

OMNI

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**FUTUREScape 2081:
GERARD D'NEILL ON
THE NEXT 100 YEARS •
RAY BRADBURY'S
HOME-MADE MUMMY •
RENT-A-CONSCIENCE:
THE MORALITY OF
FUTURE SCIENCE •
ALIENS IN OUR SEAS •
THE IMPOSSIBLE BOX:
MAGIC IN THE
4TH DIMENSION**





FIRST WORD

By Ben Bova

Science fiction is often considered the literature of change. It has arisen to explain, to warn, to explore, to humanize the future.

Literary critics, librarians and teachers (with a few exceptions) are uncomfortable about science fiction. After all, they revere, and prize, science-fiction pulp literature—and therefore, it is not the best of all. The most science-fiction magazines were small in size and circulation—and many of them featured (and covers depicting grotesque alien monsters.

Hollywood did little to improve science fiction's reputation, for the nation's educators. For every 2001, A Space Odyssey that came to the screen, there were dozens of vapid films featuring even more grotesque alien monsters.

And literary critics would rarely condescend to review a science-fiction novel. There was an unwritten motto among them: "If it's science fiction, it can't be good. If it's good, it can't be science fiction."

Yet young readers loved science fiction, kept buying those pulp magazines, flocked to those vapid movies, and patronized their librarians for science-fiction books. Most of the astronauts who have walked on the moon first became interested in space and science through reading science fiction.

Modern science fiction is an increasingly wide field, ranging all the way from steampunk-still stories of robots, space ships, lasers, and high technology to outright fantasies about enchanted cyborgs, mighty blessed warriors, and the supernatural.

There is a wide range of stories that deal with future societies, the frontiers of human knowledge, extraordinary perceptions, and the politics and possibilities of tomorrow.

In short, modern science fiction offers the reader (and writer) the largest canvas imaginable: the entire universe and all of the past, present, and future.

One thing that all good science-fiction stories have in common is that they deal with the concept of change. They are not about the here-and-now world. They explore new ideas, new possibilities, and new dangers and opportunities.

Change. Science fiction, in fact, has often been considered the literature of change. Tomorrow will be different from today. That is the overriding axiom of science fiction. If you want the antidote for future shock, it is science fiction. Asimov offered himself prescribed it in his book on that subject.

We live in a world of awfully changing possibilities. Fueled by scientific research, by vastly complex technologies, our society changes before our eyes. And in response to the societal fact, a literature of change—science fiction—has arisen to explain, to warn, to explore, to humanize the future.

Today hundreds of colleges and universities offer courses in science fiction. No one can keep track of all

the secondary schools that have science-fiction classes. Secondary schools devoted to the subject at national meetings of English teachers and at annual conventions of science-fiction writers. The United States organization of teachers, librarians, and researchers on the subject has been formed. It is called Science Fiction Research Association.

At the University of Kansas in Lawrence, a summer long seminar on teaching science fiction is held each year, under the direction of James Gunn, a first rank science-fiction writer and a professor of English. Michigan State University annually hosts the Clarion Workshop for new writers interested in science fiction.

Here at *Orrin* magazine, science fiction has been an integral part of our editorial "mix" from the very beginning. Because *Orrin* is "the magazine of tomorrow," our aim is to examine the future in every way that we can, with feature articles, columns of subjects as diverse as television and astronomy interviews of the world's leading thinkers—and with science fiction. In fact, science fiction allows us to present dimensions of the future that cannot be seen in any other way.

Back before the computer became the ubiquitous tool it is today, aircraft manufacturers used sandbags to test the structural strength of new planes. A prototype plane would be built, and then its wings would be loaded with sandbags or other forms of strain until the wings snapped. That was called testing to destruction.

Today engineers can feed into a computer all the structural characteristics of a new airplane design, and the computer will tell them swiftly and economically how much strain the structure can stand before it will break.

Writers use science fiction as a computer simulation laboratory. They create in their science-fiction tales, future societies that are different from our own. In some cases the differences are relatively slight: a twentieth century in which nuclear power was not discovered, in other cases the differences are enormous: a distant alien world where the native intelligent species has many different sexes. In all cases, the story not only tests the assumptions on which that society rests; it also shows the results in human, emotional terms. It is virtually impossible to achieve this goal impact in a nonfiction article.

That is why we publish science fiction. Today's readers understand that tomorrow will be different from today, and they turn to science fiction to catch glimpses of future possibilities, to forecast the onset of future shock.

Until someone invents a working time machine, science fiction will be the best way we have to examine tomorrow. That's why it is so exciting. And useful. **CC**

CONTRIBUTORS

OMNIBUS



DAVE



DRABURY



DONG



VAZCO



O'NEILL

If we survive these dangerous decades the human race will be unkillable, because it will have begun to spread throughout the solar system," writes Gerard K. O'Neill in his new book, *2081*. Not since Alvin Toffler's *The Third Wave* has a forthcoming book generated such excitement. A sneak preview of this landmark work, prepared exclusively for *Omnis* readers, begins on page 52. Combining the scientific facts of today with his years of experience as an applied scientist and Princeton physics professor, O'Neill foresees a century of dynamic technological innovation. Introduced in *Omnis*'s July 1979 issue, the man who wrote the best-selling *The High Frontier* and invented the mass driver talked about his ideas on space colonization. In 2081 he predicts that space colonies, computers, automation, energy and communications will determine the course of the next 100 years. A second excerpt will appear in next month's issue.

Can the people we turn to for moral support, for example, our religious leaders, guide us through the labyrinthine ethical issues now being raised by science and technology on their ever-widening frontiers? This issue dominated the World Conference of Faith, Science, and the Future, held at MIT more than a year ago. Douglas Coligan, after reading about the conference, wanted to know more. "There is a greater need for experts in ethics because of the moral complexity of science issues." To fulfill that need, ethical

think tanks have come of age. "In *Faith & Conscience*" (page 85) Coligan explores the new ethical revolution in science and tells of its influence in determining grant bequests. A general science writer, Coligan has published such books as *Creative Incomes* and *The Science of Coincidences*.

Ray Bradbury's first original short story for *Omnis*, "Colonel Stonesteele's Genuine Home-made Truly Egyptian Mummy" begins on page 78. Over the past four decades his stories have appeared in magazines as disparate as *The New Yorker* and *Weird Tales*. Bradbury's remarkable novel *Fahrenheit 451* and his books *The Martian Chronicles* and *Dandelion Wine* won him international acclaim. His most recent book, *The Stories of Ray Bradbury*, is a volume of his 100 best, published by Knopf. Accompanying Bradbury's story this month is William Gibson's "Johnny Mnemonic" (page 56). Gibson is a full-time writer living in Vancouver, British Columbia. His work appears in two anthologies, *Universe 11* and *Shadows 4*, both published this year by Doubleday.

How can city schoolteachers keep their students interested in science? One way is to involve them in a special project nicknamed "Orbit 81," an experiment to be conducted aboard the space shuttle. In "Tiger in Orbit" (page 72) Fawn Vazco writes about a group of disadvantaged Camden high school students, who, with some help from RCA, won a NASA

competition to put an art experiment on the shuttle. While working as a reporter for the *Philadelphia Bulletin*, Vazco covered the children's experiment. "I'm excited about young people putting their energy into the space program, and I hope NASA will have the patience to continue this novel idea of bringing space exploration and city school students together," Vazco says. Recently Vazco and two fellow reporters at the *Bulletin* received a public service award from the New Jersey Press Association for exposing job abuses in Camden's city work force.

In this month's UFO Update, Paul Dong, the American editor of the *Chinese Journal of UFO Research*, gives us firsthand glimpses of China's response to UFO sightings, which were previously unavailable to the public. In "Mindland Mysteries" (page 36) edited by Harry Lobolov, Dong discusses the reasons behind official Chinese denials of an academic UFO study group in Peking.

In "Stellar Technician" (page 100) award-winning science-fiction illustrator Vincent Di Fate provides *Omnis* a visual survey of the mechanical wonders of a future technocracy. Di Fate, an SF art historian and lecturer on the subject, says "If science fiction and the art that illuminates it have a function beyond that of merely entertaining us, it is to remind us of our imperially and of the value of human dreams." Di Fate has three paintings in the permanent space art collection at the National Air and Space Museum. **CD**

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LETTERS

COMMUNICATIONS

Divine Alchemist

As an American art student on extended study in Vienna with Professor Ernst Fuchs, I enjoyed seeing his concepts reach a more diversified audience, but I was disappointed by the brevity of Thomas Wey's article [January 1981].

Fuchs's subtle veils are tempered not only with the forcefulness of the conquering lion but with the understanding and patience for which saints are famous. We in the Western world should emulate Fuchs's vision if harmony is to accompany our conquests of inner and outer space.

The artist must be nurtured as a dear consultant in matters of both politics and science. To this end, *Omni* has greatly contributed.

Joseph Askew
Vienna, Austria

Ecoethics

Living in the hinterland of British Columbia, I find that my life-style revolves around the animals near me. I felt that "Ecofighters" [Earth, February 1981] was completely biased.

The seal hunt is a managed harvest that's been going on for hundreds of years. It is necessary, as man and seal both compete for fish off the Grand Banks. The seal hunt is not any crueller than a cattle or chicken farm.

Ecological activists are mainly city dwellers. They have no understanding of the people in the wilderness whose lives depend on the survival of the fittest. Just ask a trapper or seal hunter.

Tony Nighula
Nelson, B.C., Canada

The tide is changing against the many illegal whaling operations. They are getting just what they deserve.

Thank you for your excellent article. The ramifications fill me with new hope. Whom can one enlist?

Susan Lee Thomas
Huntington Beach, Calif

We have received numerous requests for information about environmentalist Paul Watson and the activist publication *The*

Boat. Contact Paul Watson, c/o Sea Shepherd Conservation Society, 1825 West Fourth Avenue, Vancouver, British Columbia, VJ1 1M5, Canada; The Boat, 2 Blenheim Crescent, London, W71 1NW, England. Copies of the quarterly can be obtained singly at \$5.75 (airmail) or \$4 (surface), annual subscription \$26 (airmail), \$21 (surface). — Ed

The Prometheus Special

Regarding Art Oula's Last Word [February 1981], the problem is not Senator [William] Proxmire but rather the long-standing distribution of aerospace dollars. Many states and congressmen could easily (and rightfully) view the approval of aerospace dollars as a subsidy to the California aerospace industry. But if Wisconsin received a major subcontract from Rockwell, TRW or Hughes for a space project you can be sure attitudes would change.

Aerospace companies should distribute operations nationally if they desire national dollars for support. If this had been done during Apollo, perhaps the shuttle mission would not have languished for lack of funds.

Michael Baruch
Anaheim, Calif.

Big Brother's Influence

I am horrified by the growing acceptance of subliminal persuasion and angered by the closing paragraphs of *Omni's* article on the subject, "In Through the Out Door" [February 1981]. Why rationalize the differences between conventional and subliminal advertising?

Today's ads rely heavily on hidden messages and sexual implications, but at least the entire ad is right there in plain sight. Subliminal ads, however, ignore any consideration of mental privacy and are effective through subconscious manipulation.

You admit that "it would be foolhardy not to keep an eye out for Big Brother's intrusion." Now can you tell us the difference between Big Brother and Big Business?

Craig Walker
Tucson, Ariz. **OC**

HEAD

THE NEW HEAD VECTOR

In construction, a hexagonal aluminum, like the famous Head Pro®™, but its head is slightly enlarged for a bigger "sweet spot." So, the Vector hits big without feeling bulky. Its extra hitting area is more forgiving on off-center hits. The Vector adds strength and depth to your game. Gives the better player the extra power that produces winning shots.

NEW STRINGING SYSTEM



Strings are individually locked in into place by tiny lightweight wedges.

This year, the Vector introduces the new Head "String-Lock" System, a whole new concept in racket technology. Each string is individually locked into place. This means you can keep your racket in top playing condition by replacing strings as they become worn or broken. If a string breaks during a match, you can keep playing because the remaining strings maintain their tension. Ask your authorized Head dealer how "String-Lock" works. And try a Vector demonstration racket!

DIALOGUE FORUM

In which the readers, editors, and correspondents discuss topics arising out of Omni and themes 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, 809 Third Avenue, New York, NY 10022.

Whose Right to Life?

In response to the article by Kathleen McKusick on brain mending [Life, January 1981], I found that the moral question raised by William Regelson—"Whose are we going to get the embryonic tissues?"—is most important.

I find it truly amazing that a graft of embryonic brain tissue can heal a brain lesion in an adult. But even if many adults could be helped greatly by this procedure it disturbs me that the unborn child is sacrificed for the adult. The question that needs to be studied and weighed carefully is, Which human being should have the right to live a healthy life: the adult or the unborn child?

Sandra Seipie
Rochester, Mich.

More "Moonstruck" Debate

We were somewhat taken aback by Ben Bova's evaluation of the implications of the Moon Treaty in his article, "Moonstruck" [December 1980]. What troubled us was the number of factual inaccuracies and distortions. For example, Mr. Bova states that the Moon Treaty has now come into force for all signatory nations. The treaty provides that five nations must ratify it before it comes into force at all, and then it will be in effect only for those nations ratifying or acceding to it. While a few nations have signed it, not a single country has yet ratified it. Incidentally by August 1980, six (not five) nations had signed the treaty: France, Chile, the Philippines, Romania, Austria, and Morocco (not Canada).

Throughout the first half of the article, Mr. Bova overlooks the fact that the treaty is only a framework of principles. Far from being "the most far-reaching international

document ever written," the treaty does little more than elaborate on the principles of the outer space agreement of 1967. The treaty says that in due course a regime should be negotiated to govern lunar resource development. Furthermore, contrary to Mr. Bova's assertions, the treaty does not entrust the United Nations with the mandate to set up these new arrangements; the regime is to be established through agreement among the nations that ratify the Moon Treaty. By ratifying the Treaty, a country would be committed only to participating in the conference on the regime, not necessarily to accepting the final product of that negotiation.

Mr. Bova also underscores the treaty's application to all U.S. citizens and organizations as if this were unusual. Any treaty governing activities in areas beyond national jurisdiction—whether on the high seas, in international airspace, or in space, or in the international seabed—requires that activities undertaken by the nationals be sponsored by the country concerned. Ships, airplanes, spaceships, etc. must all be registered under the laws of a given nation, with whose standards they must comply.

Implicit throughout the article are assumptions that hardly seem justified in light of America's long-standing support of international law as a basis for relations among nations. It is neither for cooling other countries nor for "moralistic" reasons that the United States has adopted this policy. It is vital for a nation's security that it operate according to a set of expectations shared by other nations. We could not agree more with Mr. Bova's final sentence quoting former astronaut William A. Anders that "if we can't cooperate in space as mankind, then we likely won't get together on anything, and we will bring about our own extinction."

Mr. Bova's statement that the Moon Treaty will have a dire effect on private enterprise in space development exaggerates the implications of the treaty and implies alternatives that are unrealistic. There is absolutely nothing in the Moon Treaty that would justify the fears

of the L-5 Society, quoted and apparently endorsed by Mr. Bova, that the regime would give the Communist nations an unbeatable advantage in space operations and establish a new "OPEC-like monopoly" that will impede private enterprise in space development.

It is hard to conceive that the United States or any other Western developed nation would agree to terms and conditions that would rule out participation by private industry in space development. The L-5 Society's conclusions draw on a worst-case analysis of the decision-making arrangements that are being negotiated in the Law of the Sea Conference to control the mining of the deep seabed.

When Mr. Bova argues that Third World nations will insist on a one-nation/one-vote system, he conveniently ignores the fact that initial demands do not final agreements make. The Law of the Sea negotiations have rejected this approach in favor of an arrangement that gives weight to all the different interests involved and is thus a compromise between the initial demands of the Third World and those of the major industrial nations. Mr. Bova makes the same mistake when he suggests that Third World nations are exclusively responsible for the elaboration of the common-heritage concept. Developed, industrialized nations have also played a part in shaping this principle, in both the Law of the Sea and the outer space discussions.

Incidentally, as far as the pro-Soviet bent of the treaty is concerned, it is worth noting that Moscow opposed the application of the common-heritage doctrine. The 1971 Soviet draft of the treaty omitted any reference to common heritage. Besides, any operations contemplated by the United States would of necessity be at least partially spon-

sored and funded by the government.

As to the range of alternatives for coastal development, Mr. Bova writes that if it were not for the Moon Treaty, private enterprise would have no hesitation in investing hundreds of millions of dollars in space operations in the hope of earning a profit. The deep-seabed-mining analogy simply does not bear this out. In both cases an international agreement that is already in force prohibits any nation, or its nationals, from making a claim of sovereignty. What this has meant in the case of the seabed is that, although the U.S. government supports the view that mining of the seabed may be conducted in the same way that one would harvest fish from the ocean, it refuses to recognize exclusive claims to any area of the international seabed. Unable to demonstrate exclusive and secure rights to particular sea bodies, companies find it difficult to obtain investment loans.

In outer space an even stronger prohibition on claims obtains under the 1967 Outer Space Treaty. Unless the United States were to abrogate these long-standing treaty commitments, some form of international agreement is needed to confer secure and exclusive rights to these areas for purposes of resource development.

The alternative of unilateral action has proved inadequate in the case of the seabed. In June 1980 the United States enacted a law that unilaterally sanctions deep-sea mining, but mining companies still require additional written government assurances against future international rules that could adversely affect financial investments.

In our view a spirit of cooperation would better protect national interests than would withdrawal from the framework of international law. By participating in the development of that framework, the United

States could only help create the security necessary for private investment in outer space development.

Lee Kimball
United Method of
Law of the Sea Project
Washington, D.C.

Barbara Mitchell
International Institute
for Environment and
Development
Washington, D.C., and
London, England

Ban Bova replies: It is quite true that the nations that have signed the Moon Treaty have not yet ratified it, so the treaty is not yet in force for any nation. One might regret the misinterpretation. We still believe firmly, however, that the Moon Treaty's aim of creating an international bureaucracy to regulate every facet of space exploration and development works decidedly against the best interests of the United States—and of the same Third World nations that are attempting to carve out a share of the profits from space without doing any of the work. If their aims are fulfilled, there will be no profits from space for anyone.

When the Music's Over: *Chris's article "The Endless Scale" (March 1981) quoted Douglas Holstadter: "I don't hold out any great hope for a computer to write a masterpiece, but for someone to say that all a computer can do is produce Muzak, you've got to ask, 'What is Muzak?'"* If this question had no answer...

Muzak abounds in skepticism. Muzak does not recognize the human voice, with all its subtle inflections, as the fundamental inspiration for music-making; the world over, it does not address itself to the human condition. That we are both rational and irrational beings, that we have a capacity for both tragedy and comedy, Muzak is opposed to the scientific methods and techniques that whet man's appetite for a deeper understanding of nature and his own living body, it destroys our individual rhythms and substitutes for them feelings of inadequacy; it even strips us of our individuality as if we cannot experience life, as if we have no stores to tell. Muzak worships science to the exclusion of flexible, integrated rootedness. It measures in numbers ("Who does what with how many?") Muzak intends to explain the unexplainable and renders our voices, instruments, and souls antiquated; it thrives on the transparent theory that the arts and sciences become easier in time. Muzak is impatient and thinks it cannot fail, and yet when the lights go out, or when you pull the plug, its messengers simply disappear.

Chris Forster
San Diego, Calif.



Leading the fight against Muzak: Chris Forster plays his experimental instrument, the Chrysalis.

EARTH COLLEGE

EARTH

By Gordon F. Sander

Earth Day this month will officially mark the ecology movement's eleven-th birthday. But, like most utopian movements that emerged out of the cultural and political upheavals of the late Sixties and early Seventies, the ecology movement produced as much chaff as wheat. It gave us Earth Day and it gave us Earth Shakes. It generated worthwhile legislation and a lot of legs-lame pollution. Earth still looks pretty sick. So what is to be celebrated?

Ten years ago, at the movement's outset, a disgruntled ex-dean from Harvard and a handful of relatively wild-eyed environmentalists branched from the university to found their own alternative college in Maine. They called their school the College of the Atlantic (COA), and, armed with an untested, unaccredited degree program in something called human ecology, they set up shop.

"People thought I was crazy to come here," recalls COA's president, Ed Kaelber. "It was an era in which the alternative academic institution was becoming something of an endangered

species." But to everyone's surprise, "Earth College" or "Backpack U" began to attract bright, serious students to the isolated beauty of Mount Desert Island. Enrollment is still growing.

In order to survive, the college's founding fathers adopted their new home's frontier spirit; they chose to refurbish existing buildings, rather than spend themselves broke on a brand-new campus. And the community, usually suspicious of strangers, was quick to recognize an affinity with the college and offer it support.

"But the main reason we have survived," Kaelber says, "has been the dedication and involvement of all elements of the college itself. We are truly a democracy."

When the college applied, about four years ago, for accreditation, the New England Association of Colleges and Universities dispatched an examiner to Maine to look the school over. "Here is a humanistic institution," he reported, "defining the essence of human ecology, which seeks to study man in relationship to man, and man in relation to his

environment." The college won accreditation from the association in the record time of four years.

Ironically, it was an ecological catastrophe that gave this unusual institution its original impetus. The great fire of 1947 destroyed most of the oceanfront mansions that once made Mount Desert Island the "Newport of the North," and much of the summer industry disappeared with them. An island-based college sought a good replacement, particularly one that would make use of the island's open-air natural museum. It remained only for the ecology movement to supply a theme: human ecology.

Over the years this holistic philosophy has been translated into a curriculum that stresses the relationship between various disciplines. Students take courses in those areas calculated to impart both an appreciation of nature and an advanced set of independent thinking and research skills. Applied Human Studies includes the humanities and social sciences. Field sciences such as ornithology and ichthyology are covered in Environmental Science. And Environmental Design focuses on man-made environments, energy-efficient designs, and low-impact technology. "We emphasize hands-on experience here," says Harris Hyman, one of the instructors of the Environmental Design course. "3-D. That's the main reason why I come here myself."

COA's special curriculum is designed to enable students to come up with imaginative solutions to complex, interrelated problems. "We're not trained as scientists, economists, or poets, but as all three," says one recent graduate. "Students bring to biology a knowledge of design, and to their environmental studies an understanding of economics."

Visiting the college can be something of an alternative experience in itself. To a casual observer, student life seems to consist mostly of hugging, knitting, and defining one's terms. Scanning the bulletin boards only reinforces the feeling of being lost in educational space. Here is a complicated poster on how to distinguish between the blowhole of a sperm whale



A unique curriculum in human ecology trains students to protect and restore our natural resources.

CONTINUED ON PAGE 30

A TEST OF AGE

LIFE

By Dr Bernard Dixon

Old many years before his time
Everlastingly youthful Looks
Twenty years younger Shows
her years . . . Has the secret of eternal
youth . . . Aged quite remarkably white in
office

Clichés or accurate comments? Do we really grow old at different rates? Does the biological clock tick more slowly for some people than for others? If so, what influence might one's occupation have on its timekeeping? These are some of the many intriguing questions posed by the science of aging. Until recently there was no satisfactory way of attempting to answer these questions. Now as a result of research carried out at the University of Jyväskylä in Finland, we have an interesting new technique that may provide answers.

Dr Anja Kiskinen and his colleagues became concerned with aging as a result of their work in occupational health. Some jobs, as everyone knows, are less healthy and more tiring than others. But could it be that onerous occupations actually age employees prematurely?

There is no single factor, such as blood pressure, that may be measured to give an unambiguous answer. What we can do, however, is use a battery of different indices, all of them associated with aging to calculate the "functional capacity" of a person being tested. If, for example, we assess an individual's grip strength and nearsightedness and breathing capacity and a range of other aptitudes, the combined results provide a measure of his or her functional capacity. This is certainly related to chronological age because whenever our personal strengths and weaknesses, the aggregate score worsens as we get older. In other words, the so-called functional capacity provides us with a single numerical measurement that can be used in order to rate a person's bodily well-being.

The secret of Dr Kiskinen's research is the way in which he uses measurements of functional capacity. He simply compares a person for person, with chronological age. The resulting ratio provides an entirely new measure known as "functional age." It is an indicator of our real, as

opposed to our expected, bodily capacities. On this basis, Kiskinen's results show that some of us are indeed younger or older than our calendar years suggest.

Workers at several Finnish refining factories were assessed by the method. Persons under thirty-three years of age and those over fifty-two were studied. They included blue collar employees doing foundry work and white-collar employees in planning and administration. More than 300 people took part in the survey, and all underwent tests of their senses, blood circulation, muscles, lungs, and central nervous system. Kiskinen's team then calculated mean values of the results for managerial, skilled, and semiskilled groups.

The outcome, as reported in *WC5 Medical Science* (1981, Vol. 9, p. 6), is fascinating. The average functional age of managers of types is indeed better—for both sexes—than that of skilled and semiskilled employees. More detailed analysis shows that a low (young) functional age in men is associated with longer education, higher income, and lighter and more interesting work. For women, the important factors are longer education and physically active leisure time. Particularly revealing is the influence of socioeconomic status and education in all three groups: this correlates more strongly with chronological age than with either health status or living habits.

Whenever a public figure dies in office, we hear that the pressure of his job was to blame. History does not support this view. Since 1850, for example, only one British prime minister has died below the age of seventy. Seven passed the age of eighty, and Churchill was over ninety.

Kiskinen's studies illuminate this paradox. The last group to show signs of premature bodily wear and tear is that of well-educated, middle-class managers and administrators. We have to look elsewhere—in this case to nonmanagerial employees of Finland's metal-refining industry, for unambiguous evidence of accelerated aging. There may be lessons in this research for all of us. **OO**



Occupational hazard: Semiskilled laborers age more rapidly than those in white-collar jobs

RETURN TO EARTH

SPACE

By Nick Engler

Last April, when cosmonaut Valeri Ryumin entered outer space for the second time in as many years, his body immediately began to change. The transition from a one-gravity environment to zero gravity affected every part of the cosmonaut's metabolism, but Ryumin remained healthy, comfortable, and untroubled. As he adjusted to the tedious routine of another half year aboard Salyut 6, he reduced mission control at Yuri Gagarin Space Center in Zvezdnyi Gorodok (Baikar City), that he had hardly noticed the changes.

Ryumin's favorable physiological reaction echoed the experience of his first six-month mission a year earlier, which set a record for the longest time anyone had ever spent in space. The second trip was the much-hoped-for duplication of space acclimatization data. "It [was evident that the success of the previous flight] was not just an accident or good luck," Dr. Gerald A. Mohler, director of life sciences at NASA, said. "It really proves that humans are engineered quite well for spaceflight."

The major aim of the Salyut program

has been to monitor and control the cosmonaut's adaptation process. Physicians are experimenting with regimens of diet and exercise calculated to keep a person fit on Earth without interfering with his adaptation to space. "Our basic goal is to retain the adaptability to both environments," says academican Oleg Georgievich Gusevko, who designed and monitored the biomedical experiments aboard Salyut. "During spaceflight our cosmonauts take countermeasures to remind [their metabolic systems] of the typical features of life on Earth."

"Upon leaving Earth, the spaceman is helpless," Gusevko says. He loses his reflexes and responses to his native environment. In a word, once man becomes adapted to space, he loses his ability to return to Earth. Although Ryumin remained vigorous and in fine condition during both spaceflights, he could neither stand nor walk when he touched down.

The space experience alters almost the entire human physiology: from the shape of a man's face to the density of the cartilage in his heel (see Bernard Dixon's

Life column "Space Aging," October 1980). Most of these changes are subtle, but they are so pervasive that the overall effect is amazingly complex. Because spaceflights of long duration are still new to human experience, no one knows what the potential hazards of moving from Earth into outer space and back are.

The changes in the body that accompany spaceflight are not pathological. Dr. Stanley R. Mohler, director of the Aero Space Medicine Training Program at Wright State University in Dayton, Ohio, believes everything that happens to the human body in space is as it should be.

"The normal adaptation process takes over," says Dr. Mohler. "We're looking at a continuous spectrum of environments with Earth somewhere in the middle. In space we simply adapt to a different level along the continuum." The return to Earth, however, necessitates readaptation.

The considerable environmental shifts that a space traveler encounters on the way up are an increase in radiation and a decrease in gravity. Of the two, the less troublesome, for our consideration, is radiation. Astronauts can simply return home if their space vehicles become too hot. When missions stretch out to one or more years, moderate doses of the amino acid methionine may be used to control the effects of exposure to higher-than-normal radiation. Future space stations will probably incorporate storm cellars, heavily shielded areas where the inhabitants can wait out radiation storms produced by sudden bursts of solar activity.

Weightlessness, however, is another matter. On Earth human beings expend one-third of their total energy in overcoming gravity. In zero gravity muscles shrink and metabolism slows down. The heart does less work and becomes smaller. The gravity-compensating curve of the spine unbends and human bodies lengthen appreciably. Body fluids and minerals adjust to lower levels. Some of these changes occur quickly, others occur over several months. And some, such as demineralization, which began immediately, continue for more than half a year.

Most space biologists believe the



Rescue team meets Vladimir Lyakhov and Valeri Ryumin after their 175-day spaceflight in 1979.

GROUPTHINK

MIND

By Wall F. Laff

Ronald Reagan, says his former campaign manager, John Sears, is an endorser: If his advisers are adequate, there is nothing to fear from President Reagan. "Reassuring as this might sound," work by social scientists shows that presidential advisers are seldom adequate. In fact, when working in a pack, they are much likelier to be harmful, no matter how talented individual advisers may be.

Presidential working groups suffer from a peculiar irrationality that Yale University social psychologist Irving Janis calls groupthink. It occurs when an intimidating leader and the group around him must make decisions under great stress. Fearful of finding better solutions than the leader's, the group may permit its desire for unanimity to preclude a realistic appraisal of alternatives. The result is total failure.

The classic example of groupthink in action is the Bay of Pigs fiasco. Two days after John Kennedy's inauguration, Allen Dulles, head of the CIA, and General Lyman Lemnitzer, Chairman of the Joint

Chiefs of Staff, gave the President a briefing on the plan to invade Cuba. For the next 80 days a group of the most brilliant and accomplished men in the country discussed the plan, then approved it. What followed was a debacle that undermined America's power and prestige and left the new administration reeling. It was, in Janis's words, "a perfect failure," a case of severe mental myopia.

The latent power of the presidency, when wielded by a charismatic individual, is so strong, Janis believes, that it can overwhelm even experienced White House advisers. The scruples and attitudes of administration members evaporate under the pressure of office. The President, instead of hearing and responding to a variety of opinions and courses of action, receives nothing from his staff but echoes of his own views. Every position the President takes becomes an accepted fact among the groupthinkers around him. No President can pull the best plan from his mind on every occasion, and groupthink ensures that the President's errors will be

fed back to him, unchallenged, until the President becomes unable to accept the possibility that he might be wrong.

Telling symptoms, Janis says, point to groupthink in operation. The whole group shares an illusion of invulnerability; they are inclined to overlook the ethical and moral consequences of their decisions. Opponents are viewed as too evil to deal with or too intellectual to worry about. Through collective rationalization, groupthinkers ignore warnings that might otherwise lead them to reconsider their assumptions. Enormous pressure is exerted on group members who dissent. They are made to believe that general silence denotes unanimity.

These conditions vastly enhance the potential for reaching wrong decisions. Alternative plans and pertinent information are rejected out of hand, while the risks of the preferred choice go unrecognized. The Nixon White House is a classic case. UCLA social psychologist Bernard Raven concludes that the Nixon team practiced a type of defective decision making called risky shift, in which group members adopt riskier positions than they would ever choose in private.

Raven says: "The groupthink phenomenon can be looked at in the same way as the risky shift. How do we deal with the Communist threat? Well, as a member of the group, I want to be at least as militant as somebody else. Each one tries to be at least as extreme as others in the group and preferably a little more so. And if a person begins to show any signs of reticence, he's immediately isolated as a softie."

Banning major mistakes, groupthink can continue indefinitely. A disaster, however, cannot be ignored. The Bay of Pigs, for example, hit home so hard, Janis says, that President Kennedy introduced sweeping changes in his decision-making procedures.

Policymakers were thereafter expected to act as critical thinkers, not as mere mouthpieces for their agencies. The President instructed his brother Robert and his adviser Theodore Sossamon to act as intellectual watchdogs for the group, to



THE ARTS

By Mitch Tuchman

Canadian writer-director David Cronenberg confessed his hearts desire: "Some part of me would love to make a movie of William Burroughs's *Naked Lunch*."

Curious, because some part of him already has. Cronenberg's stylish and increasingly test science-fiction/horror films have consistently been "out to Lunch." Thumbing pages, it is easy to find in Burroughs's self-styled "brutal, obscene, disgusting" book about "public health problem number one" (heroin addiction) the promises, as well as numerous images, for Cronenberg's films—films that range from the experimental *Leslie's* to the recent full-length releases *Rabid* and *Scanners*.

Viewers familiar with Cronenberg's brand of commonplace terror know what it is like to gaze transfixed at a world of madly half-mad scientists, white-powdered Pandoras, whose experiments in whistle-clean corporate institutes let loose upon an unsuspecting populace nauseating and unusual public-health

problems, virulent organic afflictions, Cronenberg's doctors and their institutions and victims—drooling, puking, rotting, and screwing—people like Bosch-like canvases of Burroughs's work as well. The venereal parasites in *They Came from Wawa* are "creatures from the id," Cronenberg says, "that will not be denied." The "morphogenetically neutral" skin graft in *Rabid* that turns an amputee into a bloodsucking, penislike syringe is none other than Burroughs's "undifferentiated tissue, which can grow into any kind of flesh sex organs sprout anywhere."

Cronenberg's newest film—and his first American hit—*Scanners* concerns what one character, a scientist of course, labels "a rearrangement of the synapses we call telepathy." More than mind readers and sidewalk prostigulators, scanners, like Burroughs's *Senders*, annex entire nervous systems, regulate "scanner" heartbeats, and bend their wills. Cronenberg's screenplay composes two corporate cliques of power-mad manipulators whose plans for domination depend on the allegiance of the world's

237 known scanners. As the picture begins, the odds stand at 236 to 1. But consider this from Burroughs: "One Sender could control the planet... [though] control can never be a means to anything but more control."

Scanners' corporate cortisomps engenders a screamful of exploding craniums, spontaneous hemorrhages, telepathic reflexes, and a dazzling, climactic scanning duel with blooded pulsing vascular systems rising purple through the skin, rupturing in steaming gore. It's truly impressive if you can stand to look. The effects are designed by Dick Smith of *The Exorcist* and *Alien* fame.

Compatible though they may be in detail, Burroughs and Cronenberg are far apart in world view. Burroughs's world, for all its whole-hat syntax, is an old-fashioned battleground of good and evil, suffused with the author's moral outrage. Cronenberg's is a new cold world of absolute moral indifference.

Into what domain has God forbidden men to pass? "I'm not really interested in whether there are things on Earth that humans should not know or whether science is going wrong," the thirty-seven-year-old director declares. Cronenberg could well be picking up a doctorate in microbiology from Harvard, instead of making brain-ourting films.

In the war between the body and the soul (a favorite Cronenberg theme), has either side gained the upper hand? "In the Middle Ages people who were crippled and deformed were thought to have crippled and deformed minds," he continues. "It would be nice to feel that there was no [mind/body] schism at all. But at the same time there is something in me that's very Cartesian, and if I hear I resolved what I feel to be the schism."

So, in *They Came from Wawa* and *Rabid*, the mind is helpless to resist the body run amok. Blaming herself for the rabies epidemic that her well-lit, grafted organ has instilled, Rose (Marilyn Chambers) comes out from her puzzled soul, "I'll tell you, I'm still Rose." In *The Brood*, a cancer patient complains that his psychotherapist "encouraged my body to



Scanners' Individuals who are not satisfied and are trying by force of intellect to change things

UNIVERSAL CASTING

THE ARTS

By Sal Manna

Good-bye, casting couch. Hello, computer impersonal. As it sounds, casting by computer is well under way in the movie business. Not surprisingly this disturbs many of Hollywood's creative artists, whose suspicion of the newfangled technology springs from their fear that these cold machines will take over the decisions that they used to make. Though such apprehension has slowed their adoption in filmmaking, computers are becoming increasingly widespread in their use.

Computers can already control cameras, lighting, and sound recording, so some in 1981 computer-generated animation will make its debut. Thus far however, only Francis Ford Coppola has been adventurous enough to plan the installation of highly sophisticated computer equipment for actual filming at his new Zoetrope Studios in Hollywood. Everyone else is wary because these advances imply serious problems for the innumerable technical unions and artists' guilds; these machines are destined to change not only the technique of moviemaking but also the nature of the final product and even the kind of people from whom it emanates.

A portent of things to come is the inroad computers have already made in casting—a very sensitive, well-guarded aspect of the industry.

"Let's say we got a call from the casting department this morning," says Al Jenamans, director of Universal Studios' computer operations (Hollywood's largest). "They're filming a special tomorrow and they need twenty Los Angeles Police Department types for extras. They need ten whites, five blacks and five Chicanos, and they all have to meet LAPD specifications on height, hair length, and so forth. We enter the description into the computer and almost instantaneously those who fit have their files displayed on a video terminal in the casting office.

The eligibles are called up to find out availability. Jenamans continues, "and within a couple of hours the roles are cast. What formerly took us until eight PM, we

now get finished by one in the afternoon. The computer also prepares the work voucher, which when turned back in to the computer, say the next day at one PM, generates a paycheck before the afternoon is over.

Universal now has approximately 8,000 extras in its active computer files. Each is a member of the Screen Extras Guild or has worked at the studio within the last year on a waiver basis. The information on file, gathered during a personal interview at Universal's casting office, is extraordinarily detailed. It specifies up to 150 personal characteristics, such as height, weight, sex, ethnic origin, and special skills or talents. If someone owns a motorcycle, or a tuxedo, or can ride a horse, the computer coughs him up.

There's even a category called "Hands." Jenamans says, "so that when they need a close-up of a nice pair of hands and the star's don't fit the bill, we can call in an extra."

Universal began choosing extras by computer four years ago after management had a falling-out with Central

Casting. "When 30 days the operation was in full swing, I had to call the phone company to install some new lines and put in the video screens and printer, and that was it," Jenamans recalls. "We already had the computers in place because they were doing all our bookkeeping functions. There was a lot of programming to do, and the casting people had a job doing all the interviews. But from a cost point of view it turned out to be very attractive."

Universal is still the only major film studio using computers for casting extras. Jenamans asserts this is not because technology is limited but, rather, because high start-up costs discourage acquiring the hardware. Indeed, according to Carl Jock, a vice-president of Central Casting, it's doubtful that the end justifies the means as far as expense goes. "For a small operation without a computer already working, He adds, "The computer could come in handy for us sometimes—like, when we have to find an extra who owns a van. Let's say—but I'm not sure the frequency of use would offset the costs."

Jenamans disagrees, contending that in the end the computer pays for itself. In a business where time costs a great deal, he explains, in a few seconds he can find an extra who both belly-dances and owns her own costume. Though it might take a conventional casting office an entire afternoon to track her down and then find a costume for her. "One of the side benefits," Jenamans remarks, "is that it provides more time for the casting directors to concentrate on the more special problems of the major roles. It also allows a more comprehensive review. The computer won't overlook somebody."

It is this capability that, in 1976, inspired the Screen Actors Guild to start computerizing its membership rolls. "Producers were saying there wasn't enough minority talent," says Bumbaru, who installed the project.

"Well, we know that wasn't true. It only looked that way because minority actors tend not to be with traditional agents—the ones the producers know. We were being passed over. So we sent out a survey to our minority membership and



Artist casting video expert located in seconds

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THE ARTS

By Christopher Evans

Twenty-two years ago, while attending a science-fiction writers' workshop in Milford, Connecticut, Gordon R. Dickson sat in his hotel room, immobilized by an attack of asthma. With chest muscles cramping, blood surging from shots of adrenalin, Dickson envisioned a 12-volume series of historical novels entitled *The Childe Cycle*, which spanned the millennium from the Italian Renaissance to the intergalactic age of the twenty-fourth century. The October publication of the fifth novel in the series, *The Final Encyclopedia*, will bring Dickson's ambitious opus one step closer to completion.

Since that night in 1959, *The Childe Cycle* has become the focus of Dickson's lifework, providing readers with some of science fiction's finest moments.

"The Cycle's main purpose," Dickson explains, "is to present the thesis that an evolution of the human race may be going on under our noses, unrecognized. It is an evolution that is neither physical nor mental, but, for want of a better word, ethical."

"We're moving closer to the point where one person can destroy the entire race," Dickson continues. "There is a growing apprehension that the great tool-using powers are available to individuals who cannot be trusted to use them wisely. It is an evolution in the area of responsibility."

The Cycle has a long way to go before it comes full circle. Of the three historical sections (past, present, and future), only future histories have been written so far: *After Dorsai* (1959), *Neocomancer* (1960), *Soldier, Ask Not* (1968), *Troops of Mistake* (1971), and the just-completed *Final Encyclopedia*; only one novel remains to complete this section. The six other unwritten novels will be divided equally between the past and the present.

The present of human history in Dickson's view is a dramatic struggle between two opposing inclinations of the human psyche: the instinctive conscious urge toward conservatism and safety, which opposes the unconscious urge toward adventure and possible danger.

"In paleolithic terms," Dickson explains,

wouldn't it be interesting to climb out on the beach and see what it's like there," and the other critic who says, "Are you crazy? It's nice and warm and safe here in this shallow adze pool. There are things fish were not meant to know." Nowadays this argument takes the form of a debate about the possible benefits of space exploration as opposed to its possible dangers.

Now fifty-seven years old, Dickson began his writing career at the age of nine. To date, he has published 41 novels and more than 170 short stories and has sold 4 million copies worldwide in languages from Portuguese to Bulgarian. He has also won every major science-fiction award: the Hugo, the Nebula, the Jupiter, and the British Fantasy Award.

Since the beginning of his career, Dickson has been searching for new literary forms. *The Cycle* is the product of that search: what he calls "an expansion of the novel." It has allowed him to develop a story where the theme is employed in the narrative the same way most authors use a character. The thematic novel supplies realistic elements and leaves it up to the

reader to draw conclusions; its literary forebear, the propagandistic novel, forces the reader to take sides.

"Suppose you walk into an art gallery," says Dickson. "On one side of the corridor you see a statue of a man throwing a thick spear through somebody on the ground. The man on his feet is wearing a business suit, the man on the ground, black pajamas. The withdrawn spear becomes a baseball pen. The man in the business suit has a hat on his head with a press card."

"Now," Dickson says, his characteristic energy charging his words, "across the hall is a series of piquous. The first one has a dagger; the next a Roman short sword; the next a flintlock pistol; the next an M16; and the next a headline that says, 'Viet Cong Commit Atrocity at Ben Ho.'"

"The point I want to make is that, as a piece of art, the statue leaves you no choice. It is very obvious what the message is. The series of piquous leaves it up to you to decide what the message is; it gives you freedom of choice."

Dickson is the model of the committed writer. He abandoned a career in teaching to write full-time, selling his blood for cash and resting on a diet of stale bread, peanut butter, and vitamin pills. When he is not reworking drafts of his stories, he is reading—a skill he taught himself at the age of four.

"All my books are laboratory papers," he says. "I'm trying something new in each one. They all have the same roots as the morality tale, but what I'm trying to say is deeper. It's the human urge to reach out for something better and bigger that is driving us off the line as a race. Science fiction is particularly well-suited for this message since it is the form with fewest rules and the most possibilities. It is respectable fantasy: a literature of ideas."

"Fortune is fine; somebody's got to pay the bills. Fame is necessary because it is a signal that you are on the right track. But the real reward—and this is why people write in garrets and in prisons—is the feedback from the page. You write something, and it's just right. 'By God,' you say, 'nobody's ever said this before.' It's a humble, godlike feeling. **DO**



Dickson: Treating theme as character

UFO UPDATE

By Paul Dong

On November 13, 1978, China's leading newspaper, the *People's Daily*, published an article entitled "UFOs—An Unsolved World Puzzle." It was the first of its kind ever to appear in the Chinese press. The author, Sheng Heng Yen, is an editor at the Chinese Academy of Social Sciences. Almost a year later China's next-largest newspaper, the *Guang Ming Daily*, published a second article about UFOs. Written for the paper's science column, the article pondered the question: "Do flying saucers exist?" Its author, Chow Hen Yen, is science group editor of TV broadcasting at the Peking Central Broadcasting Bureau.

Chow reported that a group of scientists on an expedition in Hubei Province had seen unidentified flying objects. This sighting was later confirmed by members of the Chinese Liberation Army who, at the time, were on maneuvers in the area. The article also reported other sightings throughout the provinces of China.

It wasn't until May 12, 1980, that the *Guang Ming Daily* again published an article on UFOs. This article, by me,

featured detailed reports of pilots, scientists, and other professionals throughout the world who had seen UFOs.

These articles aroused public curiosity throughout mainland China. Several hundred letters written to *Aerospace Knowledge* magazine asked the Chinese government to launch a study of the UFO phenomenon. Publication of this request in the magazine drew enormous response from China's provinces, leading the government to sanction a probe under the auspices of the university in Wuhan, central China. Thus the Chinese UFO Studies Association was born. This organization, the first of its kind in China, maintains branches in the cities of Peking (China's capital city), Shanghai, and Guangdong. Other branches are located in the Guangxi region and four other provinces. It publishes its own journal, *UFO Explanation*, and it comprises workers, students, teachers, journalists, doctors, and researchers in the sciences. Although the association was founded in May 1980, it wasn't until December 4 of that year that the official *New China News*

Agency publicized the group's creation.

Two important events prompted Peking to permit a serious scientific evaluation of UFOs. One summer evening in 1965 Peking, with a population of 8 million, had its airspace violated when two bright, disc-shaped objects flew overhead. Two years later a similar incident occurred near the outskirts of the city. A bright, globe-shaped object with flashing red lights was observed by thousands of people as it raced across the night sky at fantastic speeds, stopped suddenly, paused, and then resumed its speedy flight until it disappeared beneath the horizon.

Because of this second violation of security many observers surmised that the object was a prototype vehicle or weapon from Taiwan or some other country. Speculation led to more speculation among the population, who suggested a multitude of sources for the events. To allay the growing fear that these unexplained phenomena threatened the country's national security, the Peking authorities sanctioned the establishment of an academic UFO study group. Another contributing factor in China's decision to evaluate UFOs was the frequency of reports converging upon the authorities in Peking from the provinces during the 1970s.

A different opinion on this subject came from Cheng Tao, a science editor for the *Guang Ming Daily*. In footnoting my article of May 12, 1980, he stated, "Far too much clamor has resulted from the latest interest in UFOs in the area of research. Within the context of scientific involvement, UFOs are just part of a broad spectrum of study and investigation. Without a formal study UFOs cannot be dismissed as being the product of delusional minds."

Concurring with the viewpoint, Hsieh Chu, editor of *Aerospace Knowledge*, commented, "One cannot deny that UFOs exist, owing to the large number of sightings that have been recorded thus far in this country."

Aerospace Knowledge and *Science and Life* have published reports of UFO sightings in China. One sighting occurred on an autumn afternoon in 1970, when Chen Yufu, a worker in a coal-washing



Rare UFO photo taken in 1942 by street photographer in Peking, the People's Republic of China.

EARTHQUAKE WATCH

EXPLORATIONS

By Kenneth Jon Rose

The year marks the seventy-fifth anniversary of the great San Francisco earthquake that left about 700 people dead and another 250,000 homeless. It is hardly an occasion to mark with festivity, but it does indicate to scientists at least just how far earthquake research has come since the 1906 disaster.

Seventy-five years ago such studies were funded about as stringently as the space program is now. Much of the information about tremors actually came from the accounts of excited eyewitnesses. Those earthquake-recording devices that did exist were usually located at astronomical observatories. Besides being crude instruments that scratched their readings on smoked glass plates they were used mainly to keep telescopes aligned.

Things have changed radically since then. Thanks to a literally shaken public that poured money into research after the San Francisco tragedy, institutions all over the globe are studying the causes and mechanics of violent tremors with the goal of predicting, and perhaps even preventing, future earthquakes. These observations are open to the public and free of charge, but call first to find out the visiting hours.

Though many links in the informational network are merely monitoring posts, the larger earthquake-watch centers often play a much more active role in research. At the University of California's Earthquake Engineering Research Center at Richmond Field, in Richmond, scientists are creating their own tremors. To see how the shaking of the ground affects structures, test models have been constructed of everything from bridges and offshore oil rigs to apartment complexes and office buildings. In California, where earthquakes are as frequent as beach parties, the conclusions reached through this research are reflected in building codes. Research is equally vital in determining the best sites for nuclear-power plants, especially since they are all too often constructed in close proximity to active fault lines.

Structural testing is done at the center's Earthquake Simulator Laboratory. Inside what looks like an abandoned airplane hangar, you're apt to find researchers attaching electrodes to a 5-story steel model of a 35-story office building. During this experiment the electrodes will feed important information into a computer room nearby. The structure itself is mounted on one of the largest "shaker tables" in the United States. Essentially it's nothing more than a giant slab of reinforced concrete embedded in the floor. But once the slab is activated from below it becomes a mechanical bronco, able to whip up the exact ground motions of a real earthquake or to make up one of its own. The action that follows makes Monday night football look tame by comparison.

If you call ahead to find out the exact time of an experiment, you may witness a life-size brick house crumble into face powder or a Los Angeles skyscraper do its version of the jittersbug.

Such violent exercises have yielded valuable lessons. Stay inside a modern high-rise during an earthquake; it resists

the ground motions better than older buildings do. And be careful when purchasing a home in the San Francisco Bay Area. During an earthquake the soil tends to turn into quicksand, swallowing your house and probably your car along with it.

For those interested in the global forecast, NASA's Goddard Space Flight Center in Maryland, is coordinating information that will aid in mapwork and also pinpoint areas likely to have earthquakes. This is being done with the aid of a satellite called Lageos and 36 laser satellite-tracking stations operating on each of the dozen or so rock segments, or plates, that fit together almost like the pieces in a jigsaw puzzle to form the earth's mantle.

A quick call to Wally White, the laser network manager at Goddard, will get you permission to see close up how the operation works. The ground stations, like the one near Haystack Observatory, north of Boston, Massachusetts, usually consist of four vans. Every second one of the vans flies a laser pulse up to Lageos, 4,000 miles overhead. The light bounces off the satellite and returns to a second van, where its round-trip time is calculated by a computer. Compare this information with the data obtained from a station on an opposite plate, and you can get a precise measurement of how far the plates have moved. An average distance of one inch to two inches a year is not uncommon.

Almost all earthquakes and volcanic eruptions occur along fault lines, the boundaries between plates. In places like California, where two plates are sliding past each other at the rate of two to three inches a year, such information could indicate when and where another earthquake will occur. Ironically, it is usually not the movement of the earth's crust, but its lack of movement, that is a cause for alarm. This is because no motion is recorded at points where plates have become interlocked. Seismologists view these "locked" regions along an otherwise active fault as a bad omen—the calm before the storm. It is here that the ground tends to deform and distort until the



Shaky ground: California's San Andreas Fault

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CONTINUUM

Edited by Dick Teresi

LAW OF THE SEA

For centuries man has exploited the two thirds of the earth that is saltwater, as sailor, explorer, conqueror, fisherman, whaler, warrior, scientist, miner, and mere poet in quest of solitude for his restless spirit. But only recently—for little more than a decade, in fact—has he begun to recognize that as technology continues to shrink that earth, he can no longer indulge in these selfish pursuits without some kind of international game plan.

The United Nations Conference on the Law of the Sea (UNCLOS) is the outgrowth of that belated recognition. Launched in 1973, UNCLOS has since convened in various nations at least once a year. At last August's meeting, a final treaty seemed but a year away. Now that optimism may prove unfounded.

Treaties involving more than two nations are never easy to draft. The UNCLOS treaty involves dozens of nations. Yet because of its complexity and the magnitude of its economic and legal implications, the delay would not be surprising even if it were only a bilateral pact. Still, because it is such an important document, the lost-dragging is annoying.

At issue are several legal questions involving the world's coastal zones and the deep-ocean seabed as well. It is the question of who does what on the seabed. Beyond the continental shelves, where lie untold billions of dollars' worth of fist-sized manganese nodules among other mineral treasures, on which delegates seem unable to agree.

The latest source of contention is a charge by a group of developing nations (known as the Group of 77) that eight countries, including the United States, are clandestinely reneging on agreements made last August regarding deep-sea mining. Instead of agreeing to share the technology and profit from seabed mining, the Group of 77 alleges, the eight have embarked unilaterally by economic means, to take over the mining in defiance of the terms of a final UNCLOS treaty yet to be signed.

Whether the charge is true or not depends on whom one listens to. What seems certain, however, is the basic truism of any treaty that it is only as good as the intentions of whoever signs it. If the United States is reneging, we would be in the same position morally as the nations some accuse—Japan and the Soviet Union—of ignoring international quotas on whaling.

UNCLOS covers far more than seabed mining, of course. For

the first time, it would spell out in a single document the kinds of rights and limitations now contained in a proliferation of other treaties: traditional freedom of the seas, fishing rights, territorial limits, rules of the road, control of oceanic pollution, marine research. A number of American scientists are very disturbed at the prospect of including research in such a treaty since there is a growing tendency by many coastal nations to extract increasingly substantial fees for research in their waters. In turn, since much of this scientific probing has a military application, the Pentagon is no less concerned over what the final terms and implications of such a treaty will be.

Ocean mining, however, is the major issue, and in terms of the stakes, that is understandable. Consider that each cubic mile of seawater is estimated to contain \$3 billion worth of dissolved chemicals, or that all magnesium produced by the United States today comes from the ocean, and the question of mining not only on the seafloor but in the massive water column above it suddenly becomes highly significant.

There is little doubt that an UNCLOS treaty is long overdue. The idea was triggered in 1967 when Italian Ambassador Arvid Pardo addressed the U.N. General Assembly. In the race among nations to "carve up the oceans" Pardo saw a parallel with the way Africa was once sliced up by colonizing powers, to that continent's everlasting chagrin. In a swiftly advancing technological society Pardo warned the Assembly chaos could result in an oceanic sense as well.

In the Space Age the oceans are no longer the vast barriers between nations they once were. They have instead become avenues for mutual benefit, the only place on the face of the earth (save, perhaps, Antarctica) not yet ravaged by man's pollution, and the final region to which he can turn to satisfy his basic needs. The UNCLOS treaty, despite the relative downplaying given it by the lay media since 1973, therefore looms as one of the most crucial international agreements ever drafted.

No nation will be happy with all its provisions, especially the economically and militarily muscular nations like the United States. But few treaties ever satisfy every whim of all the countries that sign them.

Isn't it time to swallow a few bitter pills, quit the quibbling, and get on with the vital business at hand?—JOSEPH E. BACAW

CONTINUUM

EVOLUTION OF A SMILE

When animals show their teeth, it usually means that they're ready to attack. When people do it, in a smile, it usually means they're ready to laugh—or at least register pleasure in something. But that may not always have been true, according to one linguistics expert.

Professor John J. Ohala, of the University of California at Berkeley, believes the smile is a more vestige of what was once a cry of submission.

His reasoning is based on some ingenious acoustics. When you draw and tighten your lips in a smile, you also change the timbre of your sound coming out of your mouth. The pitch is slightly raised.

Traditionally, higher pitched sounds come from smaller creatures—and those deliberately making the sound of creatures smaller than themselves—in order to send out the message: "I'm small and helpless; don't hurt me!"

Ohala made his pitch change Discovery by using clay models of the human voice pathways and lips that he shifted to series of varying intensities. The biggest, broadest smile, he found, also made the sound with the highest timbre.

Why is smile has long been an evolutionary puzzle. Some mammals smile as a threat, true, but others such as monkeys, Ohala asserts, smile and produce a high-pitched noise when they are

frightened or submissive. In faceoffs of various kinds, birds and mammals will often change the pitch of their cries to suit a situation—a deeper tone to frighten, or a higher one to show they are frightened and submissive. What happened with humans? Ohala



The smile may have begun life as a gesture of submission.

suggests, is that we used to do the same thing but somewhere along the way we lost the sound and kept what was left, the smile.

The bigger the grin, the more total the submission. Now you don't have to lean in order to learn whether anyone has succumbed to your charms—just read his or her lips. —Douglas Coligan

"If we continue at this leisurely pace, we will have to pass Russian Customs when we land on the moon."
—Mikhail von Braun, 1959

"The past is gone, the present is full of confusion, and the future scares half out of me."
—David Lewis Stern

LEAVES OF GOLD

Canadian scientists have developed an economical way of using atomic physics to aid prospectors looking for precious minerals.

Underground gold (and uranium, thorium, and other valuable minerals) is absorbed by tree roots and becomes an integral part of leaves and needles. An exact analysis of the leaves can indicate whether mining would be profitable.

At McMaster University in Hamilton, Ontario, scientists take leaves—compressed into wafers with other decayed vegetation—and bombard them with neutrons from the university's five-megawatt pool-type reactor. The neutrons make radioactive isotopes of the elements in the sample; these decay and emit gamma rays, which can be observed in a spectrometer. Gold can be detected if it's present in quantities as small as one part per billion, according to Eric Hoffman, who runs the service for the university.

So far, with about 1,000 samples tested each day, the reactor-aided assays have located two gold deposits that have commercial potential. —Chris Larson

RADIOACTIVE SURPRISES

Your wristwatch, coffee maker, eyeglasses, gas lantern, and smoke detector may all contain traces of radiation, often placed there on purpose. The federal government has disclosed the U.S. Nuclear Regula-

tory Commission recently compiled a thick volume on the amounts, risks, and benefits of radiation in ordinary consumer products.

The commission found that tiny amounts of tritium, krypton, and other radioactive elements are placed in indicator lights on millions of clothes washers, stereos, coffeemakers, and other things to increase their reliability. Radioactive thorium gives a more even glow to the 25 million marbles in gas lanterns sold each year—four-fifths of them for camping. Tritium and radium are used in tons of millions of watches and clocks to illuminate dials or numbers.

The NRC report says the health risk from these products is small, compared with other daily risks or with the products' benefits.

"But the bottom line is that we shouldn't use radioactive substances if we don't have to," says Jake Kastner, who managed the NRC study.

—Stuart Diamond



Coffeemaker indicator lights emit a radioactive glow.

COLD SUITS

Six men recently slipped into a pool chilled with several tons of ice to test out a new water-survival suit designed by a Washington State wetsuit manufacturer.

For six hours the volunteers floated in the pool-

part of the body at least one third of the body is out of the water. Water conducts heat off the body 25 times faster than air does.

Though the use of water-survival suits so far has been limited to the military and to merchant seamen, they may soon be on board passenger



Rescuers float in cold-water survival suits. They prevent hypothermia by keeping one fourth of the body above the water.

sized highball under constant monitoring by a physician to learn whether the suit was an effective deterrent to hypothermia, subnormal body temperature caused by exposure to freezing conditions, in this case water temperatures of 0° to 28°C (32° to 37°F).

"We didn't have more than a one- or one-and-a-half-degree variance" in the core temperature of the body, said Harvey Groh, the Kent, Washington, designer.

The key to the suit's success, Groh said, is buoyancy. At any given time at least one fourth of the body is above the surface of the water, with an additional accessory: a man-inflatable that conforms to the upper

torso: at least in Washington State, where it's rumored legislation may soon require them.

Should an accident occur, a passenger traveling on Washington ferries who is equipped with the \$500 suit should suffer no reduction in his or her core body temperature, Groh predicted. Noting the water temperature of Washington's waterways is about 7°C (45°F). At such "ishmy" temperatures, you can actually sleep, Groh said. "It's just like sleeping on a water bed." —Cathy Stone

Kids get ideas about UFOs where I learned about the tabloids and the silly press

—J. Alan Hynak

WHISTLING AIR CRASHES

Would you worry if you heard the pilot or crew members of an aircraft whistling during a flight? Some aviation accident investigators think that perhaps you should.

Debate on the question began in the mid-1970s when Robert Rudich, an air transportation consultant to the Federal Aviation Administration (FAA), revealed that "of more than two hundred sixty cockpit voice-recorder tapes removed from aircraft involved in accidents ranging from the minor to the catastrophic since 1966, over eighty percent have a recording of one of the pilots whistling during the last half hour of the flight.

Rudich attributed the whistling to "a sense of complacency that led pilots or crew members to make 'logical' errors." Other experts, such as Gerard Bruggink, former director of the



Investigating disasters have been linked to whistling pilots.

Society of Air Safety Investigators, questioned this interpretation, saying whistling can also have stressful connotations, including an attempt "to create an atmosphere of confidence in conditions of uncertainty or fear."

Paul Turner of the National Transportation Safety Board, who went through the tapes to count the number of whistles, and himself a pilot cautions against worrying too much about it.

"Many times," Turner said, "things are always moving awkwardly in the cockpit. Your ears are always scow. Then, when things get quiet, you whistle. I guess pilots just don't like quiet."

Turner admits, however, that "whistling is a reaction to stress in some cases," noting one incident in which pilots pucker up while a fire raged in the rear of the plane.

One researcher noted the debate raises the important question as to whether pilots have too much to do at some times and too little at others, either of which might adversely affect performance.

The question cannot be dismissed lightly in any event. Rudich, who first raised the issue in a speech to the Lawyer Pilots Bar Association, ended his presentation by playing a cassette tape from several aircraft accidents.

Rudich said that the tune one captain was whistling just before his Boeing 707 crashed was the first few bars of "The Battle Hymn of the Republic."

—Alan Maurer

CONTINUUM

LUCID DREAMING

With the right kind of mental training, it's possible not only to be an objective, clearheaded viewer of your own dreams but to step in and tinker with them as well.

So claims Dr. Stephen LaBerge, psychophysicologist and sleep researcher at the Sleep Research Center of the Stanford University School of Medicine in Palo Alto, California. His claim revolves around what sleep researchers call lucid dreams, in which the sleeper knows he is in a dream while it is happening.

The lucid dreamer can reason clearly, remember freely, and act voluntarily upon reflection, all while continuing to dream vividly," says Dr. LaBerge.

With this kind of objectivity the lucid dreamer can step in and change whatever he doesn't like—the way a director or playwright instantly rewrites the plot of a play.

LaBerge himself happens to be a natural lucid dreamer. As a child, he managed to defuse a series of terrifying dreams about drowning simply by stopping in and giving himself the ability to breathe underwater.

"There is a talent for this," he explains, "just like every thing else." But he says it is also possible to develop the knack with the right amount of motivation and a technique he calls MILD.

An acronym for the Mnemonic Induction of Lucid Dreams, MILD enhances the lucid dreaming of those who already do it and develops it in those

who don't. Very simply it is a method of auto-suggestion. As LaBerge gets ready for sleep, he says to himself: "The next time I'm dreaming, I want to remember I'm



Now there's an antidote to nightmares: Through auto-suggestion, you can learn to intervene in your dreams and change the outcome.

dreaming." Then he visualizes himself simultaneously lying asleep in bed and being in a dream and knowing full well where he is. With this simple method he managed to have an average of 21.5 lucid dreams each month and as many as 4 in one night.

LaBerge is interested in hearing from experienced lucid dreamers. He is at Sleep Research Center, Stanford University School of Medicine, Stanford, CA 94305 — Douglas Coligan

"Most people would die sooner than think in fact they do so."

—Bertrand Russell

"Something hidden? Go and find it!"

—Rudyard Kipling

CHOCOLATE TOOTHPASTE?

There is a new weapon in the continuing war against Mr. Tooth Decay: It's chocolate.

substance that in a cup of strong tea leaves a furry sanitation on your tongue, can help prevent caries, or tooth decay. Two sources of the tannin-like substance, she says, are red wine and cocoa powder, the prime ingredient in chocolate.

The threat of cavities starts with the buildup of dental plaque, a sticky coating that traps bacteria and sugar. In order to form, the plaque needs a certain enzyme, and what cocoa's tannin-like substances do is interfere with that enzyme. Dr. Guille, who wrote her monograph with a grant from the Chocolate Manufacturers Association, explains.

Does this mean a low-carb candy bar is on the way? Not likely, says Dr. Berry Zornes, a nutritionist at Hershey Foods, home of the Hershey bar. Because chocolate bars are made with two kinds of sugar, sucrose and lactose (the sugar in milk), you can't just slip in a substitute sweetener, like sugarless gum, Dr. Zornes explains.

—Douglas Coligan



There's no tannin in wine, mouthwash or chocolate toothpaste, even though wine and chocolate contain antiseptically acting

COMPUTER GHOSTWRITER

If President Reagan wishes to avoid the fate of his predecessor, all he has to do is seek the assistance of Professor John Cragan, at Illinois State University and Professor Donald Shields, of the University of Missouri. A Nasco AS-5000 computer and an IBM 1403 printer have produced a speech on foreign policy that will (guaranteed, no doubt about it) play in Peoria.

The problem for creating such a computer program, says Cragan, "is not that difficult, because the universe of verbalizations on foreign

America" and had them select the statements they liked most and the ones they hated most and those they felt neutral about. What we wound up with is a speech that will please the most people and offend the fewest. This avoids "the big error," like George Romney's "I was brainwashed" when he was in Vietnam.

The resultant speech says fascinating things like "The state of our Union depends on the state of the world and freedom and peace in the world depend on the state of the Union." And "The United States will continue to meet its responsibilities to its allies. However, to maintain world order, we will continue to seek and negotiate stable relationships with all nations. The United States is not a crippled giant."

Has George Orwell's *Newspeak* (from his novel *1984*) reached us three years earlier than expected? Not really, but Cragan believes the speech should alert the American public to the fact that the potential for verbal manipulation is already in the hands of politicians should they choose to use it. —Harry Wadsworth Longfellow

Look not mournfully into the Past, It comes not back again. Wisely improve the Present, It is thine. Go forth and meet the shadowy Future, without fear, and with a merry heart.

—Harry Wadsworth Longfellow

When I hear the world gun, I reach for my culture.

—J. J. Good

SLURP!

Australian astronomer Dr. Alec Rodgers believes he has an explanation for what astronomers call maverick



Fighting galaxies: The Milky Way devoured its neighbor.

stars, an odd group of stars out on one edge of the Milky Way. Dr. Rodgers and his colleagues at the Australian National University think the stars are leftovers from another galaxy swallowed by the Milky Way.

Stars in and of the Milky Way are typically slow moving and rich in metals. Some are fast-moving, but they are metal-poor.

Clumped on the outer edge of the galaxy is a third group, which astronomers have long called maverick stars. There are not very many—only about 0.1 percent of the galaxy's stars are mavericks—and they are odd. They move rapidly and they are also rich in metals.

After studying several hundred million of these high-velocity stars, Rodgers now offers the theory that 2

billion years ago the Milky Way collided with another galaxy and swallowed it whole. The galaxy may have been a companion to the pair of existing galaxies known as the Clouds of Magellan. The galaxy disappeared in the collision, and what resulted, Rodgers says, was about 700 million mavericks now on the rim of the Milky Way.

—Douglas Corrigan

RAPE ZAPPER

A wristwatch-sized device that stuns would-be rapists with a 60 volt jolt of electricity is being marketed by Kinconcept Inc. in Massachusetts.

Called the Zapper, the device is a battery-operated bracelet with two electrodes. When the bracelet is pressed against the skin of an assailant, a step-up transformer wired to a nine-volt battery delivers two currents. The first 60-volt current breaks down skin resistance, then zaps quickly to a stunning 30-volt shock. The stunning effect lasts several minutes, allowing a victim time to escape.

Two Massachusetts Institute of Technology scientists, Dr. George Plotkin, a cancer detection specialist, and Kevin Rhodes, an engineering doctoral student, began working on the device after a friend of theirs had been raped on the MIT campus.

"The Zapper causes no permanent skin or tissue damage," said a spokesman for Kinconcept. The device sells for about \$90.

—Alan Maurer



The *Newspeak of Big Brother* and 1984 is available now.

policy is not that large. There are only about twenty to twenty-five issues in any given campaign that manifest our views on foreign policy. So we surveyed this popular press for a period of six months, cut out the best letters, statements, and put them on a deck of sixty cards.

"Next we got a stratified random sample of the population of Peoria. We did

CONTINUUM

COMPUTER WAR

World War III may be fought with computers and telephone lines instead of with missiles and bombs, a computer security expert at Stanford Research Institute predicts.

"It's a problem of escalation," says Donn Parker, who specializes in ferreting out crime in the computer field.

The increasing dependence on the use of computers makes advanced nations more vulnerable to attack on their computer networks than they are to nuclear war. It's happening today and will reach stages of vulnerability in the next ten years unless we can make computers much more secure.

"Blowing up a country with nuclear bombs is not a very smart thing to do anyway," Parker says. There's nothing left to take over. But there is a real possibility of causing economic chaos or complete collapse by electronically sabotaging defense, banking, and other computer systems."

As an example of what might occur, Parker cites an incident from last October. A small clerical error in calculation of the MIA (amount of money in circulation) cost stock traders \$66 billion. What might happen if computerized government economic figures were tampered with deliberately?

Terrorists, too, might take advantage of computer vulnerability. "You have to look at who the enemies might be," says Parker. Terrorists in Europe have already

blown up twenty-eight computers, because they know how to hurt multinational companies. Third World countries with little to lose might also consider resort-

HANG GLIDOSAURS

What does hang gliding have to do with the study of extinct dinosaurs? Very much, according to research-

nearest prehistoric sea. This giant pterosaur possessed a wing span of 16 meters and was apparently capable of flight over dry land.

Structurally hang gliders resemble pterosaurs—a thin layer of skin and connective tissue stretched taut over long, hollow finger bones being analogous to Dacron fabric, steel cables and aluminum tubing. Hang gliders have reached altitudes of 5,000 meters and traveled distances of up to 60 kilometers. Cornell researchers are now applying the principles of low-speed hang glider aerodynamics in simulation models of pterosaur flight. The study supports the theory that these inland pterosaurs may have been canyon fliers, soaring high above the landscape in search of the decaying remains of land-dwelling dinosaurs.

—Michael P. Harrison



Computer science: Sophisticated terrorists don't need bombs, they can cause economic chaos by sabotaging computer systems.

ing to computer war.

The solution to this problem," Parker says, "is protection. Money spent to develop computer security systems such as an electronic fence that blocks one computer program off from others should increase as our dependence on computers does. It's a question of keeping security concepts advancing so that we keep up. We're in a close race."

—Alan Mauter

"We shall not cease from exploration/And the end of all our exploring/Will be to arrive where we started/And know the place for the first time.

—T. S. Eliot

ers at Cornell University. Paleontologists have been intrigued by fossils of pterosaurs, the flying dinosaurs, and how these once-abundant creatures could have flourished for millions of years without ever flapping a wing. Pterosaurs, unlike modern birds, were passive gliders, incapable of powered, flapping flight. Held aloft by constant prevailing winds, pterosaurs were assumed to restrict their flights to cliffs bordering the ancient seacoasts.

Recent excavations in east Texas, however, have uncovered the fossilized remains of a new species of pterosaur in deposits more than 400 kilometers from the



Pterosaurs in Pterosaur Flight

ROBOT EGGS

The trouble with humans Jake Mendelssohn claims "is that they just don't understand robots. To foster better understanding between metallic and nonmetallic life forms," the Pennsylvania engineer created Intergalactic Robot Eggs, Inc.

Through the parent firm of Nationwide Robots, the company sells robot eggs—which, not so surprisingly resemble ball bearings—in a hermetically sealed robotonium. They're guaranteed to hatch within 1,000 years "or double your money back," Mendelssohn promises. Actually he insists, with proper care, some of the eggs should hatch "within three or four hundred years, so you don't really have so long to wait."

The eggs, which sell for \$4.99 a clutch (12), plus \$1 for postage and handling, come with two panoramas of typical robot-colony scenes and an instruction-and-care manual. The manual advises keeping the eggs dry (to avoid rust) and away from magnets. "Magnets could cause excessive self-inductance and a whole lot of other conditions too horrible to mention," says Mendelssohn.

To entertain the eggs, the manual suggests playing music such as "Little Deuce Coupe" and "Willow Submarine" or reading aloud from the "Dodge Dart Owner's Manual" and the zip code directory. They also entertain themselves by playing a game called Freeze, in which the object is to see

which one can sit motionless longest. "They have a natural ability to play this game," according to the manual.

When the Boston Globe, wanting no part of another Pat Rock-type novelty, refused an ad for the eggs, Mendelssohn was upset. But the robots were uncensored, he recalls: "How would you feel if you were called superfluous and unworthy of publication?"

Mendelssohn adds a bit of advice for those who are around when the eggs hatch: "Everyone wants to know how you raise a baby robot. It's simple: with a hydraulic lift." —Alan Mauser

"Give an hour a day to your brain. Think—and think regularly every day. An open mind is the best beauty parlor."

—Ray May



Rotating array is the two-inch square panel on top of 3-D machine.

3-D MACHINE

Scaldestepping holography, a team of researchers at Massachusetts Institute of Technology's Innovation Center have developed a

unique video system that takes abstract information and turns it into a realistic three-dimensional image floating in space.

The device has two in-



Robot eggs provide video images, only viewed in motion.

usual parts. The first part is called a high-speed data link. It can quickly digest the facts and figures from a sensor reading or even a computer-generated 3-D image. Using these, it sends

rapid instructions to the second part, called a rotating array. Very simply, this is a small panel, roughly two inches on a side, perched atop a short, squat cylinder. The panel is faced with diodes that light up.

When the cylinder is set spinning, the data link starts playing out different cross sections of an object across the opening panel. It does this rapidly in a continuous sequence. At any given microsecond in the sequence, what is actually being played out is only a horizontal slice of an object, but it happens so fast the eye is fooled. The technique depends on something called persistence of vision, the ability of our eyes to retain an image for a short time after the object itself has disappeared. This is what helps us see what's on a television screen as a whole picture, instead of what it actually is, an image continuously projected line by line.

One big advantage of the technique, explained Dr. David Jansson, principal researcher and director of the Innovation Center, is that you don't need an image already recorded on a piece of film as with holography. "You can go from the data to the finished image."

Now Dr. Jansson and his fellow researchers are working to link their device with a CAT (computerized axial tomograph) scanner which provides x-ray cross sections of the body. It would be the next best thing to opening up the patient and taking a firsthand look.

—Douglas Colligan

CONTINUUM

ACID-RAIN PROPAGANDA

A study financed by the electric-power industry says acid rain has not really killed 200 of New York State's Adirondack lakes. It's just



Bladderwort. Replaces trout.

that some of the life forms in them have been replaced by others. Bladderworts abound where brook trout once swam.

This optimistic note is sounded in a reprint mailed to reporters by Conoco, an oil company whose subsidiary, Conoco/Consolidation Coal Company, has been trying to downplay a direct link between power-plant emissions and acid precipitation. Conoco's reprint asks, while the recreational value of some Adirondack lakes has diminished and the fish have disappeared, "Are the people living in Columbus, Ohio, willing to spend an extra \$100 or \$200 in their fuel costs so that fish can continue breeding in some 50 DMH

obscure lakes hardly anyone ever sees in northern New York, Vermont, and New Hampshire?"

But many scientists, including at least two doing the study for the Electric Power Research Institute (EPRI) "bristle at what they say is a politically motivated misuse of their data. "No credible scientist disputes that the lakes of the Adirondacks have become acidic from acid precipitation that comes from the combustion of fossil fuels," says George Handley, chief of environmental sciences at Brookhaven National Laboratory on Long Island.

Conflicts are many. Though EPRI says damage from acid rain appears limited, congressional testimony by experts puts the damage at \$5 billion a year affecting not just Adirondack fish, but commercial salmon fisheries, car brakes, crops and forests.

The EPRI study is scientifically trying to quantify the process by which lakes become acid—and damage occurs—so that more precise public policy decisions can be made.

Meanwhile a reduction in the number of microorganisms to decompose plants in acid lakes sometimes produces that rotten-egg smell more typical of [Manhattan's] East River on a bad day," says Stephen Scholle, of the Adirondack Council. And an environmental group is publicizing its cause by selling an acid-rain umbrella to prevent "slinging in the rain."

—Stuart Diamond

PSYCHIC FOOLS

A dramatic series of experiments has shown that college students have strong beliefs in psychic powers.

Berry Singer and Victor A. Benessa, psychologists at California State University at Long Beach, demonstrated that a magician performing simple stage tricks could convince students he had psychic abilities—even when the students were told beforehand he was a magician and not a psychic.

An actor-magician, dressed in a purple chorizo sandals, and a gaudy meditation performed his act before several introductory psychology classes. To some, he was introduced as a person who believed he had psychic abilities. To other classes, he was pre-

pared, and finally he bent a steel rod by stroking it with his index fingers while the class chanted the word *bending*. All three stunts are common amateur tricks that are explained in children's books of magic.

Yet three-fourths of the students in the first group—who had been told the performer was a psychic—felt he had shown paranormal abilities. It is even more surprising that two-thirds in the group who had been told explicitly he was a magician also said the performer had demonstrated psychic powers. The psychic belief among the students was charged with emotion. Some students covered their faces with exorcism rituals and exhortations against Satan. In a report in the *Skeptical Inquirer*, Singer and



College students accepted a magician's tricks as psychic events.

sented strictly as a magician. While blindfolded the magician read ten three-digit numbers, then he smeared cigarette ashes on the backs of a student's hands and made them transfer to her

Benessa call their results "bizarre" but of "wide generality." They concluded that psychic beliefs are present and active in the general population.

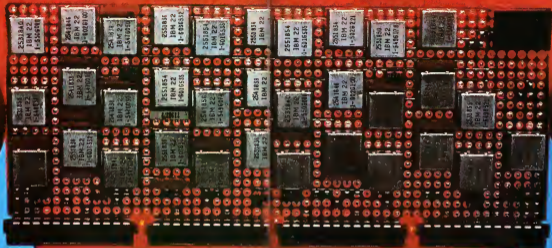
—Kendrick Frazier

2081

A new report from the architect of the High Frontier assays five emerging technologies and their impact on society

BY GERARD K. O'NEILL

Computers, automation, space colonies, energy and communications. These are the five forces that will drive the changes of the next century. "The captains and the kings" will come and go, but unless we are destined for the final catastrophe in the brief time that lies just ahead, the few will endure and shape the world of A.D. 2081. Hope, laughter and love—the human elements—



will be there, too, accompanying the rise of the five drivers of change to envelop human affairs, just as they have already shaped the automobile, the jet airplane and even the telephone in the twentieth century.

No one who's lived through the past two decades would venture to place computers on our short list of drivers of change. Yet there have already been surprises in this first quarter century of the Computer Age. Computers are affecting our lives differently from the ways that inventors would have predicted.

The surprise in the computer field during the late 1960s and the 1970s was largely concerned with the cables rather than the giant minicomputers and calculators; rather than huge con-

PHOTOGRAPH BY
ERIC MEOLA

tralized facilities. As the cost of doing calculations and memorizing facts in computers went down, some enterprising companies realized that most users, even those doing scientific computation, didn't really need the full capability of the monster computer system. So companies began manufacturing minicomputers and selling them. It was small enough to fit on a desk and had memories of modest but adequate size. You could turn it on, knowing that it was immediately at your service. You could be sure no one had butchered your stored program while you had been away and, best of all, using it was free. Given the high rate of progress of the computer art, the mini of one year was fully equal to the giant computer of a decade earlier.

The advent of the transistor with its compact size, low power and high reliability gave a great boost to computer development. Transistors in their turn evolved, first to integrated circuits, then to the large-scale integrated circuits with a whole computerful of transistors on one chip. Long before 2081, it will be possible to store in a machine the size of a business card all the information of a good-sized library. That will bring about a reduction in the scale of institutions—what one might call "social miniaturization."

Memories evolved, too. Originally the one/zero distinction that makes up the code in which computers store information was made by the presence or absence of current in a relay tube, or transistor. Now it's possible to store the binary ones and zeros as tiny magnets with their north poles pointing up for a one and down for a zero. A quarter million of them can be put in a space the size of your thumbnail, forming what's called a magneto bubble memory.

By 2081, any major central computer will have rapid access to at least 100 trillion words of memory (the number 1 followed by 14 zeros). A computer of that memory capacity will be no larger than a suitcase. It will be fast enough to carry out a complete operation in no more time than it takes light to travel from this page to your eye, and perhaps in a tenth of that time. That will mean, for example, that such a machine will be able to read, digest, and present conclusions on 10 to 100,000 books in a second!—and it's a big if—designers are ingenious enough to figure out ways to get the information into and out of the computer fast enough. Already what's called the I/O, the input and output equipment of a computer (the typewriters, printers, and television screens that humans utilize), sets limits on how small a computer system can be built and therefore on how fast it will be able to receive, process, and relay information.

Will the computers of 2081 be creative? Only if they are designed on wholly different principles from those of today. Intelligence is more than the storage of words and numbers and their manipulation according to the rules of grammar and arithmetic. It's also a maze of associations and

cross-connections that constantly shift in. The imagination and the creative process are deeply connected with the power of association, and that is the aspect of intelligence that we understand least. Every cell in the cortex has on its surface an average of several thousand terminals from the fibers of other cells. That is radically different from the way in which every digital computer built so far is designed to operate.

Pattern recognition, even of a simple kind, is extraordinarily difficult for a computer. Anything approaching artificial intelligence on the part of computers is so far from present reality that we should avoid the phrase. The positive approach to the problem has two parts. One is already being followed: to give a computer so large a table of possible combinations and so great a speed that it can try millions of combinations and stop when it recognizes a good one, all in a reasonable time.

The other path is to continue and extend the present vigorous research into the as-

● If even 5 percent of the available thorium can be burned in reactors of the CANDU variety, we will have enough energy available to run our civilization at 15 times its present energy use for 30,000 years. ●

sociative and creative processes of the human brain and simultaneously to begin thinking about wholly new kinds of computers whose thinking will be holistic and associative rather than linear.

AUTOMATION

The word automation, when used in its broadest sense, means designing and constructing a machine to carry out a task once done by a human being. The windmill, used since the Middle Ages, can be called an example of automation, so can the steam engine of the 1700s and the Jacquard loom of 1801, a machine capable of producing complex, multicolored textile patterns by control from a steel card "programmed" by a coded series of holes.

The transition to automated production is going on, but in a slower and more conservative way than enthusiasts predicted. It's been hampered by several facts of industrial life that weren't properly appreciated at first. One is that the programming of computers is expensive, even though computers themselves are cheap. To get around that problem, modern computer-controlled systems are "trained" rather than pro-

grammed. A welding machine is led through its task of spot welding several dozen points on a car body, for example. The "trainer" is a welder, not a computer programmer, and the machine's computer need only store and remember the exact sequence of operations the human trainer went through.

The trainable welding machine is the longest step in automation that's been practical so far. It combines a minicomputer with a single, motorized arm that can move in and out, left and right, and up or down from a "shoulder." In the welding machine, the arm is connected to a gripper that rotates and swivels like the human wrist. Once it's trained, the robot is content to repeat the same task thousands of times without getting bored and sloppy and without arguing with the foreman. It's also content to work three shifts without complaint. Factories that automate normally use their robots full-time, with routine maintenance checks scheduled only in one short period each day.

The most advanced level of automation right now—the level that's just moving from the research laboratories into the factories—adds a system of vision and the pattern recognition to the minicomputer and the motorized arm of the now-standard industrial robot. In one such system, developed by the Industrial Automation Center of the Stanford Research Institute (SRI) under the direction of its founder Dr. Charles Rosen, a television camera looks down on an assembly table that can be moved by computer control. On the computer's first instructions, the robot arm picks the block and the head of an automobile air-conditioner compressor out of a typical factory tote box, places them on the table and waits while the television camera senses where they are and the computer recognizes how they're oriented. Then the table positions the block, and the arm assembles the compressor by picking eight bolts out of a bin, inserting them one by one, and tightening them. For those of us who remember the old factory catchphrase "bash off paint to fit," it's amusing to find that in the SRI system there's substantial use of "adaptive soft materials" to allow the parts to move a little while the robot attempts to fit them together.

Dr. Rosen, who founded the Machine Intelligence Corporation upon his retirement from SRI, has attacked the problem of pattern recognition in a way that's reminiscent of the "learning" used for the standard industrial robots. His firm makes a system in which a part (for example, the block the head, or a bolt from the compressor assembly) is shown to the system's TV camera in each of several orientations by a human operator who names the part each time he shows it. After that, the system recognizes the new part each time it turns up and handles it according to a procedure that can be put into the computer's memory by training.

The transition to automated production

won't require any "breakthroughs," nor will it require the development of robotic intelligence of a level or kind that would equal human intelligence. The machines involved will wear out, just as ours do, but they will be replaced wholly or in part by the subassemblies manufactured in other automated factories.

When the level of automation becomes a practical economic reality, as I believe it will within a few decades, it will be of great help to those developing nations whose populations are still technologically unsophisticated.

One of the most difficult problems in countries now struggling to industrialize is the repair and maintenance of production-line machines. The workers who perform such tasks generally grew up in a world without machinery and lack the technical sense that a child in the developed world picks up "by osmosis" from the everyday environment.

An automated factory can be effective for producing, at low cost, a very large number of simple tools and devices needed by a poorly educated population still mainly engaged in agricultural labor in a village environment. It can produce planting and harvesting equipment, windmills for pumping water, solar cookers, and even solar cell panels to provide electricity for lights and radios. Used in that way, automation will help, I believe, to raise the standard of living in those countries at a rate that needs to be more rapid than our own.

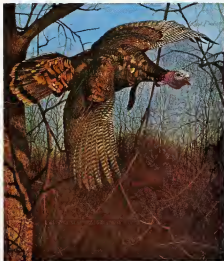
SPACE COLONIES

Unlike the other drivers of change, space colonies are still on the drawing board, not yet realized. Yet I believe they will transform society during the twenty-first century as much as the automobile, airplane, and radio, none of them in existence in 1880, transformed our world during the twentieth.

A space colony would be an Earthlike habitat outside Earth's shadow, growing its own food and deriving all its energy from the sun. A metal shell can hold the atmospheric pressure we need for breathing. Water, once introduced into a space habitat, will remain, circling through a closed ecological cycle. The effect of Earth's gravity can be duplicated by rotation. Sunlight, constant outside the shadows of planets, can be admitted for as many hours of the 24 as the residents choose so that they may obtain any desired climate. Lunar soil taken into space can rest on the interior of a metal shell to form land area, as land on Earth is formed by soil resting on bedrock.

For a civilization now tightly constrained within Earth's biosphere and infected with nuclear proliferation, the most important possibilities opened by space colonies may be a reduction in the scale of inequities and a dispersion of mankind far outside the bomb-laden pressure cooker that now seals it in.

The fundamental transformation that space colonies will bring about is from an economics of scarcity—the zero-sum game that we are forced to play on Earth—



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JOHNNY MNEMONIC

He had information that the gangsters wanted desperately, even if they had to kill him

BY WILLIAM GIBSON

but the shotgun is an Adidas bag and padded it out with four pairs of tennis socks, not my style at all, but that was what I was using for. If they think you're crude, go technical, if they think you're technical, go crude. I'm a very technical boy. So I decided to get as crude as possible. These days, though, you have to be pretty technical before you can even aspire to crudeness. I'd had to turn both those twelve-gauge shells from brass stocks, on a lathe, and then load them myself. I'd had to dig up an old microphone with instructions for handloading cartridges. I'd had to load a lever-action pistol to heat the primer—all very lanky. But I knew they'd work.

The meet was set for the Dome at twenty-three hundred, but I rode the tube three stops past the closest platform and walked back immaculate procedure.

I checked myself out in the chrome siding of a coffee kiosk, your basic sharp-faced Caucasoid with a ruff of stiff, dark hair. The girls at Under the Knife were big on Sway Mao, and it was gotta be harder to keep them from noticing that chic suspension of specular folds. It probably wouldn't fool Rollie Face, but it might get me next to his table.

The Dome is a single narrow space with a bar down one side and tables along the other, thick with preps and hardlers and an arcane array of dealers. The Magnetic Dog Sisters were on the door that night, and I didn't relish trying to get out past them if things

didn't work out. They were two meters tall and thin as greyhounds. One was black and the other white, but aside from that they wore as nearly identical as cosmetic surgery could make them. They'd been lovers for years and were bad news in a bustle. I was never quite sure which one had originally been male.

Rollie was sitting at his usual table. Owing me a lot of money, I had hundreds of megabytes stashed in my head on an eight/sevent basis, information I had no conscious access to. Rollie had left it there. He hadn't, however, come back for it. Only Rollie could retrain the data, with a code phrase of his own invention. I'm not cheap to begin with, but my overtime on storage is astronomical. And Rollie had been very scarce.

Then I'd heard the Fall. Face wanted to get out a contract on me. So I'd arranged to meet him in the Dome, but I'd arranged it as Edward Bee, clandestine importer, son of Rio and Peking.

The Dome stank of bar, a rickety tang of nervous tension. Mueselstoyen scattered through the crowd wore brass stock pins at one another and trying on thin, cold grins, some of them so lost under superstructures of muscle grit and their outlines nearly really human.

Pardon me, Pardon me, friends. Just Eddie Bee here, Fast Eddie the importer with his professionally nondescript gym bag, and please ignore the suit, just wide enough to scint his right hand.



PAINTING BY ETIENNE SANDORFI

Ralf wasn't alone. Eighty kilos of blond California beef perched alertly in the chair next to his, martial arts written all over him.

Fat Eddie Bax was in the chair opposite them before the beef's hands were off the table. "You black belt?" I asked eagerly. He nodded, blue eyes turning an automatic scanning pattern between my eyes and my hands. "Me, too," I said. "Got mine here in this bag." And I shoved my hand through the slit and thumbed the safety off. Click. Double twelve-gauge with the triggers wired together.

"That's a gun," Ralf said, putting a plump, restraining hand on his boy's fat blue nylon chest. "Johnny has an antique firearm in his bag." So much for Edward Bax.

I guess he'd always been Ralf. Something or Other, but he owed his acquired surname to a singular variety. Built something like an overripe pear, he'd worn the once-famous face of Christian White for twenty years—Christian White of the Anyan Reggae Band, Sony/Mao to his generation, and final champion of race rock. I'm a wizard at this.

Christian White, classic pop face with a singer's high-definition muscles, checked checkbooks. Angelic in one light, handsomely depraved in another. But Ralf's eyes lived behind that face, and they were small and cold and black.

"Please," he said, "let a work this out like businessmen." His voice was marked by a bombie prehensile sincerity and the corners of his beautiful Christian White mouth were always wet. "Lewie here," nodding in the barboy's direction. "Is a realball." Lewie took this impulsively, looking like something built from a kit. "You aren't a realball, Johnny."

Sure I am. Ralf, a nice meatball chock-full of implants where you can store your dirty laundry while you go off shopping for people to kill me. From my end of this bag, Ralf, it looks like you've got some explaining to do.

"It's the last batch of product," Johnny. He sighed deeply. "In my role as broker—"

"Fields," I corrected.

"As broker, I'm usually very careful as to sources."

"You buy only from those who steal the best. Got it?"

He sighed again. "I try," he said wearily, not to buy from fools. This time, I'm afraid I've done that. "The third sigh was the cue for Lewie to trigger the neural disruptor they'd taped under my side of the table."

I put everything I had into curling the index finger of my right hand, but I no longer seemed to be connected to it. I could feel the metal of the gun and the foam-padded tape I'd wrapped around the stubby grip, but my hands were cool as distant and inert. I was hoping Lewie was a true meatball, thick enough to go for the gym bag and snag my rigid trigger finger, but he wasn't.

"We've been very worried about you, Johnny. Very worried." You see, that's

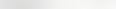
Yakuza property you have there. A bad look it has on them, Johnny. A dead fool."

Lewie giggled.

"It all made sense then, an ugly kind of sense, like bags of wet sand settling around my head. Killing wasn't Ralf's style. Lewie wasn't even Ralf's style. But he got himself stuck between the Sons of the Neon Chrysanthemum and something that belonged to them—or more likely something of theirs that belonged to someone else. Ralf, of course, could use the code phrase to throw me into idiot/savant, and I'd spill their hot program without remembering a single quaver's tone. For a fence like Ralf, that would ordinarily have been enough. But not for the Yakuza. The Yakuza would know about Squids, for one thing, and they wouldn't want to worry about one thing those dim and permanent traces of their program out of my head. I didn't know very much about Squids, but I'd heard stories, and I made it a point never to repeat them to my clients. No, the Yakuza wouldn't



**•The Magnetic Dog
Sisters were at the door. They
were two meters
tall and thin as greyhounds.
One was black and
the other white, but they were
as nearly identical
as surgery could make them. •**



like that, it looked too much like evidence. They had I got where they were by leaving evidence around. Or else.

Lewie was grinning. I think he was visualizing a point just behind my forehead and imagining how he could get there the hard way.

"Hey," said a low voice, leaning from somewhere behind my right shoulder, "you cowboys sure aren't having too lively a time."

"Pack it, bitch," Lewie said, he barked free very still. Ralf looked blank.

"Lighten up. You want to buy some good free base?" She pulled up a chair and crouched before either of them could stop her. She was barely inside my feet, hold of verson, a thin girl with mirrored glasses, her dark hair out in a rough shag. She wore black leather open over a T-shirt splashed diagonally with stripes of red and black. "Light those gram weight."

Lewie snorted his exasperation and tried to slap her out of the chair. Somehow he didn't quite connect, and her hand came up and seemed to brush his wrist; as if pressed. Bright blood sprayed the table. He was clutching his wrist white-knuckle tight.

blood leaking from between his fingers. But hadn't her hand been empty?

He was going to need a لندن staele. He stood up carefully, without bothering to push his chair back. The chair toppled backward, and he stepped out of my line of sight without a word.

"He better get a medic to look at that," she said. "That's a nasty cut."

"You have no idea," said Ralf, suddenly sounding very tired. "The depth of shit you have just gotten yourself into."

"No kidding? Mystery. I got real excited by mystery. Like why your hand here is so quiet. Frozen, like. Or what this thing here is for," and she held up the little control unit that she'd somehow taken from Lewie. Ralf looked at it.

"You ah, want maybe a quarter million to give me that and take a walk?" A fat hand came up to stroke his pale, lean face nervously.

"What I want," she said, snapping her fingers so that the unit spun and glittered, "is work. A job. Your boy hurt his wrist. But a quarter'll do for a retainer."

Ralf let his breath out explosively and began to laugh, exposing teeth that hadn't been kept up to the Christian White standard. Then she turned the disruptor off.

"Two million," I said.

"My kind of man," she said and laughed. "What's in the bag?"

"A shotgun."

"Cude." It might have been a complete.

Ralf said nothing at all.

"Name's Millions. Molly Millions. You want to get out of here, boss? People are starting to stare." She stood up. She was wearing leather jeans the color of dried blood.

And I saw for the first time that the mirrored lenses were surgical implants, the silver rising smoothly from her high cheekbones, sealing her eyes in their sockets. I saw my new face twinned there.

"In Johnny," I said. "We're taking Mr. Face with us."

He was outside, waiting. Looking like your standard tourist leech in plastic zone and a silly Hawaiian shirt, printed with blowups of his firm's most popular micro-processor, a mild little guy, the kind most likely to wind up drunk on sake in a bar that puts out miniature rice crackers with seaweed garnish. He looked like the kind who sang the corporate anthem and cry who shakes hands anxiously with the bartender. And the perks and the dealers would leave him alone, pegging him as an innately conservative. Not up for much and careful with his credit when he was.

The way I figured it later, they must have amputated part of his left thumb, somewhere behind the first joint, replacing it with a prosthetic tip, and cored the stump, fitting it with a pool and locker molded from one of the Oro-Senda diamond analogs. Then they'd carefully wound the spool with three meters of monomolecular filament.

Molly got into some kind of exchange with the Magnetic Dog Sisters, giving me a chance to usher Ralf through the door with the gym bag pressed lightly against the base of his spine. She seemed to know them. I heard the black one laugh.

I glanced up, out of some passing reflex, maybe because I've never got used to it, to the scoring arcs of light and the shadows of the geodesics above them. Maybe that saved me.

Ralf kept walking, but I don't think he was trying to escape. I think he'd already given up. Probably he already had an idea of what we were up against.

I looked back down in time to see him explode.

Playback on full recall shows Ralf stepping forward as the little tech slides out of nowhere, smiling. Just a suggestion of a bow and he left thumbtalls off. It's a conjuring trick. The thumb rings suspended Mirrors? Wires? And Ralf stops, his back to us, dark crescents of sweat under the armpits of his pale summer suit. He knows. He must have known. And then the pike-shop thumbtip, heavy as lead, arcs out in a lightning yo-yo track, and the invisible thread connecting it to the killer's hand passes laterally through Ralf's skull, just above his eyebrows, whips up, and descends, slicing the pear-shaped torso diagonally from shoulder to rib cage. Cuts so fine that no blood flows until synapses melt and the first tremors surrender the body to gravity.

Ralf tumbled apart in a pink cloud of fluids, the three mismatched sections rolling/forward onto the tiled pavement. In total silence.

I brought the gym bag up, and my hand convulsed. The recoil nearly broke my wrist.

It must have been raring ribbons of water cascaded from a ruptured geodesic and splattered on the tile behind us. We crouched in the narrow gap between a surgical boutique and an antique shop. She'd just edged one mirrored eye around the corner to report a single Vokes molecule in front of the Dome, red lights flashing. They were sweeping Ralf up. Asking questions.

I was covered in scorched white fluff. The tennis socks. The gym bag was a ragged plastic cuff around my wrist. I don't see how the hell I missed him.

Cause he's fast, so fast. She hugged her knees and rocked back and forth on her bootheels. His nervous system's jacked up. Her factory custom. She grinned and gave a little squeal of delight. I'm gonna get that boy. Tonight. He's the best number one, top dollar state of the art.

What are you going to get, for this boy's two million, wmy ass out of here. Your boy's hand back there was mostly grown in a vat in Chiba City. He's a Yakuza assassin.

- Chiba. Yeah. See, Molly's been Chiba

too. And she showed me her hands. Ingers slightly spread. Her fingers were slender, tapered, very white against the polished burgundy nails. Ten blades snicked straight out from their recessed beneath her nails, each one a narrow double-edged scalpel in pale blue steel.

I'd never spent much time in Nighttown. Nobody there had anything to pay me to remember and most of them had a lot they paid regularly to forget. Generations of sharpshooters had chipped away at the neon until the maintenance crews gave up. Even at noon the arcs were soot black against faintest pearly.

Where do you go when the world's wall-to-wall criminal order is leaning for you with calm, distant fingers? Where do you hide from the Yakuza, so powerful that it owns comets and at least three shuttles? The Yakuza is a true multinational, like ITT and Cro-Sondar. Fifty years before it was born the Yakuza had already absorbed the Thads, the Mafia, the Union Corse.

Molly had an answer. You hide in the Pit, in the lowest circle, where any outside influence generates swift, concentric ripples. Betwixt you're above Nighttown, because the Pit's inverted, and the bottom of its bowl touches the sky, the sky that Nighttown never sees, sweating under its own firmament of acrylic resin, up where the Lo Tek's mouch in the dark like gargoyles, black market cigarettes dangling from their lips.

She had another answer, too.

So you're locked up good and tight, Johnny-san? No way to get that program without the password? She led me into the shadows that waited beyond the bright tube platform. The concrete walls were overlaid with graffiti, years of them, twisting into a single meteor-streak of rage and frustration.

The stored data are fed in through a modified series of microsurgical contactum prostheses. I reeled off a numb version of my standard sales pitch.

Client's code is stored in a special chip, barring Squads, which we in the trade don't like to talk about, thanks no way to recover your phrase. Can't drug it out, cut it out, torture it. I don't know if never do.

"Squads? Crawly thing with arms? We emerged into a deserted street market. Shadows figures watched us from across a makeshift square, littered with fish heads and rotting fruit.

Superconducting quantum interference Detectors. Used them in the war to find submarines, suss out enemy cyber systems."

"Yeah? Nasty stuff? From the war? Squad'll read that chip of yours? She'd stopped walking and I felt her eyes on me behind those twin mirrors.

Even the primitive models could measure a magnetic field a billionth the strength of geomagnetic force, it's like pulling a whisper out of a cheering stadium."

Cops can do that already, with parabol-



to microphones and lasers.

"But your data's still secure." Pride in profession. "No government'll let their tops have Squids, not even the security heavies. Too much chance of interdepartmental funnels, they're too likely to waterpilla you."

Navy stuff, she said, and her grin gleamed in the shadows. "Navy stuff. I got a friend down here who was in the Navy, name's Jones. I think you'd better meet him. He's a junkie, though. So we'll have to take him something."

A junkie?

A dolphin.

He was more than a dolphin, but from another dolphin's point of view he might have seemed like something less. I watched him awing sluggishly in his galvanized tank. Water slopped over the side, wetting my shoes. He was surplus from the last war. A cyborg.

He rose out of the water, showing us the puffed plates along his sides, a kind of visual pun, his grace nearly lost under articulated armor, clumsy and prehensile. Twin deformities on either side of his skull had been engineered to house sensor units. Silver lesions gleamed on exposed sections of his gray white hide.

Molly whistled. Jones thrashed his tail and more water cascaded down the side of the tank.

What is this place? I peered at vague shapes in the dark, rusting chamlink and things under tarps. Above the tank hung a clumsy wooden framework, crossed and recrossed by rows of dusty Christmas lights.

Funland. Zoo and carnival rides. Talk with the War Whales. All that. Some whale Jones is.

Jones reared again and fixed me with a sad and ancient eye.

How's he task? Suddenly I was anxious to go.

That's the catch. Say hi, Jones.

And all the bulbs lit simultaneously. They were flashing red, white, and blue.

RWBWRBWRB

RWBWRBWRB

RWBWRBWRB

RWBWRBWRB

RWBWRBWRB

RWBWRBWRB

Good with symbols, see, but the code is restricted. In the Navy they had him wired into an underwater display. She drew the narrow package from a jacket pocket.

Pure shit, Jones. Want it? He froze in the water and started to sink. I felt a strange panic, remembering that he wasn't a fish, that he could drown. We want the key to Johnny's bank, Jones. We want it fast.

The lights flickered, died.

Go for it, Jones!

B

BBBBB0000

B

B

B

B

Blue bulbs, out-of-focus

Darkness



Pure! It's clean. Come on Jones!

WWWWWWWWW
WWWWWWWWW
WWWWWWWWW
WWWWWWWWW
WWWWWWWWW

While sod and glare washed her features stark monochrome shadows clawing from her cheekbones.

R RRRRR
R R
RRRRRRRRR
R R
RRRRR R

The arms of the red swastika were twisted in her silver glasses. 'Give it to him. I said. We've got it.

Raffi Face. No imagination. Jones heaved half his armored bulk over the edge of the tank, and thought the metal would give way. Mully stabbed him overhead with the syringe, driving the needle between two plates. Propellant heated. Patterns of light exploded, spasming across the frame and then fading to black.

We left him drifting, rolling languorously in the dark water. Maybe he was dreaming of his war in the Pacific, of the cyber mimes he'd swept noisily genitally into their circuitry with the Squad he'd used to pick Raffi's pathetic password from the chip buried in my head.

I can see them stepping up when he was demobbed, kicking him out of the Navy with that gear intact, but how does a cyborgetic

dolphin get wired to smack?

'The war,' she said. 'They always Navy did it. How else you get 'em working for you?'

I'm not sure she profiles as good business. 'The prize said, angling for better money. Target specs on a console that isn't in the book—'

Waste my time and you won't profile at all,' said Mully, leaning across his scarred plastic desk to prod him with her forefinger.

So maybe you want to buy your micro-waves somewhere else? He was a tough kid, behind his Mac job. A nighttowner by birth, probably.

Her hand blurred down the front of his jacket, completely covering a label without even rumpling the fabric.

So we get a deal or not? Deal, he said, staring at his ruined label with what he must have hoped was only polite interest. Deal.

While I checked the two recorders we'd bought, she extracted the slip of paper I'd given her from the zippered chest pocket of her jacket. She unfolded it and read silently, moving her lips. She shrugged. 'This is it?'

Shoot, I said, punching the record stubs of the two decks simultaneously.

Christian White, she intoned. 'And he Anyan Reggabo Band.

Faithful Raffi, a fan to his dying day. Transition to robot's exact mode is always less abrupt than I expect it to be. The pirate

broadcaster's front was a fading travel agency in a pastel cube that boasted a clock, three chairs, and a faded poster of a Swiss orbital spa. A pair of fly baits with blown glass bodies and tin legs were sipping monotonously from a styrofoam cup of water on a ledge beside Mully's shoulder. As I phased into mode, they accelerated gradually until their Day-Glo-leathered crowns became solid arcs of color. The LEDs that told seconds on the plastic wall clock had become meaningless pulsing grids, and Mully and the Mac-faced boy grew hazy, their arms blurring occasionally in insect-quick ghosts of gesture. And then it all faded to cool gray static and an endless tone poem in an artificial language.

I sat and sang dead Raffi's stolen program for three hours.

The mall runs forty kilometers from end to end, a ragged overlap of Fuller domes roofing what was once a suburban artery. If they turn off the arcs on a clear day, a gray approximation of sunlight filters through layers of acrylic, a view like the prison sketches of Giovanni Pratese. The three southernmost kilometers roof Nighttown. Nighttown pays no taxes, no utilities. The neon arcs are dead, and the geodesics have been smothered black by decades of cooking fumes. In the nearly total darkness of a Nighttown noon who notices a few dozen mad children lost in the rafters?

We'd been climbing for two hours, up concrete stairs and steel ladders with perforated turrets, past abandoned garages and dust-covered tools. We'd started in what looked like a disused maintenance yard, stacked with triangular roofing segments. Everything there had been covered with that same uniform layer of spraybomb graffiti, gang names, initials, dates back to the turn of the century. The graffiti followed us up, gradually thinning until a single name was repeated at intervals: LO TEK in dripping black capitals.

Who's Lo Tek? Not us, boss. She climbed a shivering aluminum ladder and vanished through a hole in a sheet of corrugated plastic. Low technique, low technology. The plastic muffled her voice. I followed her up, nursing my aching wrist. Lo Tek's, they'd think that shotgun tick of yours was effective.

An hour later I dragged myself up through another hole, this one sawn crookedly in a sagging sheet of plywood and met my first Lo Tek.

S'okay, Mully said, her hand brushing my shoulder. It's just Dog, Hey Dog.

In the narrow beam of her taped flash, he regarded us with his one eye and slowly extruded a thick length of grayish, tongue-like huge canines. I wondered how they wrote off tooth-bud transplants from Gobemans as low technology, immunosuppressive, don't I exactly plow on trees.

Mull. Dental augmentation impeded his speech. A string of saliva dangled from his twisted lower lip. 'Hoard yit, comin' Long time. He might have been fifteen, but



the fangs and a bright mosaic of scars combined with the gaping socket to present a mask of total bestiality. It had taken time and a certain kind of creativity to assemble that face, and his posture told me he enjoyed living behind it. He wore a pair of decaying jeans, black with grime and shiny along the creases. His chest and feet were bare. He did something with his mouth that approximated a grin. BenTM followed you.

Far off, down in Nighttown, a water vendor used his trade.

Slings jumping Dog? She swung her lash to the side, and I saw thin cords tied to eyeballs, cords that ran to the edge and vanished.

"Kill the fuckin' light!"

She snapped it off!

"How come the one who's followin' you's got no light?"

"Doesn't need it. That one's bad news. Dog. Your sartrian's give him a tumble, they'll come home in easy-to-carry sections."

"That a friend, friend, Moll? He sounded uneasy. I heard his feet shift on the worn plywood.

"No. But he's mine. And this one, slapping my shoulder, he's a friend. Got that?"

Sure, he said, without much enthusiasm, pecking to the platform's edge where the eyeballs were. He began to pluck out some kind of message on the last cords.

Nighttown spread beneath us like a toy village for rats. Any windows showed candlelight, with only a few harsh, bright squares lit by battery lanterns and outside lamps. I imagined the old men at their endless games of dominoes, under warm, fat drops of water that fall from wet wash hung out on poles between the plywood shanties. Then I tried to imagine him climbing purlieus up through the darkness in his zans and ugly tourist shirt, bland and unturned. How was he trading us?

"Good," said Moll. "He smells us."

"Smoke?" Dog dragged a crumpled pack from his pocket and prised out a fat-tined cigarette. I squirmed at the trademark while he lit it for me with a kitchen match. Yheyuan filters. Beijing Cigarette Factory. I decided that the Lo Tek's were black marketers. Dog and Moll went back to their argument, which seemed to revolve around Moll's desire to use some particular piece of Lo Tek real estate.

I've done you a lot of favors, man. I want that floor. And I want the music."

"You're not Lo Tek."

This must have been going on for the better part of a sealed kilometer. Dog leading us along swaying cobblewalks and up rope ladders. The Lo Tek's leech their webs and huddling places to the city's fabric with their gobs of epoxy and sleep above the ropes in mesh hammocks. Their country is so attenuated that in places it consists of little more than holds for hands and feet, seen into geodesic studs.



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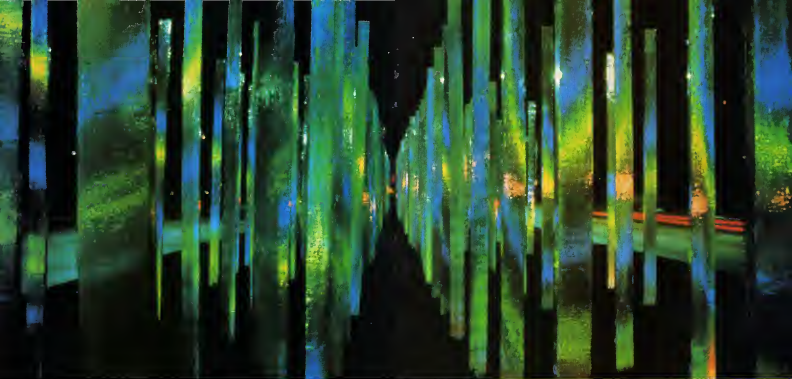
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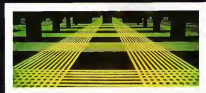
Sun structures create visual proof of the earth's rotation

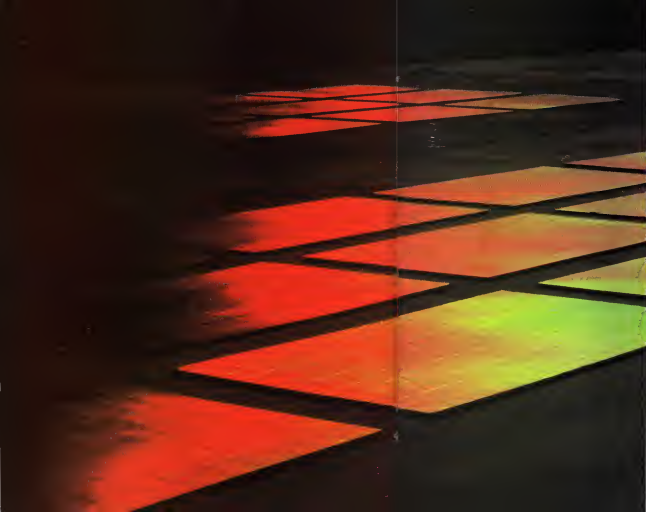
SOLAR CHRONOMETRY

BY KATHLEEN STEIN

Seven A.M. in Kansas City: The sun's first rays strike a stand of 18-foot-high pillars wrapped in mylar-bonded aluminum. A motorist's vision is filled with a hot blast of prismatic color. Twelve noon, the forest of pillars is silvery but dormant. Sunset: Only the western end of the 500-foot-long progression of posts is

PHOTOGRAPHS BY DALE ELDRED AND JOHN LOWERY

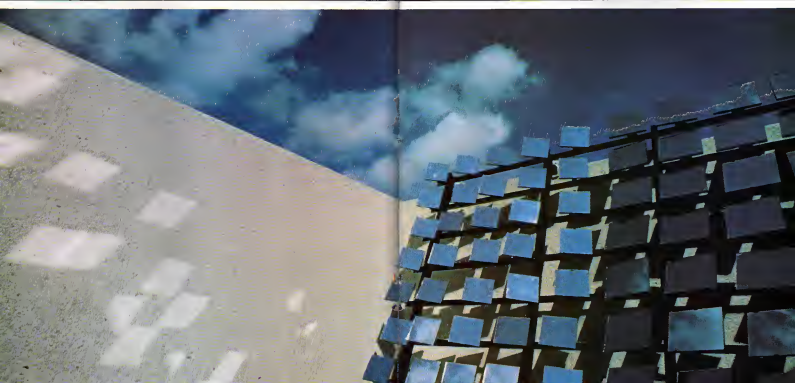




burning in an effervescent afterglow. "My art is about human perception of sun, earth, light, and shadow," says Dale Eldred, whose giant works are constructed with mirrors, slats, and his own grade of diffraction grating. Eldred's art explores the breakdown of pure light into spectra (above). But beneath that preoccupation is an obsession with time. Not abstract Einsteinian time, but ancient temporal measurement: the scintillating shadows dottering the pyramid, the navigator's secret, the garden sundial—celestial parameters, in the A.M. at the Central Loan Gallery of the Kansas City Museum (opening page), skylights are opened and phosphorescent strips soak up light. Skylights shut, the "charged" room experiences a day-long energy burn-down. "This is like looking into a room that has no previous history!" Eldred meditates in *Corpus Christi* (left). Eldred laid down 50 four-by-eight-foot diffraction panels, 84 pads of solar energy. For the "Icaxa" project Eldred used 35 miles of this material (on which light bounces off thousands of par-



also grows 0.00027 each apart). At exactly 9 A.M. sunlight hit the uppermost mirror (bottom), below and earlier light reflecting from each of the precisely angled mirrors for 16- to 30-minute intervals tracked across the museum walls and played there throughout the day. This, Ekhted explains, is a passive system. After the mirrors are aligned and hard to catch the light, the sun does the rest of the work. "Ultimately the piece has millions of positions from which it can be viewed, yet, in fact, none of these can ever be seen again in the same way." Ekhted's next big projects will be set up in Jerusalem and Las Vegas. "Las Vegas is a city that consumes everything. But what it does, it does the best, and I like to examine anything that's good at what it does." When we begin to harness down our planet's energy from sun platforms in space, Ekhted will probably be asked to build the solar-satellite version of the Masjid-e Shah, the royal mosque in Esfahan, whose structure is a celebration of light and measurement. **DO**



*A remarkable space experiment
embodies the dreams and
aspirations of Camden, New Jersey's
hard-pressed high-schoolers*

TIGERS IN ORBIT

BY FAWN VRAZO

It is not your normal high-school assembly. A tiny spaceship, regulation-saucer-shape, floats over the Camden (New Jersey) High School stage on the end of a wire. When it lands, a "spaceman" wanders in from stage right, looking like Curly Howard in a goatee. He beams an "extravagant" flashlight around the cluttered auditorium, illuminating the faces of rapt students. At last, the "alien" speaks: "It is time for me to report on our project. Orbit Eighty-one. I am pleased that you have decided to study arts. You, the students of Camden High, have made a wise choice!"

Meanwhile, over at Woodrow Wilson High School, Camden's other battered but unbowed seat of secondary education, an art marches onto the auditorium stage. Latha Miggy Natal, the smallest kid in school, stands before her peers:

PHOTOGRAPH BY MICHAEL SOMOROFF



dressed in a homemade anti-body space suit. Her antennae wiggle as she waves to the roaring throng.

"Tigers in Space! Orbit Eighty-one! Tigers in Space! Orbit Eighty-one!" chant the Woodrow High cheerleaders in a suitably space-like harmonies while Meggy marches around a giant paper-mâché moon rock.

Have Camden's two high school student bodies joined clubs? Is this preparation for interplanetary wars? Hardly. This raucous scene, early last year, denoted the beginning of something far more real and exciting to Camden's inner-city high schoolers than games, something important enough to draw Dr. Robert Froesch, then administrator of NASA, to the schools.

Addressing the assemblies, Dr. Froesch heaped praise on the students, few of whom had heard of him a few months before. "This is the most elaborate space project we have in any high school in the country," he announced to proud cheers.

Hundreds of high schools all across the country had leapt at NASA's offer to put the very best student space-science projects on the space shuttle. Swank private schools, sophisticated suburban campuses, high-powered technical schools all gave the High School Get Away competition their best shot. Camden's hard-pressed schools entered the fray only with financial aid and technical assistance from RCA's centers in Camden and southern New Jersey. At least everyone figured, the students would get a taste of science. When the Camden project to test effects of weightlessness and spaceflight on ants beat out all the other projects in the country, it was a minor educational miracle.

There is much more at stake in Camden's shuttle experiment than a mere high school science project. This program proposes to take hundreds of black and Puerto Rican high-school kids from one of America's grimmest cities, team them with high-level technologists from a giant corporation, and infuse them with the knowledge it will take to send a canister of living beings—ants—to outer space.

No one—not even NASA's top scientists has attempted to send ants to space before. Not for that matter, has anyone attempted to bring Camden and outer space together before. No two points in the universe could be farther apart. Space is unexploited and pure, waiting for mankind to make its imprint, good or bad. Camden looks chewed up and spit out, full of abandoned row homes, boarded-up storefronts, and residents who can't afford to move anywhere else.

Camden's poverty is reflected in the graduation rate of its two public high schools. Between 30 percent and 60 percent of the entering freshmen never make it through four consecutive years of schooling. They cut along the way to raise their own children, or to help support their families, or maybe to raise hell.

"Poor," Camden has the poorest economy and the highest unemployment in the

state of New Jersey," says Camden High principal Rietta Cream.

A Woodrow Wilson administrator adds without a hint: "I don't think there are many middle-income families living in Camden who send their kids to a public school. You can't fight it."

Beset by the full load of urban ills, Camden's schools have never been able to take educational accomplishment and excitement for granted. But the Orbit 81 project has transformed attitudes, galvanizing teachers and students to levels of accomplishment far beyond anything they'd ever attempted before.

Carman Aules, seventeen, a student at Woodrow Wilson High, feels a new determination and sense of self-worth blossoming among her classmates. A lot of people think Orbit Eighty-one is the reason. Every day you learn something new in the Orbit Eighty-one space-science class. "Aules says, "It's really exciting. I'll be sitting with my friends and say to myself, 'Hey, I know

● *A tiny spaceship floats over the stage on the end of a wire. A spaceman wanders in and says, "I am pleased you have chosen to study ants. Camden High has made a wise choice."*

something they don't know!" Like, how big the space shuttle project is, or what it's like to meet people from NASA. No one in my family ever did that. When the family sees me on TV they talk about it for days. They say, 'We know we'll get ahead even though she has a kid.'

Sixteen months ago Carman had a baby. That experience, coupled with her mother's move back to Puerto Rico after someone fire-bombed the family home, nearly forced Carman, a junior to drop out of school. Orbit 81 kept her in class, teacher Nick Timpane'll believes. Carman likes to tell about the time when she was just becoming involved in the project. Ninety-eight months pregnant, the teen-ager became so taken with her newfound goal that she would sit for hours on the bare wooden floor of her one-bedroom apartment, making model rocket tubes.

"I'm doing this for myself most of all," Carman says now while her baby, also named Carman, scoots across the floor in a wheel toy. "And when she grows older, she can say 'My mom was in this.'"

Timpane'll, the Orbit 81 coordinator at Wilson, encouraged Carman and scores of

other students to participate in the complicated space experiment. The test involves building a giant ant farm in a pressurized space canister and then regulating the farm's lighting, temperature, humidity and food supplies with a preprogrammed computer while recording everything with a minicamera. It has been a challenge. The students' ignorance at the start was absolutely shocking.

"Some of my students even thought that the earth was in the center and that the sun revolved around it," Timpane'll says. "Many of them did not believe that men had ever landed on the moon. They thought it was a hoax, that the American people had been put on. Many bring with them the prejudices their parents have at home. Why waste money on space? Why are there such things as satellites? It's just something Uncle Sam is using as an excuse to spend money."

Space science in Camden must coexist with a surly, tough inner-city environment. A scene in the spring of 1985 in one of Timpane'll's Orbit 81 classrooms is straight out of the TV show *The White Shadow*.

"On April twenty-first all of you will be going to ICA in Cherry Hill to see the construction and testing of a satellite," Timpane'll announced to his 20 students. One of them slept, while most laughed, talked, or played with a ball. "Dress tight," Timpane'll warned over the din. "I don't mean suits. But there're no basketball courts at the RCA astro lab. So no sweaters are allowed."

"You mean," one student queried with mock astonishment, "we have to wear shorts?"

"Try to," the unflappable Timpane'll answered laconically.

Much of Orbit 81's success at motivating Camden's scientifically unsophisticated students rests with the ants. The excitement of sending live creatures into space has captured the teen-agers' imaginations. The ants will be their astronauts. By proxy, those students will fly into their dingy city in the clean expanse of space.

While most of NASA's 340 Get Away special projects were chosen after careful analysis by the top scientific brains at participating high schools, colleges, and corporations, Camden chose ants by instinct.

"I was throwing out an idea during class," recalls Wilson student Ken Henry seventeen. "To be funny I said, 'Put a frog in water and see if he finds his way up.' Then I remembered in second grade we had an ant farm in class, and I said, 'Why not send up an ant farm?'"

Timpane'll took the idea to RCA, which earlier had challenged the two Camden schools to develop a space experiment that the company could support. RCA's assistant coordinator for Orbit 81, Thomas Chavis, had no objections and talk of an "ants in space" project spread through Wilson's classrooms and hallways.

It has been three years since the project began, and the ants continue to grab the

students' attention in a way no nonbiological project could. At both schools functional-looking corridors are adorned with pictures of ants wearing space helmets and of black spacemen at the helm of space-ships. Fewer than 50 students at both schools are directly involved in the experiment, yet hundreds of others have been moved to write news stories about the art project, to sculpt model space shuttles and space rockets, and to prepare special menus for "visiting NASA and RCA dignitaries." The space experiment's effect has fused every facet of school life into a coherent whole.

Student street bravado pales before the trials and tribulations of experimental ants. At one point in the experiment whole colonies of carpenter ants lay dead or dying inside several five-and-dime ant farms at the rear of Timpanelli's classroom.

Mr. Timpanelli: are they dead? What are you feeding them—poison or something? A distraught student asked as Timpanelli lifted yet another plastic farm full of dried-out ants from the bottom of a metal garbage can with a light bulb on top—a primitive simulation of the space shuttle canister that is still to be built.

Minor setbacks notwithstanding, the Orbit 81 project is no five-and-dime effort, not a make-believe high-school experiment that RCA technologists will build while the Camden kids take the bows. (Some experts close to the project do believe, though, that RCA will have to amputate off the project's rough edges before it is completely ready for launch.)

So far the Camden students have been designing the ant canisters and doing the computer programming on their own, while the teachers and RCA engineers stand by with advice. The students do have the help of nearly \$500,000 in used scientific equipment donated to the two schools by RCA, which is also paying the Get Away special experiment's \$19,000 space shuttle rental fee. Recently the launch agency designs were approved by astronautical advisors at RCA and Temple University in Philadelphia, which has donated the services of ant expert John Tarka, a biomedical engineer.

Camden High School's project differs slightly from Wilson's. Camden advisers Fred Rees and Eric Zaun have chosen only their best science students to participate directly in Orbit 81 work. At Wilson High any student can take part. The contrast between the Orbit 81 students at the two schools is striking. Wilson's kids are tough and gutsy. At Camden High one finds the cream of the school's brains—nicely dressed youngsters who always intended to go to college anyway. Orbit 81, they say, has merely given them a new range of career ideas.

"I might want to be a biomedical engineer because engineering seems difficult and I like challenging things," says Camden High student Marilyn Gordon, part of the school's specialized Orbit 81

computer group. The experiment, she adds, seemed impossible at first. "I said, 'Wow! Actually putting something in space? You must be kidding!' But it seems possible now. We've advanced a lot through our work on the project."

Even at Camden High, though, the space project has at times, seemed as far from realization as the farthest star. Last spring, students could be found spinning ants on turntables, heating them under lights, and cooling them in a refrigerator. Still, unsolved was the question of how to keep them alive on Earth, let alone in the near vacuum of outer space.

Ants can take it, though. "They're an excellent animal—possibly the best animal for the experiment," says Dr. Tarka. They're hardy. They survive in extreme environments. They have a joint exoskeleton

which protects them against changes in pressure. They can float."

It's a challenge to see whether we can do it," says Ken Henry, who dreams of becoming a pilot, though he has never flown in an airplane. "Can we put an ant farm in space and bring it back? That would be a compliment to us."

One student told Chavez, "All I can wait for is when they open up the canister. If one of those ants is alive, you will see the biggest party ever in Camden take place that night!"

Still, there are problems ahead, and they raise doubts that many of the students will actually achieve their goals. Delays with the space shuttle have stalled the students' launch, originally planned for 1991, until sometime in 1992. By then many of the students who labored for years to build the

CONTINUED ON PAGE 31



DRAMBUIE OVER ICE
WITH THE SUNDAY PUZZLE



FICTION

COLONEL STONESTEEL'S GENUINE HOME-MADE TRULY EGYPTIAN MUMMY

BY RAY BRADBURY

Green Town was dull, until a secret brought it to life

That was the autumn they found the genuine Egyptian mummy out past Loon Lake.

How the mummy got there, and how long it had been there, no one knew. But these it was: all wrapped up in its crocodile rags, looking a bit spoiled by time, and just waiting to be found by someone.

The day before, it had been just another autumn day with the trees blazing and dropping down their burnt-looking leaves, when Charlie Flagstaff, aged twelve, straddled to the middle of a pretty empty street, stared at the sky, the horizon, the whole world, and shouted, "Okay! I'm waiting. Come on!"

Nothing happened. So Charlie kicked the leaves ahead of him across town until he came to the tallest house on the greatest street, the house where everyone in Green Town came with his troubles. Charlie scowled, shut his eyes, and yelled at the big house windows, "Colonel Stonesteel!"

The front door burst open, as if the old man had been waiting there, like Charlie, for something incredible to

happen in Green Town, since

"Charlie," Colonel Stonesteel called, "You're old enough to knock. What's there about boys makes them shout around houses?"

The door slammed shut.

Charlie sighed, walked up, and knocked softly.

"Why, Charlie Flagstaff, is that you?" The door opened a spurt for the Colonel. "Good gray, look at that weather!"

The old man strode forth to hone his fine hatchet nose on the sharp wind. "Don't you just love autumn, son? Just smell that air."

He remembered to glance down at the boy's pale face.

"Why, son, you look as if your last friend drowned and your dog died. What's wrong? School starts next week? On top of which, Halloween's not coming fast enough?"

"Still eight long weeks off. Might as well be ten years," the boy sniffed, staring out at the autumn town. "Is over notice. Colonel, not much ever happens around here?"

"Why, hell's bells, son, it's Labor Day tomorrow big parade, seven

PAINTING BY MICHEL HENRICOT

almost-brand-new cars, major in his next-best suit: tweed, maybe — er —

The Colonel stopped, not impressed with his own grocery list. "How did it go, Charlie?"

"Thirteen. Almost."

"Things do tend to run down, come the lean. Meanwhile, Charlie, what do we do to survive 'til noon today?"

"If anyone knows, it's you, Colonel."

"Charlie — The old man finched from the boy's clearwater stare. "I can mow politicians big as prize hogs, shake town hall skeletons, make locomotives run back uphill. But small boys on long, dry autumn weekends, suffering from a bad stack of the desperate empties? Well —"

Colonel Stonesteel eyed the future in the clouds.

"Charlie," he said at last, "I am loused and moved by the circumstance of your lying there on the damn railway tracks waiting for a murderous train that will never come. So listen. I'll bet you see Baby Ruth candy bars that Green Town, upper Illinois, population five thousand sixty-two people, one thousand dogs will be changed forever, changed for the best by God, sometime in the next twenty-four miraculous hours! Bet?"

"A bet!" Charlie seized and pumped the old man's hand. "Colonel, I knew you could do it!"

"Ain't done yet, but look. The town's the Red Sea. I herewith order it to part. Gangway!"

The Colonel marched (Charlie ran) into the house, where the Colonel sniffed a vast door leading up to a dry-amber attic. "Listen, Charlie. Hear The attic storms."

The Colonel yanked the door wide on autumn whispars, high winds trapped and shuddering in the beams.

"What's it say?"

Just then a gust of wind hurled the Colonel like so much flimsy chaff up the dark stairs. He was philosophical along the way. Time, it says, mostly Oldness. Memory. Dust. Pain. Listen to those beams. When the weather cracks a roof's skeleton on a fine fall day you truly got time talk, Bombay snuffs, tombyard flowers gone to ghost —

"Boy, Colonel," Charlie gasped, climbing, "you oughta write for *Top Notch Magazine!*"

"Did once. Got rejected. Here we sit!" And there they were indeed, in a place with no calendar, no days, no months, no years, but only vast spider shadows and glints of light from collapsed chandeliers lying about like shed teardrops in the dust.

"Boy!" Charlie cried, scared and glad of it.

"Charles," the Colonel said, "you ready for me to birth you a real live, half-dead, sockolotager on-the-spot mystery?"

"Ready!"

"Now!"

The Colonel swept charts, maps, agate marbles, glasses, eyes, and sneezes of dust off a table, then rolled up his sleeves

to cure

"Great thing about midwiving mysteries is you don't have to boil water or wash up. Hand me that papyrus scroll there, boy. The curing needle just boyoid. That old rickshaw blueprint on the wall, the plug of freed cantonite-cotton underfoot. Jump!"

"I'm jumping!" Charlie ran and fetched, fetched and ran.

"Here, here, and here! There, there, and there!"

Bundles of dry twigs, clutches of pussy willow, and catails flew. The Colonel's sixteen hands were wild in the air, flashing sixteen bright azure needles, fakes of meadow grass, flickers of owl feather, glazes of bright yellow fox eye.

"There, by God. Half-done!"

The Colonel pointed with a chop of his nose.

"Feel an eye, son. What's it commence to start to resemble?"

Charlie circled the table, eyes stretched so wide his mouth gaped.

"Why... why... he sputtered. And then

While the old man cackled and sewed and swooped, Charlie seized and snatched and grabbed and hauled more lizard tails, a few burned-out sparklers, and gypsy moths and beetles.

"A mummy! Can't be!"

"Is, boy! Is!"

Wet deep in his creation the Colonel listened to its needs and wishes, its dry-flower whispars.

"Now why did I build this mummy? You, you inspired it, Charlie. Go look out the attic window!"

Charlie spat on the dusty pane, wiped a clear viewing spot, and peered out.

"What do you see out there in the damn town?" the Colonel asked. "Any murders being transacted?"

"Heck, no —"

"Anyone falling off church steeples, or being run down by maniac lawn mowers?"

"None."

"Any Monstros or Mermaids sailing up the dry lake, dingibles falling on the Masonic Temple and squashing six thousand Masons flat?"

"Heck, there's only five thousand folks in Green Town!"

"Don't lynch me with facts, Stone, boy. Spy Report?"

"No dingibles," Charlie stoned. "No squashed Masonic temples."

"Right you are, boy."

The Colonel trotted over to join Charlie, surveying the dreary terry. He pointed with his great hand nose.

"In all Green Town in all your life, not one murder, not one orphanage fire, not one mad fond carving his initials on library ladies' wooden legs. Face it, son, Green Town, upper Illinois, is the most common, mean, ordinary, plain old bore of a graywold in the eternal history of the Roman, Greek, Russian, Anglo-American empires. If Napoleon had been born here, he'd have committed han-kai by the age of nine. Boredom, if Caesar had been raised here, he'd have raced to the Forum at the age of ten, shoved in his own dagger —"

"Boredom," said Charlie.

"Kee-ree!" Colonel Stonesteel ran back to felling and pushing and cramming a strange lumpish shape around on the greening table. "Boredom by the pound and ton. Boredom by the doornail yard and the funeral mile. Lavens, homes, dog fur men's haircuts, cheap suits in dark store windows all cut from the same cloth —"

"Boredom," said Charlie, on cue.

"And what do you do when you're bored, son?"

"Er... break a window in a haunted house?"

"We got no haunted houses in Green Town!"

"Used to be. Old Higley's place. Tom down."

"See my point? What else should we try? Cuck!"

"Hold a massacre?"

"No massacre here in dogs' years. Lord, even our police chief's honest. Mayor? Not corrupt. Madness. Whole damn town faced with stark-raving annus and lulls. Last chance, Charlie. What's our salvation?"

Charlie smiled. "Build a mummy?"

"Buildogs in the belly! Yes! Lend a hand. Help me to fresh boy!"

While the old man cackled and sewed and swooped, Charlie seized and snatched and grabbed and hauled more lizard tails, old nicotine bandages left from a skiing accident that had busted the Colonel's ankle and broken a romance in 1925.

Some patches from a 1922 Kaizer inner tube, a few burned-out sparklers from the last peaceful summer of 1913, and a collection of gypsy moths and death's-head beetles that once had labels and now flew nameless as Charlie and the old man kneaded and wove, shuffled and lapped and moided a brittle, dry wicker shape.

"Wola, Charlie! Finished. Done."

"Oh, Colonel!" The boy stoned and gasped with awe. "Can I make him a crown?"

"Make him a crown, boy. Make him a crown."

The sun was setting when the Colonel and Charlie and their Egyptian friend came down the dusky backstairs of the old man's house. Two of them were walking, non-heavy the third was floating light as toasted

comfakes on the September air
"Colonel," Charlie wondered aloud
"What we going to do with this pharaoh
now we got him? It ain't as if he could talk
much or run around doing things—"

"No need. Let folks talk, let folks run
Peek out."

They cracked the door and peered out at
a town smothered in peace and numbed by
nothing to do.

All right, son, now you have recovered
from your almost-fatal seizure of desperate
empire. But that whole blasted population
out there lies up to its elbows in glum and
despond, fearful to see each man and find
it's always and forever Sunday! Who'll save
'em, boy?

Amos Bubeeste: Praises Be the Third,
just arrived on the Four O'Clock Limited?

"God love your sprightly tongue,
Charles. What we got here is a giant seed
Seed's no good unless we—"

"Plant it?" Charles asked.

"Plant. Then watch it grow. Then what?
Harvest time. Harvest! Come on, boy. Er
bring your friend."

The Colonel crept out into the first night-
fall.

The mummy came soon after, helped by
Charles.

Labor Day at high noon, Osiris Bubeeste
Amn-Ra-Tut arrived from the Land of the
Dead.

An autumn wind stirred the tent and
flapped doors wide, not with the sound of
the usual Labor Day parade, seven-bouring
cars, a file-and-drum corps, and the mayor
but with a mob that grew as it flowed
through the streets and fell in a tide to muni-
cipate the lawn in front of Colonel Stone-
steel's house. The Colonel and Charles
were sitting on the front porch, they had
been sitting there for some hours, waiting
for the connotation fits to arrive, the storming
of the Bastille to occur. Now with dogs
going mad and bring boys' ankles and
boys dancing around the fringes of the
mob, the Colonel gazed down upon the
Creation (his and Charles) and gave his
secret smile.

"Well, Charles. Do I win my bet?"

"You sure do, Colonel."

"Come on."

Phones ring all across town and lunches
burned on stoves as the Colonel strode
forth to give the annual Labor Day parade
his papal blessing.

At the center of the mob was a horse-
drawn wagon. On top of the wagon, his
eyes wild with discovery was Tom Tupper,
owner of a half-dead farm just beyond
town. Tom was babbling, and the crowd
was babbling, because in the back of the
wagon was the special harvest delivered
out of four thousand lost years of time.

"Well, food the Nile and plant the Delta,"
the Colonel gasped, eyes wide, staring. "Is
or is not that a genuine old Egyptian
mummy lying there in its original papyrus
and coal-tar wrappings?"

"Sure is!" Charles cried.

CONTINUED ON PAGE 92

THE JOCKEY FASHION STATEMENT IS CONTEMPORARY.

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The trick, says the inventor of the Delphi method, is not merely to predict the future but to intervene and change the course of history

INTERVIEW

OLAF HELMER

Olaf Helmer's career in futurism began with a question he hopes will never really be answered: How many A-bombs of the type that destroyed Hiroshima would it take to cut the U.S. gross national product by 75 percent?

The Air Force posed that question over 25 years ago to what was then a fledgling paramilitary think tank called the Rand Corporation in Santa Monica, California. Helmer had moved there during the 1940s after teaching mathematics and logic at the University of Chicago, the City College of New York, the New School for Social Research, and the University of Illinois.

As the Rand Corporation's resident mathematician, he handled what is now known as systems analysis and was particularly respected with forecasting by groups of experts. Out of this interest came the most sought-after forecasting tool used in government and industry, the Delphi method.

Helmer first used it to answer the Air Force's deadly serious question: The procedure was simple. He brought together a group

of experts in fields ranging from bombing accuracy to economics and gave them a questionnaire designed to estimate the bomb number. Each participant's responses remained anonymous, so the experts could follow their intuition more freely and make estimates without criticism or ridicule. What was so special about Helmer's Delphi method was that the questionnaires were repeated, giving the experts the chance to reconsider their conclusions. At first no one knew who else was being queried, but on later rounds of questions the experts were told who was in on the survey with them. Knowing the identities of their high-caliber company encouraged serious reevaluation, confirming the gut instincts of those certain of their ideas, and bringing into the mainstream of thought those who were not so certain. The new method produced the forecast with a group mind, and the estimate Helmer turned over to the Air Force was between 150 and 400 A-bombs.

The study was labeled Top Secret and disappeared into government files. The Delphi technique remained in limbo until 1963.

when Helmer and a Rand consultant, Theodore Gordon, resurrected the forecasting method to plot the future of technology. Their group of experts correctly predicted the first human heart transplant and foresee world shortages in food, fuel, and raw materials long before the idea of limited resources became so fashionable and obvious.

A company called TRW picked up the technique and applied it to plan its own future. The U.S. government has used it to do everything from planning water-treatment facilities to working up a new national drug-abuse policy. Businessmen have used it to gauge how Americans will be spending their leisure time in the future and how computers will be used in the year 2000. Cines, in the October 1978 issue, used the Delphi method to find out what our readers expected for the future of science and society.

No doubt one reason for the technique's appeal is its ethereal name. "That was the Rand environment," Helmer says, smiling. "The initials are in the habit of using all sorts of code names. When we made up the name, we hadn't expected it to go beyond the company. That we were stuck with it."

When more work with Delphi convinced Helmer of its innovation's value, he wrote what is considered a futurist classic: *Social Technology* in 1986. In it he offered the proposition that with

methods like Delphi we can step into the future, get a feel for what is likely to happen and shape our plans accordingly.

Committed to this belief, Helmer helped found the Institute for the Future, now located near Stanford University. It was the first think tank devoted exclusively to future research and studies. After serving as its director in the early 1970s, he returned to academic life, specializing in futures research at the University of Southern California, of which he is now professor emeritus.

An energetic, trim man, looking twenty years younger than his seventy years, Helmer lives near the idyllic Big Sur area of the California coast about 120 miles south of San Francisco, where Orvis sent writer Douglas Collins to interview him. Helmer is a self-effacing man who still speaks with a hint of an accent from his native Germany where he received his first doctorate in mathematics from the University of Berlin. Fleeing Nazi Germany, Helmer briefly settled in England, where he received his second doctorate in logic from the University of London.

Although officially retired, with an occasional break for consulting, Helmer still follows the futurist movement closely and keeps abreast of the use of the Delphi method. We began the interview by getting his perspective on how far we've come since the Delphi method first became known.

Orvis: It's been more than twenty years since the introduction of the Delphi technique. Is society any more sensitive to the future than it was in the early Sixties?

Helmer: No question about it. There's been a great deal of interest in the future. Books contributed to it, like Alvin Toffler's *Future Shock*, which has been read by millions. You now have systematic efforts at long-range planning at all levels of government and industry as well as such institutions as the Office of Technology Assessment, a direct outgrowth of the futurist movement. Futurists, whether they're called such or not, are used by virtually every major corporation in this country.

I think that the people in responsible decision-making positions have begun to realize that the value of the futures outlook lies not in making concrete predictions but in realizing the opportunities that might lie ahead and in confronting the problems that can be caught early.

Orvis: Such as?

Helmer: Well, as a very obvious example we should be prepared just in case the supply of fuel from the Middle East is cut off. If we are unprepared, the effect on our economy would be catastrophic. One doesn't have to be a futurist to point that out, but that's the sort of contingency that might arise.

Orvis: That brings up your idea of social technology, the use of scientific forecasting techniques to shape society in response to possible future events. How did you come to see Delphi as part of that preparation?

Helmer: When I was at the Rand Corporation, I felt that maybe social problems were in some respect more urgent than military ones, and I still think that's the case. There's always been a greater concentration of money and effort on military problems, and a great deal of so-called progress has been made there. But the same unfortunately is not true of social and economic problems. Some of us at Rand felt that the same kinds of ideas and analyses that were being applied to military prob-

lems could well be applied to social ones. And since the problems we face continually in our society are becoming more and more complex, there would be no hope of finding adequate solutions through the traditional interdisciplinary approach. At that time this was particularly evident and unfortunately still seems to be so, in the field of economics.

Orvis: In what way?

Helmer: The economists in their prescriptions and forecasts have been wrong so much in the last decade that one begins to wonder what the reason might be. The cause, it seems to me, might well be that their analyses lack the advantages of a multidisciplinary effort. Instead of limiting themselves to the classic economic doctrines, they should also give due consideration to other factors that influence the future, such as sociopolitical developments, ecological changes, technological innovations, the psychology of individuals and so forth.

Orvis: Whose psychology are you talking about? That of our leaders and economists?

Helmer: No, the psychological motivations active on the economic scene. It turns out that if you look at what's happening in the real world, you find people not always behaving according to the laws of economics. I've somewhat simply minded examples. I've been observing that often when people put their house on the market, they find they may have to wait quite a long time before it can be sold. According to the laws of classical economics, the seller in this case, will then lower the price to make it more likely that a buyer will be found. But sometimes the very opposite happens. And that's where the psychology comes in. Because we are living in an affluent society, people often feel they can afford to wait for a buyer, and since it's costly to keep a house on the market, the sellers are asking more to receive the lost income. Instead of lowering prices, the failure to sell sometimes results in markups.

You see a little bit of the same sort of thing in the automobile and movie industries right now. They are in bad shape. Because they haven't been able to sell cars or theater tickets, they've raised prices to recover their losses. And of course they're selling lower cars or admissions. All this is somehow not quite in agreement with the laws of economics.

I'm overstating it a bit, but the point is the economists have to observe the noneconomic aspects under which buyers and sellers operate in an economic interaction. They're not always predictable according to traditional economic rules.

Orvis: So you prefer to use a mix of disciplines to make forecasts.

Helmer: I think it's important to use some kind of interdisciplinary approach. That's one of the underlying themes of *Social Technology*. There haven't been many attempts to do this in the past, because people have been more or less working within their own little disciplinary wavy towers. And there are all sorts of barriers. One of the most obvious is that different disciplines have different kinds of jargon, and so you have to invent methods to make it possible to cross disciplinary lines. The Delphi method is one. So we've gained techniques. People who contribute opinions within such a framework are exposed to the opinions of other forecasters from other disciplines, and they are forced into reacting to these opinions. So there is a structured interchange of ideas between the participants. There is really no reason why you cannot get answers to a particular problem by simultaneously consulting experts in many diverse fields.

Orvis: There have been conflicting opinions about the value of the Delphi technique.

Helmer: It's been surrounded by controversy ever since it was invented. One of the reasons why it has remained controversial has to do with the people who have used it. It's been used by literally thousands, all over the world, and many

didn't know what they were doing, designing poor questionnaires, selecting too narrow a spectrum of experts.

A more serious objection people have made is that there have been virtually no laboratory experiments to validate the outcome of Delphi studies. I don't know of any experiments carried out where the guinea pigs were experts. That's hard to do, of course, because experts are hard to come by. They're usually involved in many other things, and if you can get them, you have to pay them highly.

Grant: So, as it stands now, there's no conclusive theoretical explanation why or how the Delphi technique does what it does?

Helmer: No, and I wish some of the professional psychologists would try to find out why this particular method is so successful. Some explanations have been more logical than psychological. For instance, my former Rand colleague, and Delphi co-inventor, Norman Dalkey has pointed out that n heads are better than one. It is logical that if you properly combine the judgment of a large number of people, you have a better chance of getting closer to the truth. That is a statistical statement.

Drew: Not only are many heads better than one, but smarter too. I remember when Dalkey had a group of engineers take an I.Q. test. First they took it individually, and then they did it as a group using a Delphi technique. It turned out that the group I.Q. was one hundred fifty whereas the highest individual I.Q. was only one hundred twenty.

Helmer: That reminds me of some group experiments we did at Rand that preceded the Delphi system. We had groups of one, two, three, four, and five working on solutions of simple problems, such as doing a crossword puzzle. We found that even-numbered groups did better than odd-numbered groups. Four was better than two, but two heads were better than three. What seemed to happen in the three-person groups was that two people would join forces against the third. They came up with faulty judgments instead of coming to the more balanced judgments arrived at by evenly divided groups.

Drew: In his classic work *The Covering of Post-Industrial Society*, Harvard sociologist Daniel Bell described the Delphi technique as being an intuitive method of forecasting. Would the ideal Delphi forecaster be someone who uses her intuition heavily, say a night-brain, creative type?

Helmer: It's hard to say. You don't want people who follow only their intuition. You need people who know some of the hard facts of their particular discipline. So you really need both. In the first technological forecasting study we deliberately included science-fiction writers, such as Arthur C. Clarke, for instance, not because we sought his judgment as a scientist, but because we expected he might lead in some intuitive ideas and expose these to other people on the Delphi panel.

Drew: Will you ever be able to do a Delphi

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forecast using computers instead of human experts?

Helmer: Well, you could instruct machines to use data banks and extract from them information that could be used like opinions. For example, I suppose you could pose a question in the context of a Delphi inquiry and then instruct the machine to answer the question so, let us say Aristotle or Julius Caesar would have, using information in the data bank put together from publications and pronouncements they made. That is possible in theory.

But I don't know whether we have any means of simulating intuition in a computer although we may reach that point. Admittedly, there are chess programs that can learn in that they can recall past similar situations in which particular moves did not work very well. So they discard them in the future. In that sense there's some learning going on, but I can't see how that you could talk about a computer having any kind of intuition.

Orin: It's been said that some of the more valuable forecasts are the ones that don't come true. Do you think that was the case with the Club of Rome forecast? That seemed to make many people fearful and get them worried about a global scarcity of food and fuel and about pollution of the environment.

Helmer: I feel that the Club of Rome was quite aware that its Limits to Growth study sounded too pessimistic. Their study said

that either through the poisoning of the atmosphere or through a lack of food or through an exhaustion of raw materials, things are going to come to an abrupt end. One of the effects of the study was to serve as a warning. For instance, people don't just sit around and wait until the air becomes more and more poisoned. They do something about it. Antipollution laws get passed, and those dire forecasts turn out to have been too pessimistic.

Orin: What about the forecasts of someone like Herman Kahn, whose viewpoints have been labeled far too optimistic?

Helmer: On the whole, I must say I tend to agree with the split in which he writes. I find myself in the same category of being optimistic in the long run and, mostly in the short run, pessimistic. I have not by any means given up on what is sometimes referred to as the technological fix. I think we haven't nearly exhausted all the available technological possibilities. There are too many pessimists around these days who say that technologically we have reached the end of the line. When it's a military necessity we can do miracles. There was the Manhattan Project. There was the space program, so far as landing on the moon is concerned. I have not been able to understand why we have given up on that spirit in attacking important problems.

Orin: Where could we use a miracle now?

Helmer: If ten years ago we had put a Manhattan-type project together to address the

problem of solar energy we would have it today. I'm convinced of this. We would have to worry about where our next year's supply of oil is coming from. Even now it wouldn't be too late, but only very feeble efforts are being made in that direction. I suspect, from my layman's point of view there are too many adverse interests involved. Some people just want to make a quick buck and they don't see it in solar energy but in the OPEC countries, so they've been exploiting that situation.

Orin: Are there other areas that could use more attention and foresight, maybe using the Delphi technique to think them out?

Helmer: Certainly there are, but I don't want to seem to be predicting things. Just as an example, however, when I listen to economic forecasts, it seems to me I hear something like, "The recession is already over and there's a mood of optimism." Occasionally I hear "The recession is not over" or "We're entering a new recession." I never hear stated that we might be entering a severe depression. I do want to emphasize that I am not predicting there's going to be a depression, but I think the possibility is very real. For example, look at what is happening to the auto companies, which after all are at the core of American industry. Chrysler could go broke. Possibly one of the other companies could, as well. That might cause some of the big steel, glass, and plastics companies to go bankrupt. And we might well have a real depression in this country.

Obviously a depression would mean we might have unemployment figures at fifteen to twenty percent, and possibly twice that among minorities. In contrast to the conditions during the first great depression, there is a sharp deterioration of public morality and mutual trust, and there's civil unrest and large scale riots would be a distinct possibility in this country. We have to be prepared for all that, just in case.

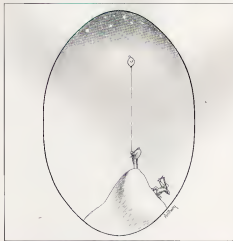
Orin: Is there any other area where we seem to have a blind spot?

Helmer: Yes in the military budget. There's a lot of talk now about inflation and the military budget, and I think rightly so. But what is being overlooked is the very strong possibility that war in the conventional sense might be completely obsolete and we're preparing for the wrong thing.

Orin: What do you mean?

Helmer: It is possible that the new form of war will be terrorism, and I fear that we are inadequately prepared to deal with that kind of warfare. We were held up by the Iranians with the threat that some harm would come to the hostages unless we handed over billions of dollars. It doesn't take much imagination to picture other variations on that theme involving perhaps whole cities immobilized by credible terrorist threats. Then what would the President do? We have thus far had no effective mechanism and firm policy for dealing with that kind of attack. I hope our military planning includes a shift in this direction.

Orin: You've suggested that we establish





*The lords of ethics may be
science's saviors, or bullies of a new Inquisition*

RENT-A-CONSCIENCE

BY DOUGLAS COLLIGAN

Richard McCormick remembers vividly the day Louise Brown, the world's first test-tube baby, was born. The Today Show wanted to send a camera crew straight to his house to ask him the essential question: What does it mean? The following morning McCormick's office phone was swamped with calls. News organizations were stacked up like planes over LaGuardia waiting for him to address them. Again, they all had the same desperate question: What does it all mean? They turned to McCormick because he is one of the leaders of the influential new

PAINTING BY RENE MAGRITTE

● If your child had the disease, ethicists asked the researcher, would you give him the drug you're testing?

into in the scientific community, the professional ethicists. These are men and women who, for a salary, decide what is right and what is wrong—what is moral, what is immoral. More important, they are powerful enough to affect which scientific experiments will be conducted and which ones will never be attempted.

Professional ethicists see themselves as keepers of the flickering flame of scientific social responsibility. Others see them as ethical harem for government officials too nervous to make their own decisions.

The controversies swirling around in the moral vortex are summed up in McCormick. He has written and spoken widely on the social implications of new biological techniques. Still, somewhat portly and distinguished-looking, he fits the image of a secure, successful research scientist. But he is something else, too.

He is a priest.

The Rev. Richard McCormick, S.J., runs the Kennedy Institute of Ethics, in Washington, D.C., one of the most influential of new ethics think tanks. This man of God sits in judgment on scientific work that strikes at the very roots of traditional religion. He can influence the course of research, not on the basis of good or bad science, but by the criterion of subjective morality. It is a judgment science has not seen in centuries.

A few years ago ethical think tanks were dismissed as ivory-tower toys for bored philosophers. But now ethicists are a force. They serve an influential government panel, and their opinions carry enormous weight in channeling research dollars. They have persuaded, in some cases even compelled, scientists to think about the moral implications of what they do. The new ethicists have also anchored themselves in the bureaucracy of science. Some say this is good because it will force scientists to be accountable to society for their work. Others say they are simply an extra layer of lat on an already bureaucratic system.

But nobody can ignore them. Those whose work makes the standards set by professional ethicists get the dollars. Those who occasionally clash with their research partners evaporate along with the money. The ethical panels, commissions and boards formed in the past few years in-

clude the President's Commission for the Study of Ethical Problems in Medicine, the National Commission for the Protection of Human Subjects, the Office of Protection from Research Risks, the (now defunct) Ethos Advisory Board, and the Institutional Review Boards, locally mandated for university and college research.

Ethicists are making the biggest waves in health care and the research that supports it. As Father McCormick explains it, "Increasingly, government is becoming a partner not only in health-care delivery but also in research establishments. When that occurs, you have policies that have to be made and the basis of a good policy is good morality, or ethics."

The heaviest demand for policy advice these days lies in the category of biotech. There are only two think tanks today that are capable of satisfying that need. One is a sleepy little Hudson River village, about 40 miles north of Manhattan; a place called the Hastings Center. The other is located in a charity-filled brick building near the campus of Georgetown University in Washington, D.C.

This is where Father McCormick works. The institute was conceived in the early 1970s by Dr. Andre Helaget, a physician and Renaissance man with a vigorous interest in philosophy. The name derives from its having been funded by the Kennedy Foundation—yes, those Kennedys. A part of Georgetown University, the institute encompasses three suborganizations: the Center for Population Research, the Laboratory for Reproductive Biology and the Center for Bioethics.

The institute is a pure think tank, an intellectual cluster where 12 members, heavy-weight thinkers with degrees in philosophy and religion, are free to study whatever moral questions or bioethical problems interest them. They may ponder genetic engineering one day, abortion the next, and the relevance of the soul to defining death the third. The institute also teaches ethics courses at the university, publishes a much-praised four-volume *Encyclopedia of Bioethics*, and operates an ultraconscientious bioethics data bank in tandem with the National Library of Medicine. The Kennedy Institute is the nes-

us of the government conscience network.

Father McCormick himself tackles such moral questions as whether Karen Ann Quinlan should be allowed to die or what is the morality of proziliglut. In the Quinlan case he consulted with the family's lawyers in their attempt to have life-support systems legally removed from the comatose young woman. As for boxing, McCormick wrote in *Sports Illustrated* that pugilism is immoral because its sole reason for existence is physical injury and its appeal is to our most brutal instincts.

The issue of McCormick's priesthood is central to many controversies in which he has become embroiled. When he served on HEW's Ethics Advisory Board, scientists wondered whether a Roman Catholic priest could vote fairly on something as touchy as test-tube babies. Would a Catholic theology guarantee his casting a negative vote on all biological progress?

Not necessarily, McCormick argues forcefully. That his distinguishes ethical judgment from personal belief. With respect to laboratory fertilization, McCormick surprised researchers by voting in favor of test-tube-baby research within the United States. "I was roundly criticized for my participation on the Ethics Advisory Board," he said, but he felt the board's decision was right.

"You listen to your traditions," he says, "but you are not enslaved by them." In the test-tube-baby situation, McCormick insisted upon a stern legislative review of all the literature and all the arguments about the technique. Then, like intellectual engineers, he and his colleagues would strip bits of argument from the case and put them with their own. In fact, one intellectual and remove one there. Then they would reassemble the arguments bit by bit and compare whether the shifts had improved either position. Eventually McCormick became convinced that no argument against was as strong as the pro-development argument, modified by a few specific limitations. Since it represented the stronger moral argument, he voted for it.

McCormick feels that church attitudes toward artificial insemination, contraception, and *in vitro* fertilization are drastically out of step with the times. He agrees with



his church's opposition to abortion, however because to his mind the Catholic view is a soundly reasoned one. Not all the people at the institute agree with me on this," he says wryly, "but I respect that."

Even though it is affiliated with a Catholic university, the Kennedy Institute is staffed by Protestant and Jewish, as well as Catholic scholars, each of whom has an equal voice in setting its agenda.

One of the quieter voices is that of Dr. Leroy Walters, a philosophy and religion Ph.D. from Yale and director of the institute's Center for Bioethics. Pale, slim, soft-spoken, Dr. Walters behaves reassuringly like the serene, thoughtful philosopher one would expect to find in a think tank of this sort. But his relaxed, almost subdued manner is deceptive: It masks the amount of work he does. Walters edits an annual compendium of writings in bioethics, teaches at Georgetown, serves on Institutional Review Boards, and is perpetually in demand as an adviser to various government agencies. Just recently he retired from a four-year tour on the National Institutes of Health's Committee on Recombinant DNA, a post that positioned him near the center of one of the most volatile scientific controversies of the 1970s.

The DNA committee was charged with determining what limits should be placed on genetic-engineering research; its work was filled with strife and drama. Shortly after Walters joined the committee, all hell

broke loose. Demonstrations erupted on college campuses where rumors of planned genetic-engineering research surfaced. Right-wing preachers raised against the new technology as a tool of Satan. Everywhere people were panicky. At a public meeting on the issue, for instance, the mayor of Cambridge, Massachusetts, contributed to the discussion by wondering aloud: "The scientists may come up with a disease that can't be cured. Even a monster!"

At the time Walters left as if he had been appointed safety officer on the Titanic. The situation was clearly a mess. It is ironic, he recalls, that microbiologists themselves first raised the DNA safety issue out of a moral concern to do the right thing. But the public reacted by thinking, "If scientists are frightened and are taking all these precautions, things must be really dangerous. The more scientists tried to be careful, the more risky their research looked."

There was tremendous pressure for Congress to enact laws that would bind the new technology. Researchers were dismayed at the thought of dried government intervention. Walters is proud of the fact that the committee, in the face of hysteria, examined the problem objectively and formulated flexible guidelines that time has proved very successful. Biotechnology has since grown like a weed, but there have been no serious accidents, no monsters, no Andromeda strain.

Looking back on the controversy, Walters is obviously delighted with the approach that was taken. "All the information thus far seems to indicate that risks were overestimated early on. I think it was important in this case," he continued, "for society not to overreact. After all, it was the conscientious scientist who first brought the issue to the attention of society."

At the Kennedy Institute Walters now examines other, less volatile, but scientifically crucial questions in bioethics. One particularly tricky question was raised by a researcher looking for a way to treat herpes simplex encephalitis, a highly infectious ailment that kills or renders the newborn child of an infected mother. The doctor brought his proposal to an Institutional Review Board of which Walters was a member. The researcher wanted to try out a promising drug on newborns by giving it to some and, for comparison's sake, denying it to others.

The moral dilemma in his research was this: If the drug did as was hoped, then by approving the research proposal the board would essentially be condemning the untreated babies to death or to a lifetime of being mentally crippled. "Our board did not know what to do," Walters said. "We finally agreed to ask the investigator: If your child had herpes simplex encephalitis, what would you want to have done? He replied: There's no question in my mind. I'd want the child to have the



drug." Hearing this, the board suggested he change his study to inoculate all the infants, not just some of them. "In a sense we said no to his proposal for that kind of study. Unless advised."

The methods by which ethicists reach these decisions do not parallel those that one would expect of a scientific variant of the Spanish Inquisition. All that the board members may see of a scientist is his written proposal for research, one of many spread before them in an evaluation meeting. The board discusses the pros and cons of the proposal, each member drawing on his personal readings, background, and intuition. Some proposals meet with routine approval. In tough cases specific members will look into the background of the problem more deeply. Then the researcher may be asked in to answer questions personally. Eventually a consensus is achieved and the committee draws up a report on what institutions it feels must be set on the researcher's work.

Making such far-reaching decisions exacts an emotional toll on ethicists. "We don't actually decide who will live and who will die," Walker explains, "but we do indirectly determine where the greater ethical need for funding lies. These are terrible decisions to contemplate, but we're going to have to come face to face with some kind of trade-off if any sort of progress is to occur. He points to a case in which government money could go to either a heart-transplant program or a nutritional program for schoolchildren. In the first instance, \$50,000 might keep one person alive for a decade or so. In the second, the lives of hundreds of children positively could be altered from an early age. Ethics eventually demanded that the money go to the children, but somewhere a heart patient died without the transplant he needed to save his life.

Dennis Callahan must cope with many such wrenching choices of his own. In fact, he began making them before the Kennedy Institute even existed. Callahan is cofounder and director of the Institute of Society, Ethics and Life Sciences, more familiar as the Hastings Center. It's situated in an old mansion at the end of a narrow side road in Hastings-on-Hudson, a small bedroom community just a short train ride north of New York City. About ten years ago Callahan, who lived in Hastings, realized that problems between science and society were due to become more complex. He came to this realization after finishing what was to become a classic study of abortion. Medical experts and scientists on the cutting edge of research told him about other amazing feats of research expected within a decade or so: sex selection, genetic engineering, quick and easy behavior control with drugs and electrical implants, life spans stretched to the century mark and beyond, cloning. They would, he thought, generate deep moral dilemmas.

With seed money from grants, Callahan and his partner Dr. Wilford Gaylin recruited

a team of concerned philosophers, lawyers, theologians, and scientists and established the Hastings Center. Response from the world of science was overwhelming. When Callahan approached medical schools to suggest they incorporate ethics in their training, he got responses that ranged from polite, gassy-eyed looks to old-fashioned hostility. "We have no ethical problems," his tombstones being told more than once.

But he and Gaylin knew better. Life and death were growing more complicated. Even the medical and legal definitions of death were being challenged by medicine's new skills. Traditionally a person was considered dead when his heart stopped beating. But sophisticated techniques let doctors restart stopped hearts. And life-support equipment could keep a

body functioning almost indefinitely even if the brain had ceased working.

The questions that needed answering were: Can the brain-dead human vegetative be considered alive, and does it require the extraordinary and expensive attention of high-powered life-support systems? The old medical definition of death—a stopped heart—suddenly seemed rather pointless.

Through the mid-1970s Hastings focused its intellectual energies on establishing a new definition of death. The center gathered together a group of experts in many fields to scrutinize the topic. They began by discussing broad philosophical questions about death and worked their way down to a practical legal definition. In this and they adopted what is sometimes called the brain-death definition—that a person whose brain is no longer active can

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INTERVIEW

CONTINUED FROM PAGE 18

an apolitical national goals institute to work up a list of national priorities. Do we need some kind of taking stock of where we are and where we're going, similar to the Peley Report of the 1950s?

Helmer: I think we do. We need some re-consideration of our national values, of our preferences as a nation. I'm very optimistic in the long run, but I anticipate our having to go through some very rough times in the Eighties. Maybe by the year 2000 we will be able to strengthen ourselves out, but the Eighties look bad in many respects.

One thing we're going to see is a shortage of energy. I think we're going to live through a decade of energy shortages everywhere. The consequences might be catastrophic. During the decade, particularly the second half, there is a very serious chance of famine on an unprecedented scale in various parts of the world, especially in Africa, South America, and some parts of southern Asia.

Omni: What if a Delphi poll predicts worldwide famine? How do you prepare for something like that?

Helmer: The eventual solution has to lie in the direction of reducing fertility rates. We can see some progress in that direction when we conducted that long-range forecasting study in 1963. The prevalent fore-

casts about world population in the year 2000 had been between eight billion and twelve billion. The experts we consulted via the Delphi method came up with a much smaller estimate, around six billion, which it now seems is much closer to the mark. It shows that the people we consulted foresaw that the fertility rate would go down.

It doesn't take that much really. If every family in the world decided to have one child fewer than originally planned, it would make an enormous difference in population growth. That is a relatively small-scale decision. I don't think it's impossible to reach some kind of stabilization in the population sooner than had been originally assumed, but this cannot be done fast.

Omni: You have also proposed what you've called a D-net, a network of computers that can be used by experts of all kinds all over the world or at least all across the country to participate in a Delphi poll from where they work. Have there been any efforts to realize that?

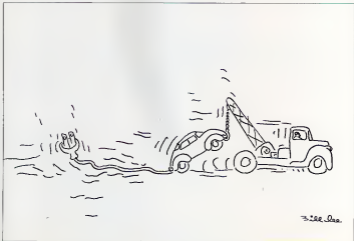
Helmer: A certain amount of work is being done. As you know, there are computer networks already in operation for a variety of purposes. They have been used at times for conducting Delphi studies. Murray Turill (associate director of the Center for Technology Assessment and professor of computer and information science at the New Jersey Institute of Technology) has been doing that sort of thing. Professor Paul Gray, at Southern Methodist Univer-

sity with his work on a decision-room project, may also be moving in the direction of applying such a technology. Much has been done, but not as much as I'd like.

It seems to me that it's an excellent vehicle for extracting expert opinions. I've always felt that the people in government, in particular, could have access to experts at a much lower cost if they used a computer network. It would be easy to compile a comprehensive roster of very many experts in different fields organized to be on call when needed. Then those most appropriate for a particular need could be told "Please be at your terminal tomorrow morning. We are going to have a Delphi survey on a problem in your area."

Omni: If the D-net were to become widely used, wouldn't we be in danger of becoming what Daniel Bell calls a technocracy, a society run by technicians?

Helmer: There's not any danger of that. But I do think that the postindustrial society is so complex that you need a great deal of expertise to govern properly. The return to the good old days of hunching decisions over to local authorities is no longer possible. I'm not exactly clear what the revised system of government would look like, but the people would retain their decision-making powers through some kind of voting system. To run a large, complex country like the United States successfully you need centralized decision making and centralized information sources. **DD**



IN ORBIT

CONTINUED FROM PAGE 15

experiment will have graduated. Realizing this, students at both schools have begun selling pen-and-pencil sets to raise enough money to fly graduates to Cape Canaveral for the eventual launch.

The experiment also has been stalled for at least six months by the Camden schools' failure to win \$6,000 to \$7,000 in outside funding—money that would have paid for a third-level Orbit 81 space-science curriculum. Without the third-year class guide, the Orbit 81 project this year was reduced to an extracurricular activity.

"Frosch indicated to us that we would get a follow-up on the money," Chavis recalls. "Then we got a no. NASA said it needed every cent it could get for the shuttle." Camden businesses and RCA are trying to raise money to help them out.

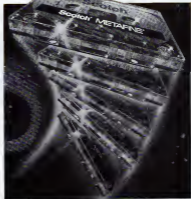
So far the Orbit 81 project has resulted in just one scholarship—to an artistic student so poor that he used to walk to class wearing two shirts and three sweaters in lieu of a coat. The project has brought no promise from NASA that Orbit 81 students will have an edge when they apply to the agency's college internship program, even though the Camden experiment seems to have done more than any other NASA project to unto the goals of the nation's space agency and its urban youth.

And what of jobs for inner-city scientists such as the Camden teens? Will the exposure to space improve their chances of breaking free of the low-paying inner-city chain? No one knows. "We don't expect to make great scientists or aerodynamics experts out of them," says RCA group vice-president Irving Kisselitz, "but, at least they can develop pride in their school, in themselves, in what they can do—in the fact that other people are interested in them."

However, Camden has a way of clashing early and painfully with the dreams of its young. Awles, perhaps more than any other Orbit 81 student, was certain that the project would somehow lead her to a scholarship and professional career, possibly as a computer technician or even as an astronaut. "I want to go to the launch at Cape Canaveral!" the small, intense teen-ager said several months ago. "When you go there, you get a lot of offers from many colleges. And because you are a minority a Puerto Rican they give you a scholarship. I have it made if that happens to me."

But it didn't happen to her. Instead, several weeks ago—following two weeks in a hospital after she was severely beaten by an acquaintance—Carmen moved back to Puerto Rico in fear for her own safety and that of her child.

It may seem that, for her, Orbit 81 failed. But maybe not. At least it planted in her mind the hope of growing beyond poverty of becoming a professional, and perhaps of living someday in the stars. She carried that seed back to Puerto Rico. **CC**



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STONESTEELS

CONTINUED FROM PAGE 79

"Sure is!" everyone yelled.

"I was plowing the field this morning," said Tom Tuppen. "Plowing just plowing and—bang! Plow turned this up, right before me! Like to have had a stroke! Thank the Egyptians must've reached through Illinois three thousand years ago, and no one knew! Revelations, I call it! Outta the way kids! I'm taking this find to the post office lobby. Setting it up on display! Gid-dap, now giff!"

The horse, the wagon, the mummy, the crowd moved away, leaving the Colonel behind, his eyes still pretend wide, his mouth open.

"Hot dog," the Colonel whispered. "we did it, Charlie. This uproar, babble, talk and hysterical gossip will last for a thousand days or Armageddon, whichever comes first."

"Yes, sir, Colonel!"

Michelangelo couldn't've done better. Boy David a cataway, lost and forgotten wonder compared to our Egyptian surprise and—

The Colonel stopped as the mayor rushed by.

"Colonel, Charlie, howdy! Just phoned Chicago. Newsfolks here tomorrow breakfast! Museum folks by lunch! Glory Hall-ajah for the Green Town Chamber of Commerce!"

The mayor ran off after the mob.

An autumn cloud crossed the Colonel's face and settled around his mouth.

"End of Act One, Charlie. Start thinking fast. Act Two coming up. We do want this commotion to last forever, don't we?"

"Yes, sir—"

"Click your brain, boy. What does Uncle Wiggly say?"

"Uncle Wiggly says—ah—go back two hops?"

"Give the boy an A-plus, a gold star and a brownie! The Lord giveth and the Lord taketh away eh?"

Charlie looked into the old man's face and saw vestiges of plagues there. "Yes, sir."

The Colonel watched the mob milling around the post office, two blocks away. The life-and-drum corps arrived and played some tune vaguely inclined toward the Egyptian.

"Sundown, Charlie," the Colonel murmured, his eyes shut. "We make our final move."

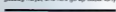
"What a day it was! Years later people said, 'That was a day!' The mayor went home and got dressed up and came back and made three speeches and held two parades, one going up Main Street toward the end of the trolley line, the other coming back, and Orens Bubasta Amro-fre-tul was at the center of both, smiling now to the right as gravely as if his heavy weight and then to the left as they rounded a corner

The life-and-drum corps, now heavily augmented by accumulated brass, had spent an hour drinking beer and learning the Triumphal March from Aida, and the they played so many times that mother's took her screaming babies into the house and men retired to bars to soothe their nerves. There was talk of a third parade and a fourth speech, but sunset took the town unawares, and everyone, including Charlie, went home to a dinner mostly talk and short on sale.

By eight o'clock, Charlie and the Colonel were driving along the leafy streets in the old man's darks, taking the air in the tumbler 1924 Moon, a car that took up trembling where the Colonel left off.

"Where we going, Colonel?"

"Well," the Colonel mused, steering at ten philosophical miles per hour, nice and easy, "everyone, including your folks, is out at Grossett's Meadow right now, right? Final Labor Day speeches. Someone I light the gabgab mayor, and he'll go up about forty



*● On top of the wagon,
Tom Tuppen was babbling,
and the crowd
was babbling, because in the
back of the wagon
was the special harvest
delivered out of
four thousand years of time ●*



feet, see no? Fire Department'll be getting off the big skyrockets. Which means the post office, plus the mummy, plus the sheriff sitting there with him, will be empty and vulnerable. Then the miracle will happen, Charlie. It has to. Now ask me why the miracle will happen."

"Why?"

"Glad you asked. Well, boy, folks from Chicago'll be jumping off the train steps tomorrow, hot and fresh as parakeets, with their party nooses and glass eyes and microscopes. Those museum snoots plus the Associated Press, will rummage our Egyptian pharaoh seven ways from Christmas and bring their fuse boxes. That being so, Charlie—

"We're on our way to mess around with the evidence."

"You put it delicately, boy, but truth is at the core. Look at it this way, child. Life is a magic show or should be if people didn't go to sleep on each other. Always leave folks with a bit of mystery, son. Now before people get used to our ancient hind, before his wheels out the wrong bush towel, like any smart weekend guest, he should grab the next scheduled camel west and hitchhike

it out of town. There?"

The post office stood silent, with one light shining in the foyer. Through the great window they could see the sheriff seated alongside the mummy on display, neither of them talking, abandoned at last by the attentive mobs that had gone for suppers and fireworks.

The Colonel brought forth a brown bag, in which a mysterious liquid gurgled. "Give me thirty-five minutes to mellow the sheriff; down, Charlie. Then you creep in, later, follow my cues, and work the miracle. Here goes nothing!"

And the Colonel stole away.

Beyond town, the mayor sat down and the fireworks went up.

Charlie stood on top of the Moon and watched them for half an hour. Then, figuring the mellowing time was over, his dog-trotted across the street and moused himself into the post office to stand in the shadows.

Well, now," the Colonel was saying seated beside the Egyptian pharaoh and the sheriff, "why don't you just finish that bottle, sir?"

"It's finished," said the sheriff, obeying without hesitation.

The Colonel leaned forward in the half-light and peered at the gold amulet on the mummy's breast.

"You believe them old sayings?"

"What old sayings?" the sheriff inquired. "If you read them hieroglyphics out loud, the mummy comes alive and walks."

"Horzarabadah," said the sheriff.

"Just look at all those fancy Egyptian symbols!" the Colonel pursued.

"Someone stole my glasses!" the sheriff blurted. "You read that stuff to me. Make the fool mummy walk."

Charlie took this as a signal to move, and he sidled around through the shadows, closer to the Egyptian king.

"Here goes," the Colonel bent even closer to the pharaoh's amulet, meanwhile slipping the sheriff's glasses out of his cupped hand into his side pocket. "First symbol on here is a hawk. Second one's a jackal. That third's an owl. Fourth's a yellow fox eye—"

"Continue!" the sheriff commanded.

The Colonel did so, and his voice rose and fell, and the sheriff's head nodded, and all the ancient Egyptian pictures and words bowed and touched around the mummy until at last the Colonel gave a great gasp and pointed.

"Good grief, Sheriff! Look!"

The sheriff blinked both eyes wide.

"The mummy," said the Colonel. "It's going for a walk!"

"Can't be! The sheriff cried. "Can't be!" "It," said a voice, somewhere. Maybe the pharaoh under his breath.

And the mummy lifted up, suspended and drifted toward the door.

"Why," the sheriff suggested, tears in his eyes, "I think he might just fly!"

"I'd better follow and bring him back," the Colonel said.

"Do that!" the sheriff replied.

The mummy was gone. The Colonel ran. The door slammed.

"Oh, dear!" the sheriff lifted the bottle and shook it. "Empty."

They drove through avenues of autumn leaves that were suddenly the temples of dusting Egypt and the fly-sculpted pillars of time. Charlie let the car motor hum in his seat while over his shoulder in the back seat, taking the ancient air, enjoying the warm river of wind, the mummy leaned this way and that as the car swirled.

"Say it, Colonel," said Charlie at last.

"What?" asked the old man.

"I love to hear you talk. Say what I want to hear. About the mummy. What he truly is. What he's really made of. Where he comes from—"

"Why, boy, you were there, you helped make, you saw—"

But the boy was looking at him steadily with bright autumn eyes. The mummy, their ancient harvest tobacco dried up Nile River bottom old-time masterpiece, leaned in the wind over their shoulder, waiting as much as the boy for the talk to come.

"You want to know who he truly was, once upon a time?"

The Colonel gathered a handful of dust in his hands and softly filtered it out before he answered.

"He was everyone, no one, someone. You, Me."

"Go on," Charlie whispered.

Continued, said the lapis-lazuli gleam in the mummy's eyes.

"He was he is," the Colonel murmured, "a bundle of old Sunday comic pages stashed in the attic to spontaneously combust from all those forgotten no-bone and stuffs. He's a stand of papyrus left in an autumn field long before Moses, a paper-milchke tumbledweed blown out of time this way long gone dusk, that way come again dawn, a chart map of Sam, Blue River Nile source, hot desert dusted all the confabls from lost trolley transfers, dried-up yellow cross country road maps peeling off in sand dunes, dry crushed flowers from wedding memory books, funeral wreaths, ticker tapes unwraved from gone off-forever parades to Far Rockaway, lost scrolls from the Great burned library at Alexandria, small the chess?" He hit his cage, covered with what? Posters torn off seed beds in North Storm, Ohio, shuffled south toward Fulfillment, Texas—dead gold-miner certificates, wedding and birth announcements—all the things that were once need, hope, dream, first rickel in the pocket, dollar on the wall—wrapped and ribboned yellow-skinned letters from failed old man-to-be orphaned woman saying "Tomorrow and Tomorrow there'll be a ship in the harbor, horse on the road, knock on the door. He is—he's telegrams you're afraid to open, poems you wrote and threw away, all the dumb, strange shadows you ever gave, boy, or I ever missed

out inside my head at three A.M., crushed, slashed, and now shaped in one form under our hands and here in our gaze. That, that, that is what old King Pharaoh Seventh Dynasty Holy Dust is!"

"Wow," Charlie sighed.

As they drove up and parked in front of his house, Colonel Stonesteel peeked out cautiously.

"You folks ever go up in your attic, boy?"

"Too small. They poke me up to rummage."

"Good! Hold our ancient Egyptian friend out of the backseat there. Don't weigh much, twenty pounds at the most. You caned him fine, Charlie. Oh, that was a sight. You running out of the post office, making the mummy walk. You shoulda seen the sheriff's face!"

"I hope he don't get in trouble because of this."

Oh, he'll bump his head and make up a fine story. Can't very well admit he saw the mummy go for a walk, can he? He'll think of

•The boy was looking at him steadily with bright eyes. The mummy, their masterpiece, leaned in the wind over their shoulder, waiting as much as the boy for the talk to come •

something—organize a posse. You'll see. But right now, son, get our ancient friend here up, hide him good, visit him weekly. Feed him right talk. Then thirty forty years from now—"

"What?" Charlie asked.

"In a bad year, son, brimmed up with boredom it drips out your ears, when the town has long forgotten this first arrival and departure on a morning, I say when you're in bed and don't want to get up, don't even want to twitch your ears or blink, you're so damned bored—well, on that morning, Charlie, you just climb up in your rummage-sale attic and shake this mummy out of bed, toss him in a confab, and watch new hellfire mobs break loose. Life starts over that hour that day, for you, the town, everyone. Now grab off, and hide, boy! Hop to it!"

"I hate for the night to be over," Charlie said, very quietly. "Can't we circle a few more blocks and then finish off some lemonade on your porch, and him along, too?"

"Lemonade! Colonel Stonesteel banged his heel on the car floor. The car exploded and surged. For the Lost and

Found King, and the Pharaohs, Illinois, Son!"

It was late on Labor Day evening, the two of them seated on the Colonel's front porch again, rocking up a far breezy lemonade in hand, ice in mouth, sucking the sweet savor of the night's incredible adventures. A wind blew the mummy behind Charlie's rocker, propped against the porch wall, almost seemed to be listening.

"Boy!" Charlie exclaimed. "I can see tomorrow's Clarion headlines. PRICELESS MUMMY KIDNAPED, RANSOM NOT WISHED, GREAT HAD DONE, BEAKING OFFERED, SHERIFF UNEXPLODED, BLACKMAIL EXPECTED."

"Talk on, boy. Like I taught you."

The last Labor Day fireworks were dying in the sky. Their light faded in the lapis-lazuli eyes of boy and man and their withered friend, all fixed in shadow.

"Colonel," Charlie gazed into the future. "What if, even in my old age, I don't ever need my own particular mummy?"

"Er?"

"What if I have a life chock-full of things never bored, find what I want to do, do, make away day count, every night swell, sleep tight, wake up yelling, laugh lots, grow old, still running fast, what then, Colonel?"

"Why then, boy, you'll be one of God's luckiest people!"

For you see, Colonel, Charlie said, looking at him with pure round, unblinking eyes, "I made up my mind. I'm going to be the greatest writer that ever lived!"

The Colonel braked his rocker and searched the innocent fox in that small face.

"Lord, I see it. Yes, you will. Well, then, Charlie, when you are very old, you must find some lad, not as lucky as you, to give Corno-Ris to, 'your life may be full, but others' lost on the road, we need our Egyptian friend. Agreed? Agreed?"

The last skyrocket soared and fell, the last fire balloons went sailing out among the gentle stars. Cars and people were driving or walking home, some fathers or mothers carrying their tired and already-sleeping children. As the quiet parade passed Colonel Stonesteel's porch, some folks glanced in and waved at the old man and the boy and the tall, dim-shadowed servant who stood between. The night was over, forever.

Charlie said, "Say some more, Colonel."

"No, I'm shut. Listen to what He has to say now. Let five tell your future, Charlie. Let him start you on stones, Ready?"

A wind came up and blew in the dry papyrus and sifted the ancient wrappings and trembled the curious hands and softly latched the lips of their old/new four-thousand-year nighttime visitor whispering.

"What's he saying, Charlie?"

Charlie shut his eyes, waited, listened, nodded, let a single tear slide down his cheek, and at last said, "Everything. . . Everything I always wanted to hear. CC

to an economies of abundance. Once we break out from the confines of this planet, we can begin building new lands from the limitless resources of our solar system and can use freely as much as we need of the sunlight that now streams out, wasted into the cold darkness beyond the planets.

If we were to attempt to lift from Earth into space the raw materials necessary for construction of space habitats, the total cost in energy would be prohibitively high. It takes as much energy to put a ton of mass in high orbit above Earth as it would to lift that ton straight up against the pull of Earth's normal surface gravity from the bottom of an empty well 4,000 miles deep.

You might then ask whether ordinary people in large numbers will ever find it easy to travel into space, and I can answer that question in terms of energy costs. Within the limits of the space shuttle, or of launch vehicles being built by several nations other than the United States, 50 to 100 people could be lifted into orbit at a time using no more fuel per person than the amount of gasoline a typical citizen of an industrial nation burns in his car in the course of a year. A fleet of reusable vehicles of 1990s vintage, far fewer in number than the commercial jet transports of today's world, would be quite enough to provide transport into space and back again for several hundred million people per year.

A voyage of a few days to a space colony will be as commonplace in 2081 as a Caribbean cruise is to us today. Some people will certainly choose to emigrate, and they may do so in part because the civilization in space will be separated into large numbers of small, self-sufficient colonies, each able to grow its own food and run its industries on free solar energy.

The links in the logical chain that will make possible the opening of the high frontier are really all in place. Given the present state of technical readiness and economic incentive, a breakout into space within the next decades is a certainty.

ENERGY

Among the drivers of change, energy is unique because it will speed change if we find it in abundance but will become a barrier to change if it is in short supply. The debate between those who look to the future with hope and encourage the study of change and those who anticipate at best only a dismal monetary return on the availability of energy.

Americans now use ten times as much energy as their ancestors of 1881. But the increase in the rest of the world has been still more dramatic: 3.5 percent per year, for a per capita growth in energy usage of 30 times as much as in 1881. The disparity between North America and the rest of the world has therefore diminished to about a factor of six and is shrinking further as the

Third World continues to industrialize.

To meet these greatly increased needs, we must turn to new energy sources. Unfortunately none of the new energy technologies that are now on the horizon can help much before the 1990s, and even a substantial increase in energy supplied by present methods can hardly occur in much less than a decade.

It seems to me that there are just four ways in which energy could be transmitted from one place to another on the surface of the earth in 2081: as electricity or in the chemical bonds of pure hydrogen, synthetic ammonia, or synthetic hydrocarbons. In chemical form energy can be stored as well as shipped, but all four methods of energy transmission will be used, because each has special characteristics that will be of importance for certain applications.

It will probably shift during the next century from a fossil-dominated economy to a healthier reliance on long-term resources. In my guess, from 50 percent to 95 percent of the energy used on Earth in 2081 will be from such self-renewing or near-infinite resources. You may be surprised that I don't list ground-based solar power as a viable option, but it's not if we were to add all forms of solar energy for the entire continental United States—including wind power, tide-power photovoltaics, and hydroelectric power—dam every stream for hydropower, burn every forest, and throw in geothermal power for good measure, the most energy we could get would still be 2.9 watts per square meter short of projected energy use a century from now.

Nuclear fuels are "fossil" reserves of energy in the sense that they don't renew themselves. There isn't enough uranium available to run our civilization for very long on the most familiar nuclear reaction, the splitting of the ²³⁵U nucleus, because that isotope constitutes only a fraction of a percent of natural uranium. To obtain enough nuclear fuel so that the nuclear-energy reserves would last a very long time we would have to resort to some form of "breeding," that is, the transmutation of some common isotope to a fissionable one by exposing it in a nuclear reactor to a hot bath of neutrons.

For some years there's been intense controversy over a pilot plant fast-breeder reactor, which was built to transmute the commonly occurring isotope ²³⁸U into the fissionable isotope ²³⁹Pu (plutonium). The controversy has raged because the fast breeder reactors are much trickier and more dangerous than ordinary fission reactors and because ²³⁹Pu is a suitable material for making atomic bombs as well as for fueling reactors.

There seems to be a way to avoid both problems by breeding from the element thorium (Th) in an ordinary "slow" reactor (the fast/slow distinction refers both to the average speed of the neutrons in the reactor and to the speed with which it could go from a safe to an unsafe condition). Canadian scientists have developed the CANDU

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reactor, which uses slow neutrons to breed fissionable ^{235}U from the commonly occurring isotope of thorium, ^{232}Th . If the thorium is kept mixed with nonfissionable ^{238}U , as it can be without degrading the operation of the reactor, the resulting nuclear material couldn't be used to make a bomb without very elaborate large-scale laboratory equipment. It has been estimated that if even 5 percent of the available thorium can be burned in reactors of the CANDU variety, we will have enough energy available to run our civilization at 15 times its present energy use for 30,000 years.

My own favorite energy source, not only for 2081 but for the last decade of this century, is the solar power satellite (SPS). A power satellite as a large array of solar cells or of turbogenerators, located in synchronous (24-hour) orbit above a fixed point on the equator. The satellite receives solar energy full-time, converts it to low density microwaves, and relays it to a ground station, where it is rectified to direct current with an efficiency of about 90 percent. Because of interruptions by nighttime and clouds, and lower illumination near sunrise and sunset, a solar cell at the earth's surface puts out power averaged over the year that is only one sixth as much as its output at noon on a clear day. By contrast, a solar cell in synchronous orbit receives sunlight constantly at an intensity that's about 30 percent higher than we ever experience on the ground, giving it an overall advantage of a factor of eight over a ground-based cell. The continuous sunlight of synchronous orbit makes storage unnecessary.

Energy will be more expensive in 2081, and its higher price will provide the pressure to develop more sophisticated technologies; so our descendants of 2081 will use energy much more efficiently than we do. They will also use a great deal more of it than we do, but they will feel no guilt in doing so, nor should they. As they study their history books and see photographs of the smog over our cities, they'll probably thank us as careless as we thank our ancestors of 1881, to whom the thick, black plume of soft-coal smoke above a factory chimney was a thing of great pride, a symbol of civilization's progress.

COMMUNICATIONS

In 1840, soon after the early experiments in electricity by Michael Faraday and Joseph Henry, the electric telegraph came into service as the first application of the new science. The telephone, introduced a few decades later, brought speed of light communications to ordinary people, not just to trained telegraphists in central offices. As of 1981, we're still in the telegraph stage as far as satellite communications are concerned. It takes big, expensive equipment to send and receive signals by way of the small, low-power satellites that now orbit at synchronous altitude. To gather enough signal strength from the weak transmissions of our present satellites, the receiving antenna must be at least several

feet in diameter. The ground transmitter is housed in a truck rather than carried in a pocket.

In time, as the market for communications continues to grow, it will be profitable for us to lift into orbit larger satellites with bigger antennas and more powerful transmitters. When that happens, the ground equipment can be reduced in size and cost, which will further expand the market. That process can't go on indefinitely though, because we'll run into fundamental limits to the flow of information: the speed of light and the bandwidth, the range of frequencies available. The bandwidth is roughly proportional to the frequency of the medium of communication; what engineers call the carrier frequency. You might think that the information flow in 2081 will be hampered entirely by satellite, but because of those fundamental limits, that won't be the case. Satellite communications will always be limited by the need to use radio frequencies that penetrate the

satellite systems; there would be bandwidth enough for at least a minute of communication per day for everyone. That limitation is sufficiently serious that much of the traffic, especially between people in built-up areas, is likely to go by a complicated route: from a person's own communicator to a relay station close by (most buildings will probably have them), then to a central switching point, and so on to a conduit to any other city on Earth.

Notice that I said a conduit rather than a wire or cable. There's a system already close to large-scale use that's almost sure to take over within the next decades. Light has a frequency about 10,000 times higher than that of the microwaves that can penetrate Earth's rainstorms. Modulated infrared-light beams can travel through glass fibers the size of a pencil lead; fibers so transparent that the light sent into one can travel more than 12 miles before it has to be amplified. Many thousands of such fibers, all independent, can be bundled together and every fiber in each bundle will be able every second to transmit the equivalent of 200 books, letter by letter.

Since most of our phone calls are to people who are close by, it makes no sense to saturate the limited bandwidth of a satellite system. By 2081 everyone will have the Dick Tracy wire radio. Its signal will go only to the nearest relay point, no farther than walking distance.

The limit on natural conversation that's imposed by the speed of light will strongly affect those many humans who will be living in space by 2081. They'll choose to reside within easy communications distance of coworkers and close friends. Colonies can be located in all three dimensions within a volume of space. And in a vacuum, laser beams can travel thousands of miles with little attenuation. It would be quite possible in 2081 for a group of space colonies with a population of several billion people to communicate with one another much more extensively and more quickly than could two cities far apart on Earth.

With all the clues that we've gathered, these are the technologies that will shape the century just ahead of us. Their combination in various ways will shape our lives profoundly; they will all still be of vital importance a full century from now, and all of them have much more than 100 years to go before they reach any limits.

Reading history and appreciating the power of these drivers of change, I am compelled to conclude that technological change will continue and that we should take advantage of the possibilities it will open for finding new solutions to previously insoluble problems. The future is even more exciting than the past; we should meet it with courage and a spirit of adventure. **□**

By 2081, central computers will have access to 100 trillion words. Such machines will be the size of a suitcase, and able to read, digest, and present conclusions to 100,000 books a second.

rainstorms of Earth's atmosphere. The highest frequency that can penetrate, corresponding to a wavelength no longer than your thumb nail, is more than 15 billion cycles per second. That seems high, but it's not high enough to provide satellite channels for all the messages of great complexity that will be flowing back and forth between the computers of 2081.

There are already more than 100 communications satellites in orbit, and by 2081 there will surely be several thousand. As the frequency bands become saturated with the transfer of information up and down to the satellites, there will be no recourse but to add more channels in parallel. That can be done only by building satellites with much larger antennas, defining narrow, separated footprints of beam coverage on the earth. The smallest satellite antennas will serve large areas that have low population density and require only a few communications channels, whereas the largest antennas, about a mile in diameter, will define a beam-footprint on Earth so small that you could walk across it in ten minutes.

If everyone then on Earth were to be into

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MNEMONIC

CONTINUED FROM PAGE 52

The Killing Floor she called it. Scrambling after her my new Eddie Bax shoes slipping on worn metal and damp plywood. I wondered how it could be any more lethal than the rest of the territory. At the same time I sensed that Dog's protests were ritual and that she already expected to get whatever it was she wanted.

Somewhere beneath us Jones would be circling his tanks, feeling the first twinges of junk sickness. The police would be boring the Dome regulars with questions about Rala. What did he do? Who was he with before he stepped outside? And the Yakuza would be selling its ghostly bulk over the city's data banks, probing for faint images of me reflected in numbered accounts securities transactions bits for utilities. We're an information economy. They teach you that in school. What they don't tell you is that it's impossible to move, to live, to operate at any level without leaving traces, bits seemingly meaningless fragments that can be retrieved, amplified.

But by now the prate would have shuffled our message into line for blackbox transmission to the Yakuza console. A simple message. Call off the dogs or we will bend your program.

The program. I had no idea what it con-

tained. I still don't. I only sang the song with zero comprehension. It was probably research data, the Yakuza being given to advanced forms of industrial espionage. A genteel business stealing from Ono-Senda as a matter of course and politely holding their data for ransom, threatening to blunt the conglomerate's research edge by making the product public.

But why couldn't any number play? Wouldn't they be happier with something to sell back to Ono-Senda, happier than they'd be with one dead Johnny from Memory Lane?

Their program was on its way to an address in Sydney to a place that held letters for clients and didn't ask questions once you'd paid a small taster. Fourth-class surface mail. I'd erased most of the other copy and recorded our message in the routing gap, leaving just enough of the program to identify it as the real thing.

My wrist hurt. I wanted to stop to lie down to sleep. I knew that I'd lose my grip and fall soon. knew that the sharp black shoes I'd bought for my evening as Fiddle Black would lose their purchase and carry me down to Nighttown. But he rose in my mind like a cheap religious hologram glowing the enlarged chip on his Hawaiian shirt looming like a reconnaissance shot of some doomed urban nucleus.

So I blowed Dog and Moly through Lo tek heaven, jury rigged and jury-buit from scraps that even Nighttown didn't want.

The Killing Floor was eight meters on a side. A giant had threaded steel cable back and forth through a junkyard and drawn it all taut. It creaked when it moved and it moved constantly swaying and bucking as the gathering Lo Tek arranged themselves on the shell of plywood surrounding it. The wood was silver with age, polished with long use and deeply etched with moths, threats, declarations of passion. This was suspended from a separate set of cables, which lost themselves in darkness beyond the raw white glare of the two ancient floods suspended above the floor.

A girl with teeth like Dog's hit the Floor on all fours. Her breasts were tattooed with indigo spirals. Then she was across the Floor, laughing, grapping with a boy who was drinking dark liquid from a liter flask.

Lo tek batten ran to scars and hitbos. And teeth. The electricity they were taping to light the Killing Floor seemed to be an exception to their overall esthetic: made in the name of ritual sport art? I don't know but I could see that the Floor was something special. It had the look of having been assembled over generations.

I held the useless shotgun under my jacket. Its hardness and heft were comforting, even though I had no more shells. And it came to me that I had no idea at all of what was really happening or of what was supposed to happen. And that was the nature of my game, because I'd spent most of my life as a blind receptacle to be filled with other people's knowledge and then drained, spouting synthetic languages I'd never understood. A very technical boy Sue.

And then I noticed just how quiet the Lo Tek's had become.

He was there at the edge of the light taking in the Killing Floor and the gallery of silent Lo Tek's with a board's calm. And as our eyes met for the first time with mutual recognition a memory clicked into place for me of Pans and the long Mercedes electrica gliding through the rain to Noble Dame, mobile greenhouses, Japanese faces behind the glass, and a hundred Nikons rising in blind photogram, flowers of steel and crystal. Behind his eyes, as they found me, those same shutters whirring.

I looked for Moly Milans, but she was gone.

The Lo Tek's parted to let him step up onto the bench. He bowed, smiling and stepped smoothly out of his sandals, leaving them side by side perfectly aligned, and then he stepped down onto the Killing Floor. He came for me across that shifting vampirine of scrap, as easily as any tourist padding across synthetic pile in any featureless hotel.

Moly hit the Floor moving.
The Floor screamed.

It was madd and amplified, with pickups riding the four fat coil springs at the corners and contact mikes taped at random to rusting machine fragments. Somewhere the Lo Tek's had an amp and a synthesizer, and



now I made out the shapes of speakers overhead, above the cruel white floods.

A drumbeat began electronic, like an amplified heart, steady as a metronome.

She'd removed her leather jacket and boots; her T-shirt was sleeveless, faint bellfollies of Chile City circuity traced along her thin arms. Her leather jeans gleamed under the floods. She began to dance.

She flexed her knees, white feet tensed on a flattened gas tank and the Killing Floor began to heave in response. The sound it made was like a world ending, like the wires that hold heaven snapping and coiling across the sky.

He rode with it for a few heartbeats, and then he moved, judging the movement of the Floor perfectly like a man stepping from one flat stone to another in an ornamental garden.

He pulled the lip from his thumb with the grace of a man at ease with social gesture and flung it at her. Under the floods, the filament was a refracting thread of rainbow. She threw herself flat and rolled, jacking up on the molecule whipped past, steel claws snapping into the light in what must have been an automatic reflex of defense.

The drum pulse quickened and she bounced with it; her dark hair wild around the blank silver lenses her mouth thin lips taut with concentration. The Killing Floor boomed and roared, and the Lo Tek's were screaming their excitement.

He retracted the filament to a whirling mile-wide circle of ghostly polychrome and spun it in front of him, thumbless hand held level with his sternum. A shield.

And Molly seemed to let something go, something inside, and that was the real start of her mad-dog dance. She jumped, twisting, lunging sideways, landing with both feet on an alloy engine block wired directly to one of the coil springs. I cupped my hands over my ears and knelt in a vent of sound, thinking Floor and benches were on their way down, down to Nighttown, and I saw us teeing through the shambles, the wet wash, exploding on the sies like rotten fruit. But the cables held, and the Killing Floor rose and fell like a crazy metal sea. And Molly danced on it.

And at the end, just before he made his final cast with the filament, I saw something in his face, an expression that didn't seem to belong there. It wasn't fear and it wasn't anger. I think it was disbelief, stunned incomprehension mingled with pure aesthetic revulsion at what he was seeing, hearing — at what was happening to him. He retracted the whirling filament, the ghost disc shrinking to the size of a dinner plate as he whipped his arm above his head and brought it down, the thumbtip curving out for Molly like a live thing.

The Floor came her down, the molecule passing just above her head, the Floor whiplashed, lifting him into the path of the fast molecule. It should have passed harmlessly over his head and been withdrawn into its diamond hard socket. It took his hand off just behind the wrist. There was

a gap in the Floor in front of him, and he went through it like a diver, with a strange deliberate grace, a detached wankage on his way down to Nighttown. Partly I think he took that dive to buy himself a few seconds of the dignity of silence. She'd killed him with culture shock.

The Lo Tek's roared, but someone shut the amplifier off, and Molly rode the Killing Floor into silence, hanging on now her face white and blank, until the pitching slowed and there was only a faint prying of tortured metal and the grating of rust on rust.

We searched the Floor for the severed hand, but we never found it. All we found was a graceful curve in one piece of rusted steel where the molecule went through. Its edge was bright as now chrome.

We never learned whether the Tek's had accepted our terms, or even whether they got our message. As far as I know their program is still waiting for Eddie Box on a shelf in the back room of a gift shop on the third level of Sydney Central-5. Probably they sold the original back to Oro-Senda months ago. But maybe they did get the pirate's broadcast, because nobody's come looking for me yet, and it's been nearly a year. If they do come, they'll have a long climb up through the dark, past Dog's sentries, and I don't look much like Eddie Box these days. I let Molly take care of that with a local anesthetic. And my new teeth have almost grown in.

I decided to stay up here. When I looked out across the Killing Floor before he came, I saw how hollow I was. And I knew I was sick of being a bucket. So now I climb down and visit Jones almost every night.

We're partners now, Jones and I, and Molly Milona, too. Molly handles our business in the Dome. Jones is still in Runland, but he has a bigger tank, with fresh seawater trucked in once a week. And he has his junk, when he needs it. He still talks to the kids with his frame of lights, but he talks to me on a new display unit in a shell that I rent there, a better unit than the one he used in the Navy.

And we're all making good money, better money than I made before, because Jones's Squid can read the traces of anything that anyone ever stored in me, and he gives it to me on the display unit in languages I can understand. So we're learning a lot about all my former clients. And one day I'll have a surgeon dig all the silicon out of my amygdalae, and I'll live with my own memories and nobody else's, the way other people do. But not for a while.

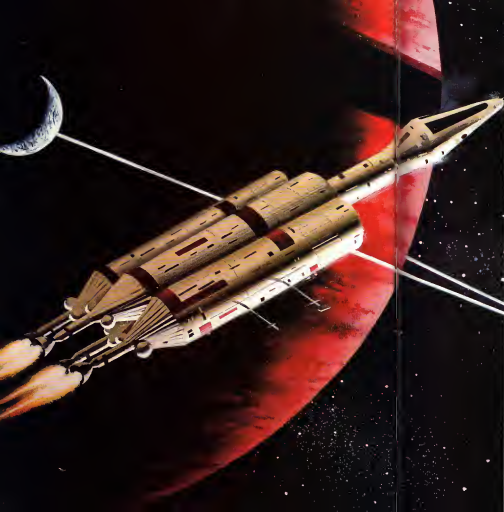
In the meantime it's really okay up here, way up in the dark, smoking a Chinese literpip and listening to the condensation that drips from the geodesics. Real quiet up here — unless a pair of Lo Tek's decide to dance on the Killing Floor.

It's educational, too. With Jones to help me figure things out. I'm getting to be the most technical boy in town. ☐

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STELLAR TECHNICIAN

BY ELLEN DATLOW



Dark,
moody, and powerful, the paintings
of Vincent Di Fate
depict mechanical marvels
and far frontiers
of a future technocracy
built on
complicated machinery
and human
resourcefulness.

Art brings the concept of intelligent machines to life



"I have a Victorian belief in the mystical powers of the machine," says Di Fate, who at thirty-six is something of a grand old man in the highly specialized field of technological space art. Striking images of far-flung environments have been his trademark for more than a decade, in his Weppingers Falls, New York, studio. Di Fate paints scenes of bewildering book-jacket covers and magazine illustrations.

Preceding pages: tanker ship (left), man in power suit with solar rifle. At right: mother ship designed for planetary colonization above clockwise from top: space station, remote environment and Ringworld (detail)





◀ To survive, humankind must embrace technology ▶



With bold strokes and somber colors, Di Fate accents the powerful tools that will enable humankind to assert its citizenship in the universe. Our thrust outward toward the hostile environment of space makes us increasingly dependent on technology. Even so, Di Fate maintains, it is man who must bear the responsibility for his actions, not his science or his machines.

DC

At left: the Alien Educator, a computerized library above the SkyStation Cytherea. These paintings appear in *Di Fate's Curiosity of Science Fiction Hardware*, by Vincent Di Fate and Ian Summers, published by Workman Publishing Company, 1980.



A relative of the lowly clam, the octopus developed a large brain and intelligence

ALIEN IN OUR SEAS

BY ROBERT L. FORWARD

We share this planet with a form of intelligence so foreign, so completely lacking in mammalian attributes, that it might have been from the pages of best science fiction. Yet this highly intelligent creature lives and thinks foreign thoughts as it watches us foot past its hidden lair: the alien in our seas—the octopus.

We know we are intelligent. We have decided that some of our mammalian cousins should also be included among the ranks of those worthy of an I.Q. But intelligence is not limited to the vertebrate clan alone. An unlikely branch of the animal kingdom—the mollusks—contains some very bright species. Starting as a lowly clam, the octopus shed its protective shell and ventured out into an evolutionary gauntlet that whipped it into a highly intelligent shape. Like its mollusk relative the squid, the octopus has amazing eyes, sophisticated manipulators, and a large brain.

The evolution of intelligence in mollusks happened independent of the rise of the vertebrate brain. The mollusks and vertebrates parted ways when our common ancestor was just a tiny clump of cells formed into a tubular gut, not unlike the near-microscopic hydra. The common heritage is so remote in our past that we might as well have evolved on different planets. The brains

mollusks with their alien logic, may have much to teach us about intelligent life elsewhere in the universe.

The two separate developments of intelligence on Earth produced many similar characteristics: flexible limbs, a central and brain, eyes with lenses. There are, however, some interesting differences. We have four articulated limbs, octopuses have eight flexible ones. Our brain, like that of every vertebrate, is a two-lobed mass of nerve cells perched above the mouth; but the brain of an octopus is a five-lobed ring of nerve cells around the esophagus, behind the mouth. The circulatory system of an octopus has three pumps pushing a green copper compound. Our two-lobed pump pushes a red iron compound. These deformed caricatures of human features only make the octopus seem even more alien, though we have shared the planet since prehistoric times.

To some, the octopus is a devil fish or sailor-killing monster. Yet it has a "rightness" when seen in its own environment. Tiptoeing across the sands on curled legs, gliding across rock-strewn seabeds its undulating flesh automatically follows the grooves and ridges of the ocean floor. But when propelling itself at high speed through the open water, the flexible body reconfigures into a smoothly curved, ideally hydrodynamic shape.

The octopus gave up the security of a hard protective shell for the independence of motion, turning instead of hiding. In the process it developed a brain that far outstrips those of the immobile oysters and clams. The soft, unprotected flesh of the octopus is all too vulnerable, especially in an ocean inhabited by voracious toothed sharks. However, to eat an octopus, you must first catch it, and there is no better expert in camouflage and escape. It can change its shape, its form, its surface texture, even its color, to elude the notice of predators and divers. When all else fails, it can squeeze its amorphous body into the tightest hiding place. An untrained swimmer can pass a dozen octopuses without knowing they are there. It takes an experienced eye to distinguish them from the rocks and kelp and branches of coral.

The remarkable camouflage of the octopus is largely due to two types of color cells, called chromatophores. The darker ones produce browns and reds, the lighter produce oranges and yellows. At birth, an octopus has only 70 color cells. The cells do not grow as the animal does. Instead they become more abundant until there are more than 100 color cells per square millimeter of skin. An adult has several million such cells, all controlled by the nervous system. Specialized muscles can tug each chromatophore, spreading it from a tiny disk out into a wide expanse of colored skin 15 to 20 times its original diameter. The octopus can also turn shades of blue and green when sulfated against a clear backdrop. Instead of pigments, these chromatophores contain reflective plates

of organic crystal. They act like tiny prisms, with their tilted angle determining their color. Similar effects are seen in hummingbird feathers and some jewelry.

When the octopus is moving, its color pattern flows in the direction opposite to its motion. Even when fleeing to safety, the octopus appears to be stationary—an optical illusion that has fooled more than one predator. The texture of the animal's skin is also controlled independently of color. Muscles working on small portions of skin can make it smooth or brittle, it up in an extreme case of gooseflesh that simulates a sandy surface.

The creature's astounding ability to mimic its surroundings indicates that the brain exerts a high level of control over bodily functions. Because octopuses have good vision, there is a real possibility that they may use the color patterns of their skin to communicate, not single words at a time, but whole pictures. If one picture is truly worth a thousand words, the octopus would

◆ *Intelligence is not limited to the vertebrate class. An unlikely branch of the animal kingdom—the mollusks—contains some very bright species.* ◆

be capable of conveying thousands of times faster than we can.

Deep-sea squid, being closely related to the octopus, may communicate similarly. Specialized cells on the skin generate their multicolored brilliance. Some of these light-emitting spots are as complex as eyes, containing irises and lenses. The light show can be modulated by the squid's brain according to its moods and reactions to stimuli. Flashing displays of color might well be a form of social interaction.

Octopus intelligence has not been extensively investigated, but a few experiments have found that even smaller members of the species are capable of rapid learning. One film shows the response of an octopus to a "monkey and banana" problem. A falbowl filled with water and containing a tasty lobster is sealed with a cork and placed near an octopus. The octopus spends a long time probing the container's smooth sides and rough top, then returns to its lair in indignant frustration. Finally it leaves its hole, unhesitatingly wraps three tentacles around the bowl, one about the cork and pulls. The cork shoots to the surface, and the octopus eats. In

similar experiments, other octopuses have ultimately solved the mysteries of a screw-on top. If a small octopus can demonstrate almost mammalian intelligence, what might a giant deep-sea squid achieve?

An octopus is every quick learner. In one experiment, the researchers lowered a black disk into a tank. The octopus touched it and was immediately rewarded with a piece of fish. Then a white disk was placed in the tank. This time the octopus received a mild electric shock and withdrew in indignation. When the black disk was again placed in the tank, the octopus came out, touched it without hesitation, and received its reward. But when the white disk was lowered into the tank a second time, the octopus looked at it, began to extend its tentacles, and then declined. The speed of learning in this situation again reveals an intelligence of a higher order.

One diver at a marine garden trained an octopus to put on a show for visitors peering through an underwater window. The diver would go to the house of rocks that the octopus had made for itself and lead the creature to the window, so the visitors could see it. The octopus quickly learned that the tours came every 20 minutes and soon was waiting patiently outside its home as the time for the tour approached. After a while, all the diver had to do was flick the octopus's arms, and it would swim over to the window by itself, let the people get a good look at it, and then go back to its house. The behavior is even more remarkable when you consider that the diver did reward the octopus with food. Perhaps the inquisitive animal was just as interested in seeing the new batch of tourists as they were in seeing it.

An octopus's reaction to a mirror also indicates superior logic. Most sea animals assume their reflection is a rival and attempt to drive it away, never learning not to waste their effort. An octopus, too, normally attacks intruders. Yet, after looking at its reflection for a long while, one particular octopus put out an arm until it touched the surface of the mirror. The arm then waved back and forth across the image as if trying to wipe away the reflection. After a few minutes of this, the octopus, obviously clearly disturbed, returned to its hole and refused to come out. The experience of meeting an offhanded copy of itself was too much to cope with that day.

Only a few mollusks, notably those with large brains, take time out to sleep. The octopus rests every day, staying immobile and slowing its breathing just as mammals do. The unconscious state is obviously hazardous, since predators can easily sneak up undetected. The fact that intelligent mollusks like vertebrates, have found it necessary to sleep gives us a clue to the nature of this strange behavior. Its main purpose may not be to rest the physical body. Rather, an organism with a high degree of neural activity may use sleep to reprogram its central computer, dumping the day's accumulated garbage and put-

CONTINUED ON PAGE 116



*He built this impossible box
and creates other baffling illusions
that twist our sense of reality*

MAGIC MAN

Magic begins when we ring his doorbell. A cascade of electronic beeps echoes from within. The house is large, dark, and gabled, and rests on a quiet corner lot in the small town of Albany, Oregon. The man inside is a magician, a magician, a second to wizard. The Great Blackstone called his close-up magic, "the best I have ever seen." Doc Vernon says that this man is "the most original magician in the world." And Martin Gardner calls him "the one man in the country who is most capable of fooling a professional magician." We are prepared to be amazed.

The door opens to another electronic riff, and there stands Jerry Andrus, six feet tall, with curly gray hair, a rugged face, a square jaw, and a welcoming smile. He looks much younger than his sixty-three years.

"Welcome to the Castle of Chaos," he announces. "Before we go in, there's something in the yard I want to show you. I built it just for your visit. Come on. The light should be just about right now."

We walk around the house to a large, open lawn, and there, perhaps 100 feet away, is a carpenter's

TEXT AND PHOTOGRAPH
BY SCOT MORRIS

nightmare. A box made of two-by-four boards hangs from a pulley suspended between two stepladders. And yet this box cannot exist. All of the two-by-fours are solid, straight and uncut, but the eye refuses to believe it. A board that is supposed to form the rear of the crate passes in front of a board that should be in the foreground, another board at the front passes behind those at the back. Andrus stands to one side, his hands separated to demonstrate that the box indeed has depth. ropes tied to the base of the box bend over the boards as if nothing were a-miss.

As it is impossible to see it, the illusion slowly dissolves. Sides of the box shift and no longer meet as they seemed to from 100 feet away. When we finally stand next to this structure, we realize it is a brilliant illusion with but one purpose to fool. I step inside the Escher-like contraption, and a camera records the moment of unreality.

Why does a grown man spend time constructing such an assault on the senses? "Well," says Andrus, a bit nonplussed by the question, "I figured out how to do it, and nobody else has ever done it, at least not without straight, uncut boards. I am interested in how the mind works. That's why I create illusions. That's why I do magic. Besides, when other magicians see the pictures of this box, it'll drive them crazy." Andrus loves to drive other magicians crazy. He is famous for it.

JUST A NICE LITTLE MIRACLE

Early in his career Jerry Andrus decided to perform only the illusions he himself had created. He purposely avoids reading magic books so that he will not be contaminated by learning the usual ways tricks are done. Using none of the traditional sleight-of-hand maneuvers, he invents new ways to control and conceal objects.

For example, Andrus scrupulously avoids the one central principle of most magic—misdirection, that is, getting the spectator to look at one place while the magician is doing something else. The effect of misdirection he feels is that you realize your attention has been drawn away at a critical moment. "You don't know how the trick was done, but you feel something happened when you weren't looking."

"I want people to waver their eyes on my hands," Andrus says. "If they look away even for an instant, the miracle is lost as far as I'm concerned, because in a layman's mind the hand is still quicker than the eye. Well, the hand definitely is not quicker than the eye, but if people see the magician out and shuffle the deck before revealing the chosen card, they will think, 'Oh, he just shuffled my card to the top so he'll couldn't see it.' I don't want my audience to even entertain the hypothesis that they were misdirected. That's not a miracle."

Pick a card, any card, and write your initials on it. Then place it in the center of the deck held by Andrus, and push it flush. Don't take your eyes off his hands. There is

no cut, no shuffle, no fast moves that you can blame for your apparent inattentiveness. You know you haven't been distracted, so when you reach out for the top card and find not only that it is the one you wanted, but that somehow before your eyes, the rest of the deck has disappeared, you've witnessed an Andrus miracle.

"Nobody else invents magic tricks the way Andrus does," says Ray Hyman, University of Oregon psychology professor. Hyman is an accomplished magician in his own right—he worked his way through college reading minds and telling fortunes—and he is a recognized authority on illusion and the psychology of perception. "Other magicians," Hyman says, "usually start by learning a move, then they decide how to turn it into an effect. Jerry starts by saying, 'Wouldn't it be a nice little miracle if I suddenly reached through a hole in a piece of cardboard and whatever was in my hand disappeared.' At this point he may have no idea how he's going to perform it, just what

Why does a grown man spend time constructing such assaults on the senses? "I'm interested in how the mind works," says Andrus. "That's why I create illusions. That's why I do magic."

it's going to look like. Then he sets out to find a way to do it."

FOOLING THE FOOLERS

Andrus has not always been a member of magic's inner circle. Hyman recalls the first time he met Andrus, at a Hartford, Connecticut, convention. "The best card magicians in the United States were there, Harry Lonyani among them, each one trying to impress the others. Then up steps Andrus, whom most of us had never seen, and he starts to do what looks like the standard card effect called the slip shuffle. Usually it's done with palter about a drunken magician who fools things up and mixes the cards clumsily face-up, face-down, face-up, face-down so that the deck is a bloody mess. Now these magicians know this trick, they do it. "You end up with two sets of cards stacked at different angles. You must first separate the face-up cards from the facedown cards, then turn half the deck over in a move magicians call a pass."

"So they're all sitting there, watching this trick from the country and wondering how he's going to do his pass. They're going to

catch him at it and show him up. It came time for Jerry to do his pass, and, as far as anyone could see, including myself, nothing happened. No pass, no misdirection, not a single move. He calmly put the cards on the table and spread them out—and there it is: facing the same way. Big bush. Thirty-some of the top card men in the country and they're absolutely worthless."

Miloussa Christopher, past national president of the Society of American Magicians, said, "Jerry Andrus lived in a small town where he didn't have contact with major magicians and didn't know the traditional way effects are worked. He had to make up his own way of doing tricks. Consequently when he performed, he astonished everyone, including the experts."

SIMILAR TO LSD

Andrus's fascination with the world of illusion is not confined to stage performances. He has also invented or improved upon several optical illusions that are now being studied in psychology laboratories—illusions that may provide clues to the workings of the mind.

One of his most astounding creations is his hypnosis- or 3D-zonal Space Warper (patent pending), reproduced on page 113. Cut out the disc and carefully poke a small hole in its center. Spin the disc on a turntable at 33 1/3 rpm and gaze at its center. You'll get an immediate 3-D experience that is striking in itself. After about 30 seconds look at a picture containing clouds (the Phenomena photo on page 134, for example). The clouds will seem to bubble and boil, almost as if they were in a time-space movie. Look at the back of your hand. The skin crawls and ripples. The effect, lasting just a few seconds, has been described as quite similar to those seen under the influence of LSD or other mind-altering drugs.

This is a motion-aftereffect illusion, something like the well-known waterfall and train illusions. If you stare at a waterfall for a minute or so and then look away, everything seems to be moving upward. Similarly the spiral illusion has an aftereffect of motion spiraling the other way. Andrus took the spiral-aftereffect illusion, which is already quite potent, and improved it immeasurably by adding outer spirals that turn in two directions simultaneously. There is still no clear explanation of how the illusion works. The traditional theory takes on paired receptors in the retina, each pair responsible for seeing the opposite end of a continuum. When you wear yellow sunglasses for several minutes and then remove them, for a moment everything looks blue. The theory is that the retina contains paired yellow-blue receptors. When the glasses are on, the yellow receptors are "fatigued" but the blue receptors are not.

Devised? Jerry Andrus peeps up his "paradox box" as author Scott Morris names between the third and fourth elevations. 3D-zonal Space Warper at right, in an illusory hallway that will be cut out and viewed on your record turntable spinning at 33 1/3 rpm. For full directions, see text.

When you remove the glasses, the blue receptors now overpower the weakened yellow receptors, and for a time the world takes on a bluish cast.

Is that what is happening with Andrus's spiral illusion? "Something similar must be operating," says Hyman, "but that can't be the whole story. For one thing, we really can't focus our eyes that well—they move rapidly even when we are trying to concentrate on the center of the disc. Also, there is some transfer from eye to eye: You can watch the disc with one eye and look at the clouds with the other and still get a slight effect. So the explanation can't be totally in the retina; it must go deeper into the brain. Exactly how it works, no one knows."

Andrus has also worked on other optical

illusions that still mystify psychologists. He has made improvements on the Mach-Eden illusion, which causes reversals in three-dimensional contours—making a corner that is concave and pointed away from you appear to be convex and pointed toward you, for example. He has also worked with Benham's disc, a black-and-white disc that, when spun, gives the illusion of rainbow colors. There is still no agreed-upon explanation of how it works.

WHERE BALLS ROLL UPHILL

A famous attraction in Andrus's home state is the Oregon Vortex. Some believe it is a true natural anomaly; others call it an illusion. It is a place where, we have been told, the laws of physics are on vaca-

tion—people lean in odd directions and change sizes before your eyes, and gravity doesn't seem to work right. There are other similar "mystery spots" to be seen (most notably in British Columbia in Santa Cruz, California, and also in Florida, Michigan, Ohio, and several other states), but the Oregon Vortex is the oldest of the lot and the one most often claimed to be an authentic scientific curiosity.

My wife and I wanted to visit this mysterious place, and we could have had no better trends along than Andrus and Hyman.

As we drove up the winding mountain road near Gold Hill, Oregon, past the billboards shouting, "See the Oregon Vortex," Hyman said: "The producers of the TV show *That's Incredible!* called me a few



months ago to ask about the Vortex. They said they were planning to come out here and they wanted to film me here talking about it. I told them about the perceptual principles operating here and basically warned them to be careful what they reported. They never called back.

We entered the grounds and joined a tour through the House of Mystery, a dilapidated wood-frame shack that apparently slid down the side of a hill some decades ago. Its walls are all slanted grotesquely, its floor and ceiling tilted at about a 30-degree angle. The house, the guide said, was in a spherical vortex measuring 156 feet 4.5 inches in diameter which was an "antigravitational electromagnetic field." Inside the field, he said, "gravity is three feet per second per second less dense [sic] than outside it." The result, the guide said, is that people not only tend to lean toward the center of the vortex but also get inexplicably taller when they stand near it. Physicists, he said, had studied every inch of the place with compasses and surveying instruments but were unable to explain its baffling mysteries. The crew from *What's Incredible!*, he said, had spent a whole day filming there recently and they planned a major feature on it. Hyman winked.

Standing in the House of Mystery is indeed unsettling. A ball seems to roll uphill. A heavy weight hanging on a chain is easier to push downhill, in the direction of the "vortex," than it is to push the other way. On a plank outside the house a man standing at the downhill side seems to be taller than he is at the uphill side. Curious.

When we left the guided tour and got out our measuring tape, levels, and cameras, however, things became less curious. It is almost impossible for anyone to judge accurately where a horizontal plane is when one is standing on the side of a hill. If you try to estimate the horizontal while facing uphill, your judgment will usually be too high, while facing downhill, too low. We had to triangulate to find the spot to place our cameras exactly equidistant from the two ends of the plank. It was not where we would have placed it had we trusted our senses. Andrus, standing at the left side of the plank, looked only a little taller than Hyman at the right side. They switched places, and Andrus looked much taller. Measuring their images on my photographs showed that their sizes had not changed. Wheel!

Our other tests were equally disillusioning. A carpenter's level showed that the ball rolling "uphill" was, of course, really rolling down. The weight on the chain required the same force to push it in either direction. No miracles.

"It is a very convincing optical illusion, but that's all it is," said Andrus. "I wouldn't mind if they called this a fun house, like at the carnival. There's no harm in it and I'd say it's worth the two-fifty admission to see all the interesting illusions. But they're advertising this as an incredible scientific phenomenon that has never been ex-

plained. They say that the reason people are shorter at one end of the plank is that light is warped and that there is a change of mass. That's nonsense."

As we were leaving, Hyman said, "The last time I was here I wrote down the names of the scientific papers said to have been written about the place—the physicists and the universities. I called those universities and they have no record of any scientists by those names or any such papers. The scientific evidence seems to have disappeared. That's just how powerful this Vortex is!"

Our experience here points out a dilemma at the heart of Andrus's profession. When is deception an integral, essential part of the magician's trade, as entertainment, and when is it carried too far as fraud? So far the major magic fraternities, the Society of American Magicians and the International Brotherhood of Magicians, have avoided making a distinction, but Andrus is trying to draft a resolution they will

● *The Oregon Vortex is a very convincing optical illusion, but that's all it is. They are calling it an unexplained scientific phenomenon due to a warping of gravity. That is just simply nonsense.* ●

adopt. "When these mentalists put on their phony blindfolds," he says, "and pretend to answer people's intimate questions and give medical, financial or personal advice all by apparently miraculous means, they are harming people. They are worse than any Oregon Vortex owners. They are criminals, and a disgrace to my profession."

THE HONEST DECEIVER

When acquaintances talk about Jerry Andrus, the characteristics they mention most—after his originality and his inventiveness—is his extraordinary moral sense. Andrus's honesty in this day and age, can only be called eccentric. A few years back he quit a 33-year job as lineman for the power company because his Electrical Workers' Union was constantly trying to get more pay for less work. He thought that was dishonest, and so he resigned. When Andrus was visiting New York City we walked with him to a restaurant across town. We crossed streets only when the signs said walk, when they said don't walk, we walked on the curb, alone.

Andrus is compulsively honest in his magic, too. In one trick, after you have cho-

sen your card, Andrus takes a card from the deck and—under the table, places it inside the card box. Then he takes it right back out and replaces it in the deck. At the end of the trick he will open the box and pretend to take your card out of it. Why the unnecessary move? It's so he can honestly say while he's doing it, "I am now putting a card into the box," and say it convincingly without covering a lie.

The ultimate illustration of Andrus's honesty is a story told by Gar Vernon, magician-in-residence at Holywood's Magic Castle. It seems that a magician was saving a woman in half, using the old routine in which two women were used, one for the head and one for the feet. Then one of the women fell sick. So the magician hired a boy to hide in the box and stick his feet out at the appropriate moment. "Onstage," Vernon said, "he opened the box, saw that the halves, and being compulsively honest like Jerry Andrus, he said, 'Behold! On this side you see her head — and on this side you see his feet!'"

Andrus's moral sense colors the way he treats his audiences—he wants them to feel fooled, never foolish. He never makes himself out to be superior. "That's unusual, too," says Hyman. "Many magicians get a charge out of the feeling of being the one-upmanship. Jerry is always telling his audiences that the only reason he can fool them is that they are as intelligent as he is."

Andrus elaborates: "Children are notoriously hard to fool because they don't take many things for granted. To a child, cards might dissolve or be in two places at once. They don't know what can't be done. The smarter, more intelligent you are, the more easily you can be fooled because you have more to work with."

Hyman teaches classes in cognitive psychology at the University of Oregon, Andrus is a frequent guest lecturer there. "Jerry's philosophy of magic fits right in with contemporary theories about how the mind works. In fact, he has anticipated our current psychological thinking by about ten years," Hyman says. "Traditionally there was the assumption that when people are fooled, it is because there has been some breakdown in normal functioning, some deficiency or abnormality that needs correcting. We are coming around to the idea, which Jerry has held all along, that people are fooled precisely because their senses are working as they should. The mind has to cut corners and fill in blank spaces, if it didn't do that, it wouldn't be much of a mind. There is nothing in the world that we see that we don't contribute to by evaluating in the light of all our past experiences."

This notion that errors in perception are not the mind's shortcomings but in fact are evidence that the mind is working exactly as it should is right at the forefront of contemporary psychology. The mental processes that make up the great cognitive achievements that we are, are the same processes that make us vulnerable to Jerry's magic. The only way to be saved from

being fooled is at a price you wouldn't want to pay—it would be to cease to believe anyone, even yourself, not to make any conclusions at all, not to do anything."

The idea that the capacity to make mistakes is a sign of superior cognitive development is not just the latest fashion in psychological theory. Oliver Sacks, a computer specialist at the University of Massachusetts, has said, "My goal in life, as a scientist, is to create a program that is sufficiently intelligent that it can be fooled."

MAGIC IN THE CRYSTAL BALL

Historically magicians have been among the first to make use of a new technology before the technology becomes widely known. Electromagnets, mirrors, hydraulic lifts, electronic signaling devices, miniature radios (even one small enough to be embedded in a tooth), all were used by magicians and spiritualists to work their wonders before these devices became widely understood by the public.

But pure magic, the magic that looks like a real miracle, Andrus-style, is in a strange way antithetical to new technology. As society becomes more technologically sophisticated, we, as an audience, become more suspicious and harder to please. Any trick that hints of possible gadgetry becomes suspect. What will happen when we get a three-dimensional color hologram that you can't tell from the real thing? Andrus wonders. "If a magician produces a girl from a box, he'll have to prove each time that it's a real girl and not a hologram. In a few years if I give you a deck of cards and have you go over in the corner and I name them as you look at them, you'll just say, 'Oh, you've got one of those micro-transmitter vessels in the cards and a receiver on you. Once you know that a trick could be done with microprocessors or fiber optics or lasers, the trick becomes suspect, even if the technology isn't used.'"

Jerry Andrus's style may be the future of magic. There are no machines, no gimmicks, no fancy apparatus to make you suspicious. You bring him your own deck of cards, you sit close and watch carefully. You aren't diverted or confused, yet something happens that you know can't happen. That's pure magic: a nice little miracle. **CC**

The hypodisco invented by Jerry Andrus, (page 112) has a patent pending. For a patent, 12-inch-diameter disc, mounted on stiff paper and printed on both sides in mirror-image fonts, web instructions and materials for several interesting experiments, send \$3 to Jerry Andrus, 1638 East First Avenue, Albany, OR 97321.

We are interested in readers' hypotheses about the construction of the "impossible box" on pages 110-111. Make a drawing of what you think the box "actually" looks like as seen from above or from the side, and send it to Omni Games Editor Scott Marra. In a future issue we will report on readers' designs and show how Andrus's "paradox box" is actually built. —S.M.

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1987/112

ALIEN

CONTINUED FROM PAGE 102

ing the more memorable experiences into permanent storage.

The octopus has excellent vision. Its eyes are the equal of all the higher vertebrates, including man's. Though they developed separately, there is a remarkable degree of similarity between their eyes and ours. Both have iris, iris, crystalline lenses, and retina. When we travel to alien landscapes, the native eyes that meet our gaze may be startlingly familiar for it seems there is only one good way to build a camera out of protein and water. Nonetheless, evolution on Earth has taught us to expect variations in the final points of construction. An octopus pupil is a thick, black horizontal bar across the center of the yellow eye. Since there are fewer sensing cells in its retina than in a human eye, its vision is coarser than ours. Yet octopus eyes have incorporated one improvement over our own: The optic nerve in the human eye comes around the retina and attaches in front, causing the well-known blind spot. The optic nerve of an octopus connects to the back of the eye, where it cannot block the incoming light.

When an octopus is calm or resting, its eyes remain fixed, the black band of the pupil giving it an otherworldly appearance. As soon as prey or a diver comes into view, the eyes rise up like periscopes. They turn and look in different directions, alert and curious like those of a human. These are the eyes of an intelligent being, not the blank, round-eyed stare of a fish.

The arms of an octopus are much more versatile than the human arm and hand. An octopus eats a crab by making one crack in the shell between the tail and the abdomen (just where we start), then inserting its tentacles to pull out the meat. The lips can reach into the smallest portions of a lobster's legs and claws, and the pieces of meat are carried from sucker disk to sucker disk all the way back to the mouth at the juncture of the arms. When the lobster is empty of meat, the intact shell is then pushed outside the octopus's home to join the shells of previous meals.

The octopus's sense of touch is more highly developed than ours, which is based only on pressure. The octopus sees and smells with its skin, especially with the exceptionally sensitive skin covering its tentacles. With the touch of a tentacle tip, the shape, texture, smell, and chemical composition of an object all become immediately apparent.

As far as we know, the octopus does not talk. Although some squids have been recorded on tape, the octopus seems mute. It makes up for this by expressing its moods through remarkable metamorphoses. Even human divers can tell when an octopus is afraid or angry by its color shifts and changes in shape. Since an octopus does not produce sound, some scientists

believe that it also cannot hear. This would make it unusual for an animal in the sea, where sound is often a replacement for sight. However, there is evidence that an octopus can hear the approach of a friendly ship. One known to Jacques Cousteau was always outside its home waiting for the Calypso, whose camera crew paid well in lobster and crab.

Once an octopus gets to know a person and has overcome its natural fear, it likes to be petted. Any handling, however, has to be done gently. The large ones are especially fragile. Their very sensitive nervous systems are all too easily damaged. Some octopuses have gone into shock and died from rough handling, even though they were not lethally hurt.

Although the highly evolved octopus brain will continue to develop, alien intelligence on this planet may be stuck in a genetic dead end. The body of an octopus is very flexible and boneless, which is fine for the seas, but this limits its mobility on land, where strong structures are needed to support body weight. And an octopus has gills instead of lungs. That may not be an insoluble problem; however, octopuses can survive out of water for a number of hours if they are kept wet.

The octopus's nerve fibers present a more serious limitation. They don't have the insulating layers of a myelin sheath around them. In vertebrates, the myelin sheath keeps the electrical signals channeled along the nerve and provides a fast reaction time with a small-diameter nerve. To get the same speed, the octopus must grow a nerve with a very large diameter big enough to be seen with the naked eye.

Another fundamental limitation of the octopus is the nature of its blood. In the octopus, its copper-based captures the oxygen from the air and transports it to the cells. Copper limits the total oxygen-transporting capacity of the green blood to about 4 percent, the red blood of humans, whales, and fish is three to five times more efficient.

For a spiritless creature, the octopus has been remarkably daring. After descending its shell for a life on the high seas, it became predator—not prey. It walks, swims, and jets above the ocean bottom like an underwater Superman. Its intelligence is demonstrably worth attention, and one wonders whether our present low opinion of this exotic mollusk is based more on our limited understanding than on its inherent ability.

We have found it difficult to communicate with our genetic cousins the ape and the dolphin, even though we know they have intelligence. Could it be that octopuses are so foreign to alien, that we are not intelligent enough to evaluate them? When we start to visit new worlds under alien suns, will we be able to recognize an intelligent life form when we meet one? Our long acquaintance with our distant relative on Earth may help, for it is hard to imagine a being more strange than the alien in our seas. The octopus **OO**

CONSCIENCE

CONTINUED FROM PAGE 105

be considered dead. This model piece of reasoning was later used in its entirety by the Michigan State Legislature and served as the basis for legally determining who is dead in more than 20 other states. The "impractical" theorizing of the ethicists had enormous practical impact.

In another case the center helped stop Massachusetts from enacting a law requiring sickle cell screening for schoolchildren. A black geneticist asked the center to study the problem. Hastings concluded that early screening could stigmatize a person as a disease carrier and cost him or her money later in life as a high-risk insurance customer. When the report was published, talk of screening for sickle cell faded away.

Hastings has other ongoing projects that keep its members busy: studies on the use and abuse of drugs in behavior control, the impact of labeling homosexuality a psychiatric disorder, a massive effort to introduce more ethics courses into colleges and universities, and more recently the quest to sort out just how safe or risky is nuclear power.

Their evident willingness to rush where politicians and scientists fear to lead has made both the Hastings Center and the Kennedy Institute highly visible forces in scientific decision making. With power behind them, Callahan and his fellow ethicists no longer see the old gazed look when they open their mouths. Their opinions are suddenly valuable and sought after. Congress calls them. Medical societies bring them around to make speeches. Religious leaders bring their problems to them. Charles McKay, deputy director of NIH's Research Risk Office, has worked with Kennedy and Hastings. He swears about them: "The quality of their advice is not only excellent, it has been persuasive and influential in shaping policy."

Not all scientists agree. The Spanish Inquisition was effective, too, snips a psychologist who sees ethicists as one more unneeded layer in a swollen research bureaucracy. Others are more cautious in their views, but no less worried about the negative effects of too much ethics. "If you simply take the judgment of people who earn their living by worrying, you'll find they can do lots of harm as well as good," suggests Dr. Ethel De Solé Pool.

Dr. Pool, a political scientist at MIT, is leading a movement to block the application of ethical oversight on the social sciences. Most ethicists see this as long overdue. But Pool and many other social scientists see the ethicists' involvement in setting guidelines for their research as one more nail in the coffin of scientific freedom.

"There just aren't the same kinds of serious risks in social science research as there are in medical research," Pool ar-

gues. The social scientist does not need the same kind of sleep monitoring. The only effect of this officious retooling? Pool says is to "build an enormous bureaucracy to worry about nothing. The real ethical problems that face social scientists today are not risks to subjects, but problems of confidentiality, keeping the identity of subjects and their information secret."

Callahan was hardly surprised by this reaction. "Social scientists are still fighting," he says. "They are where physicians were ten years ago." Evidence of how deep the feeling runs turned up in a survey that Harvard social psychologist Donald Warwick did for the Hastings Center. Most social scientists opposed having ethics taught in their departments. Many sociologists and anthropologists said it only served to give radical ideologues a soapbox from which to propound their crazy ideas. Psychologists weighed against ethics because it interfered with the pure scientific search for truth, and at best was just "a mess of conjectures."

Callahan has a standard reply to the ethics-is-so-much-hot-air argument. "I say Karl Marx and John Locke and all those other people just sat and wrote theoretical stuff and made no difference."

McCormick has a more pragmatic reply: one that is guaranteed to chill the heart of even the most hostile grant seeker. "I say if you don't take ethical matters seriously, then Ralph Nader and Teddy Kennedy are waiting out there. And then you're going to have [wicked pause] legislation."

On the other side are scientists who think ethics is an absolute necessity. One expert in the philosophy of science, Dr. Jerrold Ravetz, of the University of Leeds, England, declared in an address to a special conference on science and religion, held at MIT: "The biggest secret needing a cover-up is that science is not, and cannot be, self-sufficient in determining priorities and in distributing risks fairly."

While the public is concerned about scientific risks, its commitment to ethics is an open question. Walters got a sense of how quickly the public loses interest in yesterday's unprecedented and revolutionary advances. In June 1980 he spotted a cryptic wire-service story buried in his local paper. It reported that another test-tube baby, the fourth by that date, had been born in Australia. Period. Walters began looking through other newspapers for more information but couldn't find a mention of the story. Finally he called the Australian Embassy in Washington to find out whether the story was true. No one at the embassy knew anything about it, but they promised to check it out.

A short while later the officials called back and told Walters that a test-tube baby girl had been born in a Melbourne hospital. All during this time neither Walters nor McCormick's phone rang when once with someone wanting to know what it all meant.

No one seemed to care anymore. **CC**

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"It's not much, Lobbar but it's home"

dig up every bone of contention so that errors of superficial analysis could be avoided. Rules of protocol were suspended to encourage free discussion. The President left the room periodically to avoid exerting excessive influence on the group, especially during the preliminary discussions. And outside experts were brought in to provide fresh information and views, subgroups worked on policy independently and then presented their positions to the group as a whole.

And 18 months after the Bay of Pigs when faced with the Cuban missile crisis, virtually the same group that had once failed so miserably managed to avoid groupthink, find a creative solution to the impasse, and avert disaster.

Unfortunately the group process that the Kennedy Administration so painfully developed is not automatically inherited by succeeding administrations. The progression of failed programs shuffling out of the White House over the past decade proves that unhappy fact.

Time will tell whether the Reagan Administration will avoid the groupthink pit. Janis expects the effectiveness of the President's decision-making group will be determined after a few months. In any case he thinks groupthink is a problem that the new President and all future leaders will have to cope with. "It's the type of thing to look for whenever you see gross defects in decision making on the part of a group." At the same time, Janis cautions, elimination of groupthink won't guarantee error-free government. "I think the potential sources for error in governing are so enormous that it's not necessarily going to be groupthink behind all of them."

Rosen, after examining Reagan campaign positions, sees a serious risk of groupthink in the administration. "The position they presented was, 'We're through with this fuzzy-minded New Deal liberalism.' We want to make the country respectable. We want to get this country back, so that it's seen as a major power in the world," he observes. "And the Moral Majority's views. We want to be a good bit more moral than the rest of society."

"If that sort of attitude becomes an integral part of Reaganite thinking, you have the possibility for groupthink. It remains to be seen. I'm not sure how the Cabinet members will respond. Some gave impressions in the past of being independent thinkers. The more independent people you have, the less likely you'll be to have a groupthink situation."

So far the Reagan Administration team seems to be arguing healthily. That's good. As long as administration members resoundingly defend their independent positions, we'll have a fighting chance to see decisions based on true compromise and balance rather than on groupthink. **□**

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02/81

PEOPLE

By Dick Teresi

The name of the game is *Killer*, and over the past 15 years it has been one of the most popular pastimes on U.S. college campuses.

There are many variations of the game—which is alternately known as *The Hunt*, *Assassination Game*, *Seventh Victim*, and *Eradicator*—but essentially it involves dividing a group of students into assassins and victims. Assassins know everything about their victims, but victims know nothing about their stalkers, not even their identities. The actual "killing" has been done with dart guns or ping-pong ball guns and in a variety of more imaginative methods—one student dropped a pillow labeled 2,000-*ILL* SURE, on his target.

A common rule is that there may be no more than three witnesses to the kill, so victims try to stay in crowds or to keep themselves totally isolated. The tricks that assassins use to lure their victims into the proper killing environment are in part what make the game a creative experience. According to John William Johnson, an assistant professor of folklore at Indiana

University, assassins have posed as policemen or reporters to get close to their victims.

Last fall Johnson gave a talk entitled "The Assassination Game: Campus Folklore from a Literary Source" before the annual conference of the American Folklore Society. What interested us was that he was able to trace the game back to its origins. It struck very close to home.

He says the game showed up on campuses in 1965, the same year Carlo Ponti's feature film *The Seventh Victim* was released. The premise of the movie, starring Ursula Andress and Marcello Mastroianni, is that warfare has been eliminated from society. In its place is *The Hunt*, in which people play assassin and victim, for real. For those old enough to remember, this is the film made famous by Andress's shooting bra, with which she dispatches one of her victims.

Johnson traced the plot back further, however. He found that a similar program had been broadcast over Armed Forces Radio in Europe in 1957 and even before that on the NBC radio program *X Minus One* in the United States. But the original source was a short story called "The Seventh Victim," published in *Galaxy* magazine in April 1953. The author, our own fiction editor Robert Shekley. He says he feels no remorse for the thousands of fictional deaths he's caused.

Writer James Gunn continues his crusade to educate those teachers who would attempt to educate their students in the subject of science fiction. Gunn, an English professor at the University of Kansas and SF writer himself, will be offering his fifth annual intensive English Institute on the Teaching of Science Fiction, July 13–31, at the university. Gunn notes that more and more science fiction is being taught in schools, but teachers themselves are ill prepared to teach the genre. Participants must finish a reading list of 25 to 30 books before the course begins, which itself will consist of eight-hour to ten-hour days of discussions, lectures, and lecture films. Writing lectures this summer include writers



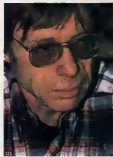
King Tut, his corpse in pajamas

Gordon H. Dickson, Theodore Sturgeon, and Fredrick Pohl. For more information, write to Professor James Gunn, English Department, University of Kansas, Lawrence, KS 66045.

The curse of King Tut's tomb is a fraud, a device to keep grave robbers away, says a man who claims to have slept in the tomb without suffering any ill effects. Richard Adamson, a security officer, said the story was invented by the very men who headed the team that found the burial chamber. Howard Carter and Lord Carnarvon, Adamson himself is the last surviving member of the now-legendary 1922 expedition.

According to *The Skeptical Inquirer* magazine, Adamson said, "We allowed the story of the curse to circulate because it helped with security at night."

If there was indeed a curse, it wasn't particularly effective. Or at least it didn't work on Adamson. "I had to sleep in the tomb at night for seven years," he explained, alongside the gold coffins and the mummy. ☐



Robert Shekley. Shooting bras: artist's remorse
100 OMM

SPACE

CONTINUED FROM PAGE 22

Human body eventually reaches homeostasis, a stable physiological balance with the space environment. But this condition may not be as desirable as it would sound if the skeletal, muscular, and cardiovascular systems become completely homeostatic; they could easily degenerate to a point where Soviet cosmonauts and American astronauts may not be able to return home safely. "Our Earthman," says Gaggenik, "should not become completely a spaceman."

As each Salyut mission generates a better understanding of space biology and space physiology, each crew returns from orbit in better condition than the one preceding. After the first 96-day mission, cosmonauts found it hard to lift a teacup or to turn a radio dial. The second crew fared better, even after 140 days in space; by keeping in shape with rigorous exercise and vacuum suits that forced their blood to circulate at Earth pressure.

But the two most recent long-duration flights lasting 175 and 185 days, respectively, suggest that Soviet space scientists are following the right track. Both cosmonaut crews were able to adapt quickly and work comfortably in the Salyut environment and return to Earth with no lingering problems. Within a few days of landing

down, they could stand and walk normally. Ryumin, who has accumulated almost a year of time in space, appears to have suffered no ill effects. His ability to adapt more easily during his second six-month space tour indicates that adaptation can be a learned response, like any other activity.

But as these pioneers go blazing trails back and forth between Earth and orbit, what will happen to succeeding generations of space colonists? Will children born and raised in space be able to return to Earth? Though our understanding of the matter is far from perfect, the data we have gleaned from Salyut spaceflights allow space physicians to speculate.

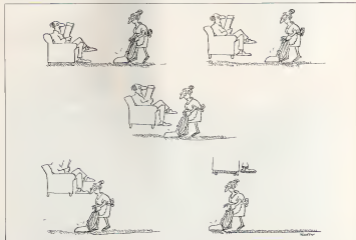
According to Mohler and his colleagues, these children probably won't be born into an environment resembling that on Earth. There is a good chance they will grow up in high background radiation and total or near weightlessness. The radiation of space can be diminished with substantial shielding, but it cannot be completely screened. There always will be secondary radiation from the shield itself.

As for weightlessness, Mohler says. There is a consensus among space physicians that it is doubtful space inhabitants would want to reintroduce anything as debilitating as gravity after adopting to life without it. Under these conditions, children will develop along radically different lines compared to their Earth ancestors. Radiation will increase the likelihood of muta-

tions, and some of these could be passed on to future generations. He suggests that Homo cosmos may eventually become a species distinct from Homo sapiens.

Even without radiation, the biological disparity will be enormous. Mohler predicts that children born in zero gravity will have elongated bodies and spindly limbs. Their skulls might have a different shape; their faces will be rounder. All their organs and bones will be smaller. Upon reaching adulthood, these individuals will have extremely fine muscle control and excellent coordination, but they will seem frail in comparison to the weakest Earthlings.

While the Russians are actively searching for a solution to facilitate cosmonauts in the readaptation process, NASA at present has no funding for permanently manned space stations. When NASA is financially able to build a space center, it can use the information already obtained by Salyut to bring back to Earth those human beings who have spent long periods in outer space and those people who were born out there. One proposal to help space-bred colonists who have to travel between Earth and its outposts is the halfway house, where people's adaptive reflexes will be stimulated and directed by methods we are just beginning to develop. But first funding must come from Congress to further the study on the ways Earthlings can return comfortably to their home planet. **DC**



pressure becomes so great that it finally snaps into a new position, causing a seismic tremor to radiate from that point.

This is what happened in 1906. If two geophysicists are correct in their calculations, it could happen in Peru and northern Chile this August. Based on a set of complex equations, Brian Brady of the U.S. Bureau of Mines and William Spence of the U.S. Geological Survey, are predicting that a major earthquake will occur in Peru on August 10 or 11. If they're right—and many geologists are skeptical about their findings—it would be the closest any scientist has come to predicting the exact place, time, and intensity of the tremor months before it occurs.

Before the advent of satellites, earthquake researchers did their work on the ground. They still do. One of the largest of these facilities is the Lamont-Doherty Geological Observatory in Palisades, New York, proving that the East Coast has its own faults. Inside the squat, corrugated steel seismology building, scientists are busy collecting and analyzing data from their meters in the field. Others are constructing mathematical models of seismic waves to discover things about the interior of the planet. You get an idea of the work involved from glancing at the various maps and charts on the hallway walls. One map, generously peppered with dots, shows where earthquakes have occurred. Another chart profiles the deep gashes in the ocean floor where new plate material is being formed.

In another part of the complex, seismographs record the vibrations of earthquakes on the East Coast as well as those happening elsewhere. Once an earthquake is recorded, scientists can determine everything from the exact time it struck and where it originated to the amount of energy released by the tremor, as measured on the Richter scale. Lamont-Doherty can pick up any 6 magnitude earthquake in the Western Hemisphere and any 7 or 8 magnitude earthquake in the world. The San Francisco earthquake had a magnitude of 6.3 on the Richter scale. That is enough energy to raise Mount Washington, in New Hampshire, more than a mile off the ground.

Interestingly, seismology got a big boost in the late 1960s from an unlikely source: the Nuclear Test Ban Treaty. One of the best ways to find out whether the other side is cheating is to place meters into the ground and "listen" for the seismic vibrations of a man-made earthquake caused by an explosion. Seismologists benefited from the many stations that were built around the world for that purpose. While you're watching out for one of the six or so minor quakes that occur daily, be sure to keep your eyes peeled for the next spikes a nuclear explosion produces on the graph. Call Dr. Alan Kafka before showing up. **DD**

NEXT OMNI



ART



ART

RENEGADE ROCKETEERS—The secret and twisted history of a private space transportation company called OTRAG is the subject for OTRAG: Transit and Rockets. *Affengetriebene Räder* leads you to the spy bureau. Here is a group of German ex-rocket technicians who seemed to offer the world an alternative to government-monopolized space programs. And yet, in its efforts to cooperate with NASA and the European Space Agency, OTRAG became entangled in political maneuvering, international propaganda campaigns, espionage, and outright war. Frustrated in its efforts to set up a launching site in Zaire, OTRAG has since cut a deal in Libya and is reported—conspiring with things being OTRAG distributor Jochen Oberg reveals the story behind this provocative book, explaining why the Communist press made up the story that OTRAG is really a front for Neo-Nazis.

THE ONCE AND FUTURE TING—Ornate may be the grander title of a physicist, but the king of today's subnuclear explorations is neither fancy-headed nor forgetful. Samuel C. C. Ting is crisp and knowledgeable. He handles the subtleties of big time science as easily as the intricacies of feeding, gluing, and quans. Ting revolutionized our view of matter's core. He discovered particles that shouldn't exist, but that may explain the basic forces holding the universe together. We like you. We're the head of a genus who exists with atoms in the Jungles' issue of *Omni*.

ART AS MAN—What people wear and how they decorate their bodies form an important part of social communication. Clothing establishes a persona, modifies it, and transforms it into statements of age, sex, and status. Adornment celebrates the delicate boundaries between group identity and the aspiration that we are individuals. Next month the power of nonverbal communication is explored in a new pictorial study of New Guinea tribesmen by Malcolm Kirk. "Decorated bodies and clay masks mirror the primal forces still evident in our own high-tech societies. You may even see some of yourself in this special feature for June.

RISE OF THE POTENT PROTEIN—Joan Kariwasa is among the chosen few. The British housewife is one of eight cancer patients who received the first dosage of genetically engineered interferon. This unique natural protein is hunting in the laboratory in the fight against disease. It has been touted as a cure, or at least a temporary treatment of choice, for life from leukemia to the common cold. Can interferon live up to its billing? *Omni* associate editor Mike Edsall examines where interferon research stands today and suggests how this substance will change our lives.

SCIENCE FICTION—A young girl is obsessed with space travel in Orson Scott Card's "A Republic of Songs." hopes of the future are the only best men and women in Russell M. Griffin's "Ample at the Gate" and a child living in a post-apocalyptic society unexpectedly encounters Frank L. Calloway's "Mr. Mouse."

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UFO

CONTINUED FROM PAGE 36

factory in Shanxi Province, spotted a luminous, round, ringlike mass in the sky. The object, which appeared to resemble a washbasin, was trailed by a vaporous exhaust as it was observed in flight west of the factory's transformer substation.

Six years later, on September 9, 1976, at about 6 PM, a group of employees from the Jintai Second Chemical Factory and a few residents of Yichun City in Jiangxi Province, observed a metallic, copper-colored object shaped like facing symbols that was spinning on its vertical axis. Eyewitnesses declared that the object was in full view.

The following year, Zhang Zhousheng, an employee of the Yunnan Astronomical Observatory, saw an unidentified flying object over Chengde, capital of Sichuan Province, in southwest China. Some people who lived within 160 kilometers of the sighting also witnessed the event.

One final account described a huge, rectangular UFO that appeared over an airport in Gansu Province at 8:40 PM, on October 23, 1978. Its altitude was estimated at between 6,000 and 8,000 meters, and it was estimated to be 1,000 meters in length.

This random sampling of UFOs is indicative of the types of reports that have been brought to the attention of the central authorities during peak periods of UFO activity. The observed phenomena can be divided into three groups: (1) 80 percent appear to be round, dish-shaped objects; (2) 10 percent are large and rectangular; (3) 10 percent appear as nebula-shaped bodies.

Although China strives to acquire a contemporary perspective on UFOs, reports date back to 1947, while much of the country was still under Nationalist influence. From then until the present, many people have witnessed UFOs. One such person is Chu Fook Tsang, editor of *World Book Monthly*, who, having allegedly witnessed a UFO, has since tendered his support for a program to study UFOs.

To gain a better understanding of these phenomena, China has afforded its people accessibility to information regarding UFOs. Educating the masses about this subject is an important objective of the Chinese government. Some recent steps in that direction were Chinese television's screening of an American made film, *UFOs Are Real*, and the publication of books and periodicals on UFOs.

One clear evidence that progress is being made toward this end is the establishment of the China UFO Research Organization, an official unit of the Chinese Academy of Social Sciences. With the granting of government approval for studying the UFO phenomenon, these members of the Chinese scientific community, in whose sphere of interest these studies lie, will no longer be victims to the clichéd out-mortality that permeates UFO research in the United States today. **DO**

I.Q. of 145 And Can't Remember?

A noted publisher reports there is a simple technique for acquiring a powerful memory which can pay you real dividends in both business and social advancement and works like magic to give you added power, necessary self-confidence and greater knowledge.

According to this publisher, many people do not realize how much they could influence others simply by remembering accurately everything they see, hear, or read. Whether in business, at social functions, or even casual conversations with new acquaintances, there are ways in which you can dominate each situation by your ability to remember.

To acquaint the reader of this magazine with the easy-to-follow rules for developing skill in remembering anything you choose to remember, the publishers have printed full details of their self-teaching method in a new booklet, "Advantage in Memory" which will be mailed free to anyone who requests it. No obligation. Send your name, address and zip code to: Memory Studies, Dept. 116-941, Division of Career Institute, 3900 Cardinal Drive, Little Falls, New Jersey 07424. A postcard will do.

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SCIENCE-FICTION TABLE OF ELEMENTS

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Russian chemist Dmitri Mendeleev devised the periodic table of the elements in 1869, as a means of classifying the chemical elements known to science. In this adaptation of the table, science-fiction fan Arlan Keith Andrews, Sr. uses the symbol for each element to represent the name of one of the most widely known science-fiction authors of all time.

Starting with H, the chemical symbol for hydrogen, and here as the science-fiction symbol for Robert A. Heinlein, the table features fantasy writers like L. Frank Baum, who wrote the Oz books (read under element 76—cerium, of course), and various Orson contributors such as Bradbury, Clarke, Asimov, Marvin, Card, and Silverberg and even two Orson editors. **OO**

MIND, ORDER, ENERGY.



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EARTH

CONTINUED FROM PAGE 18

and a mink whale's. Next to this is an apocalyptic-sounding invitation to a film called *Survival or Suicide*. And next to this is a glossy color portrait of Kermie the Frog.

Despite offering such course titles as *Whitehead and Whitewater* and *Plant and Human Algae*, the school has managed to avoid the superficiality that undermined other alternative academic institutions. The Bureau of Land Management thought enough of marine biologist Steven Katzner's course, *Whales of the North Atlantic*, to award him class a contract for the Mount Desert Island Whale Watch, supplying valuable data on the behavior of whales.

Last year the principal assignment in the 3-D course had students design and construct ten pieces of playground equipment for the public elementary schools on Mount Desert Island.

The college has already had an impact on the state's ecology. COA students were partly responsible for preserving from peat miners the Great Heath, an ecologically unique 5,720-acre sphagnum bog. COA also sponsors the Harbor Seal Project, which rescues abandoned or stranded seals in the area. And faculty member Ernie McMullen introduced the first solar technology into the state.

"We couldn't really come out and say it, but we came out here to save the world," Vice President Sam Eliot recalls with a shy smile. "Now we're basically concentrating on Maine."

When a mink whale washed up on a nearby island, students decided to use it for a mobile *Whale-on-Wheels* project to teach their fellow Mainers about mammalian biology. Other college outreach efforts have included a *Christa McAuliffe*-like *Pride of Maine*, which celebrated the traditions of the Acadia, Native American, and Yankee cultures. Students have used their senior projects and independent study for such far-flung pursuits as observing turtles in the Galapagos Islands and apprenticing with the Lobo Wolf Foundation.

Given such training, students seldom worry about their job prospects. If the deterioration of the environment keeps going the way it is now, says senior Gen Berkowitz, people will have to use COA graduates in five or six years.

So far the employment history of the college's 106 graduates has been promising. Jobs they have found include positions as a museum naturalist, a census worker for the Bureau of Land Management, a director of the Maine Audubon Society, and an alternative energy coordinator for Santa Clara County in California.

To be sure, the college needs a gymnasium and a student center. The food, strictly vegetarian for energy efficiency, could be better. But the College of the Atlantic is alive and well. That in itself is something to celebrate. ☐



SOME SERIOUS NOTES ON MOVING.

By Victor Borge

When you move, make sure your mail arrives at your new address right after you do.

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Notify everyone
a month before you move.**

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CASTING

CONTINUED FROM PAGE 32

put the results on the computer. Now if a producer needs an American Indian who can speak while breathing fire, all he has to do is call the guild.

In the last few years the computer file has been expanded to include nearly a third of all guild members. Such systematic recording of skills and talents, according to Haru, is one way to ensure that more jobs go to bona fide actors than to nonprofessionals. "If a producer needs a pianist for a lot part," she notes, "there's no need to go out on the street looking for one. There are actors who are pianists, too." There are actors who are a lot of things. Among other talents the survey takes into account are archery, bartending, bachel twirling, judo, lumbenacking, scuba riding, snake handling, ventriloquism and yodeling.

According to Jarumanis, the day may not be too far off when computers and video discs are working hand in hand. A computer terminal and a video disc player would all not to each other when the characteristics needed were punched into the computer, the sorting would be done on a video-disc file. Then as the written information appeared on the terminal screen, the player would show a video disc of the prospective actor including selected clips from filmed performances, screen tests, and so on. In that way the computer would take on a key casting function—perhaps even for principal roles. Though the computer wouldn't be making the final decision, it would narrow down all possible candidates to those most likely to succeed.

Superstars like Robert Redford won't benefit, says Jarumanis, "but those people who are on Broadway or in films waiting to be discovered can finally get an opportunity to be seen. It doesn't eliminate work—the computer actually enhances the possibilities. Instead of having only thirty blondes to choose from because you're relying on the memories of the casting director and memory is fallible and selective, the computer can show you three hundred if it eliminates the in crowd."

Jarumanis suggests that we could install computer-casting facilities throughout the industry today in every office. But he says that such a wide expansion will have to wait until the technology becomes more cost-efficient. It will also have to wait for the filmmaking community's wariness to pass.

"Some people assign divine attributes to the computer," Jarumanis says. They feel that "it will do all their thinking for them. Others say they're not going to trust the judgment of a bunch of wires. The right approach is in the middle. As a social mechanism, the computer presents no problems for us need to know who is even potentially qualified. But there's no way we can tell how someone will respond under pressure, nor can we test the range of his or her performance."

Ken Orsatti, Hollywood executive secretary of the Screen Actors Guild, says, "It's difficult to compare creativity and you can't, or shouldn't try to, compare talent. Intricacy is an elusive quality to grasp."

For their part, those propounding computerization contend it won't diminish the need for judgment and skill on the part of the casting director. If anything, those advocates say, it will require greater insight because of the larger number of potential candidates for a given role. Moreover, as Michael Phillips (a casting director who does employ computers) points out, computers would virtually eliminate—not only the casting couch—but also the "who-do-you-know-in-the-business" syndrome. That's why those likely to suffer most are agents, one of whose major functions has been to know someone the actor doesn't—the casting director. With a well-stocked computer file at his disposal, the casting director could circumvent the agent system with a punch of a couple of buttons.

It may take years, however, for all of this to happen. The very prospect has aroused strong opposition. For example, Teri Howard, of the Lynn Stalmaster casting group in Los Angeles, says, "That's not everything we think. We do everything we can not to be a computer company."

The growing use of computers is nevertheless inevitable. If the advantages outweigh the reluctance, technology always pushes forward. One added benefit is that the computers—coupled with videotape equipment—are allowing more people into the field of casting director and agent. A newcomer such as Phillips gets places simply because he is one step ahead of the competition by using available technology.

"I helped cast *Roller Boogie*," Phillips says, "and believe me, it was much easier knowing exactly how many roller skaters we had without having to call everybody up."

A former actor, Phillips knows firsthand how self-defeating it is to go out on interviews that end up as cattle calls. By putting people on computer and using videotape, you can eliminate seventy-five percent of those frustrating experiences.

Phillips warns, however, that filmmakers and actors should beware of some videotape casting services. Before signing on, investigate the firms and ask to see their credentials.

So, no matter how far computerization goes in the casting process, there is no substitute for either the personal interview or the private reading. Though the Universal file is updated each year, the information is fairly static; how fast an actor can learn a French accent or how he'd look with shorter hair and eyeglasses cannot at the present time be visualized by a computer.

"Remember that technology is neutral," Jarumanis says. "The computer only matches according to the criteria you give it. As computers are used more and more in casting, it has to be done with built-in controls. If we're going to get into this, it has to be done with our eyes open." ☐

FILM

CONTINUED FROM PAGE 32

revel agains me." In *Scanners*, it's just the other way around. *Scanners* require "ephemeral" & a scan suppressor, to get any peace at all.

Along the same lines, Cronenberg's characters are never wholly good or evil because none are ever held responsible for their own deeds. Any characters who begin to assume a clear-cut moral posture are ready for abrupt excising. In *Scanners*, the benevolent Dr. Paul Ruth (Patrick McGowan) is ultimately exposed as a cold-hearted experimenter who made his wife and children guinea pigs for his thalidomide-like ephepheral. His archival, Darryl Rowck (Michael Ironside), having cornered the ephemeral market, assumes the mantle of consumer advocate to avenge a generation of ephepheral babies.

In the way by squelching melodrama, Cronenberg claims never to lose sight of what he calls "the real stuff, which isn't special effects but the conceptual stuff and the emotion." That is why these excised "really bloody time scenes fairly bloodless."

"For me," Cronenberg says, "scientists are creative, passionate, obsessive and imaginative. The metaphor of science is really the act of creation involved in science and behind that act the obsessive drive not only to understand the human condition but also to control it, to modify it, to modulate it and to change it. The practice of science, as I learned when I went into biochemistry, is not as exciting as the other aspect. That's the moving force behind the films: a person who is not satisfied with things as they are and is trying by force of intellect to change them."

If science has betrayed us, so has art. The battle for the hearts and minds of the scanners is symbolically joined in the gleaming corporate corridors of CorBio and the antiseptic laboratories of BioCarbon Amalgamates. "In some way my scientists are interesting to me because of the way they're trying to re-create their own environments," says Cronenberg. "Architecture is also an expression of the fact that human beings don't live out in nature. They create their own environment, which is not a given, and it's not never has been."

Since man brought the first daisy into the cave? "Since he threw the first bear out."

Hence, man is banished to a world of glass and prostrated concrete—which neatly accentuates the gore. And the gore for Cronenberg is crucial. "The road of excess leads to the palace of wisdom," he quotes William Blake. "That could be the touchstone for all horror. People have asked me why my films are so extreme, and I quote that. My audience is daring me to take them on a roller-coaster ride. They want it. There's a need to be challenged, and some people would rather meet that challenge in the theater than on the streets. I personally would." ☐

SPECKLE SEARCH

STARS

By Allen Hendry

Are there planets around other stars? The answer depends on which astronomer you ask. Some believe that such nearby stars as 61 Cygni, Lalande 21185, and 70 Ophiuchi have worlds orbiting them. Peter van de Kamp, who studied the problem at Sproul Observatory in Pennsylvania, will even tell you the exact mass, orbital period, and orbital radius of not one but two large planets circling Barnard's star, a mere 5.9 light-years away.

Measurements of thousands of photographs taken at Sproul since 1916 led van de Kamp to announce that Barnard's star has a sinusoidal wobble in its motion through the sky. He attributed this wobble to the orbital pull of two planets with 80 percent and 40 percent of the mass of Jupiter.

Yet astronomers George Gatewood and Heinrich Eichhorn dispute these findings. Using a smaller sample of plates photographed at Allegheny and Van Vleck observatories, Gatewood and Eichhorn failed to measure any periodic perturbation of Barnard's star. Systematic

errors in the Sproul telescope and measuring techniques, they contend, are masquerading as the sought-after planets. The moral of this controversy is that classical attempts to detect far-off worlds require accuracy that existing techniques cannot quite reach.

Yet one technique sensitive enough to resolve the stellar wobble is already in use. Speckle interferometry may confirm that our solar system is not unique.

Earth's atmosphere has usually been the astronomer's worst enemy, particularly when stellar positions must be measured precisely. Images of stars expand from points to diffuse disks. Yet, ironically, the speckle technique could not work without our turbulent atmosphere. When that diffused stellar image is highly magnified, "frozen" with a rapid exposure, and filtered to a narrow band of wavelengths, what looked like a disk turns out to be a cluster of tiny points, or speckles. Each is an image of the star, almost as small as optics would permit outside an atmosphere.

One current use of speckle photographs was pioneered by French

astronomer Antoine Labeyrie. When binary stars are photographed with the speckle camera, the resulting picture displays clustered pairs of stellar images. The Labeyrie technique relies on the light-interference effect first demonstrated by Thomas Young in 1801. Light projected through two pinholes appears on a screen as parallel bands of brightness and darkness formed when the wave fronts of light passing through the holes interfere with each other. The distance separating the bands indicates the angular separation of two stars — including binaries too near to be resolved by previous means.

How does this aid the search for new worlds? The speckle technique can plot the angle between two nearby stars 15 times more accurately than earlier techniques could. If one star in a binary pair is accompanied by a planet, its orbit around the other star will be perturbed. Speckle interferometry could measure the change well above the system's error level. The result: indisputable detection of new planets around an alien star.

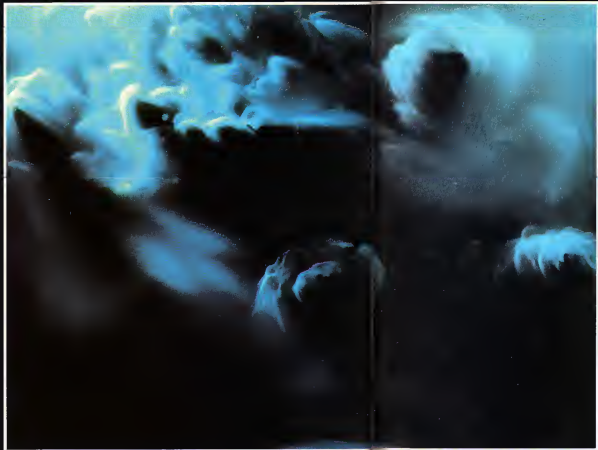
Harold McAlister, a leader in the use of speckle interferometry at Georgia State University in Atlanta, notes that approximately 100 binary stars are amenable to such measurement. Future speckle camera designs might noncevasily detect planets around single stars as long as a bright enough background star is there to measure against.

Astronomers Helmut Abt and Saul Luy of Kitt Peak National Observatory in Arizona, recently stated that one fifth to one sixth of 123 solar-type stars they had studied probably have planets. That yields an estimated 15 billion to 20 billion planets in this galaxy.

Yet if new techniques fail to produce evidence of other worlds, even in a preliminary survey of nearby stars, the implications will be equally profound. We will be forced to reconsider the nineteenth-century idea that Earth and its immediate neighbors were produced by some rare, and possibly exclusive, process — and propose ourselves to redefining the meaning of loneliness. ☐



Artist Don Dixon envisioned how Barnard's star would appear from one of its hypothesized planets.



PHENOMENA

Autumn clouds rush across central Ohio's night sky, suffused with the glow of a harvest moon. As strong thermal winds fashioned these masses of condensed water and propelled them through the troposphere, Paul D. Lewis captured their swiftness by exposing film for 15 seconds. The clouds' turbulence is intensified by magician Jerry Andrus's hypnosis, described on page 112. Cut out and spin the disc on your record turntable, then study this photo. The aftereffect of Andrus's three-why spiral will make this image—or anything else—appear to soothe and boil as if the viewer were hallucinating. Lewis photographed this exceptional vista on Ektachrome 84 film through a 210mm lens attached to his Canon F-1, set at f/16, 00.

"A word is worth
one thousandth of a picture"

GAMES

By Scott Morris

Above, the logical equivalent of an old saying: We're taking it to heart this month by offering fewer words and more images for the imagination.

First look at Salvador Dalí's painting (far right, this page). Look familiar? It should in more ways than one. From a distance or with unfocused eyes, you'll see a portrait of Abraham Lincoln. The painting has proved to be an extremely lucrative one. Lithographs sell for \$10,000 or more (John Lennon's assassin, Mark David Chapman owned one). The original is now said to have an asking price of \$19 million.

There's another reason why the image should look familiar. The block-Lincoln was reproduced widely a few years ago, in *Scientific American* and on the cover of *Science* magazine. It was created by Leon Harmon, then at Bell Labs, now at Case Western Reserve University in Cleveland. "I made the Lincoln in sixteen shades of gray in 1970," Harmon told me. "It was part of my continuing study to find how little information is needed for recognizing human faces, either by humans or by computers."

Harmon told me he intends to sue "Dalí and the galleries that peddle him as getting rich I'm getting nothing. There's a permission common law that if someone without permission takes your intellectual property for gain, an offense has been committed even if the work isn't copyrighted. The law is to protect people from having their ideas pounced on and perished. Dalí lifted my creation bodily without so much as a by-your-leave."

There appears to be little doubt that Dalí copied the black-and-white block-Lincoln. He even put a small version of it in the lower left of his painting. "It is not only approximately the same as my picture," Harmon says. "It is as far as my eye can tell, exactly the same."

The case is interesting because it points out the gray area of artistic originality and ownership. Did Dalí create something new, or did he rip off Leon Harmon? Did Harmon himself create something new or did he rip off Matthew Brady, who shot the original photograph?



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Whoever wins, we offer this case as a rite of passage. Co-opted by the art establishment, computer graphics has finally come of age.

Ken Knowlton was one of Harmon's early colleagues in producing minimum-information images but now solves the final creative step for himself.

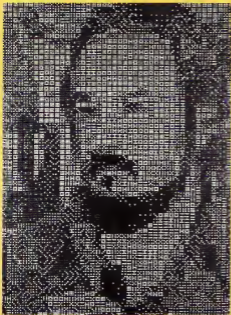
He recently invited us to a Soho loft in New York City to view his "sculpture" (S&S 1990, page 137)—a five-foot tall rendering of the photograph above, done entirely in dominoes. The subject is Joseph Scala Jr., a computer graphics artist at Syracuse University and a former student of Knowlton's.

"I shot a picture of Joe in his kitchen, holding a domino," Knowlton says. "I put the photo through one computer program

to digitize each tiny area into a shade of gray, then another to establish pairings of cells in the optimal way."

Knowlton used 24 complete sets of double-nine dominoes to produce shades of gray. There are 1,320 in all. A set of 55 contains all possible pairs from 0-0 to 9-9, each domino measuring 1" x 2".

Why use complete sets? Why not just pick dominoes as needed for the proper shade of gray? "I don't find that an interesting problem," Knowlton says. "For most areas of the picture one would just pick a double-two or a double-five or whatever shade was needed. The result might look more like Joe Scala, but the puzzle would be trivial. And you'd have to waste a lot of dominoes. My challenge was to find the optimum place for every domino, including the hard ones like the 9-0, the 8-1, and so on. I wanted to see



how good a picture I could get opening under such severe constraints."

The technology of minimum-information images can be applied to everything from Bell Labs' Pictagraph to the

transmission of photos from the surface of Mars. Despite such exotic applications, Knowlton says, the real reason he made - the domino picture was one that readers of the column understood. "It was fun."



COMPETITION #19: MEDIUM RARE

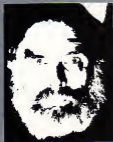
Here's a photo sent to us by Philip P. Hughes, of Woodstock, Georgia. It's pure culture in a Petri dish - our name in *Aspergillus niger*, a close relative of Penicillium.

In our own peculiar way we see a similarity between Hughes's picture and Ken Knowlton's domino mosaic. Both artists worked in a medium that is rare for such purposes. Both made something out of something else. That's what you're asked to do in this competition. For you computer buffs, here's your chance to send in that printout of the Mona Lisa made out of X's and O's or of a Christmas tree made out of the words *Merry Christmas*. Or, second thought, send in something more original.

Those of you in the precomputer stage can play, too. What unusual design can you make with a typewriter? What strange images can you produce with drop, toothpicks, paper clips, M&M's, pumpkin seeds, fertilizer on a lawn, or iron filings on a magnetic field?

Send us your creation itself, if convenient, or a sharp color picture of it. We cannot return anything. If you are typing or sending a computer printout, please make all marks as dark and sharp as possible. Our printing process does not allow us to reproduce fuzzy grips. Neatness definitely counts.

The first-prize winner will receive \$100; runners-up (2-10) will receive \$25 each. Send something made from something else, postmarked by June 15, 1981, to: *Omni* Competition #19, 909 Third Avenue, New York, NY 10022. **DD**



LAST WORD

By James Randi

While psychic wonders have earned increasing media space, this colorful aspect of human thought has too long been neglected in the awards category.

Seemed like a good idea at the time, and it was. With Tony Emmet, Oscar and Germany being awarded annually to outstanding performers in various fields of show business, it seemed appropriate to design an award for those who labor in the parapsychological vineyard. ESP, prone to spoon-bending, and a variety of psychic wonders have earned increasing media space in the last 20 years, but this colorful aspect of human thought has too long been neglected in the awards category.

The Superstar of all psychics, who have passed for review in the last 20 years is unquestionably Israeli comedian- magician Uri Geller, who at one point had prominent scientists convinced that he could bend spoons by means of psychokinesis, read minds, and teleport his body here and yon. I named my award after him, in honor of his considerable contribution to the confusion of science.

In 1980 my first annual Uri awards were announced for outstanding performance in four branches of paranormal endeavor. The award itself consists of a bent spoon mounted in transparent plastic and is given in the following categories:

- For the largest amount of money given for the safest reason related to the paranormal. Last year it went to the McDonnell Foundation, which awarded \$500,000 to a physicist in St. Louis for studying children who bend spoons. So far, no results have been released.
- For the "psychic" who takes in the largest number of people with the least talent. One Philip Jordan, of Binghamton, New York, was presented a Uri last year for convincing the public defender's office that he could tip card tables and eek euros. They tried him to sit at the side of the defense attorney, reading suras of prospective jurors and evaluating them for sympathetic vibrations.
- For the media outlet that promoted the most incredible fustery for public consumption. The 1979 award was given jointly to *Parade* and *American International Pictures* for selling the *Ameyville Horror* as fact. The book and picture bear the label "A True Story."
- For the most ridiculous academic statement of the year in relation to parapsychology. The last Uri went to physicist William Teller, at Stanford University in California, who declared that in spite of the questionable quality of much of the evidence for the paranormal and the actually shaky validity of some researchers in the field, the great volume of data available made the matter worthy of consideration.

Things are looking up! For the most outstanding achievement of 1980, I am happy to announce a selection of these sterling examples:

In the Funding Category, the prize has been raised to \$1 million by the Millennium Foundation of Texas. The group awarded this sum for use in parapsychological research, based upon the performance

of a minister named Ireland, the favorite psychic of Mike West. Ireland lured a group of leading scientists with his very ordinary blindfold act, while their collective tongue hung out in anticipation of funding for their individual notions of science. The cowboy millionaire who gave the million says Ireland found two of wells for him by psychic power.

The Performer of 1980 was Mrs. Dorothy Alison, of Nutley, New Jersey, who appeared on the *Phil Donahue Show* and convinced the law-enforcement bodies in Atlanta that she was able to find bodies and murderers. She went, she tried, and she found, saying that she had given the name(s) of one, two, or three black or white killers to the police. According to the authorities, she "showed" around town and told them nothing.

The Media Uri goes to the ABC-TV program *That's Incredible!* for delecting the performance of one James Hydrick, known as *Spoon Chin*, consisted of true psychokinesis—the moving of objects by magic power. The parlor tricks well-known to conjurers and amateur bar performers were almost denounced by host John Davidson, who was bamboozled at the last minute by Hydrick, who makes his home in Salt Lake City, where he intends opening a monastery to teach children to do paranormal feats.

The Academic Statement of the Year came from Nobel Prize winner Isaac Bashevis Singer, who declared that he believes in ghosts, imps, dybbuks, demons, and witches—the subjects he most often writes about. Singer says that he has no evidence whatsoever that these entities exist. "I have heard so many stories about the supernatural that I really believe the powers do exist," he said. He thinks that establishing the reality of these things could make our lives more bearable and more interesting.

The Special Straight-spoon-Award goes to Stanford Research Institute, which provided a change of place and practice by refusing a request from an unnamed U.S. government agency to investigate a perpetual-motion machine endorsed by *Science and Mechanics* magazine. SRF said it just wouldn't work.

An Honorable Mention to Ronald Reagan, who denied that, as reported, he consults Carol Krieger's *Astrology* column in the daily paper before making important decisions. A close friend of the family, Jeanne Dixon, is standing by.

Also for Honorable Mention, the *Peking News Service*, which admitted that demonstrations of acupuncture staged for the Nixon medical team years ago were faked. A regular anesthetic was used for the operators' admission, and so we are told that it was at the insistence of Mao Tse-tung that the magic needles were used at all. The object was to keep something Chinese in medicine. Acupuncture, one Chinese medic said just does not work. **DD**