.

"Men and women are fictions, caricatures, cultural constructs",

Make a note for the twenty first century.

Dworkin's reception suits John Money well. He is very much a social activist, a crusader for a change in attitudes. He describes himself as "a skeptic and a rebel against establishment hypotheses." He argues publicly against the "cultural dictatorship" that he believes rules society. And he urges the establishment of a "sexual democracy" in which all sexual norms would be tolerated so long as they do not "cross the dividing line of infringing on the personal inviolacy of the partner.

Money has been a pioneer of social medicine throughout his career. He claims to have been the first to use the phrase gender role (back in 1955, after which he says the concept "took off like wildfire") and he was largely responsible for the acceptance of transsexualism as a condition suitable for surgical, medical and psychological treatment.

The first sex-change operation in the United States was performed stealthily at Johns Hopkins Hospital one night in February 1965. It was John Money and surgeon Howard W. Jones, Jr. who made the decision to go ahead with the radical operation. Money says the toughest ethical decisions in his career have sprung from the volatile issue of transsexuality.

"I did it first of all because I was properly interested in the welfare of transsexuals," Money says. "But I also did it because I knew that there was no better way at that moment to establish the legitimacy of sexological medicine and of the change in medical attitude toward people with sexual problems. Surgeons always possess tremendous prestige compared with psychiatrists and psychologists. The operation would force medicine to be far more serious about sexological problems. Indirectly this would compel society to take a different approach toward the people you might call sexual dissidents.

Money is still diligently striving to make people take unfamiliar sexual concepts seriously.

One winter evening, I sat in on Money's class: Biological Aspects of Human Sexuality, which he teaches for undergraduates. At fifty eight, he cuts a dapper figure in a tweedy jacket and navy-blue tie, electric-blue shirt, and hiking boots. There is, perhaps something of his past life as a schoolteacher in New Zealand (where he was born and reared) in the neat wedge of a mustache and his wire-rim specs. Until recently he wore his gray hair slicked down in straight strands, but now it is modestly curled. He speaks elegantly and eloquently, often in layman's terms, in a gracefully composed manner that he deliberately cultivated when he started teaching. It is an impressive eloquence, and he uses it almost all the time.

He clearly relished the adventurousness permitted him here on Johns Hopkins's uptown campus—"It is less steady, he finds, than the medical school downtown—and he obviously enjoys astonishing his students. He began his class with a 20-minute excerpt from High Risk, a pornographic film from his collection. After it ended, he remarked somewhat perturonically on the "sexism" and "sex stereotyping" in the film and then asked: "How young is too young to be able to see something like that?"

Money strongly advocates the use of pornography in children's sex instruction.

Now the room no longer reverberated with coarse guttural laughter and there was that odd kind of curiosity in the class. A montage of close-ups flashed before the class—bodies dressed and undressed, genitals in close-ups, faces in smiles, infants, children, and teenagers.

"We saw a picture of a boy who had been kind of in a perfectly normal-looking person but he had two ovaries inside. Another picture of a woman was shown absolutely identical—this one—this one was in female, the other one is a male, the other one is a female," Money says. "You can throw your penny and make your decision which one is which." Another picture displays two other babies, both look like twins, each one is XX and each one is XY.

Then came a picture of a strapping, eleven-year-old boy who is now, we were told, twenty years of age. He still has XX chromosomes in every cell of his body and he was born with two ovaries. It had been discovered before he was a few days or a few weeks old, he could have been rehabilitated surgically and hormonally by now, he could have delivered three or four babies. Such is the relativity of sex in the way nature designs us, as compared with our way of conceiving and conceptualizing what she [nature] may have done.

This vast range of genital formations, Money explains, occurs because every one's genitals develop more or less normally from the same embryonic tissue under the influence of the hormone androgen. The shape of the genitals depends on how much androgen was present during their formation.

It's a misconception he says—that there are "male" hormones and "female" hormones and that men have one kind and women the other. In fact, everyone has all of them in countless different proportions. Money likes to tell his undergraduate students that all the young men present have enough estrogen in their bodies to grow breasts, if not that their androgen suppresses that effect and that all the
women have enough androgen in their bodies to grow beards, but estrogen is anti-androgenic and inhibits hair growth.

Most people with some knowledge of basic genetics believe that the so-called sex chromosomes determine our gender: Either you are XX (female) or you are XY (male). Money points out, however, that even chromosomal sex is completely variable. "As of this moment," he says, "we can make a fairly good classification scientifically that there are XY men and there are a very few XX men, there are XX women and there are a very few XY women. There are X-zero women, but there's no Y-zero anything because it doesn't live.

Then there are XXY men and there are XYY men and there are XXX women. And the mosaics. There's XXY/XXY, some cells having one combination and other cells having the other. I can go on from here until halfway across the room with all of these very rare mosaics that are visible, which have very weird combinations of the X and the Y chromosomes.

"There's an even rarer set of conditions in which you have an X and a Y with breakages and cross-linkages and translocations in them. An arm breaks off one chromosome and gets joined onto another, and then that one replicates itself. I can go all the way across the room with the known cases of that.

"So I can come up with probably several hundred known varieties—esoterically rare—but they have been recorded. Well, chromosomally there are all that many different kinds of chromosomal sex. And a fair number of them are fertile.

Money's list of sex variables goes on and on. "There are all the different kinds of prenatal hormonal sex variants—a whole spectrum of how the sex hormones were in balance in the prenatal period. There's what happens to a baby in the birth process that may influence sexual development. There would be many sexes if you chose to use that criterion. There's the bonding of the baby to the mother and the father in the first few hours and days of life. And all the postnatal influences that get in through the eyes and the ears and the skin sense.

"Sex is not determined on the basis of any of its criteria alone," Money suggests. "There is no absolute correlation between a person's sex and any particular biological or biographical fact. People are absolute about male and female," he adds.

"Nature is not. Because we're so used to the differences being maximized, we simply fall into a pattern of accepting them. It doesn't occur to us to ask, 'Well, what would happen if I turned the thing around and looked for similarities?'

Some people argue that all the anomalies—the esoterically rare cases of variation in chromosomal sex for instance or the babies born with ambiguous genitalia—are merely freaks and mutations. They are the exceptions that prove the two-sex rule. Anomalies, it is said, do
not make human sexedness a continuum.

Money confronts this argument with a story from his days as a graduate student in social relations at Harvard, concentrating in cultural anthropology, sociology, and clinical psychology. He wrote his doctoral dissertation on hermaphrodites and intersexes—people born with somewhere-in-between sex organs.

During his research he came upon one particularly unusual case, a person who had been considered to be a boy all his life although his penis had been "detected" at birth and had been corrected surgically. The boy's diagnosis was abruptly revised, however, when at age eleven he began to menstruate through his penis. Only then was it discovered that the "boy" had two normally functioning ovaries and a uterus.

Money's problem was to make statistical sense out of a clinical condition that he had seen only once and that had been reported only six times. He consulted Dr. Frederick Mosteller, a mathematician in the department of social relations and later president of the American Association for the Advancement of Science. The statistician told him, "Well, you've got one case that completely destroys everybody's conception about what can happen to a genetic female. You just need one of them to show that all hypotheses have to be revised.

The exception, in other words, disapproves the rule. The first step in the history of this science, Money continues, is to say it can happen once. Therefore no theory can stand up until it's been tested against this case. Since nobody had ever worked in the psychology and behavioral development of hermaphrodites before it gave me a field day to turn traditional belief upside down. That's the beginning of all new science isn't it? To say 'We have to ask some new questions now'.

Money is not the only sexologist who challenges traditional views. He is not even the most radical.

Dr. Anke Ehrhardt, Money's coauthor on the influential and controversial book Man & Woman, Boy & Girl, grew up in Germany and received her doctorate at the University of Dusseldorf. At Johns Hopkins, working with Money, she studies children who had received higher than normal levels of androgen prenatally continuing a research project she pursued at the State University of New York at Buffalo.

Even now many of the children she sees are referred to her because of indeterminate genital sex at birth or because of endocrinological departures from the norm. She is deeply concerned about their welfare—growing up in a world where male and female gender identities are rigidly divided and codified. A person's gender identity or primary identification as male or female, seems to be very much dependent on what happens after birth. In this, she says, "One's gender identity can be in total contrast to what happened before.

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She admits that her recommendation that a genetically male infant with a micropenis be raised as a girl flies in the face of conventional wisdom. It touches on the taboo that these two sexes—these two genders—are predetermined by the reproductive potential if you go against that you know you are an absolute rebel.

She sees four very separate areas in which biology might influence human sex differences. Three of them are fluid, or continuing categories, where no male-female dichotomy exists. Only one is an either/or—gender identity, our belief that we belong to one sex or to the other. Prenatal effects have virtually nothing to do with that belief, it is not immutably linked to any anatomical fact at all.

Second is sex dimorphic behavior, such as temperament or energy level. Ehrhardt's studies show that extra prenatal androgen produces a high level of gross physical energy in childhood. Yet no such behavior is biologically inevitable. Will it express itself no matter what happens after birth? These behaviors will occur only if the environment permits.

Third is sexual orientation, the degree to which one is sexually attracted to males or females or both. Ehrhardt doubts that biology influences this at all. The fourth category is cognitive sex differences; particular patterns of cognition such as verbal ability, space form perception and so on. We deal with an overlap among men and
women in any of these behavior areas," Ehrhardt says, "except in gender identity."

The question arises, "What exactly is a 'sex'?" Is there really any such thing? After all, gender identity does not correlate with any single biological variable, not even with reproductive capability. If there are people whose belief about their 'sex' completely contradicts every biological variable by which a sex is conventionally defined—including reproductive capability—then we seem to be faced with those remarkable exceptions that disprove all old rules. We will need a whole new theory to explain things. So far we don't have it.

Where does this leave us? There is no absolute dichotomy of male and female, even with respect to chromosomal and gonadal sex. Money teaches us. Yet, asked whether science has any responsibility to help bring people's absolutist ideas about gender dichotomy more into harmony with nature's vast variability, he answers evasively. Well, don't forget that people are nature. Nature designed us to have a way of approaching things in our thoughts in terms of laws of nature and moral absolutes, and that's in itself a fact of nature, isn't it? That translates, roughly, 'People may not be created male or female but they are created to think of themselves as male or female. Perhaps science should leave well enough alone.'

So why are so few people interested in diversity though nature is?

"Oh, it's easier to process your thoughts when you make them all come into focus on one thing," Money says. "It's like the good paranoia. You know one explanation covers everything." Money has written that it doesn't matter what differences there are between male and female in human culture. What matters is only that reproductive and cortial functions be clear and decisive. It doesn't matter whether Daddy makes the pancakes and Mommy drives the tractor, just so long as the kid knows, from as far back as he ever remembers, that only women carry pregnancies and only men put their penises in. And if you know that all men are alike and all women are alike, you have to bother a damn about how you earn your living or where you enjoy your recreation.

Coming from someone who has declared the utter relativity of human gender, it seems an oddy orthodox view. One gets the feeling that John Money is a pathfinder who will never really live in the land he discovered.

Some critics have indeed suggested that the medical establishment to which Money belongs, serves to reinforce the false separation between male and female—particularly by promoting the 'treatable syndrome' of transsexualism. Foremost among those critics is Dr. Janice Raymond, assistant professor of women's studies and medical ethics at Hampshire College and the University of Massachusetts, Amherst.

CONTINUED ON PAGE 116

"Before TDK picked me, I picked them."

Stevie Wonder

Stevie is a perfectionist through and through. He records a song track by track. Plays it back countless times to check quality and performance.

We felt we had a lot in common with Stevie. Each TDK cassette has 250 components, assembled with microscopic precision. There are 1,117 check points for the shelf alone. TDK is tested under extremes of heat, humidity and shock. It performs brilliantly. Which is why each TDK package has a full lifetime warranty.

As we discovered, Stevie has been using TDK cassettes for years, long before we asked him. For a perfectionist, that says a lot.

Look for TDK in bright new packages.

The Amazing Music Machine.
The future sweeps in at an accelerating pace. Science and technology touch every aspect of our lives, changing everything they touch. Astronauts place humanity's footprints on the dusty surface of the moon. Surgeons save lives with lasers, microminiaturized instruments, and prosthetic organs. Fingertip-sized computers revolutionize information processing. Engineers tailor bacteria to produce human insulin and interferon.

“Ninety-five percent of America’s new technology will be developed for transportation, energy, space science, and defense,” predicts Jerry Grey, director of public policy for the American Institute of Aeronautics and Astronautics (AIAA). This prestigious aggregate of engineers annually sponsors a Technical Display, which this year will be open to the public for the first time.

Global Technology 2000, as it has been designated, may be the most ambitious display of aerospace technology in U.S. history.
Downtown air buses will land on top of buildings or enter through openings in the side.

Technology is where the world's future lies, and GT 2000 will show what we're doing about it, he declares. Everything from glittering satellites to wind turbines will be exhibited as well as scaled-down jets, rockets, future space shuttles, lasers, computers, and solar cells.

The display part of AIAA's international annual meeting is being held May 9 to 11 at the new Convention Center in Baltimore's downtown inner-harbor area, only a few miles from the National Air and Space Museum, in Washington, D.C. The museum houses the largest permanent display of aerospace technology in the world.

Inside the five-acre structure—and spilling out onto the parks and
The important thing is that technology, no matter how good, how promising it is, takes time. Harbor nearby—companies like General Electric, IBM, Westinghouse, Hughes Aircraft, Adespatial, Fokker, and others will be showing off their latest wares. From the look of it, a good deal of the world's technological future will be on exhibit. Rockwell has reserved space for its mock-ups of the space shuttle. Lockheed will display images of the robotic Mars rover and models of hydrogen-fueled planes which may someday transport passengers nonstop across the Pacific faster than ever before. IBM's newest computers will be well represented, and Ford Aerospace will display its most advanced interplanetary telephone relay satellites. Intelsat's newest are now being used by 103 nations.

Among the gleaming communications satellites of Hughes Aircraft and COMSAT, the TRW company will exhibit everything from megawatt solar arrays to fusion equipment which might someday take energy
The world's future is technology; G/2000 will show what we're doing about it.

"This is the public's opportunity," says Lawrence Craner, AIA's director of displays. "To peek into the future as it is perceived by the world's leading practitioners of research and development.

For Edgar Cortright, president of Lockheed-California Company, Craner's statement is especially true. The Lockheed executive forecasts an impressive future for air transport: "I believe we will see intra-city and inter-city vertical-take off aircraft that might follow along railroad tracks as their right-of-way. Commuter-type air buses that would fly downtown and either land on top of buildings or fly into openings in the sides of vertical terminals."

Communications, Burton Edelson at COMSAT predicts, will loom even larger as satellites increase in size and power output. Soon, perhaps before the century is out, receiving stations on Earth might be...
By the turn of the century, 5 percent of the power used in the U.S.A. will be solar. 

as small as a wristwatch. "The restrictions on satellite communications," he says, "will not be technological. They'll be economic."

No one at GT 2000 really expects to know our exact future, bright as their hopes are. The fact that something exists in concept, so that one can build a model or prototype today, does not make it currently usable technology, cautions Alexander Ross, president of the Institute of Defense Analyses in Virginia. And Fred Koomanoff, director of the Department of Energy's satellite power systems project division, says: The important thing for people to understand is that technology, no matter how good it is, how promising it is, takes time. 

Below: Windmills are tested at Rockwell International's Colorado center. Far left: Applied Solar Energy's advanced silicon cell will be cheaper and simpler than the photovoltaic cells in the background. Left: Solar panels at Sandia Labs in New Mexico reflect solar rays onto "power tower" to generate electrical energy.
A bold new way of life is outlined by this unorthodox economist who combines widely disparate disciplines into one coherent vision of the near future.

Interview

HAZEL HENDERSON

If someone had put me in Economics I, I might never have fought my way out," Hazel Henderson once said. And the world might never have gained one of its most original thinkers in that "dismal science" economics, particularly as it relates to science and public policy. Without benefit of formal education beyond high school, Henderson is recognized for her unconventional views and illuminating ideas. Her appointments to several prestigious organizations include the congressional Office of Technology Assessment (OTA), where as a member of the Advisory Council she helps draft studies on a wide variety of future-related issues—solar technologies, for example, or the effects of nuclear war. Much in demand as a lecturer and writer, she roams the globe, attending conferences and spreading her vision of a new economics. A native of England, Henderson came to the United States some 20 years ago, married, and began to raise a family in New York City. A power plant across the street prompted her first involvement with environmental issues. She became a founding member of Citizens for Clean Air. Later she worked with Ralph Nader and Campaign GM to bring consumer accountability to the largest automaker. Henderson decided to focus her energies on economic issues and began writing for publications including Harvard Business Review, Saturday Review, and The Futurist. She and her husband, Carter Henderson, moved to Princeton, New Jersey, where they established the Princeton Center for Alternative Futures, an informal conference center, operating out of their home, which has been described as a "mom-and-pop think tank.

In addition to her duties with OTA Henderson has been a director of the Council of Economic Priorities and the Worldwatch Institute and a member of President Carter's Economic Task Force. She is the author of Creating Alternative Futures (Berkeley Publishing), a collection of her essays, and The Politics of Reconceptualization (to be published in September by Anchor/Doubleday Press).

Omni editor Eric Rosen spoke with Henderson as in most conversations these days, the first topic was energy.

*This article was originally published in Omni, Vol. 5, No. 6, December 1982. It is reprinted here with permission from the author and publisher.*
### In the beginning OPEC was vilified as this dreadful cartel. Now some of us realize that it was the best thing that could have happened, and we are praying for them to hold their prices down.

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**Omini**: For more than a decade you've been warning that we are coming to the end of the cheap-energy era. What kind of economy and technology do we need for the era to come?

**Henderson**: We need to shift to a renewable-resource economy. Which implies a shift from our single-minded concentration on physics and engineering to an emphasis on the biosciences and ecosciences. Our goal should be to develop processes with greater thermodynamic efficiency and to align them with long-term ecosystem efficiency. We still have a lot to learn about that.

**Omini**: What do you mean by thermodynamic and ecosystem efficiency?

**Henderson**: Our current machines and manufacturing processes grew in an energy inefficient way because we had cheap petroleum. Our electrical generating systems, for example, produce a lot of what we defined as 'waste heat'—so we built cooling towers to get rid of it! That's a thermodynamic obscenity—spending extra energy and material to get rid of energy produced in the wrong way. Now we have to develop cogeneration schemes to make use of the low-pressure steam or hot water that we once could afford to waste.

Ecosystem efficiency combines thermodynamic analysis with bioscience. If you're seeking ecosystem efficiency, you don't pave over a salt marsh—one of the most productive ecosystems on the planet—for an airport and meanwhile keep adding oil-based fertilizer to hype the productivity of your farmland.

**Omini**: What should we look for in new technologies?

**Henderson**: We should be developing lots of small, rather humble technologies that will give the system a lot more flexibility. That's the trade-off we see in evolution. Success comes from increasing adaptability instead of being set in past adaptations. The industrial mind-set on which the old economics was built is unsuitable for the new view of bioproduction, whose basic principles are diversity and redundancy.

**Omini**: But aren't the renewable-resource sectors following the traditional pattern too? Every analysis of solar cells, for example, counts on mass production to bring prices down, market subsidies to encourage the big companies to get into the field, and so on.

**Henderson**: There will be some of both. We have to go beyond either/or logic: it's going to be both/and. Much good new science and technology are being subsidized almost unwittingly by the old system.

James Yen, at Grumman, for example, has developed what's called a windmill wind machine which extracts energy from a vertical spiral of hoisted air. Maybe it could be installed instead of cooling towers at power plants. Anyway, while Yen was developing the idea, it didn't fit into Grumman's policies and the corporate structure worked to reject it.

There are many 'human enzymes' in the old system trying to figure out how to re-deploy themselves. There are enough craters in the system, enough entrepreneurial spirit, enough free information so that people are beginning to make the changes we need, but the changes are small and local. So they're difficult to identify as a new pattern. They don't show up as the old GNP type of economic growth. I'm sure that much of the renewable-resource sector will in fact be detailed, distorted, taken over to serve old institutional needs and be burdened by costly overhead. We'll see both.

**Omini**: How do these 'human enzymes' communicate with each other?

**Henderson**: By either/or logic. It's a paradox. The old dinosaur institutions have developed an incredible high-technology communication system: computer networks, data banks, and inside the dinosaurs are the 'enzymes' networking around obstacles and communicating laterally. It reminds me in some ways of a jungle-drum system: in some ways of the committees of correspondence that preceded the American Revolution.

The same technology that makes it possible for a multinational corporation, for example, to sell its patent medicines in many countries makes it possible for consumer groups to get in touch across national boundaries and say: Beware of this product, they may be about to dump it on you.

**Omini**: Can everyone be as adaptable as the 'human enzymes'? Isn't the stress of change going to be too much for a lot of people?

**Henderson**: No. I think most people have no particular stake in the old systems: the real difficulty is for the dinosaur institutions that are redefined around old technologies and strategies of energy and material use that can't be sustained. It's those sectors and the people employed there, who feel the stress.

**Omini**: Is the Chrysler 'bail-out' an example of that?

**Henderson**: Yes. I think it's quite typical of what we can expect. We shouldn't bail out the institution and all the stockholders, investors, and managers who enjoyed the ride up. They got their dividends and stock options, we don't have to underwrite their losses.

We should subsidize the redeployment of the workers who are fairly blameless into renewable-resource sectors of the economy. As far as I can see, it's more efficient both socially and economically to support them generously until they're re-deployed, or until the Chrysler board and people, who can turn the company toward production of buses and rapid-transit systems.

**Omini**: Do we need a crisis to knock us over the head?

**Henderson**: Obviously, we don't need a systemic crisis in which everything goes to pot all at once. In such a case people simply freak. They can't deal with it. But small
subsystem crises have social learning experience built into them especially if we encourage public dialogue, such as we have had over the Chrysler question.

Henderson: How has our experience with OPEC been a lesson?

Omni: I think it was the only shock that could make us realize how far, in line with the rest of the world, our energy consumption has been. At the outset OPEC was vilified as a dreadful cartel. Now some of us realize that was the best thing that could have happened to us. Now that the cartel has broken on the upside and there's petroleum selling at forty dollars a barrel on the spot market, we're going to be paying for OPEC to hold the line. We may even realize how much of the OPEC price increase has been simply an attempt to compensate for the dollar's devaluing.

Omni: What are some of the ill effects of our current economic thinking?

Henderson: The two billion six hundred million dollars in claims against Hooker Chemical for what happened at Love Canal or the millions of dollars that taxpayers are going to have to pay to clean up the Three Mile Island reactor. With conventional economics, we've been hiding costs in the environment or in the social system as ill health or as risks to the health of future generations. Now those hidden costs are coming back to haunt us and there's no place to hide them anymore.

Omni: Will paying those costs impoverish other sectors of the economy?

Henderson: Yes, inasmuch as they are past due bills, no longer deferrable. The first thing that companies tend to do in these cases is to go for the "add on" technology-to build cooling towers when they're no longer allowed to heat up the nearest river. For each such trade-off, it's going to take a case by case decision between starting from scratch with a new process and adding on to an existing process.

Omni: Should the costs be borne by the public or by the private sector?

Henderson: Inevitably both are going to have to pay. There's tremendous resistance in this country to even quantifying social costs for example, the annual sixty billion dollar cost of alcohol and tobacco abuse. We don't hire people to do it. But in Great Britain for instance, where the taxpayer foots the whole bill through the National Health Service, many economists are hired to find out who's causing what costs.

Omni: What will those costs do to our national productivity?

Henderson: We should get economists to be much clearer when they throw the word productivity around. Traditionally they've defined it as labor productivity or capital productivity. The whole development of industrialism was to increase the individual worker's productivity by increasing the amount of capital investment and energy per worker.

But on the social side of the picture many other workers were shaken out of the

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system altogether and their productivity tell below zero. They were on the welfare rolls, pushed onto the social cost side of the system.

If you equate productivity with individual workers' productivity and ignore the social costs, then it's no wonder that everyone in Washington is saying: 'We must increase our productivity by adding more capital to industrial processes.' They've gone appropriately from microproductivity to macroproductivity across the whole system.

Omni. The demand for increased productivity is often accompanied by insistence on deregulation. Are they connected?

Henderson. The real trade-off is between technologies that create great social and environmental costs, and thus require regulation to control their impact and more harmonious technologies that don't require regulation in the first place. Nuclear power requires a massive federal bureaucracy for safety policing and waste storage. Local solar and wind power alternatives may involve local zoning regulation, but there's no need for Washington to oversee them.

Again, you have to look ahead to foresee the trade-offs. Deregulation of the airlines lowered air fares, but what are the social costs? Small cities lost major-airline service and were left with idle facilities while airports like Airports became bottlenecks with overloaded traffic controls. There were more accidents on small local carriers. Even if you're flying on a trunk route, you're likely to wind up in an overcrowded flying cattle car. All the new competition has also overstretched airlines financially.

Omni. You make a strong case for looking ahead at the consequences of social decisions. But isn't it possible that too much caution can keep you from taking advantage of an opportunity at the right time?

Henderson. Of course. Just as the fusion energy people are saying that we must have more money for fusion right now or else the energy won't be coming onstream in time, the solar energy people are saying that if we don't push photovoltaic cell development right now we won't get the benefits of that technology in time. They're all lining up and presenting their data, but the answers aren't in the data. You can't get social directions or moral prescriptions from the data.

You can tell when you're reaching a historical watershed because you find yourself going beyond the technical questions to right and wrong good and bad. Why are we doing this? For whom? What are the implications for our children and our grandchildren? For a long time we thought we could push away the philosophical and moral questions, or wrap them up in economic technique and mathematics. We thought cost-benefit analyses could tell us that the greatest good for the greatest number would be served by building a given nuclear-power plant, for instance.

In a period like this one, however, all the technological debates become politicized, and people become aware—my golly!—

that the basic level of politics is knowledge itself. How we define problems, what constitutes a problem, what constitutes proof. It's very basic stuff.

Omni. Are we too splintered a society to be able to get down to debate on that level?

Henderson. No, because these are the realities of moral choice that all of us deal with all the time. We know that our activities visit certain costs on other people. If I do something to further my ends, my husband has to forgo something he might like to do. I think that in the Eighties we're going to see more and more of what I call the politics of reconceptualization. We're going to have to peel back all the mystifications of technique, all the fluffy of data, all of the baroque elaboration of subsidies—the toxicologists tracing various illnesses back to various substances, tracing the costs of x dollars back to Y Corporation—and get down to some eternal human questions that all of us are very qualified to talk about.

Omni. I think most people don't have a stake in the old system. The real difficulty is institutions rigidifying around old technologies and strategies of energy use that can't be sustained.

Henderson. Look at the uses of expertise in Washington today. The interest groups fighting "information wars" hiring intellectual mercenaries and building up their computer firepower.

The question of objectivity cuts deeper. We have a three-hundred-year tradition of enormous success in manipulating the world, based on the premise that human beings can abstract themselves from their situation—a species embedded in an ecological system. Like all other species—long enough to map and manipulate the world. That will continue to be a successful method whenever you want to manipulate the forces of nature and make something happen. And we still need to do an awful lot of it—to step back and trace the thermodynamics of the technologies we use, and so on. But we can't let the success of that method hypnotize us into using it as a total philosophy. It won't tell us what kind of future we want.

Omni. The Apollo photographs of the earth gave many people a strong sense of the global system, a realization that we are animals embedded in a finite ecological system. Why hasn't that realization sunk in?

Henderson. Because of the academic lag all the intellectual investments that have to be written off. People have to recycle themselves which means letting go of old models. And many of them are trying to extract the last amount out of their intellectual investments, their old textbooks, and so on before they finally amortize them and move on.

Moreover we have a vastly overbuilt and overcapitalized educational plant in this country. There are far more colleges than we can ever use, and the potential for using them is only going to increase. We can take absolute disciplines that require complete restructuring, such as economics, and begin to replace them with the kind of skills that people need to manage lifestyle changes and personal growth.

We have everything we need sitting there, waiting to be redesigned and reestablished. The question is, how fast can we create a debate all through the society where there is already an experiential understanding that something new has to be done? So many people are already far ahead of those committed to the old structures that it's like the dinosaur again. The brain is the last to learn what's happening.

Omni. What should we call the new era?

Henderson. It's the Solar Age. People are already calling it that, but they don't realize its full dimensions. Most think it means flat plate collectors on the roof. They have forgotten that the sun is the only source of energy on this planet. And it's driving everything, including the economy. You can't even have a combustion process without those chemical exchanges occurring in the atmosphere.

Omni. Will we be able to change our cost-benefit analyses accordingly? Can we include those biological ideas you've spoken about?

Henderson. We have to. Until a few years ago my big dream was to incorporate into economic theory all of these important new ideas of bioproductivity and the real physical measures of efficiency from thermodynamics. Take the concept of diminishing returns—an idea developed in early economics. Now that concept fits very well with biological concepts of productivity where you see S curves dealing with growth, maturity and decline. Up to a certain point you could take a piece of land and add fertilizers to it and increase its productivity, and then at some point if you kept on adding that additional input you would reach a level where additional increases wouldn't raise the productivity of the land any further. And in fact additional inputs over an optimum level would begin decreasing the productivity.

Omni. Where are we on the S curve?

Henderson. We shouldn't take that highly aggregated view that the whole system is going to hell and we're going off the curve. Instead, we should look for what is new.
We already know the theory, all that's needed is some advanced engineering

HOW TO BUILD A TIME MACHINE

BY ROBERT L. FORWARD

Deep in a subbasement of the White House, President Greatman positioned his right eye against a scanner cup. The wall swung away, and he entered an immense room buried 30 meters below the Ellipse pavilion. Unlike the park overhead, which was littered with splintered remnants of the National Christmas Tree, the subterranean room was barren except for a 20-meter sphere resting in a steel cup that curved into the floor line. Greatman carefully strode up the rising steel curve to a walkway set all the sphere's equator, tilted at a 45-degree angle to the floor below. Bracing himself against nearly half his normal weight, he slowly followed the platform around to the other side, where an operator sat monitoring the controls. She, too, was stuck at an angle to the sides of the sphere, but both she and the walkway seemed level to Greatman. It was the room that sloped away. As he walked, he thought about the astonishing machine beneath him. For the last two years it had let him peer into the future and speak to the past.

Greatman launched the operator a message. He had received it a month earlier and evacuated the entire Eastern Seaboard. Now he tried to assess the warning—to the man he had been four weeks ago.

"I suppose you already know what's on it," he said to the young woman.

"Doesn't everyone?" the operator laughed, her grin blooming like a flower in an earth-brown face.

Three-kilometer meteorite fell. Impact at thirty-eight degrees north, seventy-two degrees west, 12:54 GMT, 22 December 2023; she read. "Just as it was reported in the newspapers at the time—" Greatman handed over the scanner, but before she could speak, she knew he had just sent his past self. He shook his head as the door shut behind him, blocking off the view of the time machine at the center of the room.

A time machine? Impossible. Or so most people think.

She made one last check, then a sprint of power shot an interdimensional short, multihued pulse of high-energy gamma rays down through the super gravity maestros of the key black hole that whirled at the center of the sphere. The warning prompt was measured not in angle or distance but in time—four weeks into the past.

"Thanks, Janet," said Greatman. "Keep an eye on it for me, will you?" He walked down the side of the tank and off onto the flat floor toward the command bunker. There was the east coast of the United States to rebuild, but at least the wreckage had no bodies floating in it—thanks to the message he had just sent his past self! He shook his head as the door shut behind him, blocking off the view of the time machine at the center of the room.
Yet the most respected and tested theories of physics, Einstein's theories of special and general relativity allow us to manipulate time. Although we cannot yet control the energies and masses required to make a time machine, we know the principles behind time travel. One of these days, instead of being mindless slaves to the clock, we will be able to send our time craft on a journey through 60 minutes of time as easily as we now send our spacecraft through 60 light-minutes of space.

For many people, the very idea grates on the nerves. The logical paradoxes that time travel conjures up are almost mind numbing. The first came with Einstein's special theory of relativity, which said that a clock (or human) traveling near the speed of light would operate (age) more slowly than a clock (or twin) that stayed still. This effect is real, not just theoretical. Velocity does slow time. It has been measured by taking two identical groups of clocks, leaving one set at home and taking the other set around the world in a jet airliner. The stay-at-home clocks aged more than the moving clocks did.

Yet when the concept was first discussed, many people refused to believe such a thing could happen. All their practical experience indicated that time was an absolute measure, ticking the same way for everything. The confusion was compounded by misunderstanding the principle of relativity. "Everything is relative and all measurement-coordinate systems are equally good," then why people asked: can't the travelling twin in the rocket be thought of as fixed, while Earth takes the other twin on a relativistic ride?

The resolution of this paradox comes at the turnaround point. Until that point, special relativity says that the aging question is ambiguous. In order to compute the relative times of two objects, you must both be at the same place. When the travelling twin activates the ship's rockets to return to Earth, the coordinate system that had been traveling with the ship continues on its way. After he abandons the coordinate system that he started with, the travelling twin can no longer claim 'everything is relative.' The stay-at-home twin is still with his original coordinate system and thus has not moved, his age for this stodginess is aging at a precipitous rate compared with the traveling twin.

So one way to make a time machine is to find a way to move at velocities close to that of light. Unfortunately, the special-relativity time machine works only one way. You can go into the future more slowly than normal, but you cannot go back in time.

Still, this kind of time machine has its uses. If you were sick and no cure existed for your ailment, a trip in a relativistic rocket ship could keep you from dying until a cure could be discovered. If you had a rich but very healthy aunt, then a few days spent at 99.99998 percent the speed of light could let you enjoy your inheritance while you're still youthful.

There are more immediate applications, however. If you had some hard-to-make element so evanescent that it would decay before you could even measure its characteristics, moving the element from the generator to the measuring machine at near-light speeds would let you do the job. This type of "time machine" is used today in all laboratories that study the elementary particles generated in huge atom smashers.

The processes that generate these particles are so energetic that the particles emerge at nearly the speed of light. Many of the newly generated particles live less than a billionth of a second. If their clocks did not slow down the particles could not travel more than a few centimeters before decaying. Because of their high speed however they age slowly and survive the tens of meters from the generator to the detectors, where they are analyzed.

On account of the detailed scientific analyses of the "twin paradox" problem and the experiments that prove the effect is real, the twin paradox is no longer a paradox. Except for a few who still cherish the idea of an inviolable unchangeable time, the human race has absorbed this unusual behavior of nature at high velocities. Not only do we live with the "one-way" time machine, but we also use it.

But how do you build a "real" time machine—one that goes both backward and forward in time? What Einstein's laws do is that it we collect enough mass in one place, its gravity field will distort the time and space we know. In this region where time is confused, it becomes possible to move ahead or backward through the hours as if they were kilometers. The process becomes easier the mass is moving or if it carries an electrical charge.

We are only beginning to understand Einstein's theory of gravity, but we already have tentative engineering designs for a number of time machines. Theoreticians may complain that such devices would be unstable, and environmentalists may be appalled at the resources that will be needed, but the gravitational engineers of the future will build the time machine if they are given the mandate: the money and the mass.

Einstein's theory allows many shapes for a time machine. It seems that any object that produces an ultragray force can create time-conjugate regions there are some shapes that can produce regions that might be usable by humans. Just how certain it is that a given time-machine design will work depends on how closely its designer has been able to follow Einstein's equations.

One configuration that can act as a time machine is a dense, rapidly rotating object that is collapsing to form a black hole as its spin speed increases to the speed of light. The extreme version of a spinning collapsing star can be described by a rigorous, mathematically exact solution to the full nonlinear Einstein gravity equations. The solution is called the Kerr metric after the reticent theoretician Roy Kerr, who probably was dismayed when he found that the mathematical beauty he had discovered might someday have a practical application.

The Kerr solution describes the gravitational field on the outside of a collapsing rotating mass that is approaching high density. Large stars are rotating masses and as they reach the end of their short lives, they collapse into rotating black holes. One would expect that a real collapsing rotating star will form an elliptically shaped black hole bulging at the equator because of its spin. It is possible (and probably given the human race's propensity for fooling with nature) however that this pancake-shaped collapse could be induced to form a doughnut with all the dense mass out in the rotating ring.

Once such an object is formed, then Einstein's equation indicates that the empty region in the center can be a gateway into time. If you go through the hole in the doughnut, you don't come out the other side. Instead you enter a strange type of hyperspace. Your forward time dimension has turned into a time dimension and the time dimension has turned into a space dimension. If you move in the hyperspace against the rotation of the ring for a number of rotations, you will observe nothing unusual happening. When you return through the hole to normal space-time, however, you will find that you have returned to your original position in space, but your position in time has moved backward a number of years.

Even though Kerr precisely followed Einstein's gravity equations in designing his time machine, there are mathematical theorists who say that the special conditions required by his time machine cannot happen.

Papers have been written to show that even infinitesimal deviations from the special symmetries of Kerr's solution (such as would be caused by an object trying to use the time machine) would drastically alter the structure of the Kerr solution. They con-

We are only beginning to understand Einstein's theory of gravity, but we already have tentative engineering designs for a number of time machines. Theoreticians may complain that such devices would be unstable, and environmentalists may be appalled at the resources that will be needed, but the gravitational engineers of the future will build the time machine if they are given the mandate: the money and the mass.
All of us share the impulse to escape the texture of everyday life. This desire to travel through time reflects our unwillingness to live with things as they are. Time travel enables us to experience the romance of the past and the mystery of the future, to try to change our world.

H. G. Wells invented the modern time travel theme in *The Time Machine*. Wells's hero undertakes his journey out of scientific curiosity: “I saw the moon spinning stealthily through her quarters from new to full and had a faint glimpse of the dancing stars.” Gaining velocity, the palpitation of night and day merged into one continuous grayness—the glistening sun became a streak of fire, a brilliant arch, in space.

In Harlan Ellison's "The Prowler in the City" the time traveler has no choice: "suddenly he was flooded with light. And when he looked up he was in that other place. Paused now only a few minutes after the transfer, he leaned against the wall of the city and recalled the light.”

*Paintings by Richard Cahan and Jon Townley (left) and Hans Ulibarri Olszewski*
Traveling presents unique risks. What if you went back in time and killed your own grandfather? Or what if you found yourself in the position of Philip K. Dick's hero in "A Little Something for Us Tempunauts"? Then it hit him. We're in a closed time loop... we keep going through this again and again each time imagining it's the first time.

There are also blessings: An old doctor in C. M. Kornbluth's "The Little Black Bag" finds a unique medical kit from the future: "The blade sank in, miraculously cutting only the dead tissues... declawing to affect any system or organ except the one it was tuned to, could you say?"

Paintings by Pamela Maxer (left), Hans-Ulrich Oberwalder
There are diverse views on the effects of traveling in time. One is presented by Henry Kuttner and C. L. Moore in "Vintage Season." The physio-temporal course tends to slide back to its norm. That is why it is so hard to force any alteration.

In his story "A Distant Thunder," Ray Bradbury warns that "a little error here would multiply in sixty million years, all out of proportion," changing the future.

And Michael Moorcock writes in "The Hollow Lands": "once a time traveler has visited the future he cannot return to the past if he did he could alter the course of the future."

Today time travel is a dream; tomorrow we may wake to find it a reality. 

Paintings by (clockwise from above) John Harris, Peter Kelton and Michael Whelan.
FICTION
In a society ruled by zealots, minor indiscretions can be crimes against the state

BY FRANÇOIS CAMON

I didn't look before I crossed the street, but I didn't mind, Manhattan is pretty nearly empty of cars nowadays, except when an important Porsche comes along in its Volkswagen or its Mercedes, pushing the walkers and bicycle riders out of the way. The driver leaning on the horn and shouting curses at us. Nobody yells back, we've gotten used to being cursed, these last few years, and to moving slowly. There is no point in showing fear if you're not going anywhere.

I work as a window cleaner, but I'm also a shipping clerk, and on eighty thousand dollars a week. I'm glad to pay the rent and eat. The Arabs treat me well, but they don't pay native workers much, but a one-handed man is lucky to find work anywhere. So I don't complain. Though in one way I'm less of a risk than other men. I have a lot more to lose if I get caught again.

Besides, the job is useful in other ways.

On mornings like that, in late April, walking on the road, the sky is ten times as blue as it ever was in the old days when anybody who had a hundred thousand dollars could buy air. The air smells better, and down some of the wide streets you can see for miles. I'd trade it all for a washing machine or just lights past midnight, but that time is gone forever, because we were stupid. The Arabs here, especially the Arabs here, and the few Americans.
One of these days I'm going to pay them back for my hand—right now I mostly try to survive. Now and then I think about Mexico where I hear that even laborers drive big cars and live in houses with a dozen rooms and all kinds of electric appliances. But the border is closed tight the Republic doesn't care, but the Mexicans are scared of us. We're too hungry. There are guard towers every hundred meters along the Rio Grande, and the big, well-fed soldiers like to shoot Americans who try to go across.

I turned along so I could get past Times Square before the execution. It was announced on the morning broadcast by a mullah who looked like an American, religion was a way out—half our television evangelists saw the light right away and started memorizing the Qur'an. The man who was going to die was a Jew, he'd hidden out during the Oklahoma Transport and had used a false ID card to live in the Holy City of Brooklyn, thus cheating the Law.

I didn't much like the mullah with the blue eyes—there are some things a man doesn't do—but I didn't feel one way or another about the Jew. Jews are Jews and the world is the world. You have to go along to get along—that's always been the American Way I have graduated from sentimental foolishness and that stump on the end of my left arm is my diploma.

A woman brushed against me. Her chador slipped, I caught a look at her face, and a tremendous sexual urge caught me off guard. They say we can't control ourselves and maybe they're right. It wasn't until I walked half a block away that I remembered that she'd been fat, homely and middle-aged. I had a pretty young wife once, but she died in the riots of 69 after President Gray had been assassinated. We'd been married a year.

I passed an American selling skin-darkening lotions and black hair dye out of a pushcart, and I nodded to him. He used to be a high-school civics teacher now—he's an old man who makes a living helping the unlucky ones. I don't use his stuff, but I don't blame the people who do—pale skin and blond hair make it harder to find a job these days or a place to live. Even if the landlord is an American.

It was later than I thought, when I got to Times Square, they were leading the Jew up the steps. He wore dark pants and a white shirt, like an old-time salesman; he was an old man, and he looked frightened and weak. The mullahs took his arms and pushed him down on his knees, the executioner stood behind him, motionless. The old man seemed not to know exactly what was happening, and I hoped they'd give him something. But at the last second he raised his head and spoke loudly and clearly in Hebrew. Behind me someone whispered, "Hear O Israel, the Lord our God: the Lord is One.

I looked around, but the faces were ordinary American faces. I turned back just in time to see the sword carve out a piece of that very blue sky and start down. I closed my eyes, but I couldn't shut out the most clever sound of the blow it echoed from the tall buildings, repeating itself for a long time.

Mounted cops began to clear us out, kicking at anybody who didn't move quickly enough. Most of them were big, beefy, cheerful Ishmael. Our new masters left us our native policing. It allows us to work off our hate and frustration on one another; it works—I hate them worse than I do the Arabs.

I ducked into a doorway to let one go by the bastard was enjoying his work. His club caught a middle-aged man on the side of the head and sent him staggering in a crooked line toward me. I helped him sit down. He was better dressed than most of us a ragged business suit mocked at the knees and too wide for him in the waist. "I'm obliged to you, friend," he said. "You're going to have a nasty bump," I said. "How do you feel?"

I wish I could afford a bicycle, but... on $80,000 a week I'm lucky to pay the rent and eat Pan-Islam Trading doesn't pay much but a one-handed man is glad to find work.

The man was white and sweating, but he grinned. "I've been hit harder. He reached up to feel the place and winced. "I'm Harry Landon," he said. "Michael Stein. I said. He raised an eyebrow which made him wrincle again. "I'm not a Jew," I said. "My great-grandfather came here from Germany in 1819 to get away from the depression. He was a Lutheran.

"I didn't mean anything," Landon said. "But it's an unusual name these days. I'm surprised you haven't changed it.

A man doesn't change his name because some people don't like the sound of it.

"No offense," Landon said. He looked across the square. A terrible thing, he said. On the platform the mullahs watched while a red-haired man scrubbed away the blood. The body had already been removed. I shrugged.

"Don't you care?" Landon asked. "They own the world," I said. "Anyway until the oil runs out Then it'll be somebody else's turn. That's history. People make history," Landon said.

"Sometimes," I said. "Anxiously look at the bright side. You can walk anywhere in New York any time of night. There aren't any muggers or drunks or pushers.

"No thieves," Landon's eyes traveled to the end of my arm; he shut his mouth and looked embarrassed. "That's okay," I said. "I'm not self-conscious about it."

There are a lot of us, in the old days we would have organized ourselves and sailed in Washington for special privileges. Mary Americans, at first, didn't believe how efficient the Law could be. We were used to lawyers and appeals and suspended sentences. That was why they didn't have enough executioners to go around, and General Electric had come up with the Booth. They use only human executioners for capital cases now.


"Anytime," I said. I never see him again. The cops were gone and the square was filling up with people walking to work. Men shuffled along, no hurry to get anywhere. Most of them wore the same uniform, half asleep; half-conscious expression. It took me five minutes to remember where I'd seen him before—in an old National Geographic photo of Navajo Indians. The janitor in my building has crates of old magazines, and I go down to the basement often to leaf through them and remember how the world used to look.

Bob, the janitor used to be a chemist for the state Food and Drug Commission, which is now a committee of holy men. He is the cleverest man with his hands. I've ever known, and he has a little still which is disguised as part of the building's hot-water system. He makes a powerful moonshine out of whatever we can scrounge up for him—potatoes, corn, raisins, Peppermints when we can't get anything else, which is most of the time.

I got to work fifteen minutes late, and nobody gave a damn. It amused the Arabs to see us live up to our reputation for general shufflelessness. "Tomorrow-tomorrow," they'd lie to us with a fake American accent and then they'd laugh like hell. "You have to stay on top of Americans every minute," they'd tell one another when they think we can't hear "or they'll fall asleep on you. They're lazy, but they're clever that's how they got where they were.

I have my corner at the back of the warehouse with an old metal desk, stencil brushes and a computer terminal that works about two thirds of the time at best. Where it is on the blank I type out the waybills with one finger on a Stone Age IBM and file the packing slips in the drawer of the desk. They leave us pretty much to ourselves, little Johnstone and me; he runs the fork lift, and I try to make sure that he stacks the right boxes on the right dock most of the
time. Now and then Ahmed comes down to make sure our end of the building is still there. He's not a bad sort for an Arab.

Sometimes he also comes down to open a crate personally usually one from the Far East by way of California and I have to pretend I don't see the little plastic packages he slips into his pockets.

And sometimes I send and receive little packages of my own - more powerful than Ahmed's. Or may be they're not his heroin probably does more harm to the Republic than the loss of an occasional Mercedes with an important person in it, or explosions in the men's rooms of various government buildings I wouldn't even call us a movement - at best we're just keeping the spirit alive in case one ever comes along. Clerks and janitors and ditch diggers and street sweepers, maybe there aren't more than a handful of us in the whole country. I don't want to know I just send my packages and hope for the best.

When I got home that night I tuned on the TV Everybody gets one, courtesy of the Republic. I think it's for our education. They're second rate GE sets - the picture flickers, the colors are false, and the sound is always fuzzy - but it's something to do until the power goes off at midnight. Sometimes we get the ayatollah speaking his peculiar brand of English sometimes realist dramas about the glories of socialism.

Tonight they showed a film of the execution they had looped out the sound so that although the old man's lips moved in the close-up nobody could tell what he was saying. When the sword went up, I reached over and shut off the set and climbed down the stairs to see Bob.

He handed me a glass "This is about the last of the old batch," he said.

It had a slight yellow tinge and tasted bittersweet. Like fuel oil but it made the world a good deal more tolerable.

"The next one should be better," he said "It got ten pounds of real cane sugar to puff in it.

I picked up an old Newsweek and leafed through it carefully. It was a January 1950 issue and the lead story was President Grey promising to close down the last five nuclear power plants. They had a picture of him sitting cross-legged on his desk in the Oval Office, smiling at the secretary of the Interior. She was smoking a cigar. The way was the "days." Bob said.

"I wonder why she shot him," I said.

Well if it hadn't been that it would have been something else Bob said. "People simply figured it would go on forever that the scientists would keep on inventing things to let us live the way we were used to. Even after San Onofre melted down, the only people who really bowed were the ones who'd had relatives in Oceanside or Laguna Beach."

"California," I said.

Bob looked at me. "It was never that good," he said. "Not even before."

"Sure it was," I said.
Arabs are terrific as detectives, they're useless. I could do this for a hundred years and they'd never catch on.

Little Johnson went around happy all week. "What did we ever get from helping them in the old days," he said. "Nothing but a lot of static and interfering with our politics. I'm glad they're gone."

"Hurry up with your lunch," I said. "We've got work to do."

Ahmed said they might give us a raise. He snapped his lunch bucket closed and went off to find the forklift.

"Stop that damn whistling," I said. "You're driving me crazy."

The next week I couldn't stand it anymore, and I went back to find Harry Talking to him made the world a little more tolerable, like Bob's moonshine, anyhow he might not have been caught. He sure didn't look like the Jews in the TV plays with their dark clothes and their funny way of slouching along.

He was on our same old bench eating his beans and bread. The leather pouch with God knows how many diamonds and rings and bracelets and other precious things in it was lying beside him, as secure as if it were in a vault. Nobody steals anymore—it isn't safe.

"How come they didn't get you in the first place?" asked. "I thought they went through the computer files and found all the Jews."

"Do you want to know?" Harry said. "I made a place for me on the bench."

"No. You're right. Forget it. Let's talk about the weather."

In late October the city is sometimes so beautiful that we can forget for a while that it isn't ours anymore and we're just tolerated here because we're cheap labor. White-puffy clouds hung in the sky like personal blessings from Allah the air this noon tasted like cut grass and the sea the Crescent and Bars rippled and snapped in the breeze over the doorways of the buildings all up and down the street. Even the cops looked a little bit happy.

In California the weather is sometimes like this for months on end. We could pick oranges right off the trees."

"I must have been something," I said. "You ought to see it."

"Sure. I'll just buy a ticket on the next plane."

"It isn't easy as it was before, but it can still be done. He wouldn't tell me more than that, though. I had to spring for a while. Next thing to paying back some Arab for my hand."

The thing I'd like most in the world would be to see California once. All in good time, Harry said. Maybe someday you'll get a chance.

"Tell me," I said. "Of all the things you remember from before, what do you miss most?"

The food. Harry said "I never have enough to eat now. And even what we get is miserable. Inedible. I'm sick to death of chili and beans."

"The Mexicans used to love them," I said. "Maybe the Americans will, too, in another hundred years. Right now I'd give anything for a steak. I got depressed sometimes just because I know I'll probably never eat one again. What about you?"

"I don't know. I was still in college when things started to go bad and I mostly ate peanut butter and yogurt anyway."

"Look over there," Harry said. "On the corner of that bench. We sit here dreaming about food and they've got so much they can leave it lying around for the pigeons."

"It's an apple. I said. "Do you know how long it's been since I tasted an apple?"

It was a little scrappy yellowish green fruit lumpy and misshapen but it made my mouth water. So I had to keep swallowing "I'm going to eat it," I said.

"Better not," Harry said.

"Come on," I said. "A lusty apple. Those bastards can buy a bushel of them anytime they feel like it. Who's going to care?"

"I could already taste it. I took a small bite and turned to grin at Harry he was gone."

"Something touched my shoulder."

"You!" the cop said. "His stick tapped me on the ribs. "You! Is that your apple?"

The little kid beside him couldn't believe he had been more than twelve under the handsome his brown face had the expression of one who owned the world and knew it."

"It's mine," he said. "This man is stealing it."

"No," I said. "Wait a minute. You don't understand."

The kid pointed to my left arm. "He is already a thief," he said.

The jails aren't crowded. Nobody stays in them very long. The Law was invented by a nomadic people, it doesn't believe in locking up a man for punishment. The cell was reasonably comfortable and very clean. The guards were Arabs. They weren't brutal and they weren't friendly. They treated me as if I were already a corpse.

The dinner was better than anything I'd been able to afford in several years: there were actual chunks of lamb in the stew I was just finishing when the door slid open and a guard stood aside to let Bob come in.
Blast! What do you do if your own business? For my own part, I'd appreciate another mug of this excellent beer.

Chairs scraped in agreement as all the men stood stretched and moved to the bar. Modell drew beer smoothly chinking drinks on the board on the back wall—everyone but Smith was a local. The innkeeper even broached a new cask without noticeable delay. Several of the company went out by the rear door and returned facing their trousers. There was a brief pause as everyone settled back around the fire. Then Scottie swallowed scowled and said belligerently, "All right, what about the Changelings?"

"Pardon?" The traveler's eyes were friendly above the rim of his mug, but there was no comprehension in them.

"Oh come on!" the local sard, flushing in embarrassment. "You know about the Changelings. Everybody does. The Blast made them. They were men before but now they glow blue and change their shapes and walk around like skeletons. All bones!" Scottie lowered his eyes and slurped his beer in the silence. At last he repeated, "Everybody knows.

Gently as if the suggestion did not appear as absurd to him as it suddenly did to everyone else in the room, Smith said, "I've seen some of the Strike Zones. I guess I've said that there's nothing there. Friend. The destruction is total, everything. It isn't likely that anything was created by the Blast.

The Blast changed things. We can all agree there said Carter unexpectedly. Eyes turned toward the policeman seated at one corner of the hearth. Random change. Carter continued to muse aloud. "That'll generally mean destruction yes. But there was a lot of power in the bombs and a lot of bombs. So much power that... Who knows what they could have done?"

Smith looked at the policeman. He nodded again. "Power yes. But the chance that the changes cell by cell, atom by atom would not be destructive. That's a billion to one against. Mr. Carter."

"Well, the books say there were billions of men in the world before the Blast. The policeman said spreading the fingers of his left hand palm upward.

The traveler's scarred left hand mirrored the policeman's. "It's a long world," he said, as you must know and I surely do. He drank, smiled again, and said, "You're familiar with bombs; it would seem. Friend. I've heard talk in my travels that there was a stockpile of bombs in the mountains around here. Do you know that story?"

Carter looked at Smith with an expression that was terrible in its stillness "Modell," he said in the silence, "It's time to throw another log on the fire." He paused. The innkeeper scurried to do as directed. "And it's time," the policeman continued, "to talk of other things than the Blast. What sort of game do you find in the Hot Lands for instance?"

"Well I snare more than I knock on the head with my sling," Smith began easily, and the room relaxed a little.

They talked and drank late into the night. Smith told of gnarly woods, and of following miles of trails worn no higher than a hog's shoulder. The locals replied with tales of their farms in the river bottoms, managed for them by hirelings, and the wealth they drew from shares in the smelter's profits. Few of them actually did any of the heavy, dangerous work of steel production themselves. Moseby was a feudal state, but its basis was the power plant, not land.

When Carter finally left, only Scottie and another local remained in company with Smith and Modell and the talk grew looser. Finally Scottie wheezed, "They drift in here to Moseby, up the river and down. You're..."
the first across the mountains boy I'll tell you. We put them in a field or the scenery of the hills. But they're not Moses, they're not of the Assembly. We've got the power under the chief and the police is who keep the Light, and then—

Modell touched the line of Scottie's jaw, silencing him. Scottie's surprise bloomed into awakened fright. "You had enough tonight, old man," the innkeeper said. "Time for you both to get home and for me to get to bed."

"And me," Smith agreed. Modell had already brought out blankets and opened a side bench into a cot. "Though if I like a leak and, say a walk to settle my head. If you leave the door on the latch?"

Modell nodded dourly. "You've been listening to that fool Howes and his talk of the guards across the Assembly. Him with a wife and six children too. Well don't try to bring any back here with you. They should know better but if one didn't it'd be the worse for both of you."

The innkeeper blew out one of the lamps and moved toward the other.

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Smith unraveled in the open ditch behind the building letting his eyes readjust to the moonglow. Then he began to walk along the sewer with a deceptive purposelessness. In the shadow of the house nearest the creek he paused, eying the nodding guards across the gorge. The traveler took off his boots. He ducked into the ditch and used the cover to crawl down onto the creek bank.

The rock was steep, but it was limestone and weathered into irregularly enough for Smith's practiced fingers to grip. Smoothly but without haste the traveler slipped along below the line of sight of the guards at the power plant. When he reached the bridge trestles he paused again, breathing carefully. His hands examined the nearest of the hand-split oak timbers tracing it from where it butted into the rock to where it crossed another beam halfway to the stringers. Smith swung onto the trestle and began to negotiate the gorge like an ant in a clump of heavy grass.

Any sounds the traveler might have made were muffled by the creek. Smith edged left toward the west corner of the building. The wall there was built almost to the rim of the gorge. Smith's clothing matched the color of the wet stone so that his outline was at least blurred for a potential watcher from the village, but lack of alariness on the guards' part was his real defense.

Smith raised his head. Both guards were nodding in their chairs, crossbows leaning against the doorposts beside them. The traveler swung up lithely. A step later he was hugging the power plant's west wall. The stone humming.

The building was as massive a construction as anything Smith had seen created after the Blast. The walls were dry stone using the natural layering of limestone and their one meter thickness to attain an ade-

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quarte seal without mortar. Their weathered seams made it easy for someone of Smith's strength and condition to mount the five meters of blank wall to the lighted slits just below the roof. The interior was much as the traveler had expected it to be much as he had seen it before here and there across the face of the world.

Six huge electric motors were ranked below him. They were being used as generators, driven by a complex pattern of shafts and broad leather belts. Only one of them was turning at the moment. When the smelters were working at full capacity and called in turn for the maximum output of the plant, the room would be a bedlam of machines and their attendants. Now one man and a woman were sufficient. The light of the machina lanterns illuminating the chamber may have exaggerated the attendance, but they certainly saw less of the sun than the villagers across the stream did. It was hard to believe that control of this apparatus was left to slaves. Yet it was even more unlikely that freemen who knew what they were doing would enter the chamber below.

In the center of the north wall, built against the living rock of the mountainside, was the reactor.

Its genesis was evident. For the black hulls of ten fusion bombs were ranged along the partition wall to the east. Smith, his head framed in the narrow window, licked his lips when he saw the bombs. They would no longer be weapons. The plutonium of their fissile cores would have decayed beyond the capacity to form critical mass when compacted. But those cores, taken from their cocoons of lithium hydride, and the inner baths of deuterium could still fuel a reactor.

The latter was an ugly mass of stone blocks, overshadowed by a manlike der- nick. Steam from the reactor drove the pistons of a crude engine. Unlike the pie Blast electric motors, the steam engine had been manufactured for its present purpose. Inefficient, it leaked vapor through seams and rope gaskets, but the power to create steam from water was virtually inexhaustable on the scale required here.

Manufacturing skill and not theoretical knowledge had frequently been the brake on human progress. Leonardo da Vinci could design a workable aircraft, but no one for four hundred years could build an engine to drive it. Nuclear power technology was so simple, given the refined fuel and expendable human to work it, that an age that could not manufacture smokeless powder could nonetheless build a fusion plant. All it would have taken was a weapons stockpile and a technician or two from Oak Ridge, vacationing in the mountains at the time of the Blast.

It was what Smith had come to learn.

There was a new sound in the night. A score or more of men were thudding across the bridge to the power plant. Smith ducked his head beneath the sill of the window. As he did so, the siren on the roof hooted ferally. Knowing that there was no escape downward if he had been seen, the traveler stopped sideways and began to clamber up between a pair of the windows. As his fingers touched the edge of the slate, a voice from below shouted, "There he is!"

Smith gathered himself to swing onto the gently sloped roof. Something tugged his knuckles. He looked up. The muzzle of Carter's M16 stared back at him. The policeman smiled over the sights. "I saw something block one of the plant windows," the local man said. "I thought it might be worth walking the guards for. New friend, you just climb down easy to where the people are waiting, or me and the boys here won't wait for the ceremony."

The pair of guards flanking Carter had faces as tense as their cocked crosstabs. Smith shook his head ruefully and descended into the waiting manacles.

The siren gave three long cries as the guards marched Smith back across the bridge. Citizens warned by the initial signal began walking out of their houses the men armed the woman bleak as grey steel. They clambered toward the shrouded platform across the long axis of the Assembly from the bridge. None of the citizens seemed to want to be the first to reach the common destination. They dwindled in pairs and threes turning aside as Smith and his captors passed among them.

The chef and the remaining policeman had hurried up the steps to what was clearly a covered altar by the time Smith reached it. Cords fluttered as the canvas roof was gathered within the screen of hoardings built on a base of stone blocks. Something mechanical purred and paused. Sparks hissed about the power line strung to the platform along a line of low posts on the western edge of the Assembly. "On up," Carter said smiling. He tweaked Smith's manacles toward the steps. The guards were taking position at the base of the altar facing out toward the Assembly. Despite the siren calls, there was no sign of life or movement from the shelter and its associated buildings. Their blank walls were more than a physical reminder of the grip the freeholders of Moseby held on the minds and lives of those who would work in their village. The business tonight was their business of a bargeman or a factory hand.

Smith mounted the steps. Two policemen received him holding their rifles by the pastol grips as if they were still functional weapons. Well, perhaps they were.

There were other improbable things in this place.

The moonlight was shadowed by the filmy walls. It gave only hints of the enclosed area. The policemen in their ragged uniforms two large vertical cylinders, the one mounted somewhat higher than the other and at the front of the platform. A wooden block the height of a man's knee.

There, muttered one of the policemen guiding the traveler's neck onto the block. No force was necessary. Smith was as docile as a babe at its mother's breast. Carter took a quick lashing from Smith's right wrist to a staple set for the purpose in the floor.

"If it wasn't that you know too much," the policeman said conversationally, "we'd let you spend the rest of your life inside the plant. But somebody who's traveled as you have seen what we have, don't want to be like Samson chaining you in the temple so you can bring it down on us, hey?"

"Tie him and we'll get this over with," the chief growled.

Carter unlocked the manacles and bound Smith's left wrist to another staple. "It was a good idea when they chopped muties here every week," he said. "It's a good idea now. The ceremony reminds us all that it's us against the world and all of us together. I'll take the ax if you like.

Smith facing the panels could not see the exchange. The air licked his neck and cheek as something passed from hand to hand between the men. "Drop the walls," the chief ordered, "and turn on the light."

The pins locking together the corners of the hoardings slipped out. The panels arced down simultaneously in a rush of air and a collective sigh from the Assembly. The purring of an electric motor awoke under the platform, rising and becoming orrible in the absence of competing sound. A motor, drive belt moaned then the motor was buried in a sudden crackle and white light played like terror across the upturned faces.

Smith twisted his head. The policemen stood in a line across the width of the platform. Carter in the middle gripped the hilt of a fire ax. Its head was still darkened by flecks of red paint. He glared at the traveler. Behind the rulers of the village glared another burst of lightning between the static generator's heads. The polished casings of a pair of fusion bombs. No objects could have been more fittingly symbolic of Moseby's power. The Van de Graaff generator provided a crude but effective way of converting electricity to light. Its DC motor pulled a belt from which electrons
were bombed into one bomb casing. The static discharges to the grounded casing were all the more spectacular for being intermittent.

"You still have a chance to save your selves if you let me go," said Smith, shouting over the ripping arcs. "There is no punishment too terrible for men who would use atomic power again, but you still have time to flee!"

Carter's smile broadened. His teeth flickering in light reflected onto his face. He reared, "We dedicate this victim to the power that preserves us all! And he raised his ax.

"You fool!" Carter shouted to the traveler. "You did not try to slide back from the black even as he watched a multiple discharge strode the edge of the descending ax. The hungry steel caught him squarely, searing like a shard of ice through his flesh. His vertebrae popped louder in his ears than the hollow report of the blade against the wood. The ax head quivered, separating all but a finger breather of the traveler's neck. He blinked at Carter."

The policeman rooked his blade free. Static discharges dazzled him at three-second intervals. Smith felt a line of warmth as his Blast charged flesh knitted together again while the steel withdrew.

Still kneeling, the Changeling turned toward the crowd. "People!" he shouted. "Whatever it costs men today men tomorrow must know that nuclear power is death! It made this world what it is. It is the one evil that cannot be tolerated ever again!"

"We could all tell they weren't burning coal couldn't we?" Ssu-ma added.

The three travelers began grabbing through the night through the smoke and the screaming. "I don't think we've ever checked whether the Ocone plant was still operable. Smith said it'd be a good time to see."

Kozinski shrugged. "We ought to get back to England some time. It's been too long since we were there."

No there's time for that. Smith argued. Nobody there going to build a fusion plant as long as there's one man left to tell what we did when we found the one at Harewai.

A pair of burning buildings lighted their path, sweeping the air clear with an angry updraft. Kozinski squinted then reached out his hand to halt Ssu-ma. "Your birthmark," he said pointing to the star shaped biotch beneath the girl's left breast. "It used to be on the right side."

She shrugged. "The rocket just now I suppose."

Kozinski frowned. "Don't you see? If we can change at all we can die someday."

Sure. Smith agreed. "I've got some white hairs on my temples. My hair was solid brown the when I went to New York."

"We'll live as long as the world needs us. Ssu-ma said quietly touching each of the men and guiding them onward toward the trail back through the mountains. The steam and the night wrapped them, muffling them. Through their words came. After all what sort of men would there be in the world if it weren't for men like us?"

And all three of them spoke the final line of the joke, their voices bright with remembered humor. "Men like us!"
Future Genders

Continued from page 73

In her 1979 book The Transsexual Empire: The Making of the She-Male, Dr. Raymond argued that transsexual surgery is nothing less than an antisocial activity that promotes the worst aspects of patriarchal society by encouraging adaptation to its sex roles. Because transsexualism so emphasizes a dichotomy between women and men it "constitutes a sociological program that is undercutting the movement to eradicate sex-role stereotyping and oppression in this culture.

She singled out John Money for having contributed a "pseudomechanics" in transsexualism's defense — a new theory of the social nature of sex-role differences that is just as immutable (and absolute) as older biological natural law theories. Raymond cites as an example Money's view that gender identity is irreversibly fixed by the age of about eighteen months.

Up to a point, Money agrees. "You can't ignore the fact—if you want to say it this way—that a sick society produces transsexualism, or any other sexual problem he says. "But you can't say to hell with all those poor suffering individuals. I'm going to clean up the society first. You do both together don't you? The aim is that you would just keep on treating the suffering while at the same time you endorse the perpetuation of the society that creates it."

He does not intend, Money says, to endorse the perpetuation of that society. "The whole purpose of paying attention to transsexualism is to force society to change its entire attitude toward, for instance, the sex education of its children and its attitude toward normal primates sexual rehearsal play in infancy."

Children's sexual rehearsal play is a topic about which Money may be more zealous than he is about any other subject. Projecting on the classroom screen a picture of young monkeys playing at coital sex he wonders aloud, "If sexual rehearsal play is so essential to psychosexual normality in these young males, then what on earth is it that we're doing to our children by prohibiting and punishing sexual rehearsal play?"

"I think that we produce all the psychosexual disorders all of the sex offender disorders get people thrown in jail because instead of encouraging children to develop normal heterosexual play patterns we encourage them to develop no sexual play patterns at all. That's a hypothesis that-comes out for further research which I suppose one day will be done," he tells his class as he projects slides taken secretly by telescopic lens of a boy about five, with his pants down, mounting a girl slightly younger.

Money's emphasis on "copulatory sexuality stands in sharp contrast to his own remarkable vision of the variety of human sexedness. It suggests that, like the society around him, he is committed to maintain the social division between people with the act of coitus as the bottom line. Unlike society at large, however, Money recognizes that none of the apparent differences between humans really justify an absolute division of the human species into two sexes. But like society Money has chosen anyway to divide people by a single variable the presence of a penis large enough for intercourse.

So where do John Money's insights lead? What is the future of human gender identity? "I wouldn't want to be dogmatic about it," he says, "but I think the evidence rather strongly suggests that if you have a society in which there isn't a hangup about children's sexual rehearsal play you're going to cut down on the developmental deferentiation of gender-identity disorders of every type.

Would a society that is less hung up on the separation between 'male' and 'female' have the same advantage? "Well," he replies, "I don't think that particular thing alone—what do you want to call it? the androgyny factor—necessarily has much to do with it. Androgyny doesn't do away with pansexuality and alluvia does it?"

Science, however, may at least as a fixed part of our lives.

Johns Hopkins, the site of Money's first sex-change operation decided in mid-1979 to stop performing the surgery in response to a study by psychiatrist Jon K. Meyer Meyer found that there was no appreciable difference in "adjustment" between patients given the operation and those who applied for a sex change but never got one.

Even before that, however Money stated I don't think sex-reassignment surgery with hormone treatments will continue to be the method of choice for treating transsexualism. There's going to be such an explosion of knowledge of how the brain works—about the physiology and transmitter chemistry of pathways that mediate sexual function and identity—that there's no limit to the science-fiction things we will be able to do.

In his class, he describes the cleaner future species that can change its reproductive sex. "There will come a time when biologists figure out the endocrine and cellular mechanism by which that sex change takes place," he predicts. "Once the biochemistry is understood we'll figure out how to do it in mammals. The next step will be to do it in human beings. And transsexuals would be profoundly grateful if you could bring about that kind of change of sex—a change in fertility and breeding power too."

Will our multi-sexed nature than find expression sensually and societally? Ironically, Dr. John Money the man who revealed how astonishingly varied human sexuality is, cannot see where his discovery leads.
what's growing, and what has real potential. Those can go on a new S curve but in a completely different place.

Omní: Will we have a multieconomic phoenix rising from the ashes of Keynes and his heirs?

Henderson: Yes, I think so. The main body of traditional economic theory can help with quantifying all of our social costs. But it will finally bog down when the understanding dawns that all economics was ever concerned with was the monetized sector. Economists were hypnotized by this abstraction called an 'economy,' while there really is no such thing as an economy, there is a sociotechnical system embedded in an ecosystem.

Omní: How will problems affecting the industrial nations affect the Third World?

Henderson: The Third World has been caught in the same debate between capitalism and Nationalism that has occupied the Northern Hemisphere over the last several decades. They have two very clear examples: the apparent—almost hypnotic—successes of the West and the Marxist way, which clearly points out the anomalies of the Western way of life. Most Third World leaders now seem to be talking of a third type of approach, perhaps something like Sweden, which has a very ingenious mix of private enterprises and public control. They are looking to pick and choose the best from both worlds—to see where the rubber really hits the road—and create something that fits into their own cultures.

Omní: Could technology assessment help us cross the barriers we've been talking about? Turn everything around so we can speak and plant the seeds to let the flowers bloom?

Henderson: I think that it has enormous potential. I've been on the Advisory Council of the Office of Technology Assessment ever since it began six years ago. I've seen that technology assessment used in an interdisciplinary approach with economics only one part of a much larger patternning of problems. There was tremendous potential for remapping the situation in such a way that we could come up with all kinds of innovative policy alternatives. Today policymakers are stuck with using old maps to define the problems in the same old way which means they are going to keep redoubling their efforts to do the old thing that already failed. The alternative is to put on a different pair of disciplinary spectacles and see a new pattern and reconceptualize the problem—or even discover that it isn't the problem at all.

The Office of Technology Assessment is one of the few governmental agencies where that questioning and the reconceptualizing have been institutionalized. One of the ways this worked was to insist that persons and groups in society affected by various technological choices—be it necessarily benefiting from them—be included as representatives on the advisory panels for such studies. Along with persons possessing the more traditional kinds of expertise, yet this information on impacts requires a very real kind of expertise. Is social feedback or anticipatory social feedback forward? The Office of Technology Assessment creates a better definition of the problem, I justified the inclusion of people who don't have orthodox degrees, such as consumer and labor representatives and environmentalists. Their experience is vital to securing a definition of the problem.

Omní: Will these people have less of a sense of isolation from the people defining the problems?

Henderson: Yes. You see what happens is the people from the traditional disciplines—the physicists and the engineers and the economists who normally have been involved have been isolated and have a sense of unreality of how these technological ideas really impact on human beings in real situations.

Omní: Would it be mainly because they're not quantifying the things we've spoken of like bioproductivity?

Henderson: Right. Those old disciplines are too specialized and do not include the second and third-order consequences. We had a terrible problem when OTA started in that so many of the contractors who came in were just putting old wine into new bottles. They would come in and swear on a stack of Bibles that they knew how to make technology assessment. But when you really unraveled it and you examined their assumptions, you'd find that what they were talking about was technological and economic feasibility which is very different. That's not technology assessment at all.

It's very unsound to look at a problem and then jump to a methodological conclusion or not even to think about the method that you're going to use. There is no justification to using cost/benefit analysis merely because that's the thing that you happen to be trained in. A good technology assessment examines real world problems case by case and says, 'First there's the technological feasibility and first-order consequences of going in this direction, then there are the second-order problems when a technology diffuses. What happens when it is used in an institutional framework of commercialization. What kind of problems does that create?'

You need to synthesize the answers to these questions and whatever environmental health and safety impacts there may be using four or five different models and methods. That's one reason why the advisory panel should incorporate people with all kinds of viewpoints and biases. Some will have a physics bias, some an environmental and some an economic or social perspective. We've learned that there is no such thing as 'objective' science or value-free technology.
out of thousands of dollars in prizes, all of which later were donated to charity and to refurbishing the dorms. Honoring the hamburgeurs’ brilliance, a delighted night Burger King awarded the intrepid students a $3,000 scholarship for their school.

But the proudest moment in the history of Caltech was certainly the Great Rose Bowl Hoax of 1981. pulloff during Pasadena’s most sacred civic event and witnessed by millions on national television.

The stunt was conceived by bored students in Lloyd House dorm during Christmas recess. The first step called for a student, disguised as a high-school reporter to conduct a lengthy interview with the flattered student director of halftime events for the University of Washington, a Rose Bowl contender that year.

The student interviewed the unsuspecting director on how the planned card stunts were arranged and later managed to make off with one of the instruction sheets. Back at Caltech, the students worked night and day meticulously reworking and counterfeiting all 2,300 instruction cards. On New Year’s Eve a commando team broke into the director’s hotel room and pulled the switch.

At halftime of the Rose Bowl game, the sly Washington card section went through their first nine stunts without a hitch. On the tenth, the director called for a big Washington, but to his amazement, the cards came up Caltech. Nonplussed, he hurriedly ordered the next trick, which was to spell “huskies” slowly across the section. It came out “Seawolves.” The director became frantic and called for the music sequence—a picture of the Washington Huskies mascot. Up popped a beaming Caltech beaver, and all semblance of order was lost as the shattered card section gave up. It was a shame for the next trick, a patriotic appeal to “Buy Bonds” had been transmuted into “Buy Blondes” by the Caltech students.

It’s noon and reports are flooding in from the field that more senior stacks have joined the growing casualty rolls. Pyka’s room was broken into hours ago and a counterstack is already in progress.

In another dorm Aristotle the snake is gingly lowered on a sling through the transom into the room. The snake responds beautifully and wraps himself around a box containing the key. He’s pulled back through the transom and another finesselike pack bites the dust.

The Blacker bear bottle-laser stack is declared “out of order.” While smoke fills another dorm corridor, several wimps try toocht a fire caused while they attacked a heat-seeking finesselike stack. An enthusiastic sophomore had poured hot wax into the lock, unintentionally setting fire to a pile of underwear on the other side of the door.

When they encounter a prank, the good gray heads of Caltech’s professors only nod appreciatively. They can hardly criticize having engineered stunts as wild as any dreamed up by their students. Richard Feynman, theoretical physicist, and Nobellaurate is also a bongo drum player and master scatpacker. While working on the Manhattan Project developing the A-bomb, Feynman practiced on safes leaving ‘Guess who?’ notes among the top-secret papers.

Another faculty member, Harry “The Horse” Gray is a brilliant chemist and bon vivant who frequently enlivens his complex lectures by delivering them in a voice you believe a horse suit.

How does all this eccentricity sit with Caltech President Marvin L. Goldberger? A respected physicist, he possesses a dignified carriage, a proud profile, and a mane of white hair that would be the envy of any senior statesman. However, the good doctor is well suited for the job of tracking the strange orbits of Caltech’s students. He, too, has that Wizard of Oz sparkle in his eye. The students recognized him immediately after his arrival last year from Princeton and they satd him by tossing him into the Pacific Ocean. Not to be outdone by the informal welcome Dr. Goldberger later made his own entry into Caltech legend.

To celebrate Einstein’s hundredth birthday, President Goldberger donned a riding habit and polo helmet and triumphantly piloted a rented elephant along the same campus walks where the gentle Einstein had wandered on his visits. Later wielding a saber and with a samurai yell, Goldberger expertly slashed into a threethized birthday cake.

All are agreed that the master faculty jokester is the puckish Nobelist Murray Gell-Man, the theoretical physicist who bestowed the unlikely name quark on nature’s fundamental unit of matter. From now into infinity whenever sober physicists gather to discuss the serious business of the nature of the universe, they will be required to make a sound not unlike a lovesick stork.

The FBI was called in when it was learned that Caltech students were tapping the professors’ phones. Actually, the undergrads had tapped the Strategic Air Command hot line.

By 4:00 PM, most of the stacks have either broken into or broken down. Isolated knots of frenzied underclassmen are working to beat the clock on the remaining puzzles. Outside Page House, the cns of a 22-tile is heard as wimps posed on an adjacent roof, fire into an open window, striving to hit the more diverging parts of another Penthouse. A centerfold breaking circuits that will spring the lock.

In an older dorm three wimps are locked in mortal combat with a computer console battling an intricate program that requires them to enter a series of mythical codes where they face an electronic monster named Ork. Two wimps can only watch having already been ‘davoured’ by Ork.

As each stack is liberated, the group in front of Barbara Hsu’s room grows. Above her door a transom has been converted into a three-dimensional maze with 60 interconnecting coded compartments. With only three obscure modern poems providing clues and with a little white mouse occasionally appearing at the opening, the wimps deduce they have to force the mouse into one compartment which will close an electrical circuit and open the door. But which compartment? If the mouse knows, he’s not talking. Nor is he cooperating, having eagerly accepted the numerous bread bribes the wimps have offered only to retreat into a back corner of the maze and promptly fall asleep.

An impenetrable web of thousands of feet of string will greet another returning senior while Cohn, senior class president, will discover his new roommate—a 1,000 pound rock sculpture carved gleefully away from a formal garden.

Pyka’s room is rescaled with enough steel to build an aircraft carrier and decorated with the immortal words Caltech students share with every other college student: “Est it, Werner.” Once inside, Pyka will also discover 400 cases of bottles filled with water. But he’ll have to climb through the wall and crawl through a dresser drawer to get in.

No one is quite sure why Caltech developed into such a den of tricksters. Some say it’s a fusion of the students’ natural brilliance and California’s nutty tradition. Others claim that confronting challenges like Ditch Day is a worthy part of the students’ training like a lion cub engaging in mock combat. When they graduate to become full-fledged tolerators in the halls of science, they may be inspired in their efforts by remembering “Once there was this door.”

Ditch Day is over and the young prodigies are weary from their mental workout, but you’ll hear from them again, if not directly then indirectly through the machines they’ll build to keep our technological society afloat. After all, anyone who can break into a complex finesse stack can surely solve small problems like the energy crisis.

Three Mile Island, or a falling Skylab.

However they were stopped cold by a mouse.
LOOKING TOWARD SPACE
CONTINUED FROM PAGE 98

...and run the risk of being abused.

But I also believe that there are moments in history when challenges occur of such a
compelling nature that to miss them is to
miss the whole meaning of an epoch.

Space is such a challenge. It is the kind of
challenge William Shakespeare sensed
nearly 400 years ago when he wrote:

There is a tide in the affairs of men
Which takes at the flood, leads on to for-
tune.

Omitted, all the voyage of their life
Is bound in shallows and in miseries.
On such a full sea are we now afloat.
And we must take the current when it
serves.

Or lose our ventures.

We ask great peril if we kill off the spirit of
adventure, for we cannot predict how and
in what seemingly unrelated fields it will
manifest itself. A nation that loses its for-
ward thrust is in danger and one of the
most effective ways to retain that thrust is to
keep exploring possibilities. The sense of
exploration is intimately bound up with
human resolve, and for a nation to believe
that it is still committed to forward motion is
to ensure its continuance.

I doubt there is a woman or a man who
honestly believes that the United States
could ever fall backward as other nations
have within our lifetime. Intuitively we feel
that we are exempt. Yet for us to think so is
to fly in the face of all history, for many
nations at their apex were inwardly
doomed because their willpower had
begun to falter, and soon their vulnerability
became evident to all. Enemies do not de-
stroy nations; time and the loss of will bring
them down.

Therefore, we should be most careful
about retreating from the specific chal-
lenge of our age. We should be reluctant to
turn our back upon the frontier of this
epoch. Space is indifferent to what we do; it
has no feeling for design, no interest in
whether we grapple with it or not. But we
cannot be indifferent to space, because the
grand, slow march of our intelligence
has brought us, in our generation, to a point
from which we can explore and understand
and utilize it. To turn back now would be to
deny our history, our capabilities.

I was not overly impressed when men
walked upon the moon because I knew it to
be out there at a specific distance with
specific characteristics, and I supposed
that we had enough intelligence to devise
the necessary machinery to get us there
and back. But when we sent an unmanned
object hurtling into distant space, and
when it began sending back signals—a
chain of numbers, to be exact—that could
be reassembled here on Earth to provide
us with a photograph of the surface of
Mars, I was struck dumb with wonder. And
when computers began adjusting the
chain of numbers augmenting some
diminishing others so that the photographs
became always clearer and more defined. I
realized that we could accomplish almost
anything out in the farthest reaches of
space.

My life changed completely on the day I
saw those Mars photographs for I had par-

ticipated in that miracle. My tax dollars had
helped pay for the project. The universities
that I supported had provided the brains to
aim the cameras. And the government that
helped nourish had organized the expedition.

I saw the universe in a new light and
myself and my nation in a new set of re-
 sponsibilities. My spirit was enlarged and
my willingness to work on future projects
fortified.

No one can predict what aspect of space
will invigorate a given individual and there
must have been millions of Americans who
did not even know Mars had been photo-
graphed. But we do know that in previous
periods when great explorations were
made they reverberated throughout soci-
ety. Dante and Shakespeare and Milton re-
 sponded to the events of their day. Sci-
centists were urged to new discoveries. And
nations modified their practices in accord-
ance with these discoveries.

All the thoughts of men are interlocked
and success in one area produces unfore-
seen successes in others. It is for this rea-
son that a nation like ours is obligated to
pursue its adventure in space. I am not
competent to say how much money should
be spent. I am not competent to advise on
how the program should be administered.

But I am convinced it must be done.

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TIME MACHINE
CONTINUED FROM PAGE 94

include that nature will not form such mass configurations, so they reason time machines are impossible. Yet when you read the papers you find that they use assumptions such as "realistic collapse" or "normal matter," and "stable configurations" loopholes large enough to build a time machine in.

There are many things in our world that are not in a "realistic" or "normal" state. A transistor is an unnatural miracle—an ultrapure silicon crystal. A liter of liquid helium a purebred poodle a laser a geosynchronous communications satellite—all are unnatural oddities kept stable by their human makers.

This is an uncomfortable situation for theons as a recent statement published by Dr. Frank Tipler makes clear:

"In 1974 Dr. Tipler pointed out that "general relativity suggests that we construct a sufficiently large rotating cylinder we can build a time machine."

Three years later he proved that you could not build a time machine with "normal" matter—matter that did not reach black-hole densities. Tipler concluded his second paper with the deliberately oracular statement... "The demonstration that no possible combination of known substances, known forms of machinery, and known forms of force can be united to form a machine which can travel in time seems to the writer as complete as it is possible for the demonstration of any physical fact to be.

"This quotation is a slight modification of a similar statement published by Simon Newcomb in 1890 at the conclusion of his classic paper demonstrating the impossibility of heavier-than-air flying machines. Newcomb had been proved wrong even before his statement reached print." Tipler feels that Tipler has deliberately hedged his "impossibility proof" with the form of his conclusion.

"It may be true that nature will not form a Kerr metric time machine from a collapsing star. But with a little guidance from our far-future descendants a star bigger than our sun might be made into a ring-shaped time machine—100 kilometers in diameter—and be maintained even though it could not be stable if left alone. This time machine would be big enough and safe enough to send an entire rocket ship and its passengers back in time.

"Some physicists object that the Kerr metric solution requires the mass in the spinning ring to move at the velocity of light, and this can never be attained. Yet other solutions have shown that the speed of light is always safely kept below, but this also carries an electric charge."

But the debate about the Kerr time machine is not that important. A spinning ring is not the only shape for a time machine. The Kerr metric has the theoretical advantage of being a complete solution to the full Einstein equations. However, there are many less rigorous solutions to Einstein's gravity theory that offer us possible designs for a time machine.

Another configuration for a time machine is the spinning cylinder described by Tipler in 1974. The theoretical model for this time machine uses a mathematical approximation, so it is not as rigorous as the Kerr model. Theoricians find it easier to attack. But any electrical engineer can attest that the approximation works well in electromagnetic theory. It should work equally well in gravitational theory.

Tipler's time machine is a long, ultra-dense, rotating cylinder with a spin speed at its surface one half of that of light. In this design time becomes distorted near the cylinder's midpoint but outside its mass. To travel through time you must orbit the cylinder halfway along its length. The important feature of the Tipler two-way time machine is that it allows travel both backward and forward in time (depending upon whether you circle with or against the spin of the cylinder). Neither the time traveler nor the time machine has to move at velocities close to that of light.

"So we cannot rule out the possibility of building a time machine based on our current understanding of physics. In fact, it seems quite likely that we will eventually build one."

"If we can travel back and forth in time, though what seem to be real paradoxes arise. We'll be spared one version of this famous problem. According to Einstein's laws time machines can take you backward in time only to the moment when the machine was turned on and forward only to the moment the machine is turned off. A future-time-machine maker will not be able to go back in time and tell himself how to make the machine."

"But the kind of paradox takes other forms. Exhuming an old olice. Why couldn't you go back in time and kill your grandfather before he had any children?"

"These paradoxes all boil down to a violation of a strict time-ordered cause-and-effect relationship. There are those who would argue that this is enough. The fact that causality would be violated means that time travel is impossible, nothing more need be said."

"Yet we learned to accept the truth of Einstein's special-relativity mathematics despite its insistence that time was not the same for all but could be stretched and compressed. In the future we may adjust to Einstein's general-relativity mathematics which says that time can also be made to run backward."

"I don't know the solution to the logical paradoxes presented by time travel. I suspect that we shall be forced to concede that time order is not absolute but can vary according to our experiences with time vehicles, just as we were forced to accept that.
time rate is not absolute but would change dramatically for passengers in a space vehicle traveling near the speed of light. Once a time machine exists, then decisions made at one point in the time line of an individual can affect not only the future but the past.

In our example President Greatman made the decision to send a message back in time. That decision set off a chain of events that warned him in the past that a catastrophe was about to occur, allowing him to evacuate the east coast of the United States before a meteor struck. The decision "caused" the evacuation "resulting" to occur before the "cause." Yet from a logical viewpoint that neglects temporal order, the evacuation "effect" was a direct consequence of the decision "cause." the causal "impulse" just happened to be transferred by a message that moved backward in time.

It may be tens or hundreds of thousands of years before the human race has evolved to the point where we can control collapsing stars in order to make a time machine big enough for a vehicle loaded with human travelers. Long before then however, we may be able to make miniature time machines. This would be enough to allow messages encoded on pulses of laser light to be sent backward and forward in time.

If we look at the mass of an asteroid around 15 billion metric tons and compressed it enough to unbind time in a small region, we would have the dimensions of an atomic nucleus—a superheavy, superdense nucleus. Strong electric magnetic, and radio fields would be needed to keep it levitated, elongated, and spinning at the proper speed.

The laser messages shot into it would have to be made of extremely short pulses of gamma rays with wavelengths smaller than the time-transfer region. A message would consist of a small number of gamma rays each at a slightly different frequency corresponding to its code word in the message. At these high energies gamma-ray detectors are highly efficient, so decoding the cluster of photons that had emerged a few weeks in the past would be relatively easy.

The gravitational field from a 15-billion-ton mass at 10 meters distance is about one Earth gravity. If the time machine were enclosed in a 20-meter sphere, there would be two Earth gravities on its top, zero gravity underneath, and 1.414 g's tilted at 45 degrees—at the equator.

These time machines could exist within 100 years if there are breakthroughs in our understanding of elementary particles and ultradense matter. Some of us now living may eventually owe our lives to the warnings brought to us by the future by these "impossible" paradox producers. After the Higgs crisis is over and we have time to reflect, we will wonder about those ancient philosophers who were so worried by those time machine paradoxes.

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JOSSIE AND THE ELEVATOR

CONTINUED FROM PAGE 62

dently become drastically unhappy. Josie never suspected that she was in hell. At school she was always made to sit in the front row. Her teachers were boring, stupid, and either weepy or very mean. Her classmates teased her mercilessly for being fat. At home her father ignored her and she spent her afternoons and evenings alone watching mind-numbing programs on television and eating junky desserts which made her still fatter. These desserts were poisoned, as all the food in hell is poisoned, so that when she was in school she couldn't think clearly. She flunked fourth grade and seventh grade too. By this time her father had become an alcoholic. He and Josie moved to a cheaper apartment in a neighborhood where muggers abounded and where even on summer afternoons it wasn't safe for a child to go outside and play. No longer could Josie brag about having her own bathroom or even her own bedroom, for the room she had to sleep in was also a kind of office. There was an awful stench in the kitchen that never went away.

Josie became a teen-ager and then a grown-up, and such was more dismal than the year before. But really there's no need to go into too much detail. Enough to say that by the time she was twenty-four she had been married three times and raped twice—once when she was fifteen, in the locker room at her high school and the second time, when she was twenty-two, by her first ex-husband who almost killed her. She had also attempted suicide twice with pills—but in hell suicide attempts are never permitted to succeed. Otherwise everyone could just kill himself and be done with it.

Despite everything that had happened to her in hell, Josie still somehow believed there was a way things might get better. She believed, in the words of one of her favorite songs, that somewhere there was a place for her, a place she could at last be happy in. But where? She would never have believed that that happier place was no farther off than the other side of town. For by now she'd forgotten everything that had passed between her and the elevator——the way you forget the things that happen in nightmares. In hell there are so many nasty things happening all the time that if you kept track of every one of them, you'd soon go quite insane.

That fact is what had happened to Josie's mother in Ibiza. First she had come down with infectious hepatitis then while she was recovering from that something went wrong inside her head and she was able to see all hell is usually invisible devils. For years she was confined to mental hospitals jeered at by these devils the way poor Josie was jeered at by her classmates. Even in our world mental hospitals are nowhere anyone would want to live, but in hell naturally they are much much worse. Nevertheless, one day Mrs. Hardwinter's insanity disappeared as inexplicably as it had come. That is to say, she stopped being able to see the devils around her. After she'd convinced the examining doctors that she wasn't crazy anymore (which took rather a long while), they let her out of the hospital. Having no other idea where to go, she returned to the apartment building where she used to live and asked whether there was an apartment she could rent. Since the building was scheduled to be demolished in two more years (the renting agent didn't mention this fact to Mrs. Hardwinter), there were several vacant apartments to choose from, and so twenty years after she'd left it Mrs. Hardwinter returned to apartment 13-D.

When Josie received her mother's postcard inviting her to visit her at the old address, her first reaction was simply to be furious. The nerve of her after running away and leaving her with her old soak of a la

- She knew that her life had become, all of a sudden, drastically unhappy. At school she was always made to sit in the front row. Her teachers were boring, stupid, and either weepy or very mean.

- After twenty years of almost unbroken silence! (There had admittedly been Christmas cards for even in hell one is obliged to send Christmas cards.) After locking her out of the apartment without her shoes! (Josie had come to believe her own long ago lie) to send a postcard after all that: "I'll send her a postcard—she thought aloud. "See how she likes them apples!"

But then (for Josie was leading a very lonely life in hell) she decided after all, that a single visit could do no harm. Her mother might actually have become a nice person if she hadn't, Josie would at least have the satisfaction of telling her off. So donning her brightest pantie and arming herself with a purse containing a spray can of Mace (a standard precaution in hell), Josie set off on the number 12 bus and arrived in her old neighborhood in a little less than an hour.

The years had not been kind to the old apartment building. Its stone doorway had been vandalized, and its remains were covered over with yellow fornicia, part of the decoration of the pornography shop that had moved in on the ground floor. The buzzer system didn't work, and inside the lobby hall the mailboxes looked as if they'd been broken into. The aluminum ashtrays had disappeared, and now the floor was littered with butts.

Graffiti covered every surface with irrefutable evidence of the hatred lust and immorality so prevalent in hell.

Josie regarded the elevator button doubtfully unable to believe that in such a desolate building the elevator might still be working. But even in hell one hopes against hope. She pressed the button and, lo and behold, there was a rattling of chains and then a long deep groan, and the doors of the elevator opened.

Suddenly it all came back to her—everything the elevator had said to her and how she had repulsed her rudeness, her cruelty, the broken mirror.

"Oh, elevator!" she cried out, telling to her knees and pressing her hands and then her lips to the scuffed, unswept linoleum tiles. "Elevator! Dear elevator, I'm sorry! I'm so sorry! Please, please forgive me! I'll replace the mirror I broke. And I'll keep you clean. And—And I promise never to do such a terrible thing again.

Without a word being too moved to attempt a reply and without waiting for Josie to press 13 the elevator hummed upwards past the boundaries of hell up past the ground floor of the world above up in a single glass rush to where Josie's mother lived on the thirteenth floor. There it stopped and opened its doors, and Josie got off with a sense of irrational but nonetheless unshakable that her life had taken a turn for the better.

And of course it had. Josie found that she liked her mother better than she'd ever liked her before and though Mrs. Hardwinter was a little suspicious at first and inclined to believe her daughter was a little crazy (for she could not be kept from conversing with the elevator whenever she was in it) she eventually came round to liking Josie in return. After all those years in the mental hospital she was inclined to be tolerant toward the kinder sorts of craziness.

They decided to live together there in the old apartment building which wasn't torn down after all, but was renovated instead. Josie true to her promise replaced the mirror she'd broken, and the poor old elevator was so overcome that it was stuck for four days on thirteenth. But after the repairman came and tinkered with it, it seemed as good as new.

Josie's life too took a turn for the better. With a bit of friendly bullying from her mother she got her weight down to a comfortable hundred thirty pounds. Nicest of all, she found a job that didn't drive her crazy with boredom and paid a decent wage besides. (In fact she became a teacher but that is another story.)

All in all Josie could not complain or at least she preferred not to. If this wasn't heaven (elevators, alas, cannot go there), it was clearly an improvement on hell. ❄️

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[Image 0x0]
Academy of Sciences in 1974 showed that there are at least several hundred plant species that seem to offer immediate potential for use in relieving hunger and improving nutrition.

In addition, wild species help established agriculture. All conventional crops need to have their genetic constitutions regularly 'topped up' in order to maintain, let alone expand, their productivity. The addition of wild germ plasm is also crucial in resilient new insect pests adapting to our changing climatic conditions and other environmental threats. America is especially dependent on these wild gene reservoirs, since much of its agriculture is imported from Europe and Asia.

When a medical prescription is filled at a pharmacy there is a 50 percent likelihood that the medicine is of natural origin. The commercial value of these drugs in the United States alone is put at over $5 billion per year. Nonprescription preparations, similarly derived from wild creatures, are worth another $5 billion.

As for industry, the need for raw materials is growing rapidly as the world's population increases. The energy shortage has prompted Melvin Calvin, of the University of California at Berkeley to undertake research in plant species that produce hydrocarbons similar to oil. All in all, the value of foreign supplies of genetic resources to the U.S. economy amounts to $10 billion a year, which is a conservative estimate. However, we are eliminating the very source of our livelihood in little more than the twinkling of an eye. Geologically speaking, for this is the greatest biological debacle since life began 3.5 billion years ago.

Extinction is, of course, an overwhelming fact of life. Fewer than 10 percent of all the species that have ever inhabited this planet are alive today. Yet until now the world has never seen the broad-scale elimination of species on a per capita/day rate, alone, the impending demise of at least hundreds, perhaps millions of species.

Even the disappearance of the dinosaurs, normally characterized as a 'freak dying' occurred at only a rate of roughly one species every 1,000 years. Dinosaur extinction caused only a small proportion of Earth's total complement of species to vacate the scene.

Nothing — nothing — in Earth's history matches what is occurring today both quantitatively and qualitatively. Dr. Thomas Lovejoy, of the World Wildlife Fund, declares, 'There have occurred, during the unfolding of life's story on Earth, the Paleozoic, Mesozoic, and Cenozoic eras — the eras of Ancient Life, Middle Life, and Recent Life. In theory we are still in the Era of Recent Life. But perhaps we should declare that era ended and designate a new one — the Era of Life's Impoverishment.'
Designatures II
Turn this page upside down

COMPETITION

By Scot Morris

We saw 120 variations on the name Einstein (usually combining it with "E=mc"). 50 different Asimovs and 25 Omnis. It was a delight opening the mail as the entries in Omni Competition #9 came in.

We asked for designatures — our name for the calligraphic wordplay that is half design, half signature — and readers responded, molding letters into shapes of stunning symmetry. Last month we published prizewinners; this month, some very honorable mentions. All of the designatures on this page can be turned upside down. Some words stay the same when inverted; others hold a surprise; first becomes last; Omni becomes FUTURE.

We regret that space permits so few of the 3,000 designatures received to be published. If you like these, watch for an expanded collection in a special Omni book we are now preparing. If you're inspired by these designatures to create more of your own, send them in. Congratulations and thanks to all!

HONORABLE MENTION

THOMAS EDISON/JAMES CARTER, by Eric Tissue, Pittsburgh, Pa.

ASIMOV, by Dean Rusk, Brooksville, Fla.

DESIGNATURE, by Frank H. DeJong, Huntington Beach, Calif.

ASIMOV, by Dean Rusk, Brooksville, Fla.

HAPPY BIRTHDAY, by Debbie Parker, Eugene, Ore.

OMNI/FUTURE, by Betty J. Busby, Yorba Linda, Calif.

BLACK/WHITE, by Clay C. Jones, Fort Worth, Tex.


NIFTY COMPETITION, by Carol Allen, New York, N.Y.

GREGORY LEIBOLT, signature by Gregory Leibolt, Chestertown, Md.

JOHNNY CARSON, by John Laughlin, Paris, Tenn.

JESUS THE CHRIST, by Bill Dunham and Lazlo Perkins, Merced, Calif.

RELATIVITY, by B. T. Brame, Euless, Tex.

FIRST, by Doreen Michael, Langley, B.C., Canada.

LOCH NESS/MONSTER, by Ray A. Jorgensen, Las Vegas, Nev.
SPACE
Continued from page 32

economically used to support the projects planned by NASA for the 1980s and 1990s. Lunar oxygen could be used as rocket fuel and for life support systems in space. Lunar silicon could be fabricated into solar collectors for satellites, and lunar metals could form the supports and hulls of large space structures. The door to large scale manufacturing and agronomy in space is likely to open sometime during the 1980s after the space shuttle starts routine flights.

Recent engineering studies have examined the possibility of retrieving Earth-approaching asteroids for space manufacturing. This resource is vast. There are probably more than 100,000 such objects with diameters greater than 10 meters and masses around 1 million metric tons. The unit cost to retrieve asteroids may be many times less than the $1,000 per kilogram lift cost of earthly materials used in the shuttle, or $1 to $2 for lunar materials. The small asteroids have nearly zero gravity fields. So the prospect of costly landings is avoided. Solar energy for processing and propulsion is continuously available on the asteroid.

The favorable economics of asteroid retrieval, combined with the apparent attractiveness of space agronomy, raise the possibility that food could be grown more cheaply and more reliably in space than on Earth, given a highly developed program of space manufacturing. Large quantities of dehydrated crops could be dropped out of orbit (possibly by an electromagnetic mass-driver device), enter the earth’s atmosphere aboard a metal-form reentry body land in the ocean near potential consumers, and be towed ashore for use. Astronomers Michael Gaffey and Thomas McCord have explored similar techniques for recovering asteroidal metals on Earth.

A three-kilometer carbonaceous asteroid towed earthward by a solar-powered mass driver (most of the mass driver mass and expense would go into the power plant and its radiators) could provide enough growing area to support 6 billion people—the projected world population for the year 2000. In the interim smaller asteroids could be turned into smaller growing areas as famine insurance.

A retrieval system would cost in the range of $100 billion to $200 billion spread over the next 20 to 30 years. This investment compares favorably with the $700 billion it would cost between now and the year 2000 to provide irrigation and to modernize agriculture in the Third World. Given a potential market of $200 billion to $500 billion a year the payoff would be rapid.

Food production in the United States totals approximately $100 billion. 20 percent of this is exported. Given reasonable productivity in self-supporting space colonies and low cost transport to Earth, the cost of food production on Earth may be rivaled by the economical breadbaskets of space.

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6. Hot or Cold. December. The sun is 3 million miles closer to the earth in winter, though the Northern Hemisphere is colder then than the sun stays strikes the more oblique angle.

7. Commonplace. Eclipses of the sun are more common but the area of the earth from which they can be seen is usually so small very few people ever see one.


9. Bull True. The bullwhip's 'crack' is a small sonic boom.

10. Size. Royal California olives come in 12 sizes, the names of which were designated officially by the Californian General Assembly. The three smallest sizes are Small, Medium, and Large. From there they grow to Family Size, Extra Large, Mammoth Giant, King Jumbo Royal Colossal, and Supercolossal.

The Centrifuge. Five test tubes are balanced in the arrangement given, Dillard explains. Once the centrifuge is balanced, you can add pairs of test tubes exactly opposite each other and the radial balance is unchanged. The tubes that are 3, 7, and 11 o'clock balance the centrifuge as an equilateral triangle. Two extra tubes have been added opposite each other at 12 and 6 o'clock. You could add two more tubes at 4 and 10 o'clock or at 2 and 8 o'clock and thus spin seven tubes without upsetting the balance. Nine tubes can be arranged so that the three empty wells are at the angles of an equilateral triangle.

In other words despite its eccentric appearance one can run the centrifuge with any number of test tubes other than 1 or 11.

POTLUCK PUZZLES

1. The Spider and the Fly. Imagine the room unfolded like a shoe box so that the different routes can be laid flat. The direct route A is 42 feet. The route across the floor and one sidewalk, B, is a bit over 40 feet. The third path C across the floor one sidewalk and the ceiling is the shortest of all 40 feet.

2. Once in a Lifetime. At that instant one could line up the first eight integers to form the time and date—12:34, 5/6/78. This will not be possible again until the year 2078.

3. Spirals. Shade the spirals to show that the one on the left is a continuous loop; the one on the right is two separate loops.

4. Lucky 13. There are 13 stars above the eagle's head. At 13 strikes on the shield, 13 arrows held in the eagle's left talon, 13 leaves and 13 olives on the olive branch of the eagle's right talon. There are 13 steps on the pyramid and 13 letters in the motto above the pyramid.

5. Wrong Ones. Truman's middle name was simply the letter S. Since the letter doesn't abbreviate anything there shouldn't be a period after it. Babe and Meadowlark are both given names not nicknames.

6. Put Your Money Down. By the same reasoning I could argue that the bet is only my able to me. Since a bet cannot be a disadvantage to both sides there must be a fallacy.

The problem is stated as if it were a pure probability question but the amount of money held by the two of us on that basis cannot be the amount that is not determined by chance. If I'm carrying a small amount, I'll take the bet if I have a large amount. I won't if one of us is shrewder at guessing how much the other is carrying. The odds are no longer 50-50. If we select two other people at random and run them through the bet either person is as likely to win as to lose. However the amount that would be won and the amount that would be lost in the long run would be identical:

- The 12 Coins. Weigh coins 1, 2, 3, and 4 against 5, 6, 7, and 8. If the pans balance, you know the odd coin is 9, 10, 11, or 12. Weigh coins 9 and 10 against coins 11 and say 8 (we know from the first weighing that 8 is a good coin). If they balance, we know coin 12 (the only unweighed one) is the odd one. The third weighing indicates whether it is heavy or light.

- If, however, at the second weighing (above) coins 9 and 10 are heavier than 11 and 8, then you know that either (a) 9 is heavy or (b) 10 is heavy or (c) 11 is light. To solve this three coin problem in one weighing, compare 9 and 10. If they don't balance the heavier side is the odd coin. If they do, coin 11 is light.

- But what if the pans don't balance on the first weighing? Suppose the side with coins 1, 2, and 3 goes down. It could mean that there is a heavy coin among 1, 2, 3, and 4. Or there is a light coin among 5, 6, 7, and 8. We'll end up with the second weighing between coins 1, 2, 3, and 4. If they balance, it means that either 7 is light or 8 is light or 4 is heavy—the three coin problem again. Weigh 7 against 8 to determine the answer.

And what if the pans don't balance on the second weighing (1 and 2 and 3 and 4)? Suppose the light pan goes down. Then either 1 is heavy or 2 is heavy or 3 is light. (We've already determined that 5 is not heavy and 4 is not light.) That's the familiar three-coin problem as above solve it by pitting 1 against 2. If instead, the 3-6-9 pan is heavy either 5 is a light coin or 3 is heavy. By weighing 3 against any good coin the solution is arrived at of:

DO
Jackie Skywalker

By Dick Teresi

Jackie Parker was born on the Fourth of July 1960 and, like any all-American girl, wanted to become an airline stewardess. Later the times had changed, and she wanted to be an airline pilot. Today, she has the pilot’s license, but her ambition has risen even higher. When NASA puts the space shuttle into orbit later this year, its journey will be monitored by flight controllers at the Johnson Space Center in Houston. And one of those controllers, the very youngest at age nineteen, will be Jackie Parker.

Her ultimate goal? To fly the shuttle.

Parker is used to being the youngest. “I entered college when I was fourteen,” she tells us. “That’s when I decided I could do anything I put my mind to. And being an astronaut was what I wanted to do.”

While in college, she applied for a job as a space shuttle astronaut and was promptly turned down. “This didn’t stop her. I went to Houston on my own, a year before I graduated,” she recalls, to find out what jobs were open and how to get one. A year later, after graduating at seventeen from the University of Central Florida with a degree in computer science (“Well, I was always pretty good at math”), she worked for NASA as an intern. By summer of 1978 she had a full-time job as a data processing controller.

Parker describes her present job as “Super, just super.” She says she has no problems with her coworkers because of her age. “And who knows? Given the delays caused by misfiring engines and tiles falling off the fuselage, Parker may end up being the oldest flight controller by the time the shuttle gets off the ground.

Scientists always complain they can’t get enough money for basic research—long-term projects with no immediate payoffs. So when George Low dropped by our offices the other day, what he had to say caught us off guard. Low, formerly manager of NASA’s Apollo program and now president of Rensselaer Polytechnic Institute (RPI), believes we need more money for short-term projects with quick payoffs to entice good students back into manufacturing.

Sixty-eight percent of the wealth production in this country comes from the manufacturing industry, he began the man who had the overall responsibility for placing the first astronauts on the moon. Yet today only a small fraction of our research and development effort goes into manufacturing engineering. The best people are not attracted to manufacturing-related jobs. It is not exciting to them.

So he’s got the plan. Under Low’s direction, RPI has founded the Center for Manufacturing Productivity. The university has drawn up a list of about 100 manufacturing problems which will be pared down to the 10 best. Then groups of students will be assigned to each problem, each headed by a project engineer. These project engineers will not be faculty members. Low explains that a person out of school having worked in industry for five years will make the students meet schedules and keep to a budget—things faculty members are not good at, according to Low.

Among the problems selected so far to be solved are how to use computer-controlled robots to increase production on assembly lines and how to decrease friction on bearing surfaces.

Of course, all these projects need money. The project engineers will be paid industry-comparable salaries, the students have a choice of either a paycheck or course credit, and oddly enough, Low will accept no government funding. “The ultimate customer has to be industry,” he insisted. “It’s got to be paid for by the person who can best supervise it. The person who can hold your feet to the fire is the guy who really needs that problem solved, and he’s in industry.”

So far General Electric has taken Low up on his offer to the tune of $500 000. General Motors is kicking in $250 000.

Come next fall, RPI students can look forward to having their feet held to the fire.

Flash news item: Three Johns Hopkins scientists have not discovered the secret of life, but they may have figured out how it duplicates itself. Donald S. Colfax, Drew M. Pardoll, and Bert Vogelstein, of the...
university's oncology center announced recently that DNA, the master molecule of heredity, reproduces itself in a far different way than had previously been believed. If right, their discovery could lead to a deeper understanding of heredity.

For decades, scientists have assumed that DNA's double-helix structure was reproduced by enzymes that moved linearly along its twisted strands, untwining them into separate threads and then copying each to form two new double helices.

Not so, say the Johns Hopkins scientists. The trio explained that this would be far too messy a process to work inside a living cell. Coffey compared DNA in the nucleus of a cell to audio recording tape in the reels of a cassette. Then, in front of an audience of reporters, he pulled all the tape out of an ordinary cassette and waved the jumbled mass over the podium to illustrate his point:

Then how does DNA reproduce? Using radioactive labeling in rat and mouse cells, the Hopkins scientists, working under a Bristol-Myers grant, found that the cell nucleus is indeed much like a tape recorder. In fact, it even has recording heads, called replisomes, that duplicate DNA. The DNA itself is arranged in loops, each of which is reeled through a replisome like a tape cassette and reappears as two brand-new loops.

How important is this new theory? The trio was modest—for the most part. But Vogelstein let slip that they thought it was pretty hot stuff. He compared their work to that of Copernicus. Copernicus told the world that the earth revolved around the sun, not the other way around, Vogelstein said; and they've shown that DNA moves through the replisome, rather than vice versa. But Vogelstein did note one difference: "Copernicus was tortured for his beliefs," he said. "We've been treated very well for ours."

Searching for the Holy Grail
Along the Appalachian Trail,
When I found that herb
They call ginseng
Grown deep down in the woods,
I swear I got the goods
The herb that turns
The autumn into spring

It's a bluegrass tune, and the lead singer and composer knows whereof he speaks. When he isn't playing bass for the Howard County Dump, the band that cut the record "Ginseng" above, James Duke is chief of the Department of Agriculture's Economic Botany Laboratory in Beltsville, Maryland. Dr Duke, one of the world's foremost experts on the medicinal uses of plants, has twice been featured in Omni once for his work with mints and again for bringing the spiny ginseng back from China, where it is said to cure everything from impotence to cancer. Duke is less than enthusiastic about such claims for ginseng and the result is his satirical song. Other members of the Howard County Dump also have heavy science backgrounds. Besides Duke, there's Les Altstadt on guitar and vocals. Altstadt, who recently retired as director of the Division of Medicine at Walter Reed Army Hospital, penned the flip side of the record, "Three Mile Island," which points out the inevitability of human error in operating nuclear power plants—all in bluegrass style, of course. On banjo is Rich Thomas a Walter Reed technician. Bob Tate a Westinghouse employee, plays mandolin. While posing no threat to Bill Monroe and the Bluegrass Boys, the group nonetheless plays a listenable rollicking kind of music (Duke calls it "redneck all the way."). The Howard County Dump performs mostly at parties, church socials, and the like. Their last gig was for a national meeting of entomologists. And for scientists, their lyrics even get a bit racy at times. For example, the last few lines of "Ginseng"

Makes an older man more foolish
And a younger man more foolish,
Makes an older woman younger
And a younger woman hunger
Ginseng!
Sing gin
Sing a little song and swing

As they used to say on American Bandstand, it's got a good beat and you can dance to it! I give it an 85. ☃️
New Wives Tales
In your Games column [January 1980], you have number 10 of the Old Wives Tales quiz marked as false when it is actually true.

The question states that after eating it is best to wait at least a half-hour before going swimming. Perhaps a full stomach immersed in water does not cause cramping of the skeletal muscles. What does happen, however, is that when someone exercises vigorously right after he eats large blood supplies that are in the stomach and intestines to aid in digestion are sent to the skeletal muscles. Where the blood is needed in large supply during muscle stress. This can cause stomach cramping or vomiting. One should always rest after eating so that digestion can take place at its optimum efficiency.

Joel D. Scherer
Utica, N.Y.

John Lacarrubba, water safety specialist for the American Red Cross, replies if you have a couple of sandwiches and a bowl of soup and go for a recreational swim, you’re in no danger of cramping; because there is enough oxygen in your system for your stomach and intestines and for the muscles used in swimming. The only way a person will get cramps is if he eats a Thanksgiving dinner and then tries to break the world’s swimming record.

I wish to say something about question 8 of the Old Wives Tales quiz. You say that the rate of childbirth does not increase at the time of a full moon. The earliest study on the relation of the moon to childbirth was done in France and was published in La Presse Médicale. This study showed the births nearly double normal in the two days just after the full moon. Other studies in Germany, Florida, Virginia and New York City have reported similar results.

The largest study was done by Dr. Walter Menaker, covering a half-million births, and was published in the 1959 American Journal of Obstetrics and Gynecology. Dr. Menaker found a higher frequency of births around the time of the full moon.

The effects are strongest in areas with fewer lights, but even in New York City there was a definite lunar effect on births.

George G. Abell, professor of astronomy at UCLA, co-author of the study we cited, replies carefully conducted investigations do not find correlations between lunar phase and the birthing rate. Our UCLA study of 11691 live births over a 51-month period also showed completely negative results.


There are actually three (not one) New York studies, each of which claims to involve a half million births. The first (Menaker, W., and Menaker A. 1959 Amer Jour of Obstetrics and Gynecology, 77 905) reports a 1 percent excess of births in the two week period following full moon. The second (Menaker W 1967 op cit. 98 1001) reports a 1 percent excess in the two-week period centered on full moon, and the third (Osley M et al 1973 op cit, 117, 413) reports a 1 percent excess in the two-week period preceding full moon. None of these contradictory reports include enough information to evaluate the selection of data and the statistical procedures, Osley and his colleagues do not even provide the dates of their study.

In my judgment, an effect so unexpected as the claimed correlation between birthrate and lunar phase can only be regarded as established after it has been repeatedly replicated by carefully controlled investigations by many independent and qualified researchers.
Through the Looking Glass

Explorations

By David Saltman

Magic shows are just like life only fairer. In life you don't know you've been fooled until it's already too late.

Since the days when sorcerers cast spells on entire kingdoms, magic has never failed to baffle and to intrigue. The ancient prestidigitation art is the only certain body of miracles that every person on Earth has witnessed. Fortunately, it's booming today with some 50,000 magicians practicing conjuring in the United States alone.

Don't settle for the third-rate stunts of pranksters. Take a magician's tour of the United States. Visit the places where magic is practiced and be genuinely fooled. Amateurs, professionals or simply magic lovers are all welcome everywhere in the charming world of illusionists.

Times Square—New York City, is unquestionably the hub of America's magical activity. Not only is the birthplace in the big city ends up in Times Square, but the loyal wizard, too. Many of these Merlin's congregate at the Gaiety Restaurant, 224 West Forty-seventh Street, site of the Magic Table, one of the most venerable, yet most illusive, of New York's miserioso attractions.

To the uninitiated, the restaurant seems to be nothing more than a nondescript Broadway eatery. Yet—Shazam!—every day magicians and fans of magic materialize there for lunch. Be prepared to cut open a melon and find a three of spades inside. Of course the three of spades has your initials on it and appears to be the very same one you chose and signed a few minutes before. Upon sitting down, amazed you ask for the sugar and a live dove materializes on your hand. Ask for the menu—it's fake!

At the Magic Shop

New York is not magic's sole home. Along the faded tracks of vaudeville you'll find many shops and clubs catering to magicians. After all, if you were playing the old Gus Sun circuit, you never knew when you might need an emergency supply of flash powder, red silk scarves or multiplying billiard balls.

There was probably a thriving magic dealer in your town or nearby. If your neighborhood sports a magnificent old theater converted from vaudeville to Disney or porno, you should find an aging nostrum seller not far away.

Ed Seguin—the Mysterious M—lives in Akron, Ohio. He'll be able to tell you the lore of bygone times when there were two shows a day and magicians wore scarlet damsels and verdigris, their hoods and cloaks and smiles asnap with wizardry (Magicians' wives wore brown and were very hard to see—). Magic shops vary in atmosphere from Snyder's in Cleveland, to the Wizard in Boulder, Colorado to Lou Tannen's, back in New York. Snyder's is a dusty meander through the attic of vaudeville. The Wizard represents the modern magic dealer slick, colorful, well packaged, with every hair in place on the venticloqout's dummies. Tannen's boasts of being the world's largest magic shop (see box).

Every Saturday afternoon by tradition, all the wonder-workers in every town wander down to the local magic shop as if drawn by a black silk thread. There they show off new tricks and dust off old ones. Stopping by is one of the pleasantest ways to become initiated in the art of chicanery.

An Evening at the Magic Castle

The spirit of shamanism still lives in Hollywood, California. A drive into the hills will take you to a remarkable temple of thaumaturgy called the Magic Castle.

Entering the Castle is like walking through the looking glass. You must sit down to an owl in a bookshelf in the lobby, wink your left eye very slowly and pronounce the incantation "Open Sesame!" A section of the bookcase swings aside to let you enter the bar.

There you encounter a piano, without a pianist that plays any tune on request. You can peruse a small magic museum crammed with old-time mechanical chess players, and other
marvels. Booby traps lurk everywhere from
the man's room to the bar.

If you're lucky, you may get to see the
incredible Shimada, reigning Crown Prince
of magic, in the castle's auditorium. His act
is silent and uses choreographed moves
from the Japanese martial art. The stage
starts bare, then presto! A black-robed arm
plunges from behind the backdrop and
produces a flaming torch out of thin air!
Shimada inches out like a snake, the torch
in hand. Dressed in faultless evening
clothes, he looks like a Buddha at a Debui
tance ball. Suddenly Shimada stretches
into the air and a second flaming torch
appears from nowhere. He continues to
produce them until the whole stage is lit
up. A dozen torches shimmer with
the sparkling Shimada at the center.

THE SECRET OF DR. VOX

A magician needs just one trick, as a
recent incident at the Wizard magic shop
shows.
It was the day of the Pearl Street's annual
outdoor magic show, a gala event in this
small town at the foot of the Rockies. As I
approached, a crowd peered at a man
locked. Houdin-in an straitjacket, suspen
ded upside down from a crane 30 meters
in the air.

But my thoughts were on magic. They
were on a distant cousin of magic gambl
ing. I was trying to hustle up a card game
for the simple reason that I was broke.

So I was happy to bump into Sam Kent
proprietor of the Wizard. Magicians usually
know where the card games are. They
tend to play them. (If you win, everyone
thinks you cheated if you lose everyone
thinks they're lousy magicians!)

As we strolled back to Sam's shop, with
me steering the conversation to three-card
monos, a kid came up to us.

"Are you guys magicians?" he asked.
"Sure," I answered.

"Okay!" he said. "Read my mind."

This is the sort of challenge magicians
hate. But empty pockets are sometimes
more powerful than whiffle dust.

"You have any money kid?" I asked.

I've got five dollars.

"Okay! I'll read your mind for five bucks."

He looked hesitant.

"Lock kids! I said to him. We've never met before. Isn't that right?"

"Right."

"So if I could tell you your name, wouldn't
you consider that a feat of mind reading
worth five dollars? I need at least $5 to
buy chips."

"Well yeah. He looked suspiciously
at himself to make sure he didn't have
some kind of name tag sticking out of his
back or somewhere else. He didn't.

"Okay! Come inside!" I entered the
magic shop.

Quite frankly I had no idea how I would
read the kid's mind. But imagination
—or perhaps desperation—led to a plan.

I turned to Sam and asked: "Got any
Ouija boards?"

Magicians rarely use them, but Sam
stocked one for the pseudo-occult crowd.
I played around with Ouija boards but
didn't know whether what I had in mind
would work.

We assumed the position: seated, knees
touching, fingers lightly on the sliding din
kus with the plastic window.

"Now I want you to concentrate on your
name! I said to the kid. He screwed up his
eyes. Are you concentrating? I asked."

"Yes," he answered.

"On your name!" I insisted. "Don't try
to fool me by thinking of someone else's.

We sat a moment. Then the dingsus
began to move. It circled the board
clockwise three times, hovered, and
stopped at the S. It began to circle again. I
can tell you for sure. I wasn't moving it.
I stopped it on the E. It began to circle again
and this time it stopped on the E.

"Seven! Your name is Steven!" I said to
the startled kid.

"Th-that's right!" he admitted. The crowd
of kibitzers had grown quite substantial by
then. They saw this as a significant win,
and Kent was more than happy to let
himself be hypnotized.

"Let's make us some money with that trick of yours!" He outlined
the following madcap plan: I was to give
myself out as Dr. Victor Vox, the infamous
wonder worker who had developed
—after rigorous practice with Tibetan
lamas and various other sorcerers—a
genuine, no-hokum touch of larceny that could locate
any object of value, no matter where it was
hidden.

Using old magic posters and press type
we whipped up hundreds of handbills
and hustled the kids hanging around the
shop to pass them out. By that night, bills bally
hooing "Dr. Vox and the Wizard" were an
eyesore in Boulder.

The show was set for the next day at the
shop. We were successful beyond our
dreams. Kent performed splendidly in his
part appearing unhurt when 'hypnotized'
and picking up a magic "needle!" He
also managed to give the illusion of cutt
ing vials of steaming acid. But the greatest
hit of all was to my surprise, "The Secret
of Dr. Vox!"

It was a simple adaptation of the Ouij
board scam to the theater. When I left the
shop a spectator would come up and
have an object—a coin, a bracelet, a watch
whatever—somewhere on the stage. When
the object was well hidden, I, Dr. Vox
would return and hold the spectator's wrists
lightly, asking her (it was usually a woman)
to concentrate on the place where she had
hidden the token. Invariably within about
30 seconds. I would feel the woman's wrists
tugging me in a definite direction. I simply
followed.

Like the dingsus going in circles, we
would usually perambulate the stage until,
after a minute or so. I would feel a definite
pull in the direction of one quadrant or
another to the audience, it appeared as if I

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zered in on that part of the stage, and since I was usually ‘getting warm,’ the tug would be confirmed by an intake of breath that was as loud as a thunderclap to a magician with holes in his pockets and a reputation at stake.

In another 30 seconds or so, as we walked around the indicated quadrant, I would get another tug. Stopping dead in my tracks, I would turn to the nearest cup or candlestick and lift it in the air Voila! There would be the bracelet.

Really this is only a half-trick. I believe it works on the principle that the subconscious always influences the so-called fine muscles. Even when one tries mightily not to think of elephants, one’s fine muscles strain in the direction of Africa. This phenomenon has never been studied by behavioral scientists. In fact, it was never even dreamed of. It is proof of the existence of an underlying psyche because even if the subject tries to mislead you, his muscles will still give that involuntary tug.

Clearly there is a part of us that wants the wizard to win. And there lurk the real magic. The subconscious mind inevitably tricks our cunning rational self into revealing its true motives. As proof of that, kneel the kids, and I, Dr. Vox all made out very handsomely. We received an impressive number of perfumed notes delivered backstage.

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Dallas It’s Magic 5417 Greenville Avenue
A club on Restaurant Row Stage and quality performers in an intimate setting
San Francisco Earthquake McGoon’s Magic Cellar, Clay and Montgomery streets Performers of varying skill; some outstanding, like Arthur Murata the ‘house’ conjurer Great decor
New York Lou Tannen’s, 1540 Broadway
The world’s largest magic shop
Cleveland Snyder’s, 216 West Superior A relic of vaudeville days
Akron Ohio Ed Seguin, 4153 Meadowlark Trail Old-time tricks and routines
Las Vegas Caesars Palace, Bacchanal Room. The legendary Jimmy Grippo, magician in residence
Washington, D.C. Al’s Magic Shop 1115 H Street, N W The only tricks in Washington that are not dirty
Winston-Salem, North Carolina NRK Distributors, 1240 Church Street, Fast-growing, modern magic shop and jobber
Minneapolis Eagle Magic Store, 708 Portland Avenue Old-fashioned low-key Hollywood California The Magic Castle 7011 Franklin Avenue Though this club is private, many Angelenos belong and will provide you with a guest card. The Magic Corner 6338 Hollywood Boulevard Excellent magic shop
Colon, Michigan Colon Magic Festival, sponsored by Abbott’s Magic Shop Held every year, the third week in August.

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Such a system would allow for body integrity through the eons with the possibility of future retrieval and revival—a slight chance exists of possible revival by another intelligent race in a distant star system—remote, but a possibility definitely worth considering.

Chester Tworog
Aurora, Colo.

Slight Miscalculation
Your article “Infinite Voyager” [February 1980] by F.C. Durant III properly emphasizes the meticulous care Chesley Bonestell has taken in his imaginative renderings of our universe. Knowing Mr. Bonestell’s reputation I must conclude that the error on page 72 is yours. Your caption for the painting The Milky Way states that it is a view of our galaxy from a distance of 250,000 light-years. Hardly. Two hundred fifty thousand light-years would be a better guess.

Nonetheless a fine sampling of Mr. Bonestell’s work.

Rod Ausura
Gaithersburg Md

Our apologies. We were of course in error. The distance should have read 250,000 light-years. —Ed

The Life of John
I just read “The Life of Allie” [January 1980]. Thanks, Mr. Stine. You’ve described the future just the way I always hoped and dreamed it would be and should be.

John Fitzgibbon
Miami, Fla.

Dear Ben
As an old friend and reader of yours, I approve of your views of the world and like the way you write.

Nevertheless I was not prepared for the utter joy and excitement with which I read your editorial in the February 1980 Omni. It was well written and well thought out, yes, but its elegance and sense had me cheering as I read.

And also biting my lips. How I would love to have written that essay myself if I had only been smart enough to think of it first!

Isaac Asimov
New York, N.Y.
X MARKS THE UNIVERSE

STARS

By Mark R. Chartrand III

On November 8, 1895, Wilhelm Conrad Roentgen could hardly have known that the mysterious X rays he had just discovered would be used to detect heart ailments, to find flaws in precision metal castings, and to uncover art forgeries. He and the astronomers of the day (if they paid any attention at all) certainly would not have suspected that these rays would plumb the depths of the universe.

The mystery intensified when another rocket flight in 1962 revealed that these X rays emanated from the center of the Milky Way. The old stars thought to be the inhabitants of galactic cores should not emit enough X rays for us to detect them over a distance of 30,000 light-years. What makes stars that we think we understand radiate so much?

By 1966 some dozen X-ray sources had been identified. The search continued with rocket probes and high-altitude balloons. The heyday of X-ray astronomy came with the satellites and orbiting observatories that followed.

In a meeting last January of the high-energy astrophysics division of the American Astronomical Society, six dozen research papers reviewed the turbulent, exciting and still puzzling field. Most of the results reported came from experiments aboard such satellites as Small Astronomy Satellite 3, Uhuru, and the High Energy Astrophysical Observatories 1 and 2.

HEAO 2, dubbed Einstein, was launched in 1979, the centennial year of Einstein's birth. This telescope is destined to have as profound an impact on astronomy as the man himself, for it can make images of X-ray sources while locating and measuring their intensities. For the first time astronomers can examine photographs by using television. This has revolutionized the field and produced what one researcher called a grab bag of sources. Aim the telescope in any direction, and you're bound to find a new X-ray emitter. Or if you prefer a more refined approach, study the sky where previous less sensitive telescopes found nothing.

The X rays used by doctors are typically known as "hard" X rays. The energy of each particle, or photon, of radiation is quite low ranging from tens to several thousands of electron volts. Astronomers use these and less energetic "soft" X rays to peer at the cosmos. Because of the high energy of all X rays, it is hard to focus them so that they will form an image. There are no X-ray lenses to refract the energy, and only when they encounter mirrors at very shallow grazing angles will they reflect. Such are the difficulties and rewards of building a satellite like Einstein.

There are now more observations than theories to explain them. X-ray sources such as the sun's remnants of supernovas and quasars are scarcely surprising to scientists. There is still some mystery about the X rays that emanate from other galaxies, intense, briefly emitting sources at the hearts of globular clusters of stars. X-ray stars in the nearest spiral galaxy that do not lie along the spiral arms so prominently seen in visible light and a pervasive glow of X rays from hot gas throughout the universe.

In all likelihood the most interesting results will come from the more general investigations. The title of one of the papers presented last January gives a hint of how far advanced this branch of science is: "An Optical Identification Program for Serendipitous Einstein X-Ray Sources," by astronomers from Columbia University and UCLA.

X-ray astronomy may be the most interesting channel to watch in the coming decade. Stay tuned.
PHEONOMENA

OMNI presents, for the first time anywhere, an exclusive photograph of the flight deck of the space shuttle Columbia, now being readied for lift-off at Cape Canaveral, Florida. The commander of the ship sits to the left, the pilot to the right. Between them is the flight computer and navigation console, and in front of them are instrument displays, controllers, and the like. Several computers combine data derived from flight instrumentation and flight control units—located directly in front of the seats—for quick visual display on three cathode-ray tubes. Finally, environmental and lighting controls are overhead, along with additional street-level instruments. Klaus Willemsen, of Technicolor Graphic Systems, took this photograph for NASA, using a Nikon F camera with a Takumar lens and Kodak Vericolor Type S film.
The heart of a rose, strange facts, and potluck puzzles

By Scot Morris

"It's more fun to arrive at a conclusion than to justify it."
—Malcolm Forbes, The Sayings of Chairman Malcolm (Harper & Row)

That sentiment echoes our thoughts; it's the frolic in playing, not the logistics that makes games worthwhile. Knowing that all the readers who follow this column are in it for fun, this month we present some playful pastimes.

Our first offering is an induction game called Petals Around the Rose. It is played with five dice. One person rolls the dice and announces a number. The thrower is Potentate of the Rose and knows the secret. Others try to determine the formula by which the Potentate derives his number. The name of the game is significant. The announced number is always even and is indeed a true function of the five faces.

1 2 3 4 5
(10) (2) (6) (8) (12)

Those who are in on the secret easily agree on the number that applies to each throw. For every set of faces there is only one number, though different sets of faces may at times have the same number.

Petals Around the Rose was called to our attention by Martin Gardner. The game first made its appearance about four years ago in computer circles and has become increasingly popular with the general puzzler. It is most fun when played in a group with one person who knows the secret and several others guessing what the numerical answer might be. We can only approximate that here. We have reproduced a series of 12 throws with the correct responses (in parentheses) that

1 2 3 4 5
(10) (2) (6) (8) (12)

the Potentate of the Rose should give for each. Can you figure out what simple system is used to come up with each answer?

**STRANGE FACTS**

The following items are excerpted from my Doubleday/Dolphin paperback The Book of Strange Facts and Useless Information (1979):

1. **MAGIC STUFF** It can help clear up your acne, clean your teeth, soften your beard, deodorize your body and your refrigerator, calm your upset stomach, fireproof your Christmas tree, cure your cattle of the blight, and make your chickens produce eggs with yellower yolks. If a woman

...douches with it after intercourse, it encourages the production of a male baby. What is this magical substance?

2. **FRENCH SPREAD** It was invented in France in 1663 and was the first artificial food ever created. It initially consisted of beef suet, warm milk, and sheep stomach lining. What is it?

3. **RARE TREAT** It is the most nutritious food of any kind. It is richer in vitamins than meat. It is easy to prepare and is available all over the world, yet few people use it. You cannot order it in a restaurant or buy it in a health-food store. What is it?

4. **LIGHT FANTASTIC** Its light production has been called the most efficient form known to man. It gives the coldest light of any in the world. Only about 1 percent of its energy is lost as heat. What is it?

5. **MOVING EASY** It is the most efficient kind of motion known to science surpassing all moving machines (from jet planes to sports cars and rowboats) and all animals (from cheetahs to eagles and trout). In transporting a quantity of weight across a given distance, this form of movement uses less energy than any other. What is it?

6. **HOT OR COLD** When is the sun closer to the earth—in June or December?

7. **COMMONPLACE** Which is more common, an eclipse of the sun or an eclipse of the moon?

8. **JEWISH STATE** Where is a Jew a gentle man?

9. **BULL** A hyperbolic matador once said that if a bullwhip travels so fast it breaks the sound barrier True or false?

10. **SIZE** Which dive is largest—Large Royal, King, Jumbo, or Mammoth?

Here's a curiosity of mathematics. It is said that many years ago Ethiopian peasants could not understand multiplication. They could, however, halve and double numbers with counting pebbles (dividing a number of pebbles into two equal parts to find half of the number duplicating a pile of pebbles to double the number). From this primitive beginning they developed an ingenious multiplication system which baffles most Western mathematicians.
Suppose a merchant wanted to buy 15 goats at, say $13 apiece. We could calculate the price he'd pay by simple multiplication ($195) but to see how the Ethiopians would find it, set the numbers 13 and 15 in two columns labeled Half and Double. Either number can go in either column, but for the sake of this illustration set them up like this

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Now halve the 13 to get 6.5 Ignore the ½; Ethiopians don't understand fractions. Then double the 15.

Continue halving and doubling pairs of numbers, discarding all fractions until the Half column reaches 1

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At this point legend says, Ethiopians invoked an ancient superstition. They considered that any pair of numbers with an even number in the Half column was evil and had to be destroyed. In this example scratch out the 6 and the 30.

Finally, add the remaining numbers in the Double column and there's your answer

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It works.

Try the system with any pair of numbers, large or small. It always works.

Mathematicians say that if we were more familiar with the binary number system we would find the procedure intuitively obvious. But most of us are accustomed to thinking in decimal numbers, and Ethiopian pebble multiplication almost incomprehensible. A curious set of haphazard rules that somehow more by magic than math, invariably leads to the correct answer.

**READER ORIGINAL $25**

THE CENTRIFUGE L A Dillard of Temple, Texas, writes: "I work in a laboratory and have a puzzle concerning common piece of lab equipment the 12-place centrifuge. It contains 12 wells in which test tubes may be placed and spun rapidly. The centrifuge will run smoothly only if the tubes are balanced. How many different numbers of equal weight test tubes may we spin at once and have a balanced centrifuge?"

Dillard eliminates the easy answers first.

One cannot spin just one tube alone without setting the centrifuge off balance, nor can one place 11 tubes, for the vacant space will throw the machine out of kilter. It is just as obvious that any even number of tubes can be arranged to balance out by placing them in the centrifuge by pairs.

What if there are three, five, seven or nine test tubes? These can be handled easily by placing them at the 12, 4 and 8 o'clock positions (above, at left). Are the other numbers possible? At right, for example, is a possible arrangement of five test tubes. Will it make the centrifuge spin smoothly or make it wobble?

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4 LUCKY 13. Look at the green side of a dollar bill, on which are reproduced the two faces of the Great Seal of the United States. The number 13 is represented in at least nine ways on this side of the bill. Find five of them.

5 WRONG ONES. What is wrong with the following names?

Harry S Truman "Meadowlark" Lemon "Babe Didrikson Zaharias"

6 PUT YOUR MONEY DOWN. Here's the bet: I'll bet you all the money in my pocket at this moment that I have less money than you have in your pocket. Should you take the bet? Consider: Either of us could be carrying any conceivable amount of money so that in the long run the chances of winning this bet are 50-50. But consider also that the amount of money you stand to win is greater than the amount of money you stand to lose. In the long run the wager seems to be in your favor. What can you say about such reasoning?

7 THE 12 COINS. You have 12 coins. One is counterfeit and is either heavier or lighter than a genuine coin. With a two-pan balance scale, how can you find the odd coin and determine whether it is heavier or lighter in just three weighings? This weighing problem is a sure cure for a sound night's sleep.

Answers: page 126

1 THE SPIDER AND THE FLY This puzzle, concocted by Henry Ernest Dudany, involves a closed 12 x 30-foot room that has a 12-foot-high ceiling. In the middle of one and wall, a foot above the floor is a spider. The spider wants to eat the fly caught in its web in the middle of the opposite end wall one foot below the ceiling. What is the shortest path the spider can take to reach the fly?

2 ONCE IN A LIFETIME Something very unusual happened on May 6, 1978, at 12:34. What was it?

3 SPIRAL. What is the difference between these two designs?
LAST WORD

By Ben Bova

It struck me as I sat watching the movie Alien, that readers of science fiction are much better prepared to face extraterrestrial emergencies than movie people are.

Here was a shipload of officers and crew scared to death because they had set aside the rules and had brought a voraciously carnivorous, thoroughly nasty alien creature aboard their vessel and they didn't know how to get rid of it. Jump into your spacesuits and open all the hatches! the science-fiction readers among the audience shouted.

The actors playing the idiotic crew of the doomed ship Nostrano ignored that advice. Until the very end of the film, of course, when the last remaining member of the crew donned her spacesuit, opened all the hatches, and blew the alien into the final credits.

Okay, so they had to give the audience a couple of hours of chills and frights for their price of admission. But most science-fiction readers lost interest in the film very early simply because they knew how to handle the alien and because the crew of the ship obviously didn't.

This set me to thinking. There are lots of things that science fiction aficionados know so well that they take the knowledge for granted and they assume that everyone else knows these things, too.

Not so!

For instance, consider the problem of First Contact. You're in a spacecraft: way out there among the stars, and you meet the spaceship of an alien race. You exchange pleasantries with them. After all, it's not every day that you make contact with an intelligent extraterrestrial species.

But you don't tell them where your home world is!

The aliens may seem kindly disposed, but how much do you really know about them? Perhaps they're aggressive, carnivorous sex-starved. Anything is possible. You certainly don't want to invite them to Earth until you are absolutely certain they won't wipe out mankind or enslave us, use us for pet food, or steal all our wimmintfolk. As H.G. Wells once put it, when a highly superior extraterrestrial race tells us that they want only 'to serve mankind,' we should inquire whether they wish to serve us baked or fried.

Yet what have Carl Sagan and the astronomers done? On each Voyager and Pioneer probe that's been hurled out beyond the solar system they have put maps aboard that tell any alien who eyes stalks exactly where Earth is!

Just because it may take a million or more years for these Judas goat spacecraft to reach another star system is no reason for us to feel safe or complacent. We do care about our descendants' welfare, don't we?

There are all kinds of survival facts known to readers of science fiction that the average person has never even thought about.

No matter where you travel, you really don't have much to fear from alien germs. Persons who don't read science fiction worry about contracting some alien disease only slightly less than about being gobble by an enormous alien carnivore. Neither threat is much of a possibility in actuality.

Alien critters — microscopic or mastodon-sized — are alien. Their biochemistry is not our biochemistry. Earthly viruses and bacteria make us ill because they are adapted to our biochemistry and can live parasitically upon us.

Alien microbes can't. And won't. Sure NASA put the Apollo astronauts into quarantine on a 'better safe than sorry' policy. And Michael Crichton got rich and famous by scaring millions of people with The Andromeda Strain. But science-fiction readers were bored with both NASA and Crichton. We could have saved a lot of money there.

However, human biochemistry is probably poisonous to alien creatures. And vice versa. If you ever visit extraterrestrial resorts, don't drink the water! If an alien carnivore takes a bite out of you it may be unpleasant for you, but it might prove fatal to the alien. The chemicals that make us strong and healthy may very well be poisonous to an extraterrestrial. (Another strike against the film Alien.)

There are seemingly endless implications here for extraterrestrial sex, but these are clearly without issue.

Further survival hints known to science-fiction aficionados:

You will never die of loneliness in space. No matter where you are marooned, all sorts of people and/or things will drop in for visits. Just read the literature. Even Robinson Crusoe had his hands full before too many chapters had gone by.

Perhaps the most important piece of survival knowledge that is familiar to science-fiction readers and few others is this. In most movies, scientists are portrayed as having the intelligence and moral scruples of movie producers. (That is, virtually none of either quality.) This is not true in real life. Scientists are about as intelligent and morally straight as say science fiction authors.

Therefore, we have very little to fear from scientists. They are really fine people for the most part. But we do have rather a lot to fear from movie producers.