OMNI

JUNE 1982 $2.50

THE MARKETING OF DR. CARL SAGAN

WOMEN IN SPACE

FOUND: LOREN EISELEY'S LONG-LOST NOTES ON LIFE, NATURE, AND THE UNIVERSE

SWEET SHARKS, LOCH NESS WORMS, VIDEO HAIRCUTS, BIOMEDICAL JEWELRY, TIC-TAC-TOE IN THE FOURTH DIMENSION, AMPUTEE ASTRONAUTS

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JUNE 1982

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Andreas Nottebohm is the only foreign artist to document artistically two shuttle launches and the Saturn Encounter. A mesh of stereoscopic colors and images, this month's cover illustrates Nottebohm's cosmic visions that duplicate the frontiers of space with astonishing clarity

FIRST WORD

By Ben Bova

• The nations of the world must unite into a single government that can control arms and prevent war •

Some dreams are important, not because they are easily attainable, but because they serve as bench marks to measure how far we are from reaching a certain goal and gauge how much progress we are making toward it.

Today the nations of the world spend much more on armaments than on food production or education. Yet the men and women who can envision a united world at peace are called dreamers and are either scoffed at or ignored by the self-styled practical people of the world.

The grim prospects for the future have been summed up neatly by Lord Solly Zuckerman, the South African-born life scientist who has spent much of his career advising the British military establishment. In his new book, *Nuclear Illusion and Reality*, Lord Zuckerman writes:

"There are more than 40,000 nuclear warheads in the world today, equivalent in destructive power to a million times that of the single bomb which obliterated Hiroshima. The nuclear super powers could already destroy each other many times over. Yet their lunatic race to build 'better weapons' and cram even fuller their bursting armouries still goes on. If tactical nuclear weapons were ever used on the battlefield the all-but-inevitable outcome would be escalation into all-out nuclear war. Yet NATO planners still talk as though such warheads could be used in a 'limited campaign.' The 'independent' nuclear deterrent forces possessed by Britain or France confer little, if any real, additional world power on their possessors; yet the race towards proliferation continues unabated: today China, India, perhaps South Africa; tomorrow Iraq, Libya, who can say. The world is in deadly danger and the danger is increasing all the time. Unilateral disarmament is not the answer, but unless effective controls are instituted, unless arms limitation soon becomes a reality, there may be few left to read this book within a few years."

This scenario is nothing new to readers of science fiction, who have been pondering the horrors of nuclear holocaust since the 1930s, well before the first atomic bomb was tested. Almost invariably science fiction's answer to world destruction is world government. The nations must unite into a single government that can control armaments and prevent war.

A fine and noble dream. But the "practical" people of the world ask: How do you get there from here? The United Nations certainly cannot govern the world, and no nation seems likely to give up its sovereignty to a world government.

Wrong, says the American Movement for World Government (AMWG). Many nations have already shown a willingness to give up some of their sovereignty in exchange for disarmament and peace. The AMWG's motto is "One world or none," a quotation from the late Wendell Willkie. The organization believes that the world situation is grim, but not hopeless. It is [illegible] avoid [illegible] catastrophe.

William H. D. Cox, Jr., president of the AMWG, has said, "We see the beginnings of that 'ground swell of public opinion' for world government that Albert Einstein urged us to 'raise in every village square.' We believe this ground swell could swiftly become a tidal wave."

Cox foresees the nations of the world establishing a federal government under which each nation maintains its own form of society and control within its own borders. Not all the nations will join at once, of course. But the more that do, the more powerful the world government will become. Until all the most powerful nations have joined, wars would still be possible, but not within the federation. As a condition of membership, all national military power would be transferred to the world government for the common defense. The risk of war with hold-out nations or blocs would steadily diminish as the federation continued to gain in membership, economic strength, and military power. The stronger the world government would become, the more likely that additional nations would be persuaded to join it. Even if one of the superpowers and its satellites refused to join, they would find themselves militarily outnumbered and outgunned by those nations that had joined together under the world government.

Eventually, the AMWG believes, all the nations will join the federation, because it will be to their obvious advantage. Then the process of true disarmament can begin. The world will be relieved of the threat of nuclear war—and of *all* war. The enormous financial burden of armaments can be lifted, and the money can be spent on agriculture, education, and scientific research that will enhance the lives of all human beings everywhere.

For the federated world government to be acceptable to individual nations, it must have certain essential characteristics, Cox points out. Among them are:

A bill of rights.

A popularly elected legislature to enact world laws.

A world court to interpret those laws, with jurisdiction over international disputes.

The control of all weapons of mass destruction and the disarmament of all nations down to the level required for internal police functions.

Limited powers of taxation to support only those functions necessary to preserving world peace and solving global problems.

Most people regard such a world government as pie in the sky, a science-fiction dream that can never come true. A dream it is, but compared to the nightmare described by Lord Zuckerman and all the others who have examined the consequences of nuclear war, it is a dream well worth believing in and working toward. ∞

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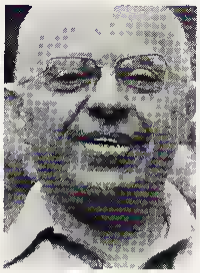
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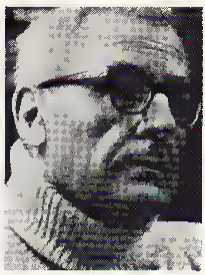
EISELEY


ROWES

Job opportunities beyond *terra firma*, once restricted to an elite group of male astronauts, have suddenly opened up for the opposite sex. Ironically, the new breed of woman astronaut owes much to a group of average women, many of them housewives, who participated in a grueling five-year study to determine whether womankind has the "right stuff" for travel in space. *Omni* contributor *Barbara Rowes* watched as the volunteers were spun around in a centrifuge until they became nauseous, poked with needles, probed with electrodes, and subjected to one exhausting test after another. Her special report, which begins on page 64, is a heartening tale for feminists. In zero g, it seems, *men* are the weaker sex. Rowes, who has interviewed Liza Minnelli, Mikhail Baryshnikov, and other glamorous people as an art correspondent for *People* magazine, seems most in awe of these ordinary women. "I identified with them very strongly, especially their courage and stamina. But you wouldn't get me on the centrifuge for all the world."

For more than 20 years the revered and celebrated naturalist *Loren Eiseley* kept a private journal, in which he gave free play to his thoughts on nature, the universe, and his fellowman. Some of these musings found their way into his published work, but others lay buried in the pages of his notebooks, unread and almost forgotten. Now, in an *Omni* exclusive, excerpts from his journals are being published for the first time. For a special look at one of the great gentle spirits of this century, turn to page 86.

Astronomer Carl Sagan has discovered another world—of multimillion-dollar book advances, high-powered agents, and movie rights. He is master of at least three kinds of cosmos: the well-known TV series, the book, and the *Cosmos* record, which is now number one on the charts in South Africa. How did Sagan the scientist become Sagan-the-superstar—a household name with the selling power of Brooke Shields? This was the question *Judi Kesselman-Turkel* and *Franklynn Peterson* asked themselves at last year's American Booksellers convention in Atlanta, where Sagan's flashy booth outshone those of Random House, Doubleday, and other giants of the publishing industry. In "The Marketing of Dr. Carl Sagan" (page 44), the authors reveal his far-flung—and sometimes far-out—business ventures, including a peculiar deal his agent offered the editors of *Omni*.

If *Jaws* and *Jaws II* have kept you from going into the water, the insights of renowned ichthyologist Eugenie Clark should provide reassurance. Sharks, she insists, are beautiful, docile creatures that have been much maligned by the mass media. She should know. Since 1955, when she founded the first research center for the study of live sharks in Sarasota, Florida, she has spent more time in their company than with her own kind. In this month's Interview (page 94), Clark speaks to international banker *John Stein* who grew up in the shadow of her institute, sailing and swimming in the emerald waters off Sarasota. "Some boys played with rubber ducks in their bathtub," Stein recalls. "My playmates were tiger sharks, dusky sharks, even hammerheads." He is now the captain of a 33-foot Tartan sailboat, *Slim*, and spends as much time in shark territory as possible.

"If a science-fiction writer is deemed worthy of a Nobel Prize in the near future, the most likely candidate would be Stanislaw Lem," writes Gerald Jonas in the *New York Times Book Review*. Polish-born *Lem* is the author of such highly praised works as *Return from the Stars*, *Tales of Pirx the Pilot*, and *Memoirs of a Space Traveler*. Stories from the last work, an anthology, were reprinted in *The New Yorker* over a three-month period last year. Beginning on page 50 is an excerpt from Lem's latest opus, *More Tales of Pirx the Pilot*. Entitled "The Accident," this story is certain to add many new converts to the growing body of his admirers.

Lem is joined this month by another distinguished science-fiction writer, *Howard Waldrop*, who won a Nebula Award last year for his novelette *The Ugly Chickens*. Don't miss "Ike at the Mike" (page 76), a droll tale about two of the most outstanding personalities of the American Fifties—and a surprising role reversal that would have changed the course of history.

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JUNE

LETTERS

COMMUNICATIONS

No Laughing Matter

Jeff Wells's UFO Update [Antimatter, March 1982] was the most ludicrous pack of lies yet written about my November 1975 experience.

Wells did not see me or my brother "staggering" drunk. My brother and I did not—and do not—drink alcohol.

I underwent a battery of psychological tests by a number of independent experts that indicated no neurosis or psychosis.

Antimatter has been good for laughs, but I am not laughing at this one. I am not.

Carol Burnett

Travis Walton
Snowflake, Ariz.

Roots

In his attempt to explain man's origin while side-stepping the Bible's account, Francis Crick [Interview, March 1982] points to the stars, suggesting that other humanoids planted us here as their own experimental offspring.

Let us assume for a moment that this theory is correct. Now try to answer the next question: Where did *they* come from?

Mark Baisley
Alhambra, Calif.

The suggestion by Francis Crick that life on Earth may have evolved from organisms "sent here in a rocket designed on some distant planet" is not as implausible as it may sound.

A text known from its Babylonian version as *Enuma Elish* states that when the solar system was still young, a large planet (Marduk) invaded from outer space and collided with Tiamat, a planet between Mars and Jupiter. In the collision Tiamat split in two; one half was shattered to become the asteroid belt, and the other half became Earth. It was then that the "seed of life" was transferred from Marduk to Earth.

Z. Sitchin
New York, N.Y.

Enthusiastic Robotics

I read *Omni*'s article "French Robots" [March 1982] with great enthusiasm. (Enthusiasm is my robot's name, and he has a habit of reading over my shoulder.)

How about featuring my robot in a coming issue? He's getting married in August to a lovely greaser, and they are spending their honeymoon in Tin Pan Alley. I think an *Omni* photographer should be assigned to their honeymoon and tastefully photograph their well-oiled manipulations.

B. Orson Ebstein
Yonkers, N.Y.

Time Trips

I read with pleasure Robert Silverberg's story "The Far Side of the Bell-shaped Curve" [March 1982]. We may not be able to "jaunt" through time physically, but it is nice to know that someone is thinking about the consequences that may have to be dealt with in the future. Hindsight may be 20/20, but foresight is the key.

Steven Miller
Buffalo, N.Y.

Sorry, Sir!

It is ironic that your article on rumors and sources [Mind, February 1982] attributes a quotation to U.S. Army Major General Smedley Butler, who is, in fact, a marine.

Joseph Butler
Billings, Mont.

Women Warriors

As usual, *Omni* delivered another great interview this time with Candace Pert [February 1982].

The steady increase in the numbers of homosexual men may relate to men's slow but progressive acquisition of favorable and logical feminine wiring. Women, thankfully, are not warriors. Modern man can no longer afford to be.

Robert Hyre
Atlanta, Ga.

Unruly Pot

As a footnote to Neil Renton's Last Word [February 1982] I have observed that, although it is true that a watched pot never boils, an unwatched pot inevitably boils over.

Kristen Mollin
Kingston, Ont., Canada

DIALOGUE

FORUM

In which the readers, editors, and correspondents discuss theories and speculation arising out of Omni. *Readers are encouraged to debate views and pose questions to* Omni, *the scientific community and the science-fiction establishment. The opinions published are not necessarily those of the editors.*

Gay Uproar

I find that *Omni*'s article about the origins of homosexuality [Mind, March 1982] not only concludes very little about the topic but confuses the nature of homosexuality itself. Comments such as "... a yen for pastel cashmere and Louis Quinze antiques" conform to a stereotype less appropriate than the Marlboro man.

Homosexuality does not determine one's life-style. It is exactly what the word implies: sexuality.

Nathan Daniels
Pittsburgh, Pa.

Omni's article "Gay Origins" has perpetrated a lie.

I met Aesthetic Realism by chance in 1974. After much critical inquiry, I found it to hold truths about the way the mind works in a way that psychology could not. Aesthetic Realism describes the self accurately in showing how one's deepest hope is to be fair to the world and how the desire for contempt interferes with it. (In the film *Yes, We Have Changed*, Aesthetic Realism founder Eric Siegel's first lesson is: "Get rid of your contempt for people and you will get rid of one of the chief ingredients of homosexuality.") This knowledge benefited my life tremendously. Judith Hooper misrepresents Aesthetic Realism and the people who study it.

The power and logic of Aesthetic Realism can make emotional and organic changes in people.

Pamela Goren
New York, N.Y.

Write On

I recently attended a congressional district meeting where I heard a simple truth on why the government is not spending more on the space program and NASA.

My congressional representative, Geraldine A. Ferraro, pointed out that funding for such programs brings about results in 20 years but that Congress thinks in terms of every 2 years.

I urge all *Omni* readers to write to their representatives and senators, even to the President, and tell them that we want more money spent on space exploration.

James Petrassi
Richmond Hill, N.Y.

Economic Rise

If James M. Beggs [Interview, December 1981] wishes to win public support for the space program, he should concentrate on publicizing the effect it could have on the employment situation in this country.

We need a frontier that will allow expansion, and we have one staring us in the face. Use the space program to create jobs and you will get all the support you need.

Phillip Skinn
Huron, Ohio

In Defense of Greenpeace

Several months ago I did an interview with Eric Schwartz regarding the position of the Greenpeace Foundation vis-à-vis Paul Watson.

In *Omni*'s January 1982 issue [Earth] there was an article by Mr. Schwartz, in which I was correctly quoted as saying we support Mr. Watson's aims but not his methods. However, the context of the quotation implies that Greenpeace says that Mr. Watson is a terrorist. I specifically told Mr. Schwartz in no uncertain terms that this was not the case. I resent *Omni*'s inflammatory implications.

Douglas Mulhall
Vancouver, B.C., Canada

Survivalists Speak Out

I was surprised at the amateurish approach to the subject of survivalism. The article you published [Books, March 1982] featured only the most negative aspects of the survivalist movement.

M. S. Kaplan, like so many detractors of survivalism, emphasizes our willingness to shoot marauders. It is axiomatic that if survival depends on aggressive defense of our lives and property from hordes of improvident looters, we will indeed use deadly force to protect ourselves and our families. After the crash, which I consider inevitable, the basic sciences and technology easily implemented by the intelligent layperson, can lead to the preservation and eventual implementation of the high technology your magazine promotes.

Kurt Saxon
Harrison, Ark.

One Little Mistake

Your treatment of geophysicist Brian Brady, who predicted a 1981 earthquake in Peru ["Laurels and Hardys," January 1982] was harsh and unfair. This man is a scientist, but merely because he is wrong one time, you treat him like a crackpot.

The world laughed at Galileo, Pasteur, and Darwin, but I don't think you will find many people laughing if Peru slides into the Pacific Ocean next week.

There is nothing wrong with being skeptical, but only fools are cynics.

Steven Montgomery
Davis, Calif.

Raked over the Coals

When Harry Lebelson [Antimatter, January 1982] refers to me as having "thoroughly" investigated the firewalking ritual, he hyperbolizes. I have never seen the ritual, other than in film accounts. It is my *theory* that the walker is insulated by a film of steam produced from the extremely hot surface and emitted from the foot, not from the coals. Those who attempt the walk on merely red-hot coals are burned.

The theorizing about mind-blocks to conquer pain is so much hot air. Whether pain is experienced or not, the fire will burn the skin unless a barrier is present. The feet of the firewalkers do not burn, thus they feel no pain.

I believe the solution is contained in the Leidenfrost Effect, and interested persons can decide for themselves what gives rise to this unusual phenomenon.

James Randi
Rumson, N.J.

BIG-BUCKS ECOLOGY

EARTH

By Douglas Starr

John Varty was stalking the battle-scarred hippo when it turned and charged across an open stretch of field. "Shoot!" he cried to his companion, and the American fired wide. A useless red wound splashed over the animal's churning shoulder. So Varty leveled his bolt-action Rigby at the animal, aiming for the brain. The hippo snorted loudly before folding on its knees just a few yards away.

Soon some neighboring Shangaan tribesmen arrived. They dismembered the carcass for food and tools. Within two days all signs of the animal were gone. The Shangaan had their bones and meat, the American had his trophy, and Varty pocketed $5,000 for leading the hunt. That money would go back into the land. Ecology, Varty says, is good business.

As one of a new breed of conservationists in Africa who are choosing profits over passion, this businessman and nature lover has restored hundreds of acres of South African bushveld, saved hundreds of jeopardized animals, and made himself money to boot. "Wildlife is a form of industry," says Varty, who decries the "sentimental approach to conservation. I have to compete with every other industry for the best use of the land."

And compete he has. He and his brother, Dave, started with a barren piece of inherited real estate: a ranch their grandfather had settled more than 40 years before. Fenced in over the years, it became trampled and overgrazed: an arid plain punctuated by gnarled shrubs and trees. Rather than sell the homestead, the brothers decided to save it.

John left college in Johannesburg and moved to the ranch, where he started a safari business from a small mud hut. In a few years he had enough money to buy a bulldozer for ripping up shrubs and contouring the ground. The ground's ability to hold moisture increased, and within a year dormant native grasses grew abundantly green. Soon the Vartys were importing sables from war-torn Zimbabwe and elephants from nearby Kruger National Park. Although several relocated animals died, wildlife at the preserve made extraordinary gains.

Conservationist John Varty. He's saved hundreds of animals and made a profit to boot.

Today the Varty game preserve is a must-see on the international celebrity circuit. That 50-square-mile chunk of African ecosystem named Londolozi (Zulu for "protector of living things") regularly hosts such luminaries as Tina Turner, Paul McCartney and Janis Ian. These and other visitors pay from $40 to $100 per day to stay in rustic accommodations and view the giraffes, elephants and other African species. Guests are so often moved by what they see that they ask how they can help maintain the area's beauty.

That says John Varty is easy to arrange. For a sizable donation (up to several thousand dollars) you can "sponsor" one of the 40 elephants that roam the property, earning the right to name it and know that its habitat will receive constant care. Peter Sellers and the Bee Gees did that. Or you can hold a benefit, as Cheryl Tiegs and Fleetwood Mac did a few years ago at New York's Studio 54. Or you can give time, as does Tedd Schorman, a vice-president for Holiday Inns, volunteering 30 hours a week for the past three years. Schorman has already raised $60,000 for Varty's preserve.

Varty stands about average height, with shoulders disproportionately large for his size. His coarse yet pleasant features and earnest manner give him a more youthful impression than his thirty-one years. He talks lovingly about wildlife and his life in the bush. Yet he puts things in a way you don't expect to hear.

"Elephants and lions are worth about fifty thousand dollars apiece, counting the tourism, hunting, and meat they provide," he notes. "Giraffes are worth only $1,000 each; zebras, which run wild and multiply prolifically, are valued as high as $500."

Are these the calculations of a preserver of animals? Well, according to a group of controversial ecologists in Africa, the profit motive is exactly what the elephant, rhino, and jungle cat need.

Wildlife in Africa is simply dying for money. In an unstable world economy, commodities like elephant ivory—valued at about $40 per pound—are becoming a valuable hedge against inflation. A

CONTINUED ON PAGE 135

MUSCLE MENDING

LIFE

By Dr Bernard Dixon

When doctors first tried grafting bodily parts they scored their earliest success with a tissue that had initially seemed highly unpromising the fragile cornea of the eye Heart transplants were a favored goal as were transplants of several other organs Ironically everyone s first choice —muscle—later proved to be one of the least suitable tissues for such surgery

Only recently after a century of dismal setbacks have surgeons succeeded in restoring motor function by transplanting muscle Suddenly a dizzying succession of breakthroughs have been announced in Sweden England, France Austria, and Italy These reports show that conditions such as paralysis can indeed be reversed by meticulous grafting of muscle into the affected area Within the foreseeable future this type of surgery should become routine

To appreciate the significance of this advance we have only to recall the preceding decades of failure The first efforts, back in 1874, were disastrous, with transplanted muscles in rabbits and frogs dying shortly afterward The spectacular evolution of surgery during the first half of this century afforded some progress, and one or two experimenters found that relocated muscle sometimes established a blood supply from its new host But despite this such grafts invariably atrophied and died

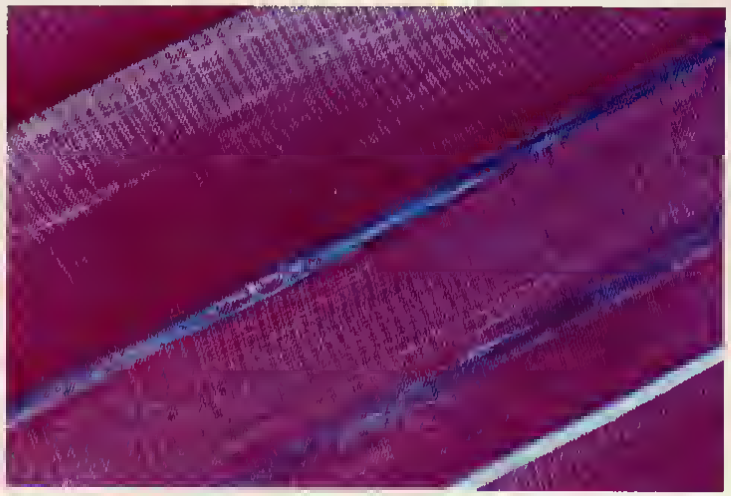
By 1955 three years *after* the Corneal Grafting Act went on to Britain's statute book muscle transplantation remained a distant prospect "All such transplants degenerate and lose contractile power almost immediately as a result of loss of blood supply" wrote the distinguished surgeon L A Peer but even when vascularity is maintained gradual but progressive atrophy results from loss of nerve supply That verdict which summarized the gloomy view of surgeons and muscle biologists around the world at that time marked a reluctant abandonment of the whole problem

Except in Russia There unfettered by theoretical or practical reasons why such procedures should fail, A N Studisky made a major discovery from work with animals Muscle grafts can survive if the surgeon is extremely cautious not to damage the myoblasts—primitive cells that give rise to new muscle Earlier doctors it seems had inadvertently injured these delicate cells Consequently they could not be encouraged to undergo their normal sequence of change into myotubules, and thence into myofibrils and finally mature muscle fibers Simply by handling the graft with care the Russians were able to induce this magical transformation producing healthy new tissue growth in the host

It was this work unknown to medical scientists in Europe and the United States for several years that triggered a resurgence of interest in the potential for human muscle transplantation In 1979 the Swede Dr L Hakelius reported 107 such grafts in 89 patients while an English surgeon Noel Thompson described 103 successful cases The patients were suffering from facial or eyelid paralysis or anal incontinence and the surgeons took the tissue required to restore normal function from other parts of the body—usually the leg or forearm

Similar achievements have now been reported by researchers in other parts of the world According to a recent report in *IRCS Medical Science* by Dr Frank Mong and Dr James Poland from the Medical College of Virginia there are three key considerations for success Transplanted muscle must be revascularized—given a fresh blood supply—within 72 hours of surgery Excessive connective tissue must be prevented from growing into the graft and strangling the new muscle And nerve connections have to be encouraged so that the implanted fibers can receive messages of command

Each of these problems is already responding to new research efforts Looking further ahead we can envision human muscle grafts from animals advances in the study of muscular dystrophy, even transplantation of heart muscle The prospects seem almost endless But the option of becoming an Arnold Schwarzenegger through plastic surgery is not one of them



Muscle (magnified 1 000×) may soon be routinely transplanted for the treatment of paralysis

GET AWAY SPECIAL CONTEST

SPACE

By Owen Davies

Contest! Contest! Contest! *Omni* is sending an experiment into orbit on board the NASA shuttle. It could be yours. Simply send in the best suggestion for a legitimate scientific experiment in space (no instant space souvenirs, please), and *Omni* will give you the chance to carry it out. Then we'll fly you from anywhere in the continental United States to watch the landing of the shuttle that carries your experiment.

Each shuttle flight is dedicated to a few major missions—lofting the European Space Agency's *Spacelab*, a couple of communications satellites, or whatever. But occasionally these large payloads will leave some extra space in the shuttle's capacious cargo bay. Hence NASA's Get Away Special (GAS) program. Whenever a shuttle flight has a little room left over, NASA will fill it with small, low-cost packages containing automated research equipment. Donna S. Miller, NASA project manager, estimates that five to eight GAS packages will fly on most launches.

Response to the GAS program has been enthusiastic. NASA has sold some 325 of the low-budget launch containers to users in countries as far away as Japan and Yugoslavia. Federal agencies have reserved 28 GAS experiments. Private corporations account for 161, educational institutions for 85. Fully 51 GAS packages have been bought by private individuals.

Experiments slated to fly during the first 50 or so shuttle flights range from genetic studies of brine shrimp and insects to dull-sounding, but highly practical, tests of soldering in zero gravity. Two Japanese high-school students plan to grow pure snow crystals directly from vapor. The experiment may reveal how to manufacture near-perfect semiconductors in space. And the Student Space Organization at Caltech is working on two separate studies. One will examine crystal growth in space; the other aims to find out how plant seedlings respond to gravity.

What can you add to this ambitious list of low-budget space research? Whatever you suggest, your experiment had better be small, tough, and self-sufficient. *Omni*'s GAS package is an aluminum cylinder only 19.75 inches in diameter and 14.13 inches high—a total of 2.5 cubic feet. It can carry no more than 60 pounds.

Your experiment will take a beating. Though the shuttle accelerates at less than 4gs, sound levels reach 145 decibels—enough to kill an unprotected animal. The GAS container is well-insulated and holds full atmospheric pressure. But it can be opened to the outside if necessary for your research.

Heat may be the most critical factor. Despite the insulation, temperatures inside an unheated container on some missions will fall as low as –296°F—cold enough to liquefy oxygen here on Earth. On other flights, container temperatures may rise as high as 110°F. It depends on whether the open cargo bay faces the sun or is aimed away from it.

First, though, your entry must endure the scrutiny of *Omni*'s judges, headed by Dr. Robert W. Bussard, inventor of the interstellar ramjet. Only 25 entries will survive the preliminary round to become finalists; only one finalist can win. Entries will be judged according to only five criteria, but none could be tougher.

- Originality. The kids at Camden (New Jersey) High School are already flying an ant colony. Termites won't interest us.
- Possibility. No demonstrations of zero-gravity perpetual motion, please.
- Scientific or practical interest. The winning experiment will reveal something new about conditions in space or physical processes outside Earth's gravity. If it contributes to the development of space industry, so much the better. Demonstrations of phenomena we already understand will not make it, no matter how interesting.
- Elegance. We're not sure how to describe this elusive combination of simplicity, ingenuity, and intellectual beauty. This criterion calls for subjective aesthetic judgment. We'll recognize elegance when we see it, and we will probably see it in the winning experiment.
- Cost. The winner will not have to pay for equipment loaded aboard our container on the shuttle. *Omni* will pick up the tab. But judges will weigh potential costs against possible scientific return. If two entries appear equal as measured by

CONTINUED ON PAGE 140

Win this contest, and NASA's space truck will carry your cargo. All it takes is an idea.

MEMORY TRANSPLANTS

MIND

By Judith Hooper

Imagine an ultramodern memory clinic in your city. A lifelong bigot sits in the waiting room, ready for his monthly "memory transplant." Gradually his bitter memories of one racial group are being supplanted by more pleasant ones, and his prejudice is dropping away. Meanwhile, in a treatment room, a troubled couple is keeping divorce at bay with therapeutically enhanced recollections of each other. Also on the clinic's roster are patients who come to drive out their accumulated Furies or to reach an understanding of their past.

Such a treatment center is what University of Washington psychologist Elizabeth Loftus says is a fantastic but possible application of what she has discovered as part of her research into human memory. Her work has also convinced her that human memory can be tampered with and falsified, like an embezzler's account ledger, and that all of us are walking around with our minds at least partly filled with forged memories.

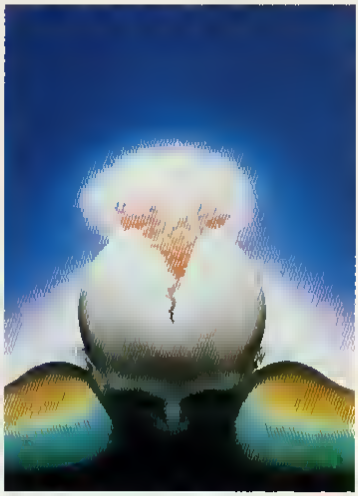
This comes as something of a blow to many mind experts. Although about 50 different theories on memory may turn up in textbooks, most psychologists cherish the sacred belief that there is such a thing as a permanent, if not always accessible, memory, a notion fortified decades ago by a neurosurgeon named Wilder Penfield.

In the Forties and Fifties, while operating on epileptics at the Montreal Neurological Institute, Penfield probed parts of their exposed brains with electrodes to pinpoint damaged areas. The patients remained conscious during surgery and, to his amazement, suddenly started giving reports of memories right there on the operating table. Some replayed long-forgotten conversations or reheard entire symphonies, and others relived childhood scenes in all their primal splendor. It must be, Penfield reasoned, that in some musty attic of the mind frozen tableaux of the past lie stored. These memory traces, or engrams, Penfield claimed, could be reawakened by hypnosis, by direct electrical stimulation of the brain, by free association, or by other truth-seeking techniques.

But what if it turns out that the magic madeleine Marcel Proust bit into recaptured a phony past? That's the drift of Loftus's work. Memory is less a faithful scribe of experience, she suggests, and more a poor answering service manned by frazzled or negligent operators.

In one experiment, a person is shown a "murder suspect" with glasses and straight hair. When the "eyewitness" later overhears someone describing the suspect's hair as curly, however, he will almost invariably "remember" a frizzy-haired culprit, Loftus says. What makes a phony memory so treacherous is that, once it is implanted, it can become the "truth." A witness can even pass a lie-detector test with flying colors, absolutely convinced that the false image in his memory is identical to what he saw. Details supplied by others can contaminate one's own memory, Loftus asserts. STOP signs can become YIELD signs, barns grow out of thin air, yellow cars can turn fire-engine red.

What about that underlying engram uncovered by Penfield's surgery? Loftus believes it vanished forever into a limbo of lost memories. For this reason, she argues, "It may be that the whole legal notion of a truly independent recollection is a psychological impossibility." Far from serving as a portal to the truth, hypnotizing a witness could evoke false memories from his mind, or even embed them there.



Out with the old memories, in with the new.

Outside influences and suggestions are not the only things that shape what we remember. Most of us, her research shows, wear rose-colored spectacles as we travel down Memory Lane. We remember voting more often, being promoted more often, taking more plane trips, and having more agreeable children than records would show. "Why are we wired up this way? Why does our past acquire this kind of prestige-enhancing glow?" she asks. "I think this helps us live happier lives."

Studies show that depressed patients typically have bleak recollections of their lives and that successful therapy tends to make their painful memories fade, Loftus says. This leads her to make a futuristic proposition. Why not have memory doctors create new memories for us? Memory tampering could construct a more benign past for a depressive, rehabilitating him through recollection.

"The idea may not be so tartetched," Loftus contends. "In the periodical *American Psychologist* two therapists argued that by creating a new truth in the present the past is necessarily changed." According to the article, hypnotist-psychiatrist Milton Erickson once used hypnotic suggestion to implant brand-new memories in a patient who recollected her childhood as an unhappy time. As a result, the woman surfaced from her depression.

Beyond problems of mental illness, Loftus suggests, a little tongue in cheek therapeutic memory restructuring might even be offered in a clinic setting, like the one described earlier in this article. Although she has not proposed it, it is tempting to envision a little collective memory tampering as well. Could we erase ancient national feuds, genocide and old colonial grievances from the world psyche? Would we wish to? OO

THE ARTS

By Sal Manna

Making movies, especially the science-fiction variety, will never again be the same after *Tron* premieres this summer. As *2001: A Space Odyssey* was the futuristic film for the Sixties, and *Star Wars* that for the Seventies, *Tron* is the film for the Eighties. It marks a watershed in film history—regardless of where the box-office figures may end up—because *Tron* jolts film a quantum leap forward and into the Age of the Computer.

"Here we are walking on the moon," laments Richard Taylor, supervisor of the film's computer special effects, "and we're still making movies using Nineteen-twenties technology. It's absurd. But *Tron* is going to help change that. We're going to melt the Naugahyde on the Lazy Boys of America."

What you will see in *Tron* is truly something you have never seen before. Of the film's spectacular 105 minutes, nearly 20 minutes are generated by computers and 53 more minutes are the result of the most sophisticated matte process ever contrived. Though director and creator Steven Lisberger prefers the term *digital scene simulation* rather than *computer generated animation* ("It makes it sound like we're doing *Bambi*," he grumbles), either will do.

For the first time a motion picture will apply electronic information technology on a large scale to the filmmaking process. To build the film's images, art was drawn by comic artist Jean "Moebius" Giraud (whose work inspired *Heavy Metal* magazine), futuristic industrial designer Syd Mead, and high-tech commercial artist Peter Lloyd. Their work was then sent on to staffs of computer graphics encoders at Information International, Inc. in Culver City, California, and to Magi and Digital Effects, both in New York.

The encoders plotted the art in three dimensions, with data on size, color, density, lighting, movement, and perspective. Each individual point of light, called a pixel, was programmed with the information. Over 5 million calculations were required to create a single frame of animation. Given that there are 1,440 frames per one minute of film, one can understand why *Tron* has been almost two years in postproduction and why it employed some 400 artists and technicians skilled in computer graphics.

Lisberger's eyes shine with excitement over the project that he started in 1978. "I'm fascinated with the idea of artificial graphics interacting with real people in a time mode," says the thirty-one-year-old on the *Tron* set at Walt Disney Studios in Burbank, California. "I've always been interested in video and computer games, and I feel it's significant that the computer people and the video people are forming a bridge between the two camps. *Tron* is giving us a chance to create our own mythology, our own archetypal characters for the Computer Age," he explained.

Tron starts off in the world of people where a young computer genius named Flynn (played by Jeff Bridges) is trying to break into the computer system of ENCOM, a huge communications conglomerate. Flynn, a video game wizard, suspects that an ENCOM executive (perennial bad guy David Warner) has stolen programs Flynn had created. Problems develop, however, when the computer shuts down its user-access and begins to patch in to other computer systems, including the Pentagon's. It even gains an ability to defend itself.

When Flynn tries to incapacitate the program, he is blasted into another world—the electronic microcivilization inside the computer itself. In this dimension where energy lives and breathes, he discovers computer programs that are the alter egos of the programmers who created them. Flynn and his compatriots battle his enemies in a massive, life-and-death struggle in a sort of monumental video-game grid.

Lisberger is plainly aware that computerized games grossed over $3 billion last year, $1 billion more than is being spent on the space shuttle. "These kids are going to learn how to relate to computers as users—not being subservient to them. But there are no myths about how people should relate to

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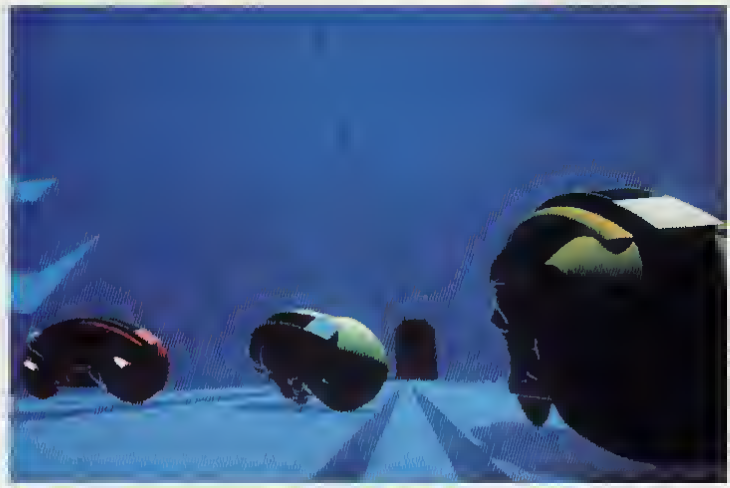


Archetypal mythology for the Age of the Computer—with a little help from Carl Jung

THE ARTS

By David I. Lewin

With virtually any other subject, whether it's *Kojak, Charlie's Angels* or *All in the Family*, you run dry—you run out of material," observes David Suzuki, one of Canada's most popular television personalities. "You will never run dry with science, because there is always new material." Suzuki should know. For almost 20 years he has brought Canadian audiences the message that science is exciting, relevant and comprehensible. His message grows from an insider's knowledge, for when he isn't filming the weekly *The Nature of Things* for the Canadian Broadcasting Corporation (CBC), he is professor of genetics at the University of British Columbia. "When I started [on TV], my hair was down to my shoulders and I wore a headband. The scientific community was absolutely outraged that I would go on as a scientist, because I didn't represent the mainstream."

Suzuki's first involvement with television occurred in 1963, when he did some programs for local television while at the University of Alberta, but his real breakthrough into the medium came in 1971 with a half-hour weekly series, *Suzuki on Science*. This led to his hosting CBC's half-hour *Science Magazine*, from 1974 to 1979. Following his five-year stint with *Science Magazine*, the geneticist joined CBC's *The Nature of Things* as host and frequent writer. The show is among CBC's top four, drawing the largest audience for its budget and garnering the highest foreign sales. While individual segments have been picked up in the United States and Great Britain, the series is seen intact by viewers in Australia, New Zealand, Europe, and Malaysia.

Its hour-long format gives Suzuki the freedom to report in depth. He devoted an entire program to explaining the prenatal diagnosis of genetic disease and exploring the ethical issues it raises. He filmed two shows in the People's Republic of China, detailing the Chinese use of modern biological techniques to investigate traditional medicine and agriculture. He investigated, perhaps for the first time on Western TV, how Mao's Cultural Revolution had adversely affected Chinese scientists and engineers.

Before establishing himself as a popularizer of science, Suzuki was a highly successful researcher. His scientific peers elected him president of the Canadian Society of Cell Biology in 1969, the same year he received the E.W.R. Steacie Memorial Fellowship as the outstanding Canadian research scientist under thirty-five years old. More recently he became associate editor of the journal *Genetics* and was elected to a three-year term as secretary of the Genetics Society of America.

Despite these honors, Suzuki remembers the transition from scientist to science communicator as a rough one. "When I started, the reactions varied enormously, from 'You're so great in science, why are you wasting your time doing this?' to a dean saying, 'Who the hell do you think you are, trying to represent science on television?'"

Today Suzuki's hair is shorter, although he still does not wear a tie on-screen. "But for the past ten years the level of funding for science has been dropping in Canada, and so in the last eight years there's been a marked change in the attitude of the scientific community."

More painful to confront than the reactions of his colleagues was admitting to himself that he was moving out of research. "It took a long time for me to accept that," Suzuki recalls. "As a scientist, your identity is tied up in publishing. If you are no longer publishing, if you are no longer at that forefront, you feel like you've lost some of your masculinity." He smiled ironically.

The transition away from research didn't happen all at once, and it involved Suzuki's other driving passion, civil rights. Like other Japanese Canadians (and like Japanese Americans in the United States), Suzuki and his family were interned in a relocation camp during World War II. "My grandparents emigrated from Japan when they were teen-agers. My parents were born in Vancouver, and I was born in Vancouver," he recounts. "But after the war the Japanese in British Columbia were faced with either going to

CONTINUED ON PAGE 137

Suzuki: "TV viewers say 'You're smart, you're on TV, you're a scientist. Tell us what to do.'"

THE ARTS

By Robert Weil

If you've ever wondered about the sex lives of yeast cells, why NASA officials are watching reruns of *The Flying Nun*, how many insect pieces the FDA allows in a two-ounce serving of cocoa, or even why pygmies are short, then you haven't read *Omni's Continuum*, a book of scientific phenomena released just this month by the prestigious Boston publishing house Little, Brown and Company.

Based on the silver-colored column of science news that has been an *Omni* staple since its maiden issue in October 1978, the book marks the inauguration of an entire line of Omni books to be published in the years ahead and suggests that Continuum is rapidly becoming an American institution, much along the lines of *The Guinness Book of World Records*. The Continuum book has already generated interest in several countries and will be published in England by Sidgwick & Jackson.

Omni's Continuum is composed partly of the most noteworthy items in the column's history, but half of the stories are brand-new happenings, never before published. There's an additional treat for the reader: *Omni* will be offering a contest—a quiz of difficult science questions that can be answered only by reading the book—with some remarkable prizes for the winners. Details and regulations will be announced in next month's Continuum column (July 1982).

According to editorial studies, Continuum is *Omni's* most widely read department. It also rates high in credibility. An amazing 96 percent of the *scientists* who read the column give it the highest rating possible for quality.

The book *Omni's Continuum*, as well as the monthly column, is edited by *Omni's* reclusive executive editor, Dick Teresi. He attributes the column's success and the book's scientific vitality to *Omni's* unique philosophy about science news. "Editors often equate length with seriousness. And because news items are shorter than feature articles, most magazines put junior editors in charge of such departments, who in turn assign stories to beginning writers. But here we put top people behind the Continuum articles."

Teresi's coeditor of the column is Pamela Weintraub, a former newspaper reporter and veteran of three science and technology magazines. Together, they manage an international network of hundreds of writers, who scour the earth for dramatic phenomena from the frontiers of science.

For instance, Continuum's Swedish correspondent broke the story of the first "Human Carrot." It's about researchers at Sweden's Institute of Molecular Cytogenetics who fused human cells with carrot cells. While the story would seem to carry many of the elements of a science-fiction yarn, carrot-human cell fusion holds important implications for cancer research.

Continuum's coverage of the space program goes far beyond NASA and makes use of journalists who constantly monitor breaking stories in the Soviet Union. One such story is a report on an experiment at Moscow University in which exobiologists at the Space Biology Laboratory there simulated a Martian environment in an airtight chamber to find out whether any forms of Earth life could survive on Mars. The surprising result: Fungi, lichens, algae, and mosses all developed and multiplied at a normal rate.

Continuum reporters have also dug up important inventions and innovations previously unnoticed by the press. An example is Sorbothane, a polyurethane protective pad that absorbs up to 95 percent of impact energy. Requests for information about the substance came in from auto manufacturers, stunt men, football coaches, and film crews, and there were even several surreptitious inquiries from the military.

You would think the moguls of high technology would not have to read of such things in a popular magazine. But Teresi points out that science and technology are expanding so rapidly that not even scientists can keep up with current events.

He cites a recent issue of a prestigious scientific journal—edited and written by scientists—that predicted X-ray holograms will soon be developed. "The boldness of that prediction," Teresi explains, "loses some of its zing when you consider that the X-ray hologram was invented ten years ago."

This is one of the recurring themes of the Continuum book. People, including scientists, get so mired down in the mundane trivialities of life that they don't notice the remarkable happenings around them. And with that tunnel vision comes pessimism. *Omni's Continuum* begins by reminding us that Dwight D. Eisenhower derided the importance of orbiting space satellites and that H. G. Wells predicted submarines could do no more than drown their crews at sea. And even Thomas Edison said, "They never will try to steal the phonograph. It is not of any commercial value."

Omni's Continuum points out that our leaders and scientific geniuses can often be overly pessimistic and that we should open our eyes during skeptical times to what is really happening. If we do so, we may discover that some of our wildest dreams not only are very possible but may already have happened. ∞

An American institution in the making?

CONTINUUM

Edited by Dick Teresi

MOTHER LOVE

Each week I collapsed on my shrink's ratty couch, fastened my eyes to a splashy, purplish wall print of Martin Buber, and talked about Mom. 'She tied my hair back in braids while other kids had perms,' I said, my eyes welling with tears. "She eavesdropped on my phone calls. And she hated all my friends."

The prognosis was bleak. My mother's inability to love, the shrink said, had left me narcissistic and nihilistic, helplessly stuck in the first dismal stages of the Oedipus complex. I'd need years on the couch to recover.

I'd just set aside $10,000 to pay for my cure when I met Elizabeth Badinter, a soft-spoken French philosopher who made me feel better for a lot less money. Maternal instinct, she told me, simply did not exist. Mother love was not innate, immutable, and biologically determined, but merely a sentiment, one that varied from individual to individual, depending on the mores of the time. And I, the child of a critical mother, was not a *tabula rasa*. I was born with a unique character, and, though my mother may have hurt me, she couldn't warp me beyond repair.

Badinter, author of the new book *Mother Love*, started forming her theories a decade ago, during walks through the streets of Paris with her three small children. Watching other young mothers, she realized that "many of them were angry, not happy at all." Given accepted notions of effusive maternal love, she puzzled over the dissatisfaction of these women. Was their behavior horribly aberrant, she asked herself, a new and dangerous force in French society? The answer she finally came to was an unequivocal no. Many of the women seemed to be normal, relatively well-balanced people who just did not like their children.

It was in the late Seventies, while teaching a class on the history of the family at the Ecole de Polytechnique, in Paris, that Badinter began to research the issue in depth. Delving into eighteenth-century police records for course information, she discovered a staggering chronicle of maternal neglect. Out of 21,000 infants born in Paris in 1780, fewer than 2,000 were cared for by their mothers or live-in wet nurses. The 19,000 others were shipped to the countryside in the care of poverty-stricken young women, hired with little regard for their character or health.

Poor mothers, Badinter learned, had no choice. By sending their infants away for a minimal fee, they were able to take desperately needed jobs. But richer women relieved themselves of children simply to have time for socializing and fun. Rich or poor, the banished babies were fed meager diets of wine-soaked bread and mashed chestnuts, and more than half of them died.

Then, during a single generation at the end of the century, everything changed. Infant mortality had reached such high levels that the French feared they wouldn't have enough soldiers to fight a future war, and frantic officials, led by Jean Jacques Rousseau, set out to improve children's chances of survival. In hundreds of speeches and books, they told women it was *natural* to keep children home for breast feeding and care.

Motherhood slowly became a consuming occupation for Frenchwomen, one that left them little time for anything else. By the 1800s they had chief responsibility for a child's moral upbringing and education. Then, in the twentieth century, Sigmund Freud imposed even higher demands on mothers. They were, he said, responsible for their children's lifelong happiness or unhappiness. A natural mother saw her child through every phase of its development. Freud explained, sacrificing other goals and desires to ensure the child sufficient love. Women who neglected their children, however, were unnatural, sick and sadistic; they created monsters, emotionally crippled for life.

Today's mothers are routinely saddled with impossible responsibility, then forced to wallow in bottomless guilt. But Badinter thinks "experts" who inspire such guilt are the *real* criminals. Though some women like being mothers, she says, some don't, and neither tendency is more "natural" than the other.

Furthermore, Badinter says, if mother love were essential to one's psychological health, psychosis would have waxed and waned with the centuries. But instead, the neglected infants of 200 years ago emerged no more psychologically scarred than the scrupulously loved children of today. As an example, Badinter describes the fate of eighteenth-century statesman Charles Maurice de Talleyrand, who acquired his clubfoot as a baby when a nurse allowed him to fall from a chest of drawers. Talleyrand barely saw his parents for the first four years of his life, yet grew up to possess one of the most rational minds in history.

As for the sessions with my shrink, Badinter has persuaded me to abandon them. I've decided to save the cash and get a good leather couch for my den.—*PAMELA WEINTRAUB*

CONTINUUM

GIGANTIC SHRIMP

Huge shrimp are growing in coastal rice fields near Georgetown, South Carolina. Up to eight inches long and ten to the pound, these gigantic shrimp are actually domestic animals transplanted to the wild. And they are delicious.

Scientists at the Belle Baruch Institute for Marine Biology at the University of South Carolina, placed microscopic South Pacific white shrimp larvae in the rice fields to see whether they would prosper in a natural environment. They grew larger than those stocked in ponds where they were cared for," says John Dean, head of the project. "They're just humongous shrimp."

Dean, who attributes the success of the project to two graduate students, Chuck Wilson and Noel Alon, says the experiment has important implications for the future of aquaculture.

"In this field we're still in the hunter-gatherer stage. But these shrimp are domestic. They've gone through several generations in the lab. Now, to use a comparison, we can begin to talk about going from longhorn steers to domesticated Anguses and Herefords. We can talk about selective breeding for high producers, egg output, and the other things beef, chicken, and pig producers have been doing for ages."

But we can avoid the mistakes of agriculture," Dean cautions. "We don't want to go into a heavily fossil-fuel-dependent system—this business of putting in twenty-five calories to get one calorie of beef. In the rice fields, he suggests, solar energy and naturally available food do the work. One private company, Palmetto Aquaculture, is planning to raise shrimp on 1,000 acres this year.

And how do these jumbo shrimp taste? In blind tests, subjects couldn't tell the difference between them and native brown and white shrimp," Dean says. "They're tender, sweet, lovely animals, and I'm getting hungry talking about them."

—Allan Maurer

Humongous shrimp. Up to eight inches long and ten to the pound, they're domestic animals that have been transplanted to the wild.

"Fear is the main source of superstition, and one of the main sources of cruelty. To conquer fear is the beginning of wisdom."
—Bertrand Russell

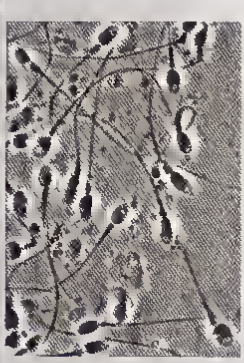
"I like trees because they seem more resigned to the way they have to live than other things do."
—Willa Cather

DEADLY INTERCOURSE

Sexual intercourse is pleasurable for most people, but it can be a life-threatening experience for a handful of women who are allergic to semen.

"Male ejaculate consists of sperm cells surrounded by a highly concentrated protein coat that can provoke an extreme allergic reaction," explains University of Cincinnati allergist Leonard Bernstein. Those affected may go into shock, suffer asthma attacks, or find it impossible to breathe. Bernstein, who has studied three women with the condition, says two of them nearly died after sexual intercourse, but were saved with adrenaline injections.

The precise biochemical mechanism that causes the protein secretions to trigger an allergic reaction has not been determined. But Bernstein hopes to desensitize patients in the future by injecting them with microscopic amounts of the irritant. For now, the hypersensitive women can have sexual intercourse only when their partner uses a condom. It is possible, however, to inseminate them artificially with sperm cells cleansed of the protein.



Sperms. Their protein coat can spell death for some women.

"These women can't have sex in a normal way. There is always the fear of dying," Bernstein says. "One of the women is extremely afraid of being raped."

—Eric Mishara

COTTON CATCHER

A Raleigh, North Carolina, company has developed what it terms a "revolutionary system" for recycling cotton wastes into a variety of usable products.

Called a CottonMaster, the machine not only recovers gin motes, fibers too short for ordinary use, but also cleans dust, lint, and harvesting dirt from baled cot

ton better than other processes, its maker claims

The CottonMaster restructures gin motes, fibers one-half inch long or shorter into longer ones useful in disposable cotton products These include household wipes surgical and industrial sponges and filters says Wayne Hurter, spokesman for Cotton, Inc which developed the machine 'They'll be price-competitive with rayon products and in some ways better offering more absorbency, for instance he notes

One of the side benefits of the machine, already at work in several factories may be cleaner air in cotton mills where dust is a suspected cause of brown lung disease or byssinosis

—Allan Maurer

VIDEO HAIRCUTS

'This isn't the way you cut my hair last time" may be the complaint barbers and hairstylists hear most often Barry Leonard of Philadelphia doesn't ever want to hear it again

So he uses computer controlled video cameras to record every haircut his patrons receive

Leonard spent two years and nearly $15,000 to develop his Tel-a-Cut system It includes three computers and a centralized command module Leonard claims it 'took six or seven engineers to build it'

His clients can choose a numbered hairstyle from a computerized slide show or view previous haircuts on videotape

Do they get the same haircut every time? Though most clients are right when they claim they do not Leonard says, some are prey to the second cup of coffee 'syndrome 'Frequently the haircut is the same but the thrill isn't there It just isn't as exciting the second time'

—Allan Maurer

Video hairstylist In any science, replicability is the goal

OUCHLESS, REALLY

Some 50 years experience with the adhesive bandage has inured us to its drawbacks It keeps healing oxygen and moisture away from the wound it kills all skin under the adhesive and it rips out hair when it's removed But technology has at last improved on the gauze and-glue dressing Manufacturers in the United States and abroad are now producing a surgical dressing made from polyurethane that not only lacks the adhesive strip's shortcomings but actually promotes healing and costs less too

The new bandages have the stretch and consistency of plastic food wrap al though they are opaque and come in all sizes from one-inch squares to large sheets several feet on a side A protective paper backing peels off to expose an underside completely coated with adhesive material that does not stick to injured skin When applied over a wound the dressing forms a bubble that looks like a blister

Most wounds take two weeks to heal, according to Dr S Randolph May director of burn research at St Agnes Medical Center, in Philadelphia But under the cloudy bubble of the new bandage even skin-graft wounds on severe burn victims heal completely in only six days

The reason for the dramatic difference Dr May explains is that the bubble breathes By allowing oxygen to reach the wound, the new bandage attracts a greater number of bacteria eating white blood cells to defend the wound site against infection And because there is no gauze covering to clog the blood, clots are smaller and can be broken down more rapidly as new skin grows

The only problem, as far as May can tell is that the bubbles are not widely available The brand he tested, Op Site is produced by Smith and Nephew in England and is also marketed in the United States 3-M makes a similar product called Tegaderm and the West German manufacturer Lohmann produces a brand known as Opraflex

—Dava Sobel

Toward the perfect bandage The new variety is a blister-like bubble that lets oxygen in, won't clog the blood and doesn't stick

Thinking is an experimental dealing with small quantities of energy, just as a general moves miniature figures over a map before setting his troops in action

—Sigmund Freud

CONTINUUM

PLASTIC WAVES OF GRAIN

The wave of the future, Dustin Hoffman is told in the movie *The Graduate* is "plastics." Erle Bartley, an animal nutritionist at Kansas State University in Manhattan, Kansas, couldn't agree more. He and his research colleagues have come up with a plastic substitute for hay. In the future Bartley expects his plastic chips to be mixed routinely with grain and fed to cattle during those last few months when the steers are being fattened for slaughter.

Like hay, the cough-drop-shaped disks keep the steers' stomach and intestinal tract clean, preventing digestive disorders. Tests at Kansas State show that the animals do not absorb any of the plastic. It takes only a tenth of a pound of plastic roughage a day to accomplish the same thing as four or more pounds of hay," Bartley points out. This means a saving of about 11 cents a day per head of cattle. Another advantage: About half of the plastic (a mixture of ethylene and propylene) can be recovered and used again.

There are also good health reasons for going to plastic hay, Bartley says. Many feedlot operators are quite allergic to the hay dust; even cattle get runny noses and eyes. — Marcia F. Bartusiak

"You lack half-wit. You crush all the particles down into close conformity and then walk back and forth on them."
— Marianne Moore

"The major task of the twentieth century will be to explore the unconscious, to investigate the subsoil of the mind."
— Henri Bergson

Good news for cattle with hay fever. They no longer have to eat hay as long as plastic chips are mixed with their grain feed.

VASECTOMIZED DONKEYS

Ossabaw Island, a wildlife preserve off the coast of Georgia, has found a novel way to control its donkey population: vasectomy.

When 11 Sicilian donkeys were brought to Ossabaw in 1965, island owner Eleanor Torrey West thought they would make a nice Christmas present for her young son. But to her surprise, they began reproducing, and by 1978 the herd numbered 75. The state of Georgia told West she would have to eliminate the donkeys, which were eating too much of the moss and grass that fed the island's native deer and other wild animals.

At first, West says, the preserve seemed to have only two options: to sell the donkeys or castrate them (remove their testicles). If West sold the donkeys, many would end up caged in zoos, and that seemed too odious. Castration would probably not be effective because it would be almost impossible to capture every male donkey; if a single fertile male remained, he could impregnate all the female donkeys. The other males, rendered passive by their castration, would fail to protect their female mates from the still-aggressive rival, giving him free rein.

Finally West, along with Ossabaw's research director, biologist H. B. Graves, came up with the idea of vasectomy. Instead of removing the donkeys' testicles, the vasectomies would require only the severing of two small internal tubes. The testicles would remain intact, and the testicular hormones that control aggression would continue to flow. Therefore, the males would guard their mates. Any fertile male that escaped capture would manage to impregnate only one or two females at most.

Because of the vasectomies, the Ossabaw donkeys will become extinct in 50 years. According to Graves, if vasectomies were limited to just some of the males in a wild animal population, it would be possible to limit the number of individuals without exterminating the group. — Kathrine Jason

"The poet is in command of his fantasy, while it is exactly the mark of the neurotic that he is possessed of his fantasy."
— Lionel Trilling

Severing a donkey's tubes saves it from castration.

SHUTTLE AGENT

When manufacturers look to the sky these days they often see dollar signs instead of stars To them space represents a giant laboratory where they can produce rare drugs, generate solar power or survey the earth for its oil and mineral deposits

But while NASA is currently putting its first shuttle through rigorous tests and awaiting the delivery of three more shuttles, industry has been unable to arrange passage for its own private space projects Now a forward-looking company wants to become a sort of travel agent, booking shuttle space for commercial companies The firm, Space Transportation Company, says its goal is to take the marketing responsibilities off NASA's hands and reap the benefits of the $20 billion in space-industry business expected by the turn of the century

So enormous is the potential, the Princeton, New Jersey company asserts, that it is prepared to put up $1 billion in investors' money to cover the cost of building a fifth shuttle The ship's giant cargo bay — a cylinder 15 feet in diameter and 60 feet long — would be large enough to carry several satellites for orbital launch

NASA is seriously considering this proposal Not only would it relieve the government agency of the arduous task of marketing payload space but it would also make possible construction of what NASA considers a much-needed backup shuttle — a shuttle that probably would not otherwise get off the ground in this time of budget cutting

— Bethany Campbell

Big business is high on the shuttle so much so that a New Jersey company is prepared to put up $1 billion to build a fifth ship

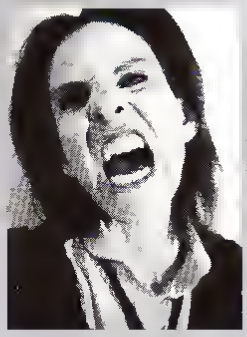
BITTEN BY LOVE

'I was in a rage at my mother So I took a bite of her arm A whole piece of flesh was in my mouth

Sitting tensely in the office of Montreal psychiatrist Harold Levitan, a young woman describes last night's nightmare Like many of Levitan's patients, she suffers from psychosomatically induced arthritis; symptoms include a stiffness of the joints and repeated dreams of biting or being bitten

Levitan has studied 25 women afflicted with the disorder, and he has found that nearly all "were savagely abused by husbands or boyfriends ' One patient was deliberately scalded, another was nearly drowned, and a third was shot

Most of these women had brutal marriages they couldn t bear to leave, Levitan explains But the relationships eventually ended either when the husband found another woman or when he was forcibly removed by legal authorities Unable to express their rage the women developed arthritis much as a high-strung salesman often develops stomach ulcers



Abuse by husbands can lead to dreams of biting rage

Only in dreams could Levitan's patients deal with their problems "Biting is an infantile expression of rage," Levitan asserts "These women revealed their unconscious hostility in dreams about biting because they have a tendency to regress '

Today Levitan helps those who suffer from psychosomatic arthritis leave their damaging relationships But he's also begun studying the early development of these women in the hope of learning why some people are continually bitten by love

— Charles Craig

PIGSKIN

British biochemist Roy Oliver wanted to try a new way of replacing tissue lost from severe burns, so he implanted a piece of pigskin in his own abdomen

First he soaked the pigskin in the enzyme trypsin to dissolve away the cells, which would have been rejected by his immune system Then he toughened what was left with a chemical used to tan leather The process left a spongy mass of collagen the fibrous tissue generally found in healthy skin

"The advantage of pigskin implants over the usual human-skin graft is thickness," Oliver claims "A skin graft can cover a hole where tissue has been lost, but the hole remains The pigskin extract fills the hole yet leaves a natural-looking skinlike substance on the surface "— Owen Davies

CONTINUUM

CHOLESTEROL CURE?

When a person ingests too much cholesterol fat piles up in his arteries The arteries harden Blood flow slows down And one more person suffers a heart attack or a stroke

The scenario is familiar, and so is the doctor's advice Maintain a low-fat diet Although low-fat diets reduce cholesterol levels in the blood, they don't always prevent hardening of the arteries And how many of us can stick to a low fat diet anyway?

With this in mind cardiologist Dieter Kramsch, of Boston University Medical Center has come up with a new way to stop hardening of the arteries His method Prevent calcium ions which promote hardening, from lodging in the artery walls

To test the treatment Kramsch and his colleagues fed 30 monkeys a high-fat diet Eight received no treatment while the others received various anticalcium drugs After two years the researchers destroyed the hapless monkeys

Traditional advice for avoiding clogged arteries is to skip foods rich in cholesterol But the real secret may be anticalcium drugs

All the animals had cholesterol levels three to four times higher than normal The arteries of the untreated monkeys were padded with the fatty deposits that lead to heart disease and stroke The treated monkeys, however, were nearly clear of such fatty deposits, and they appeared to be as healthy as a control group of monkeys fed a normal diet

These results and similar ones from experiments on rabbits may lead to new ways of preventing heart disease in just a few years "There are already avenues that one can see, where we can go, Kramsch says His optimism is shared by drug companies Several pharmaceutical concerns have already expressed their interest in developing the drugs

— Carol A Johmann

Science is a cemetery of dead ideas even though life may issue from them '

— Miguel de Unamuno

'The purpose of psychology is to give us a completely different idea of the things we know best '

— Paul Valéry

LEVOPHOBIA

Imagine a world where it is impossible to walk or even look, to your left This world really exists for people who have a rare condition known as levophobia, an irrational fear of the left

When a levophobic person faces the prospect of a left oriented maneuver, psychologist Neal Olshan, of Mesa Lutheran Hospital, in Arizona, explains, his brain triggers the release of adrenaline and his heart begins to pound just as it would before a heart attack The levophobic city-dweller never stands at the left side of an elevator and the levophobic driver maps his itinerary to steer clear of left-hand turns The mere thought of standing on the left-side checkout lines in a supermarket throws the levophobic shopper into paroxysms of fear

Left turns strike fear into the hearts of levophobics

Olshan says that levophobia is most often found in left-handed individuals who were forced to become right-handed when young As children these individuals viewed the left as abnormal and dangerous As adults, their skewed perspective causes them to have bizarre accidents while making left turns at intersections, say or while working to the left of others in a factory Ultimately these people become so traumatized that everything on the left fills them with terror

Olshan says that this crippling disorder will be obliterated only when society accepts the left handed child Meanwhile he has already helped more than 100 levophobics with simple hypnosis and relaxation exercises — Eric Mishara

'I would rather understand one cause than be king of Persia

— Democritus of Abdera

A prudent question is one half of wisdom '

— William James

ASPIRIN AND CATARACTS

Yet another medical use has been found for aspirin. It may help block the development of cataracts.

Researchers at Yale University's medical school began looking at aspirin's effects on the eye after noticing that arthritis patients who sometimes consumed up to ten aspirins a day to soothe joint inflammation had only about half as many cataracts as other arthritics not taking aspirin.

Yale ophthalmologist Edward Cotlier says aspirin opposes the cross-linking of proteins in the eye's lens fluid, a biochemical abnormality that causes the lens to become cloudy or to form a cataract, thus blocking light to the retina. Aspirin also thwarts sugar buildup in the lens (a condition that makes diabetics prone to cataracts at a younger age than non-diabetics).

Large-scale studies at medical centers throughout the country are in the planning stages to prove definitively aspirin's value in treating cataracts. Meanwhile, Cotlier and some of his colleagues are prescribing four aspirins a day for their eye patients.

"Aspirin is not going to reverse already-formed cataracts," Cotlier says, "but it will slow them so surgery can be postponed."

—Caroline Rob

Eye with cataract. Aspirin opposes cross-linking of proteins in the lens fluid, which is what causes the lens to become cloudy.

If you want to kill any idea in the world today, get a committee working on it.
—Charles Kettering

Technology... the knack of so arranging the world that we don't have to experience it.
—Max Frisch

"When you get to the point where you cheat for the sake of beauty, you're an artist."
—Max Jacob

RESPONSIVE TV

Remember Bugs Bunny's favorite remark, "What's up, Doc?" Future television viewers may be able to provide him with just the right answer, thanks to an interactive video-disc system invented by computer programmer Robert M. Best of Seattle.

Best's patented system includes a voice-recognition computer that enables viewers to converse with characters on a TV screen. In one version of the invention, cartoon characters on the screen ask questions that can be answered in several ways. Because the disc can store vast quantities of information, it can be programmed to recognize a wide range of answers and to put the cartoon characters through a different prerecorded response for each one. Depending on the video-disc program, the viewer can converse with the character or can even give it commands.

Best envisions videophiles chatting with images of famous personalities, calling the plays in athletic events or simply responding to one-liners like "What's up?" The video disc can even be personalized so that characters address the viewer by name.

Right now Best's invention is still in the conceptual stage. But he has already interested a video-game manufacturer in his idea. "Twenty years from now, when interactive movies are commonplace," he predicts, "today's movies will seem as crude as silent films."

—Phoebe Hoban

"If triangles had a God, he would have three sides."
—Charles de Secondat, Baron de Montesquieu

What's up, Doc? A new television with a voice-recognition computer allows Bugs Bunny and other characters to talk back to the viewer.

CONTINUUM

UNIVERSAL TRANSPLANT

The greatest obstacle in transplanting hearts or kidneys from one body to another is rejection. Tissues implanted in patients are quickly recognized as foreign and are vigorously attacked by the body's immune system.

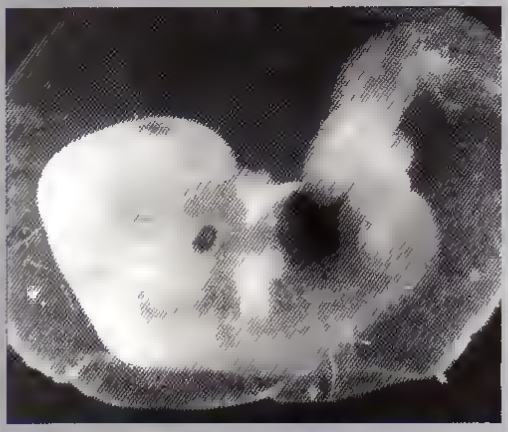
But now a solution may be at hand in the form of one "foreign" organism seldom rejected by the body that nurtures it: the human fetus. The amniotic membrane surrounding a fetus is not rejected by the mother, say doctors at Guys Hospital, in London. So it might not be rejected by *anybody*.

To test the hypothesis, physician Charles Alke examined cells from a membrane removed during a Cesarean delivery. First he showed that the cells lacked the proteins by which other tissue is recognized. Then he and his colleagues implanted bits of the membrane into their own bodies. Several months later they removed this tissue and found no sign of rejection.

Today Alke is trying to transfer part of the amniotic membrane to patients who may die because they lack the crucial enzymes for breaking down metabolic waste. He's already learned that the amniotic membrane produces such enzymes, and he hopes it will continue to do so when grafted onto the bodies of diseased individuals.

Doctors at Guys stress it will be some time before they know whether the technique will work. Meanwhile they have plans for the future, they would like to engineer fetal cells that could provide the ill with crucial substances ranging from insulin to interferon. And they would like to transfer hearts and livers wrapped in the amniotic membrane as a safeguard against rejection.

—John Newell



Human fetus. The amniotic membrane is not rejected by the mother, now scientists speculate that it might not be rejected by anybody

NEW VIRUS TEST

A new test can easily identify many serious viral infections in less than a day. It used to take three weeks to culture a virus specimen and by then the patient would be beyond medical help.

This quick test has come on the market hand in hand with new antiviral drugs for influenza, hepatitis B, and herpes of the brain.

The test is as easy to read as a home pregnancy test and incredibly cheap at $1.50 per specimen. An enzyme and antibodies against a specific virus are placed in solution with the patient's specimen. If that virus is present, the solution will change color once a liquid is added.

Dr. Robert Yolken of Johns Hopkins University, in Baltimore, who developed the test, says it will eventually make today's microscopic techniques obsolete. In the future, he says, it might also identify bacteria, toxins in the environment, and drugs. —Caroline Rob

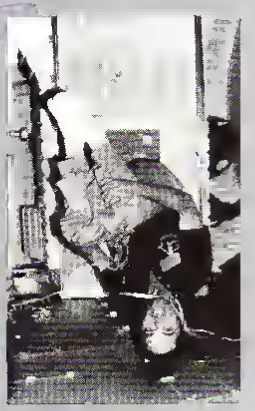
AMPUTEE ASTRONAUTS

Disabled men and women have trouble getting jobs today. But legless people may soon find they are the best possible candidates for a booming new profession—the space-travel business.

According to occupational therapist Trisha Thompson, of the Hastings College of Law in San Francisco, legless people can deal with the zero-gravity environment of space far more deftly than people with legs. During the Skylab space station program of the early 1970s, for instance, doctors found the lack of gravity made legs a drawback. More than one weightless crew member suffered bruised legs while floating through hatchways, and the leg tissue required food, oxygen, and time-consuming exercise.

Thompson is currently investigating the design of equipment that would be needed by handicapped astronauts. And in a joint NASA/Hastings research project, she is examining a wide range of space jobs that would be well-suited for amputees and dwarfs, too.

—Leonard David



Weightless astronauts might be better off without legs

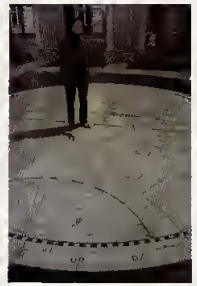
THE MARKETING OF DR. CARL SAGAN

The renowned astronomer discovers life on the world of Business

BY JUDI KESSELMAN-TURKEL AND FRANKLYNN PETERSON

in ways that Carl Sagan himself may not always be aware of some devoted and enthusiastic associates and agents are marketing Carl Sagan while the name is cosmic

In Montrose, California Sagan's space program coworker Gentry Lee watches over a staff that ships products from the Cosmos Store a division of Carl Sagan Productions (CSP), while he juggles preproduction details on the SF movie *Contact*, plotted by Carl Sagan Gentry seeks bids for magazine rights to 'The Making of *Contact*' (with pictures supplied by his wife a professional photographer) and wonders whether *Omni* is interested But back at Cornell University, in upstate New York, Sagan's office (which apparently first heard of Gentry's ideas when we sent a draft of this article for comment) writes us a snippy note "There are no plans to write articles or produce a television program on 'The Making of *Contact*' The latter would be inconsistent with Dr Sagan's credo and



will not happen," it vows

In New York City, Sagan's high-powered literary agent, Scott Meredith negotiates $50,000 from the Bendix Corporation for Carl Sagan to become an advertising symbol Back at Cornell, Sagan turns down the offer as entirely too commercial

Yet Sagan himself has signed into some of the most commercially successful ventures ever to revolve around a single scientist In the past five years Sagan has generated approximately $13 million for himself and operations he's been associated with—including the *Cosmos* TV series a foundation a society, half a dozen book projects and the Montrose mail-order store

There's no way of knowing exactly how much Sagan himself has made He declined to be interviewed on the subject He makes no direct profit from some of his enterprises, and often contributes his time—and sometimes his products—gratis His books alone, on the other hand—

PHOTOGRAPHS BY BILL RAY

written or contracted for—are reputed to have brought in at least $4 million for him.

Never before in the history of science or mass media have a scientist's name, face and voice been as familiar as a Brooke Shields's or Bo Derek's. And as he becomes more and more a celebrity, some observers have noticed, he seems to cling ever more dearly to the "Dr." part of his name that links him to the scientific community. Most Ph.D. astronomers take the title for granted and put it behind them, as Sagan himself did scarcely more than five years ago, when he wore his hair long and shaggy and dressed most days in a loose white fisherman's sweater that was almost a trademark. But at some point in the making of *Cosmos*, the grand-scale TV science series, Sagan may have seen academia slipping from him, and he became *Dr.* Carl Sagan to remind the world of his real roots.

The very suggestion that Sagan is trying to market himself makes some of his spokesmen bristle. "We're not selling Carl," says his bride of about a year, thirty-two-year-old Ann Druyan. "If we were, we'd give our name to licensing agents and say to them, 'Make anything, go ahead, T-shirts, buttons, banners.' We've turned down every offer like that." The credo of the Cosmos Store, devised by Druyan, requires that the Sagan name be associated only with products that are educational, well-designed, and inexpensive.

In fact, this credo (sometimes appearing with a capital C in communications from Sagan's staff) hasn't kept material success from Sagan's door. His income allows him to live in a magnificent house, largely renovated in the past three years, overhanging a large gorge right near the Cornell campus, with a shiny black kitchen, four large trees growing in the living room, and sliding ladders to provide access to upper shelf books. Nor has it kept Sagan's name off many of the products he's approved for sale to promote science. Druyan acknowledges: "Carl is part of the culture now."

Anyone who's watched *Cosmos* or read the book *Cosmos* must know that Carl Edward Sagan, now forty-seven years old, suddenly looked up at the Brooklyn skies six or seven years after his birth and saw stars. The subsequent discovery at his local library, that stars were really other suns, incredibly far away and "astonishingly unlike Brooklyn," set him on the course he has followed ever since.

"I was looking through some boxes Carl had stored," Druyan says, "and found some papers he'd written at twelve, at fourteen, and it's astonishing—the little [Dr.] Carl Sagan is right there, speculating about life in the universe, writing with the authority that distinguishes his work even now. It's not hard to picture the youth who was already doubtful that God occupied the heavens and who began a search for signs of something else out there, some form of life. Not life as we know it on Earth, but random productions of other evolutions on the planets of other suns."

His tenacity in the quest for extraterrestrial life continued through nine years of study at the University of Chicago, which culminated in a Ph.D. (1960) in astronomy and astrophysics. The need to pass along the word that there's life out there grew as he grew. "He was never one to hide his light under a bushel," recalls John Mathis, astronomy professor at the University of Wisconsin-Madison, who worked with the young grad student at the University of Chicago's Yerkes Observatory.

By graduate school, Carl had learned how to get his name in print. Dr. John C. Brandt, currently director of the Laboratory for Astronomy and Solar Physics at NASA's Goddard Space Flight Center in Maryland, remembers as if it were yesterday that twenty-ninth day of December, 1956, when twenty-two-year-old classmate Carl made the *New York Times* by suggesting at a New York meeting of the Society for the Study of Evolution that organisms could flourish on Mars. Felicia Antonelli Holton, editor of the

> "We're not selling Carl. If we were, we'd give our name to licensing agents and say to them, 'Make anything you want. T-shirts, buttons, banners.'"

University of Chicago Magazine, recalls Sagan's walking into her office just about then and asking whether he could submit an article.

"He said he thought he would enjoy writing for the public," she remembers. The title of this first published literary effort—which appeared in print at about the same time as his first scientific research paper—was a question: "Life on Other Planets?" The answer at the article's end was "There is reason to believe they are out there." (A tag line publicized a campus lecture series on "The Creation of Life and the Universe," which Sagan planned. One faculty member later referred to it as "Carl's circus.")

After Chicago, Sagan spent a few years at the University of California at Berkeley and at Stanford University. In 1962 he helped launch the prestigious *Icarus: the International Journal of Solar System Studies*, and was editor in chief from 1968 to 1979. In its first issue he published his paper on the structure of the lower atmosphere of Venus, which some astronomers consider his most important scientific achievement. He also moved to Cambridge, Massachusetts, in 1962 to become an astronomer at the Smithsonian Astrophysical Observatory and to teach at Harvard University.

Before he left Cambridge, Sagan coauthored (with Jonathan Leonard) his first pop-science book, a Time-Life pictorial called *Planets*, and worked in his belief that conditions on Mars might be ripe for life. Then, in 1968, he was signed by Cornell to teach as well as head its new Laboratory for Planetary Studies. He's been at Cornell ever since, except for a leave of absence during the filming of *Cosmos*. Every year another half-dozen or more research papers, bearing his name as coauthor, come from the laboratory and each semester he teaches at least one astronomy class.

While building his reputation over the past two decades, Sagan shared his professional interests with a series of intelligent wives, each with professional standing in her own right. He had two sons by his first wife, biologist Lynn Margulis of Boston University, the oldest, Dorion, is now twenty-two. In 1968 he married Linda Salzman, an artist best known for executing Sagan's design for the *Pioneer 10* and *Pioneer 11* interstellar plaques that carried a message from Earth for any interested extraterrestrials. Then he met exuberant Ann Druyan, a published novelist who worked with him to produce a collection of photos and sounds placed aboard *Voyager 1*—more material for extraterrestrials to decode—which was later made available in book form (*Murmurs of Earth*) for us terrestrials. Druyan says she also helped Sagan with "several television projects that didn't come to fruition." They began living together in 1977, when she was twenty-eight, and married last June after his divorce became final.

In spite of his three marriages, those who know Sagan say that he is anything but a philanderer. His relationships with his wives have been extremely close. He shared friends and interests with them and involved them in his work.

Sagan's fellow scientists consider him a competent astronomer who showed more aptitude for designing theories than for research, although he has served his time at the telescope and the computer and contributed to the Mariner 9, Viking, and Voyager missions. Cornell colleague Frank Drake has fond memories of rousing Carl before dawn in Puerto Rico and driving all the way out to the radio observatory at Arecibo, too tired to talk, breakfasting on crusts of garlic bread from the previous night's dinner. Some say Sagan's several scientific contributions peaked young.

Acquaintances among scientists say he's likable and entertaining if sometimes stubborn in demanding attention to his priorities. ("If I were stuck at a boring scientific meeting in a foreign country where I didn't know the language," says one, "the man I'd try to have lunch with would be Carl.") Most of his employees consider him to be a latter-day Leonardo: imposing scientist, brilliant author, gifted teacher in any medium. And those who've had to work

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with him in other fields—editors at publishing houses, public-relations personnel, television producers—variously characterize him as imperious, arrogant, boorish, and a stickler for unimportant detail.

"I haven't found Sagan to be difficult to edit when I've dealt with him personally," one science editor says. "Once you get Sagan himself on the phone, he is as professional to work with as any writer in the business. But trying to get a sentence changed by going through his various agents and factotums is sheer frustration." Such problems haven't prevented Sagan from selling his writing with ease to mass markets. A list of popular articles fills 20 single-spaced pages of his 58-page vita.

In his lectures, Sagan tells a favorite story about how he became committed to popularizing science. It was in the early 1970s when the Mariner mission to Mars drew scientists and news crews to the Jet Propulsion Laboratory in Pasadena to get the first detailed look at the planet's surface. As the spacecraft neared Mars, a giant dust storm engulfed the planet, obliterating its features so thoroughly that every picture *Mariner* returned looked like a fuzzy tennis ball. Days passed like this, until all the reporters had left. But then the dust settled and *Mariner*'s cameras revealed mountains and canyons more imposing than any on Earth. 'Come back!' Sagan said to the television crews. But they declined his invitation, he recalls, because *Mariner* was no longer "news."

His ability to popularize, though, hasn't necessarily helped his reputation as a scientist. Sagan has picked up at least seven prizes, medals, and awards for scientific achievements, memberships in 14 scientific societies, nine honorary doctoral degrees, and the Pulitzer Prize. Yet some of the biographical directories of great twentieth-century scientists have overlooked him, and he has never been invited to join the ranks of the illustrious National Academy of Sciences, although he served diligently on at least six of its panels and committees. Sagan himself has probably hoped for the possibility of a future invitation; another note from his office reminds us: 'The typical age at which scientists are elected to the National Academy of Sciences is in their 50s. Dr. Sagan is 47."

Astronomer Fred Whipple says the slights 'may mean he's not considered eminent enough, but perhaps it's because the amount of public exposure he's sought has annoyed other scientists."

Author James Michener reported in the *New York Times* that such "colleagues dismiss him as a mere popularizer."

"Let the purists scoff," seems to be Sagan's philosophy. Popularizing is important work, and, besides, it has made him a wealthy man. Even his first out-and-out commercial book, *The Cosmic Connection*, sold more than half a million copies. But his solo projects pale when compared with the dollars and cents being collected by the three organizations that he's been instrumental in forming over the last five years and heads as president.

First came Carl Sagan Productions, Inc., subtitled "Science for the Media," which has so far produced the TV series *Cosmos*, the book *Cosmos*, the record *Cosmos*, and the Cosmos Store. CSP was created by Sagan and his close friend and coworker on the NASA-JPL Viking project, B. Gentry Lee, a forty-year-old Texan whose best talent is management—although until now Lee's never had to manage a corporation. Tall and boyish-looking, he wears Western-style clothing and a gold identification bracelet with "Gentry" spelled out in diamonds. Before being "absolutely in charge of the business end of our efforts," as Druyan describes his role, executive vice-president Gentry was in charge of scientific analysis and planning for the Viking mission while Carl was on its imaging team interpreting the photos that came in from Mars. Lee agrees with Sagan that it was the lack of public enthusiasm over the Mars

> *"The slights may mean he's not considered eminent enough, but perhaps it's because the amount of public exposure he's sought and obtained has annoyed other scientists."*

landing that led them to say "Well, maybe there are not enough scientists among the communicators. So let's set up a corporation to do that." Since the medium that communicates the fastest to the mostest is television, he and Sagan leaped in.

Now there's some question as to which came first, the *Cosmos* idea or Sagan's involvement in it. Before teaming up with Lee, Sagan had been talking about doing a TV science-fiction film with the flashy director of *Apocalypse Now*, Francis Ford Coppola. Lee says he and Sagan began working out the detailed content of *Cosmos* in his own suburban backyard on December 26, 1976, after Sagan received three or more separate requests from "people around the country" to 'do something on astronomy.' Some folks at KCET-TV insist the *Cosmos* concept came from Greg Andorfer, a station staff member who became one of the producers of the series. Whoever thought up the idea, evidently its time had come. The show has already appeared on the tube in 52 countries, to paeans and pans. Some point out Sagan's excessive front-and-center screen-hogging through out the 13 segments; others wouldn't dismiss God as quickly as Sagan does. "I believe it's the most popular television series ever of its kind," Druyan effuses.

If *Cosmos* seems patterned after the popular TV import *The Ascent of Man*, it's because the Sagan team hired the producer of that series, Adrian Malone, for its executive producer. The companion book by *Ascent*'s amiable star, Jacob Bronowski, had become a best seller once *Cosmos* began production; a companion book here, too, seemed a natural. CSP asked Sagan's agent to sell the book concept to Random House, which had already signed with Sagan on a separate $100,000 four-book contract.

Heavily illustrated, with Sagan's by-line on the cover in letters nearly as tall as the title, *Cosmos* sold more than a million copies at a hefty $19.95 apiece, since hiked to $22.50, netting, conservatively, $2 million for CSP. "It's astounding!" Lee says.

The search for more media through which to market CSP's science turned next to the music industry. Lee teamed up with Geoffrey Haines-Stiles, of the KCET-*Cosmos* team, to produce a *Cosmos* phonograph record. From the original master recordings they pulled together the series' bits and pieces of Bach to Vangelis Papathanassiou background music. Sagan's office says the soundtrack generated "hundreds of inquiries" about where the music could be obtained. Yielding to the demand, paid off. "Would you believe *Cosmos* is now number one on the charts in South Africa!" Lee exclaims.

Next the *Cosmos* star tackled direct mail. In 1979 Sagan and buddy Bruce Murray, director of JPL, formed the nonprofit, tax-exempt Planetary Society. They made Sagan president, Murray vice-president, and asked Lou Friedman—another JPL friend—to run it. "It's our own media avenue to the people, to encourage exploration of the solar system and the search for extraterrestrial life," says Executive Director Friedman. Using what Friedman describes as 'mostly an aggressive direct mail campaign," the organization has mailed 3.5 million membership invitations, netting more than 100,000 members at $15 each. That's a gross of $1.5 million.

Druyan gushes. "It's the fastest growing organization of its kind in the United States." Correction. Sagan's office writes: "It's the fastest growing membership organization *of any kind* in the United States in the last decade," according to the Washington direct-mail firm of Craver, Mathews, and Smith. In return for joining, members receive what the sales literature calls "a handsome Certificate of Charter Membership" and a bimonthly astronomy magazine. A typical issue, 14 pages in length, contained four short informational space-related articles, reports of society-run conferences and happenings, mail-order coupons for purchasing photos and books, plus appeals for readers' activism in getting Congress to appropriate funds for planned space projects in the future.

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FICTION

THE ACCIDENT

A robot's disappearance mystifies his masters

BY STANISLAW LEM

When Ariel wasn't back by four o'clock nobody thought much of it. Around five it began to get dark, and Pirx, more puzzled than alarmed, had an impulse to ask Krull what could be keeping him, but he didn't. He was not the team leader, and anyhow such a question, harmless and even legitimate in itself, was bound to unleash a chain reaction of reciprocal needling. He knew the symptoms, the more predictable when, as in their case, the team was a randomly selected one. Three people of widely divergent specialization stuck in the mountains of an utterly worthless planet, on a mission that all considered a waste of time.

They had come—their transport, a minigravistat so old that it was good only for scrap iron—equipped with a collapsible aluminum Quonset hut, a smattering of hardware, and a radio station. A seven-week general recon mission. What a laugh! Pirx would have turned it down had he seen it as the mop-up detail it was. Its only purpose was to add one more digit to the raw data fed into their memory banks for programming the following year's manpower-and-resources allocation. And for the sake of that perforated figure they had sat nearly fifty days in a wilderness that, in other circumstances, might have had its attractions, say, for

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mountain climbing. But mountain climbing understandably was strictly against regs, and the best Pirx could do was to contemplate the first pitches while he was doing seismic and triangulation surveys.

For want of another, the planet bore the name Iota—116—47 Proxima Aquarii. With its small yellow sun, its saltwater oceans tinged violet-green (because of oxygen-producing algae), and its sprawling, three-shelved, flora-crusted continent, it was the most Earthlike planet Pirx had ever seen. It not for its G-type sun, a recently discovered and unstable body of low luminosity, Iota would have been ideal for colonization. But the astrophysicists scrubbed all plans for settling this Promised Land even if it would take another hundred billion years before going supernova.

Pirx's regret at having been forced into the expedition was not altogether genuine. Faced with being grounded during the three-month suspension of traffic between them and the solar system, and having to hang around the base's air-conditioned subterranean gardens, glued to a TV set and its mesmerizing programs, he had fairly jumped at the chief's offer. The chief, for his part, was only too glad to be able to oblige Krull. Two man flights were against regs, and Pirx was the only one on furlough. Thus, Pirx came as a godsend. If Krull was thrilled, he gave no sign of it, neither then nor later. At first Pirx thought that Krull had a personal grudge against him, but he soon understood that it was just Krull's natural disposition. Krull was a seasoned veteran of more than ten years of extraterrestrial duty. He was unfit for his profession, cosmography. He had really wanted to be an intellectronics engineer. What tipped Pirx off was Krull's bullheadedness with Massena every time the conversation turned to intellectronical—or, in professional parlance, intellectral—matters.

Massena was too insensitive to notice. Whenever Krull insisted on some fallacious proof, Massena was not content merely to refute the cosmographer. Pencil in hand, he had to take him to the mat, meticulously building his mathematical model and polishing Krull off with a glee that seemed motivated less by self-vindication than by a desire to prove Krull an arrogant fool. But Krull wasn't arrogant, only touchy, no more and no less so than anyone whose ambition and ability were not evenly matched.

Not daring to show Massena that he was a sore loser, Krull made Pirx the scapegoat of his frustration. Typically, Pirx was given the silent treatment. When that happened, he had only Massena for company and he might have become a buddy of this clear-eyed man, except that Massena was high-strung and Pirx had always distrusted high-strung types. Besides, Massena had his tics. His throat needed constant examining, a twinge in his joints meant a change in the weather. Not one of his prognoses had ever come true, but that didn't discourage him from making them. He complained of insomnia and made a point of collecting a hoard of pills every night. He never took the pills but placed them beside his bunk. Each morning he would swear to Pirx, who read till all hours and could hear the man snoring peacefully away, that he hadn't slept a wink, and apparently he believed it. Apart from these idiosyncrasies, he was a topflight specialist, a whiz of a mathematician, and a born programmer in charge of the computerized, unmanned surveying program now under way. He even made a hobby of it, working on one of these programs in his spare time. It rankled Krull no end. The man did his job so well and so quickly that he actually had time to spare, nor could he be reproached for neglecting his duties. Massena was all the more valuable because, paradoxically, their expedition didn't have even one certified planetologist. Krull was anything *but*.

"Robots were not really handicapped or exploited. A much simpler method of coercion had been found, one that was more sinister and much harder to attack on moral grounds."

There was another member of the team, a nonhuman one, the aforementioned Ariel, a nondigital robot, one of the latest Earthside jobs to be developed for fully automated land probes. That Massena was there as a cyberneticist was an anachronism. There was a regulation that stipulated that where there was a robot, there had to be a repairman. Regulations, as everyone knows, are seldom updated, and this one was ten years obsolete. Massena himself was often heard to quip that the robot stood a greater chance of repairing him than vice versa. Not only was it infallible, but it was medically programmed.

Pirx had long ago observed that a man was better judged by his behavior toward robots than by his behavior toward his fellowman. Pirx belonged to a generation living at a time when robots were as natural as spaceships, though their acceptance was not total because of lingering traces of irrationality. Some people were more infatuated with an ordinary machine—with their own car, say—than with a thinking machine. The era of unbridled modular experimentation was waning, and robot construction was now limited to the narrowly specialized and the universal. Only a fraction of the universal robots were human-shaped, because of all the models tested those patterned on nature proved to be the most functional under conditions simulating planetary exploration.

Engineers were never gratified to see their products manifest the kind of spontaneity that bespoke an inner life. Popular wisdom held that robots could think but were devoid of personality. Admittedly, no robot had ever been known to throw a fit or go into ecstasies. They were perfectly balanced, just as their constructors had intended them to be. But because their brains were not mass-produced and because they were the product of a laborious monocrystallization process susceptible to wide statistical variability and minute molecular shifts, no two were ever created exactly alike. So were they individuals? Not at all, the cyberneticists replied, merely the products of a random probability. This was a view shared by Pirx and by just about anybody who had ever rubbed elbows with them or had spent time in close quarters with their always purposeful, always logical bustle. Though more similar to one another than to humans, they were subject to whims and predilections. Some, when called on to execute certain commands, even practiced a kind of passive resistance—a condition that was quickly remedied by general overhauling.

Pirx's attitude toward these quaint machines, so punctilious at times, even ingenious in carrying out assigned tasks, was not altogether clear. In his mind there was something inherently wrong with a situation whereby man had created an intelligence both external to, and dependent on, his own will. The sense of having perpetrated a very clever trick left him uneasy. In the judicious restraint with which man had invested these cold machines with his own cumulative knowledge, ensuring them only as much intelligence as was required, lay a perverse subtlety. When applied to their ingenious constructors, Goethe's maxim *'In der Beschrankung zeigt sich erst der Meister'* inadvertently took on the taste of a tribute perversely transformed into a mocking condemnation. They restrained not themselves but their own products. Pirx, of course, was not about to announce his qualms, knowing full well how preposterous they would have sounded. Robots were not really handicapped or exploited. A much simpler method of coercion had been found, one that was more sinister and harder to attack morally. Robots were crippled, even before they were born, on the drawing board.

That day—their next to last on the planet—was cleanup day. But when it came time to collate the recorded data, they discovered that one of the tapes was missing. They ran a search through the computer

Excerpted from More Tales of Pirx the Pilot, *by Stanislaw Lem. To be published in the United States by Harcourt Brace Jovanovich, Inc., and in the United Kingdom by Martin Secker & Warburg Ltd. Translated by Louis Iribarne. English translation copyright © 1982 by Stanislaw Lem.*

then ransacked all the drawers and filing cabinets during which time Krull made Pirx go through his gear twice Pirx resented Krull s suspicion He had never laid hands on the missing tape and most certainly had not stashed it in his backpack Pirx was itching to pay Krull back, but he had a habit of swallowing his anger, always bending over backward to rationalize Krull's tactless even abrasive manner As usual, he held his tongue volunteering if worse came to worst to team up with Aniel for a repeat

Krull said that Aniel was quite capable of handling it on his own and after loading the robot with camera and film stock and stuffing his holsters with jet cartridges they sent him up to the massif's lower summit

The robot left at eight o clock and Massena boasted he would have the job done by lunchtime The hours ticked by—two o'clock, three, then four Darkness fell but still no Aniel

Pirx sat in one corner of the Quonset hut trying to read, but he was unable to concentrate He was not comfortable The hut's thin ribbed lightweight aluminum wall dug into his back and his air mattress was so flat that the bunk s nut-and-bolt frame kept jabbing him through the rubberized fabric Nevertheless, he didn t change his position Somehow it suited the rancor building up inside him Neither Krull nor Massena seemed fazed by Aniel s absence Massena treated the robot in a purely professional sort of way and—like every intellectronics engineer who claims to know what responses are caused by what molecular processes and circuits—branded as sheer bull the faintest suggestion that a robot could have any spiritual life Still, he was as loyal to, and solicitous of, Aniel as any mechanic toward his diesel He made sure he was never overloaded, respected him for his efficiency and babied him He even referred to him as Angel and Iron Angel

By six Pirx who couldn't stand the waiting anymore—his legs had finally gone to sleep—stood up stretched till his joints cracked wiggled his feet and flexed his knees to restore the circulation Then he began pacing the hut diagonally He was sure that nothing could rile Krull now that he was engrossed in his final tabulations

A little consideration fellas Krull said at last, seemingly unaware that the only one on his feet was Pirx Massena lay sprawled in his pneumatic couch a pair of earphones on his head listening to some broadcast with a look of bemused distraction Pirx opened the door and gazed in the direction of Aniel's return route A few vibrant stars were all he saw as a blustering, howling wind descended on him engulfing his head like an icy stream ruffling his hair and swelling his nostrils and lungs Pirx clocked it at around forty meters per second He lingered for a while until another chill blast sent him back inside where he found a yawning Massena taking off his headset and running his fingers through his hair Krull was frowning patiently going about, filing papers into folders businesslike, shuffling each bunch to square the edges

No sign of him!" Pirx said startling himself with his defiant tone Massena scowled at him

So? He ll make it back on infrared "

Pirx returned Massena s glare but held his peace Brushing past Krull he picked up the book he had left lying on a chair and settled back into his corner He pretended to read The wind was picking up at times cresting to a wail Something—a small branch?—thumped against the outer wall and then a lull for several minutes Massena who was obviously waiting for the ever-obliging Pirx to start fixing supper finally broke down and opened one of the self-heating cans

Pirx wasn't in the mood for eating Famished as he was he stayed put A cool and malevolent rage was taking hold of him and it was directed against his

"Pirx was still stooping and gracefully flourishing the detector rod when he was jolted by an explosion in his head. He peered behind a rock table and went numb."

bunkmates who, as roomies went were not altogether bad Had he assumed the worst? An accident maybe? An ambush by the planet s secret inhabitants by those creatures in whom none but a few spoofers believed? But if there d been a chance even a thousand-to-one chance, ot the planet s being inhabited they d have dropped their piddling exercises long ago and swung into action, following procedures outlined by Articles 2 5 and 6 of Paragraph 18 along with Sections 3 and 4 of the Special Contingency Code But there was no chance not even the slimmest hope ot that happening The odds were better that Iota s erratic sun would explode Much better So what could be keeping Aniel?

Pirx felt a deceptive calm in the hut which now shook with every gust ot wind All right, maybe he *was* pretending to be reading pretending to have lost interest in dinner The others were playing a similar game, too

Since Aniel came under a dual supervision—Massena's as the intellectronician in charge ot maintenance and Krull s as the team leader—either man could be blamed for a foul-up Negligence on Massena's part, or a badly plotted course on Krull's But that would have been too obvious to have escaped notice

Krull had bullied the robot from the word *go*, putting him down in schoolboy fashion, saddling him with errands unthinkable to the others A universal robot after all was not a lackey It was plain to see that Krull was out to get Massena through Aniel not being man enough to attack him openly

It had now become a contest of nerves The loser would be the first to betray any anxiety over Aniel Pirx felt himself being implicated in this crazy silent game What would *he* have done in the group leader s shoes? Not a whole lot probably Send out a search-and-rescue mission? A bad night for that No, a search would have to wait until morning That left ultra-shortwave radio contact, though the mountainous terrain made contact unlikely Aniel had never been sent out on a solo mission before Though they did not forbid such a decision, the rules made it conditional on innumerable counts To hell with the regs! Massena could at least have tried radioing, Pirx thought Instead of scraping that can for the rest of his scorched rations *What if I were out there instead of the robot*? Uh-uh something must have happened A broken leg? But who ever heard of a robot breaking his leg?

He walked over to the plotting board and sensing the furtive glances of his comrades studied the map on which Krull had charted Aniel's route *Maybe he thinks I'm checking up on him* Pirx suddenly looked up and met Krull's gaze The team leader was on the verge of making a snide remark—his lips were already parted—when he backed down under Pirx s cold stare Pirx's steely-eyed glower was not intentional it was just that at such times he was roused to something that commanded on-board obedience and a respect tinged with anxiety

He put aside the map The robot's route went up to and then skirted, the towering rock mass fronted by three imposing precipices Could Aniel have disobeyed instructions? Impossible Maybe he got his foot wedged in a crack and sprained it? Nonsense Robots like Aniel could survive a forty-meter fall They had something better than brittle bones So what the blazes was it? He was growing irritated

Pirx stood up straight and contemplated Massena who sat wincing and blowing between sips of scalding tea and then he studied Krull finally making an exaggerated about-face and retreating to their cramped bunkroom He flipped his bed down from the wall shed his clothes in four fluent gestures and crawled into his sleeping bag Sleep he knew would not come easily but he'd had enough of Krull and Massena for one day Cooped up much longer with those two and he might really have told them off But why waste his breath? The moment they boarded the *Ampere*, Operational Team Iota Aquarii

would be terminated. He shut his eyes.

Silvery streaks snaked under his eyelids, fuzzy light spots flickered and lulled the senses. He flipped his pillow onto its cooler side. Suddenly he had a vision of Ariel now close enough to be touched, looking exactly as he had earlier that day. Massena was fixing him up with the jet cartridges for momentary propulsion—standard equipment to be deployed under strictly prescribed conditions. It was too quaint to behold, as only the sight of a man helping a robot—rather than vice versa—can be, but Ariel's hunchbacklike pack kept him from reaching his holsters. Not that it hurt his pride. He was, after all, a machine, equipped with a microstrontium battery for a heart and capable of delivering sixteen horsepower in a pinch. Perhaps because he was in a semiconscious state, Pirx was revulsed by the sight of it. He was heart and soul on the side of the mute Ariel and was ready to believe fundamentally that the robot was no more the phlegmatic, easygoing type than he was.

Before dozing off, Pirx had another vision, the most intimate kind a man can entertain, of the sort immediately forgotten on waking, expunged by the dawn's forgetfulness. He conjured that legendary wordless, mythical situation that everyone now knew would never come to pass, a revolt of the robots. And knowing with a silent, unspoken certitude that he would take their side, he fell asleep, somehow exonerated.

He woke early. For some reason, his first thought was, *The wind has died down.* Then he remembered Ariel and, with some discomfort, his fantastic visions of the night before. He lay there a long while before coming to the somewhat reassuring conclusion that they had not been conscious fantasies. He slid back the shutter of the little port beside his head, through the cloudy pane saw a pale dawn on the rise, and knew at once that he would be going up the mountain. He bolted out of his sleeping bag to double-check the common room. No robot.

The others were already up. Over breakfast, as if the matter were already settled, Krull said it was time to get a move on, that the *Ampere* was due in before nightfall and that they would need an hour and a half—minimum—for breaking camp. He neglected to say whether the urgency was due to the missing data or the absent Ariel.

Pirx ate an enormous breakfast and said nothing during the entire meal. The others were still sipping their coffee when he got up and, after rummaging in his duffel bag, took out a spool of white nylon, a hammer and a few pitons and, on second thought, made room in his backpack for his climbing boots.

The three of them went out of the hut into the still-unlit dawn. The sky, drained of stars, was colorless. A heavy violet-gray, stagnant and bone clamping, filled the air. The mountains to the north formed a black mass, solidified in murk. The nearest ridge, its summit brushed with a swatch of brilliant

orange stood silhouetted like a molded mask with blurred runny features. The distant, unreal glare caught the plumes of breath billowing from their mouths. Despite the thinner atmosphere breathing was easy. They made it up to the plateau's outer rim as the scruffy vegetation, dirty brown in the half-light between retreating night and advancing day, yielded to a barren landscape. Before them stretched a rock-littered moraine that shimmered as if underwater. A few hundred meters higher a wind blew, bracing them with its brisk gusts. They climbed easily, clearing the smaller boulders and clambering over the larger ones. Occasionally they heard the sound of one rock slab nudging against another or of a piece of detritus dislodged by a boot, cascading down the mountain with a rippling echo.

The intermittent squeak of a shoulder strap or metal fitting lent their expedition a certain *esprit de corps*, the professional air of a mountaineering party. Pirx went as second behind Massena. It was still too dark to make out the profile of the far walls. Time and again, with his attention entirely at the mercy of his straining eyes, his absentmindedly placed foot slipped, as if he was intent on distracting himself not only from the terrain but from himself and his worries. Shutting out all thought of Ariel, he immersed his gaze in this land of eternal rock, of perfect indifference, which only man's imagination had invested with the horror and thrill of adventure.

With every step the gradual brightening brought a new detail of the landscape into prominence. The sky had taken on that pallor between night and day—dawnless, stark, hushed, as if hermetically sealed in a sphere of cooling glass. A little farther up they passed through a belt of fog, its wispy strands clinging to the ground. After they emerged, Pirx saw their destination, still untouched by the sun but now whitened by the dawn, a rock-ribbed buttress that reached up to the main ridge, up to where, a few hundred meters higher, its two most prominent peaks loomed forebodingly. At one place the rib flared out into a troughlike basin. In this saddle Ariel had conducted his last survey. It was a straightforward ascent and descent, no surprises, no crevasses, nothing but gray scree dappled with chick-yellow mildew. As he treaded nimbly from one clattering rock pile to another, Pirx fixed on the black wall teetering against the sky. Possibly to distract himself, he imagined that he was making an ordinary ascent. Earthside.

Pirx's eyes were held in thrall by the summit's sublime profile. As they climbed higher it receded farther, as usual with a mountain viewed from below, and the abrupt foreshortenings broke it up into a series of overlapping planes. The base lost its former flatness, and columns sprang up—a wealth of faults, shelves, aimlessly winding chimneys, a chaos of old fissures, an anarchy of cluttered accretion, momentarily illumined by the top, now gilded by

the sun's first rays, fixed and strangely placid before it too was swallowed by shadow Pirx could not tear his eyes from it from this colossus that even on Earth would have commanded respect

Massena walked ahead of him slightly stooped in a light whose growing limpidity annulled all illusion of an easy ascent This illusion of easy access and safe passage had been fostered by the bluish haze, fully engulfing every fragment of the glimmering cliff The day raw and full had caught up with them Their shadows exaggeratedly large rolled and pitched under the ridge of the alluvial cone Proportions had shifted and the wall similar to any other from a distance now revealed its unique topography its singular configuration Bellying outward was a mighty buttress that rose up out of a tangle of slab and plate shot up swelled and spread until it obscured everything else encircled by the dank gloom of places never touched by light

They had just stepped onto a patch of permanent snow its surface strewn with the remnants of volcanic debris, and Massena began slackening his pace Finally he stopped as if distracted by some noise Pirx who was the first to catch up with him saw him make a tapping gesture on his ear the one fitted with the olive-sized microphone and immediately Pirx grasped his meaning

Any sign of him? he asked Massena

Massena nodded and brought the metal detector rod up close to the dirty snow-crusted surface The soles of Aniel's boots were impregnated with a radioactive isotope the Geiger counter had picked up his trail Though the trail was still alive from the day before, there was no way to read any direction in it but at least they knew they were headed the right way They proceeded taking their time

The dark buttress should have appeared just ahead, but Pirx knew how easily distances could be misjudged in the mountains They climbed higher above the snow line and rubble following along an older smaller ridge notched with rounded pinnacles In the dead silence Pirx thought—was it wishful thinking?—that he could hear Massena's earphones crackling Intermittently Massena would stop fan the air with the end of the aluminum rod lower it until it nearly touched the rock, trace loops and figure eights like a magician then relocating the trail move on As they neared Aniel's surveying site Pirx explored the area for a sign of the missing robot

The easiest part of the route now lay behind them Before them rose a series of slabs that cropped up from the foot of the buttress at various inclinations The whole resembled a gigantic cross-section of the wall's strata the partially exposed interior revealing the core's oldest formation fissured in places under the sheer rock mass and heaving several kilometers up into the sky They climbed another hundred paces and came to an impasse

Massena worked in a circular fashion, waving the end of the detector rod, squinting—his sunglasses were already propped on his forehead—moving aimlessly with a deadpan expression, before stopping a dozen or so meters away.

"He was here quite a while."

"How can you tell?" Pirx asked.

Massena shrugged, plucked the small microphone from his ear and handed Pirx the earphone dangling on its thin connecting wire. Then Pirx heard for himself the twittering and screeching, which at times rose to a whining plaint. The rock face was devoid of any prints or traces—nothing but that unremitting sound filling his skull with its strident crackling, the intensity of which testified to the robot's prolonged and diligent presence. Gradually Pirx came to discern a certain logic in the chaos. Ariel had probably come up by the same route they had taken, set up the tripod, got the camera into position, and circled it several times in the process of surveying and photographing, even shifting the tripod to find the most favorable observation points. That made sense. But then what?

Pirx began moving out centrifugally, like an ever-widening spiral, hoping to pick up Ariel's trail, but his search was in vain.

Krull said something to Massena out of earshot. Pirx ignored both of them, his attention being diverted by a sound, brief but distinct, transmitted by his earphones. He began backtracking, almost millimeter by millimeter. *Here. I'm sure it was here.* Peeling his eyes, he scanned the terrain, concentrating on the whining sound. The rediscovered trail lay at the base of the cliff, as if, instead of taking the trail campward, the robot had headed straight toward the vertical buttress.

That's odd. What could have lured him all the way up there?

Pirx scouted around for the trail's sequel, but the boulders were mute. Unable to divine Ariel's footing on the next step, he had to canvass all the fissured slabs piled at the base of the buttress. He finally found it, some five meters from the previous one. Why such a long jump? Again Pirx backtracked and a moment later picked up the missing one. The robot had simply hopped from one rock to another. Pirx was still stooping and gracefully flourishing the rod when he was jolted by an explosion in his head, by a crackling in his earphones loud enough to make him wince. He peered behind a rock table and went numb. Wedged between two rocks, so that it lay hidden at the bottom of a natural hollow, was the surveying apparatus, along with the still camera, both intact. Leaning up against a rock on the other side was Ariel's backpack, unbuckled but full. Pirx called out to the others. They came on the run and were as dumbfounded as he by the discovery. Instantly Krull checked the cassettes. The surveying data were intact. No repeat necessary. But that still left the mystery of Ariel's whereabouts.

Massena cupped his mouth and hollered several times in succession, and they listened to the distant echoes bounce off the rock. Pirx cringed because it had the ring of a rescue call in the mountains. The intellectronician took a flat cassette housing a transmitter from his pocket, squatted down, and began calling the robot by his call numbers, but his gestures made it plain that he did this more from a sense of duty than any conviction.

Meanwhile Pirx, who kept combing the area for more radioactivity, was bewildered by the profusion of traces resonating in his headset. Here too the robot had lingered. When at last Pirx established the perimeters of the robot's movements, he began a systematic search for a new lead that would steer him in the right direction.

He described a full circle until he was back under the buttress. A cleft, roughly two meters wide, its bottom littered with tiny, sharp-edged pebbles, yawned between the shelf that supported him and the sheer face of rock opposite. He probed the near

"Thrust outward, he hung in space with his boot tips some thirty centimeters out from the rock face. Something caught his eye. A rift? But first he had to reach it."

side. Silence. A riddle as incomprehensible as it was inescapable. All indications were that Ariel had melted into thin air.

While his companions conferred in low voices behind him, Pirx slowly craned his head and for the first time took stock of the steeply rising face at close range. The wall's stony silence beckoned him with an uncanny force, and instantly the certitude of acceptance, the recognition that the challenge would have to be met, was born in him. Purely by instinct his eyes sought out the first holds they looked solid. He took one long, carefully executed step to cross the gap, establishing a foothold on that tiny but sturdy-looking ledge, then made a diagonal ascent along that perfectly even rift, which opened a few meters higher into a shallow crevasse. For a reason unknown even to himself, Pirx arched his body as far as he could and aimed the rod at the rocky ledge on the far side of the cleft. His earphones responded. To be on the safe side, he repeated the maneuver, fighting to keep his balance—he was virtually suspended in midair—and again he heard a crackle. That clinched it. He maneuvered back and joined the others.

"He went up," Pirx said matter-of-factly, pointing toward the wall.

Krull did a double-take, and Massena asked, "Went up? What do you mean, 'went up'? What for?"

"Search me," Pirx replied with seeming apathy. "Check for yourself."

Massena, rashly thinking that Pirx had made a mistake, conducted his own probe and was soon convinced. Ariel had most definitely spanned the gap and moved out along the partially fissured wall toward the buttress. Krull postulated that the robot had malfunctioned after the survey that he had become "unprogrammed." "Impossible," Massena said. "The positioning of the surveying gear and the backpack was too deliberate. It looked too suspiciously like a jettisoning prior to attempting a rugged ascent. No, something must have happened to make him go up there."

Pirx said nothing. Secretly he had already made up his mind to scale the wall—with or without the others. Krull was out of the picture. This was a job for a professional, and a damned good one at that. Massena had done a fair bit of climbing—or so he had said once in Pirx's presence—enough, at least, to know the rudiments of belaying. When the others were finished, Pirx made his intention known. Was Massena willing to team up?

Krull immediately objected. It was against regs to take risks. The camp still had to be broken down, and their gear had to be packed. They had the data they had been sent to collect. The robot had malfunctioned. Why not chalk it up and explain all the circumstances in the final report?

"Are you saying we should just cut out and leave him here?" Pirx asked.

His quiet tone obviously unnerved Krull, who, restraining himself, answered that the report would include a complete summary of the facts, together with individual comments by the crew and a statement as to the probable cause of Ariel's loss: short-circuiting of the memory mnestrones, the directional motivation circuit, or perhaps desynchronization.

Turning his back, Pirx again surveyed the base. Though he somehow sensed the impropriety of it, he now gloated over the prospect of a climb.

Massena, probably just to spite Krull, took Pirx up on his offer. Pirx listened with only one ear to Massena's maundering explanations of how they owed it to themselves to solve the mystery, how they could hardly go back without investigating the disappearance of their robot. Even if there was only a thousand-to-one chance of ascertaining the reason, it was well worth all the risks they would have to take.

Krull, knowing when he was beaten, wasted no further words. There was silence. While Massena began unloading his gear from his backpack, Pirx, who had already put on his climbing boots and stowed his rope, hooks, and piton hammer, at his side, stole a glance at him. Massena was flustered; he had been buffaloed into

doing something against his will Pirx suspected that given an out, Massena probably would have grabbed it, though there was no underestimating the power of wounded pride.

When Massena was ready they leisurely shoved off for the base of the cliff.

"I'll take the lead," Pirx said, "with line paid out at first. Then we'll play it by ear."

Massena nodded. Pirx tossed another backward glance at Krull, who was standing next to the emptied packs. They were now at a high enough altitude to glimpse the distant, olive-green plains behind the northern ridge. The bottom of the scree was still in shadow, but the peaks blazed with an incandescence that flooded the gaps in the skyline.

Pirx took a giant stride, found a foothold on the ledge, pulled himself upright, then nimbly ascended. He moved at a steady clip, as rock layer after rock layer—rough, uneven, darkly recessed in places—passed before his eyes. He braced, hoisted, heaved himself up, took in the stagnant, ice-cold breath of night radiated by the rocks. The higher they went, the faster his heart beat, but his breathing was normal, and the straining of muscles suffused him with a pleasing warmth. The rope trailed behind him; the thin air magnifying the scraping sound it made every time it brushed against the cliff. Just before the line was completely paid out, he found a safe belay.

With his toes wedged into a crack that ran diagonally across the flank, he waited for Massena. From where he stood, he could examine the large, raked chimney they had skirted on the way up. At this point it flared out into a gray, cirquelike heap of stone. Totally jejune, even flat when viewed from below, it now rose up as a rich and stately sculpture. He felt so exquisitely alone that he was visibly startled to find Massena standing beside him.

They progressed steadily upward, repeating the same procedure from one pitch to the next. At each new stance Pirx checked with the detector to verify the robot's presence. Once, when he lost the signal, he had to abandon an easy chimney, Aniel, not being a mountaineer, had simply traversed it. Even so, Pirx had no trouble in second-guessing the robot's moves. The route he had chosen was invariably the surest, most logical, most expeditious way of gaining the summit. It was obvious, to Pirx at any rate, that Aniel had gone on a climb. Never one to indulge in idle speculation, Pirx did not stop to ponder the whys. The better he came to know his opponent, the more his memory began to revive, yielding those apparently forgotten holds and maneuvers that now prompted him infallibly on each new pitch. Once he glanced down from over the top of a flake, sturdy enough to be a wall. At high elevation, despite their painstaking progress, it took Pirx a while to spot Krull, standing at the bottom of the air shaft that opened at his feet. He didn't actually see Krull, only his suit, a tiny splotch of green against the gray of the mountainside.

Then came a nice little traverse. The climb was getting tougher, but Pirx was slowly regaining his dexterity. He made better progress when he trusted to his body's instincts than when he consciously sought out the best holds. He spotted something that portended a little shelf higher up. Alas, it was glazed with frost and steeply pitched. In one place the frost bore a deep bite, evidence of some terrific impact. No booted foot could have made a gash that deep, he thought. It occurred to him that it might have been an incision left by Aniel's shoe—the robot weighed roughly a quarter of a ton.

Massena, who until now had been keeping up, was starting to lag behind. They reached the rib's upper tier. The rock face, as craggy as before, gradually, even deceptively, had begun tilting beyond the perpendicular to become a definite overhang, impossible to negotiate without any decent foot jams. The rift, well-defined until now, closed a few meters above him. Pirx still had some six meters of free line, but he ordered Massena to take up the slack so that he could briefly reconnoiter. The robot had negotiated it without pitons, rope, or belays. *If he could, so can I,* Pirx thought. He groped overhead. His right ankle jammed into the apex of the fissure that had brought him this far, ached from the constant straining and twisting, but he didn't let up. Then his fingertips grazed a ledge barely wide enough for a fingerhold. He might make it with a pull-up, but then what?

"Spreadeagled, fingers clutching the rock's craggy face for support, he bellied his way around the bulge and risked the step that had taken all his courage."

It was no longer so much a contest between him and the cliff as one between him and Aniel. The robot had negotiated it—singlehandedly. Okay, he did have metal appendages for fingers. As Pirx began freeing his foot from the crack, his wriggling dislodged a pebble and sent it plummeting. He listened to it as it cleaved the air. Then, after a long pause, it landed with a crisp, definitive click.

Not on such an exposure, he thought. Abandoning the idea of a pull-up, he looked for a place to hammer in a piton. But the wall was solid, not a single fissure in sight. He leaned out and turned in either direction. Blank.

"What's wrong?" Massena's voice shouted from below.

"Nothing, just nosing around," he replied indifferently.

His ankle hurt like hell; he knew he couldn't maintain this position for very long. Ugh, anything to abandon this route! But he knew the moment he changed direction, the trail was as good as lost on this behemoth of a rock. He again scoured the terrain. In the extreme foreshortening of vision, the slab seemed to abound in holds, but the recesses were shallower than the cup of his hand. That left only the ledge.

He had already freed his foot and was in a pull-up position when it dawned on him. There was no going back now. Thrust outward, he hung in space, with his boot tips some thirty centimeters out from the rock face. Something caught his eye. A rift? But first he had to *reach* it! Come on, just a little bit higher! His next moves were governed by sheer instinct. Hanging on with the four fingers of his right hand, he let go with the left and reached up to the fissure, whose depth he couldn't guess. That was dumb—it flashed through his mind—as, gasping, rankling at his own recklessness, he suddenly found himself two meters higher, hugging the rock. His muscles were on the verge of snapping. With both feet securely on the ledge, he was able to drive in a piton, even a second, for safety's sake, since the first refused to go in all the way. He listened with pleasure to the hammer's reverberations, rising higher in pitch the deeper the piton sank. The rope jiggled in the carabiners, a signal that he had to lend Massena a hand. Not the slickest job, Pirx thought, but they were not climbing the Alps, and anyhow it would do as a stance.

Above the buttress was a narrow, fairly comfortable chimney. Pirx clenched the detector between his teeth, afraid it would scrape against the rock if he left it sticking out of his belt. The higher he climbed, the more the rock fringed from a blotchy brownish-black, streaked with steel-gray to a ruddy, iron-flecked surface of diorite. It was easy going for another dozen or so meters; then the picnic was over. Another overhang, insurmountable without more pitons and this time shelfless. But Aniel had managed it with no equipment at all. Or had he? Pirx checked with the detector. Wrong. He had bypassed it. How? There must have been a traverse.

A quick survey revealed a pitch not especially tricky or treacherous. The buttress, temporarily obscured by the diorite, reasserted itself here. He was standing on a narrow but safe ledge that wrapped around a bulge before vanishing from view; leaning out, he saw its continuation on the other side, across a gap measuring roughly a meter and a half or two at the most. The trick was to wriggle around the jutting projection, then, freeing the right foot, thrust off with the left so that the right could feel its way to safe footing on the other side. He

looked for a place to drive in a piton for what should have been a routine belay But the wall was maliciously devoid of any cracks He glanced down a belay from the stance now occupied by Massena would have been purely cosmetic Even if secured from below he stood to fall, if he peeled off a good fifteen meters, enough to jerk loose the most secure pitons And yet the detector said loud and clear that the robot had negotiated it *Say what gives, anyway? There's the shelf One big step Come on, chicken!* He stayed put Oh for a place to tie on a rope! He leaned out and swept the shelf—for a second no more—before the muscle spasms set in And what if his boot sole didn't grab? Aniel's were steel-soled *What's that shiny stuff over there? Melting ice? Slippery as all hell I'll bet That's what I get for not bringing along my Vibrams*

'And for not making out a will' he muttered under his breath his eyes squinting, his gaze transfixed Doubled up spread-eagled fingers clutching the rock's craggy face for support he bellied his way around the bulge and risked the step that had taken all his courage Whatever joy he felt as he landed was quickly dissipated The shelf on the other side was situated lower which meant that he would have to jump *up* on the way back Not to mention that stomach traverse *Climb, my ass! Acrobatics is more like it No worse—oh damned if I know what it is Rope down? Either that or—* He stopped becoming uneasy

A total fiasco but he kept traversing for as long as he was able Aniel was the furthest thing from his mind then The rope paid out along the length of his traverse moderately taut and uncannily pristine rocked under him The shelf came to a dead end with no way up down or back *Never saw anything so smooth* he thought with a calm that differed appreciably from his previous sangfroid Things couldn't be worse So why get all worked up? Underfoot was a four-centimeter ledge then empty space followed by the darkly adumbrated vent of a chimney whose very darkness seemed an invitation yawning four meters away in a rock face so slippery and massive as to defy credulity *And granite, no less!* he thought ruefully Water erosion sure He even saw the signs—dark patches on the slab here and there even some drops of water He grabbed the rod with his right hand and probed the brink for some trace Low intermittent crackling Affirmative But how? A tiny patch of moss granite-hued caught his eye He scraped it away A chink, no bigger than a fingernail It was his salvation even though the piton refused to go in more than halfway He yanked on the ringed eye and somehow it held Now just clutch the piton with his left and slowly He leaned out from the waist up and let his eyes roam the rim He felt the pull of the half-open chute seemingly preordained ages ago for this moment and his gaze plummeted like a falling stone all the way down to a silvery-blue shimmer against the scree's fuzzy gray relief

CONTINUED ON PAGE 120

How a small group of adventurous women, and a million-dollar toilet, helped NASA take one giant step for womankind

BY BARBARA ROWES

HOUSEWIVES IN SPACE

PAINTING BY RALLE

Two and a half years before John Young and Robert Crippen first fastened their seat belts aboard the space shuttle *Columbia*, NASA slipped this ad into the classified pages of the San Francisco *Chronicle*

TEST PARTICIPANTS SPACE TRAVEL PROJECT We need female paid volunteers ages 45-55 to take part in an experiment related to space travel Nonsmokers preferred Must be able to adjust to horizontal semiconfinement of 24-hour day

It wasn't until the following afternoon in an upper-middle-class section of Oakland, that a gray-haired housewife got word of what would be for her a fateful mission. Around 14:00 hours she happened to turn on her kitchen radio. "Whenever I season a chicken," the energetic, fifty-four year old Lynn Luthi says, "I get my inspiration from country and Western." Shortly afterwards station KNEW broadcast the ad as a public-service announcement. "The instant I heard the word *NASA*," she recalls, "it was the beginning of an immediate love affair."

With one hand on the chicken, she dialed NASA. Busy signal. She was undaunted. "I made up my mind to get in there if I had to sit by the phone for the next twenty-four hours." Two days later she was still getting a busy signal. "Even while doing my shopping, I was trying to call NASA, direct from the supermarket," she recalls with a smile.

For the first time ever, NASA was actually recruiting women for a historic Earth-bound, exploratory mission at its Ames Research Center in Mountain View, California. The women weren't female astronauts or military personnel, but average women—housewives, teachers, corporate administrators, journalists, secretaries, nurses, and doctors. And they have paved the way for female astronauts who will shuttle into space in the near future and for women of all ages to fly aboard the space shuttle as passengers in the distant future.

These women, chosen from hundreds of candidates, are the unknown heroines of the Space Age. They all took part in a NASA study officially known as Shuttle Re-entry Acceleration

Tolerance in Male and Female Subjects Before and After Bedrest but unofficially and affectionately dubbed Housewives in Space As a result of the extraordinary stamina and spirit that they demonstrated they proved conclusively that women, as well as men, have the "right stuff — not only to survive but to thrive in space They also added volumes of data to the skimpy body of research NASA had on women's adaptability to space travel.

Before April of 1977, when the first crew of women were unpacking their suitcases for their stay at the Ames medical facility NASA had not investigated the physiological responses of women to space travel In the weeks that followed they went through the same battery of tests given to a select group of men tests designed to see how well they would withstand the crushing g-force of takeoff and reentry from space the debilitating effects of weightlessness and the challenge of performing, coolly and efficiently in a state of total physical exhaustion

The Ames medical study represents a major breakthrough in space development for the American woman NASA has done hundreds of medical studies over the past few decades but as late as 1972—years after the first Mercury mission—only one of these involved women and that included a lone female subject

If wasn't that women had been passively sitting back contentedly Earth-bound, while men rocketed off into space In 1962, three years after the Russians revealed they had already been training a female cosmonaut, a House of Representatives subcommittee held a little-noted hearing on sex discrimination and astronaut selection On July 17, thirty-one-year-old pilot Jerri Cobb testified that NASA had tested 25 female pilots and had found 13—including herself—qualified to become astronauts Cobb went on to excel at all the other qualifying tests but she ultimately was caught in a military catch-22 NASA required that each potential astronaut be a test pilot and female jet pilots were rare

So for the next ten years Cape Canaveral where astronauts roar beyond the *terra firma* of sex discrimination was virtually a man's world Although women played supporting roles as nurses, scientists, and engineers they were always left waiting by the launchpad at liftoff Their situation finally began to improve in 1972 when the government approved the budget for *Columbia* By then it was taken for granted that at least one woman would be strapped into a shuttle seat sometime in the future

Why were women deemed fit for passage on the shuttle but not in a rocket? A lot of reasons were tossed around," says David Winter, formerly the director of life sciences for NASA "but the main one was that until the shuttle came along, there was no way to manage women's waste If you can't handle a basic physiological need like that, you can't go anywhere And so on board the shuttle is the last piece of technology needed to liberate space a $3 million, unisexual, zero-g toilet that accommodates the male and female anatomy Equipped with handholds, footrests and a seat belt, it uses a suction fan to simulate the gravity that makes toilets on Earth work so well

Shortly thereafter Dr Winter and his farseeing associate, Dr Harold Sandler, chief of the Ames Biomedical Research Division, recruited 12 Air Force nurses between the ages of twenty-three and thirty-four, as volunteers for the first study of female fitness for space travel Although the experiment was limited the results indicated that neither body chemistry nor anatomy interfered with a woman's capability to withstand the stresses of weightlessness Encouraged by these findings the NASA experts spent three years meticulously planning a more detailed medical study designed to see whether women were the *equal* of men in adapting to the stresses of travel to and from space

"NASA has done hundreds of medical studies over the past few decades, but as late as 1972 only one of these involved women, and that had a lone female subject."

This new study, unlike all the others was to be co-ed Winter and Sandler planned to spend five years putting three different age groups—each consisting half of men and half of women—through exhaustive tests on a rotating basis In 1976 they began with the first group, thirty-five- to forty-five-year-old men, followed by a group of women in the same age spread The project moved through the forty-five to fifty-five generation and on up to the fifty-five to sixty-five bracket For four weeks members of each age group would go through a rigorous series of tests similar to the ones conducted on astronauts, designed to reveal their ability, or inability, to withstand the special physical and mental demands of traveling to and from space Though both sexes went through the same regimen, the attention was focused on the women who, for the first time in the history of the space program were really being tested seriously

When I stopped to ask myself why I wanted to do this so badly," Luthi recalls "I realized that I wanted to find out whether I could endure those physical pressures and hardships that had challenged men but somehow never seemed to touch the sheltered lives of women "She had been a housewife for 20 years "Now I was ready" she says to seize this opportunity at NASA to discover whether I really measured up physically"

Before the first female subjects arrived at the biomedical research facility there was genuine excitement and anticipation about who the recruits would be "We didn't know what kind of woman would volunteer," says manager Dee O'Hara, who has been flight nurse for NASA's manned space missions since the days of *Mercury* "We thought it would probably be housewives, because they were the only ones with flexible enough schedules"

Actually they came from all walks of life Bernice Robertson, fifty-five for example was chief of the children and youth unit of the California Department of Health While she was driving to work at Berkeley California one morning, she heard on the radio that NASA was looking for adventurous women "And at seven o'clock in the morning a *bed*-rest study sounded very appealing," she jokes

Her job posed no problem She was promptly granted a leave of absence and took some vacation days as well Her husband, George, an administrator for an ambulance service was another matter "If you're going to be gone thirty days who's going to cook for me?" he wanted to know

Ever the dutiful wife Robertson fixed up 30 meals, sealed them up individually and popped them into the freezer His meals then guaranteed, her husband became enthusiastic about her mission, so much so that he applied as a male subject himself We would have been the first couple Bernice muses "if he had made it"

It was twilight in Menlo Park, California, when Dale Graves returned home from the supermarket She threw a steak on the broiler and settled into her teal-green swivel rocker to read a story about the space shuttle in the Palo Alto *Times* A licensed pilot, a captain in the Naval Reserve, and a distinguished scientist at the Stanford Research Institute she knew about the stories of female pilots who had taken the qualifying tests for astronauts and were mysteriously rejected When she heard of the experiment, she called NASA

Some women had problems, not in qualifying, but in bearing up under their families' unexpected resistance to their becoming NASA subjects One of these was Arline Fitzgerald, a fifty-nine-year-old widow who was working as a court reporter for a municipal judge in San Francisco She hadn't anticipated the strong opposition of her children "They were dead set against it," she confides "My daughter, who is a physician, knew enough about the procedures to be good and worried about my physical well-being" Her son was even more worried and adamant "He told me if I was to go, he knew I would never come back," she says But she applied anyway "At my age you don't get many opportunities like this"

The women underwent an extensive screening process "The only time I would actually discourage an applicant" says Lynn Dunham, who handled the phone queries at Ames "was if someone asked me right out how much we pay That signaled they were just looking for a job And this is not a job but a highly technical study" The pay in fact was only slightly above the minimum wage

About half the women who called dropped out Those who did make it to the interview were carefully rated for character commitment and even congeniality "A little like the Miss America Pageant," Robertson observes

The NASA interviewers wanted well-adjusted, interested candidates "What we were looking for were mature congenial women who seemed to have a real purpose in life" Dunham notes The study was to be a group project in which eight to ten women had to get along living together in cramped quarters for weeks "You can't select a very nervous or egotistical individual You can't choose someone who is a comic or a manic-depressive Twenty-eight days confined with a woman cracking jokes or lying around with a chip on her shoulder can become very tiresome," Dunham explains

Those who passed the selection process went on to the two weeks of grueling physicals and orientation This would be followed by four to five spartan weeks of more tests and life without alcohol cigarettes caffeine drinks, or any medication—including vitamin pills

"Some women were frightened by the physical demands and dropped out" says one who didn't Donna Howell She had retired from her job as an administrative secretary at age sixty-five "It didn't faze me a bit An outdoorswoman whose pleasures include fishing and hunting with her husband on their property in Idaho, she plunged into the required physical with enthusiasm and not a little apprehension especially when asked to run the exhausting treadmill test "It was the most intense physical I ever had in my entire life" she says Once finished however she left for a relaxing vacation in Hawaii

A few days into her trip she got a call from NASA to return for more tests Even cutting short her holiday she flew back to California "I couldn't help wondering what I was letting myself in for

Over the next two weeks she found out Like all the women Donna was spun around in a centrifuge to experience the crushing forces of gravity She was dunked in a tank to be weighed under water and she was wired from head to toe while her body was partly encased in a vacuum

For some women it was traumatic but for Dale Graves it was fun "I enjoyed the other women so much and the challenge of every test I knew I had to make it" Only eight to ten of the semifinalists in each age group would be selected after orientation

At the end of the selection process the phones of the chosen women were ringing with a special message When the call came to Arline Fitzgerald, she didn't answer "I thought it was somebody bugging me for a transcript" she says Late in the afternoon NASA telephoned again with the good news She was accepted "I had gin over ice with a twist of lemon to celebrate I knew we'd have no alcohol for a whole month"

And so between April 13 1977 and April 28 1981 three different groups of women between the ages of thirty-five and sixty-five—a total of 27 in all—reported to the NASA research center in Mountain View They spent the next 28 days in virtual isolation Like the passengers on future space shuttle trips they were able to communicate with their families only remotely in their case by telephone

They were outfitted with biobelts that monitored their heart rate and deep body temperature This involved wearing a small transmitter connected to an electrode and pasted over the heart They also had to keep a rectal probe at all times "Although we were aware of it—it isn't exactly natural—nothing hurt about it The only problem was that it kept popping out" Graves says The women also got their g-suits identical to the ones that male astronauts wear, complete with their names imprinted over one breast pocket "When you put it on you couldn't help feeling a little closer to blastoff" Graves adds

The women were under constant medical scrutiny as they went through a series of tests specifically designed to gauge the response of the female body to the stresses of space shuttle travel changes in gravitational pressure, oxygen utilization the effects of fatigue on performance level and the stress of reentry Their bodies were constantly being poked stabbed and tapped for various medical samples Over the course of the study for example each woman had blood drawn from her arm 28 times "Not at all pleasant" Fitzgerald says of the blood tests "My veins got it so bad they hid from the needle"

The women were often exercised to the point of exhaustion In one phase of the test each woman lay on her back and rotated her feet pedaling an exercycle overhead "They made us work harder and harder" Graves remembers "I felt like I was pedaling uphill"

In the performance simulator they lay on their backs in a miniature cockpit the instrument panel of an airplane spread out above their eyes Experiencing the simulated turbulence of wind and rain each woman was asked to take readings off the instrument panel while doing hand-eye coordination tests at the same time "It was designed to test the effect of fatigue on performance capability," O'Hara says Often it was scheduled after the women were exhausted from riding the centrifuge

One of the stranger studies was the lower negative body pressure test in which the women lay in a cylinder and the lower half

CONTINUED ON PAGE 128

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KATHLEEN KENNEDY DIRECTED BY STEVEN SPIELBERG READ THE BERKLEY BOOK DOLBY STEREO

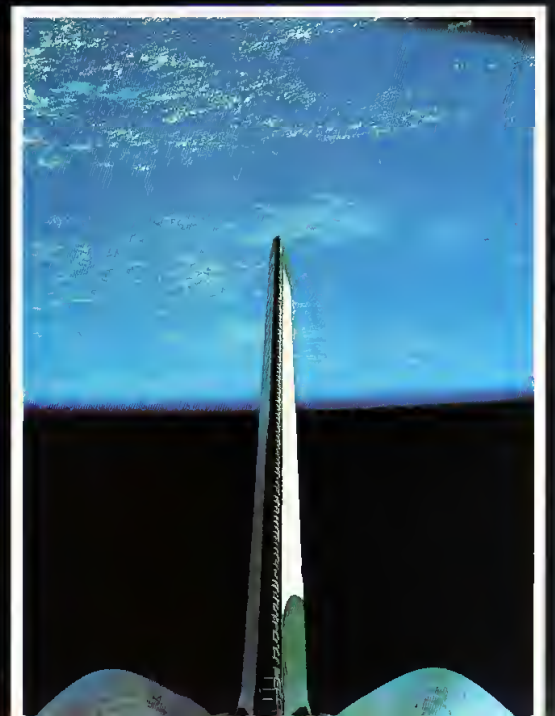
Amateur photographers, tourists on a holiday from gravity, clicked away while the strange, variegated world passed overhead

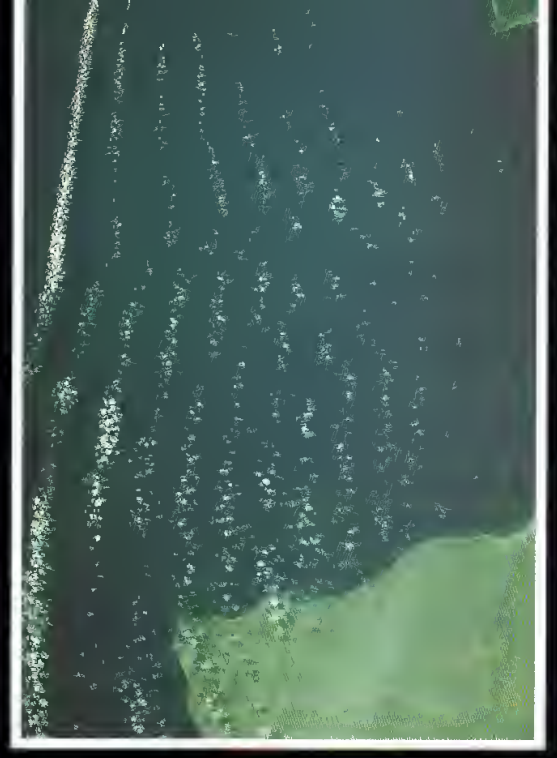
SPACE SHUTTLE ALBUM

BY ROBERT MALONE

Astronauts Richard Truly and Joe Engle, like tourists in a big city, kept looking up and snapping pictures. The earth hung a minimum of 120 nautical miles above their seats aboard the upside-down shuttle. The Pacific (in the photo below) had become their sky, the horizon turning up like a smile. Continents appeared like clouds (Asia is at left, with portions of India, Tibet, and China visible), the jagged lines of Himalayan ridges mocking simple political boundaries.

Robotic cameras have been peering at us from space for decades, methodically recording everything, with little discrimination. Astronauts cannot compete with the quantity of pictorial data from a single workhorse weather satellite. But the photos





by Truly and Engle, taken with a Hasselblad EL/M through the windows of *Columbia* last November, often reveal a human perspective. The photographer is fascinated by unusual rows of clouds over coastal areas of Oman (above), in the Middle East. A shot of the open cargo bay (right) is reminiscent of a teen-ager's photograph of his first car, hood up to show the engine, during a stop on a cross-country trip. (The bay itself actually housed mechanical photographers, lower-class passengers primed to get a shot of a lightning bolt, among other earthly attractions. Once one of these robots snapped a man, framed by his cabin window.)

Like visitors on a brief tour, the astronauts sometimes had to work quickly to record the scene. China rolled by in 10 to 12 minutes, Massachusetts in one minute or less. After the flight, the men slipped into the more leisurely pace of jet fighters, and the ancient yoke of gravity. It wasn't the same upside-down world they had photographed. "You wouldn't believe," Engle says, "some of the things we saw."

They had to work fast. China rolled by in ten minutes, Massachusetts in one minute or less.

FICTION

IKE AT THE MIKE

BY HOWARD WALDROP

Ambassador Pratt leaned over toward Senator Presley. "My mother's ancestors don't like to admit it," he said, "but they all came to the island from the Carpathians two centuries ago. Their name then was something like Kerloff." He laughed through his silver mustache.

"Hell," said Presley, with the tinge of the drawl that came to his speech when he was excited, as he was tonight. "My folks been dirt farmers all the way back to Adam. They don't even remember coming from anywhere. But that don't mean they ain't wonderful folks. Good people all the same."

"Of course not," said Pratt. "My father was a shopkeeper. He worked to send all my older brothers into the Foreign Service. But when my time came, I thought I had another choice. I wanted to run off to Canada or Australia, perhaps try my hand at acting. I was in several local dramatic clubs, you know. My father took me aside before my service exams. The day before—I remember quite distinctly—he said, 'William'—he was the only member of the family who used my full name—'William,' he said, 'actors do

PAINTING BY SKIP LIEPKE

not get paid the last workday of each and every month. Well, I thought about it awhile, and next day passed my exams with absolute top grades.

Pratt smiled his ingratiating smile once more. There was something a little scary about it, Presley thought, sort of like Raymond Massey's smile in *Arsenic and Old Lace*. But the smile had seen Pratt through sixty years of government service. It had been a smile that made the leaders of small countries smile back as King Georges number after number took yet more of their lands. It was a good smile. It made everyone remember his grandfather. Even Presley.

"Folks is funny," said Presley. "God knows I used to get up at barn dances and sing myself silly. I was just a kid then, playing around."

"My childhood is so far behind me," said Ambassador Pratt. "I hardly remember it. I was small. Then I had the talk with my father and went to service school, then found myself in Turkey which at that time owned a large portion of the globe. The Sick Man of Europe, it was called. You know I met Lawrence of Arabia, don't you? Before the Great War. He was an archaeologist then. Came to us to get the Ottomans to give him permission to dig up Petra. They thought him to be a fool. Wanted the standard ninety percent share of everything, just the same."

"You've seen a lot of the world change," said Senator E. Aaron Presley. He took a sip of wine. "I've had trouble enough keeping up with it since I was elected congressman six years ago. I almost lost touch during my senatorial campaign, and I'll be damned if everything hadn't changed again by the time I got back here."

Pratt laughed. He was eighty years old, far past retirement age, but still bouncing around like a man of sixty. He had alternately quit and had every British PM, since Churchill call him out of retirement to patch up relations with this or that nation.

Presley was thirty-three, the youngest senator in the country for a long time. The United States was in bad shape, and he was one of the symbols of the new hope. There was talk of revolution, several cities had been burned, there was a war on in South America (again). Social change, life-style readjustment, call it what they would. The people of Mississippi had elected Presley senator after he had served five years as a representative. It was a sign of renewed hope. At the same time they had passed a tough new wiretap act and had turned out for massive Christian revivalist meetings.

1968 looked to be the toughest year yet for America.

But there were still things that made it all worth living. Nights like tonight. A huge appreciation dinner, with the absolute cream of Washington society turned out in its gaudiness. Most of Congress. President Kennedy. Vice-President Shriver. Plus the usual hangers-on.

Presley watched them. Old Dick Nixon, once a senator from California. He came back to Washington to be near the action, though he'd lost his last election in Fifty-eight.

The President was there, of course, looking as young as he had when he was reelected in 1964, the first two-term president since Huey "Kingfish" Long, blessed of Southern memory. *Say whatever else you could of Joe Kennedy Jr.*, Presley thought, *he was a hell of a good man in his Yankee way.* His three young brothers were in the audience somewhere, representatives from two states.

Waiters hustled in and out of the huge banquet room. Presley watched the sequined gowns and the feathers on the women, the spectacular pumpkin-blaze of a neon orange suit of some hotshot Washington lawyer. The lady across the table had engaged Pratt in conversation about Wales. The ambassador was explaining that he had seen Wales once, back in 1923,

> *"Armstrong was born to play music. It wouldn't have mattered what world he had been born into. When his fingers closed around that cornet, music changed forever."*

on holiday, but that he didn't think it had changed much since then.

E. Aaron studied the table where the guests of honor sat—the President and First Lady, the Veep and his wife, and Armstrong and Eisenhower with their spouses.

Armstrong and Eisenhower. Two of the finest citizens in the land. Armstrong, the younger, in his sixty-eighth year, getting a little jowly. *Born with the century*, Presley thought. *Symbol of his race and of his time. A man deserving of honor and respect.*

But Eisenhower was Presley's man. The senator had read all the biographies, reread all the old newspaper files, listened to him every chance he got.

If Presley had an Ideal, it was Eisenhower. As both a leader and a person. A little too liberal, perhaps, in his personal opinions, but that was the only fault the man had. When it came time for action, Eisenhower the "Ike" of the popular press, came through.

Senator Presley tried to catch his eye. He was only three tables away and could see Ike through the hazy pall of smoke from after-dinner cigarettes and pipes. It was no use, though. Ike was busy.

Eisenhower looked worried, distracted. He wasn't used to testimonials. He'd come out of semiretirement to attend only because Armstrong had persuaded him to do it. They were both getting presidential medals.

But it wasn't for the awards that all the other people were here, or the speeches that would follow, it.

Pratt turned to him.

"I've noticed his preoccupation, too," he said.

Presley was a little taken aback. But Pratt was a sharp old cookie, and he'd been around. God knows how many people through wars, floods, conference tables. He'd probably drunk enough tea in his life to float the battleship *Kropotkin*.

"Quite a man," said Presley, afraid to let his true, misty-eyed feelings show. "Pretty much the man of the century, far as I'm concerned."

"I've been with Churchill and Lenin and Chiang," said Ambassador Pratt, "but they were just cagey politicians, movers of men and matériel, as far as I'm concerned. I saw him once before, early on, must have been Thirty-eight, Thirty-nine, Nineteen Thirty-eight. I was very, very impressed then. Time has done nothing to change that."

"He's just not used to this kind of thing," said Presley.

"Perhaps it was that Patton fellow."

"Wild George? That who you mean?"

"Oh, didn't you hear?" Pratt asked, eyes all concern.

"I was in committee most of the week. If it wasn't about the new drug bill, I didn't hear about it."

"Oh, of course. This Patton fellow died a few days ago. Circumstances rather sad, I think. Eisenhower and Mr. Armstrong just returned from his funeral this afternoon."

"Gee, that's too bad. You know they worked together, Patton and Ike, for thirty years or so—"

The toastmaster, one of those boisterous, bald-headed abrasive California types, rose. People began to stub out their cigarettes and applaud. Waiters disappeared as if a magic wand had been waved.

Well, thought Presley as he and Pratt applauded, *an hour of pure boredom coming up.* Some jokes, the President, the awarding of the medals, the obligatory standing ovation. Then the entertainment.

Ah, thought Presley. *The thing everybody has come for.*

After the ceremony they were going to bring out the band. Armstrong's band. Not just the one he toured with, but what was left of the old guys, *the* Armstrong Band, and they were going to rip the joint.

But also, also—

For the first time in twenty years, since Presley had been a boy, a kid in his teens—

Eisenhower was going to break his vow. Eisenhower was going to dust off that clarinet.

For two hours Ike was going to play with

Armstrong just like in the good old days.

"Cheer up," said gravelly-voiced Pops while the President was making his way to the rostrum. Armstrong smiled at Eisenhower. "You're gonna blow 'em right outta the grooves."

"All reet," said Ike.

The thunderous applause was dying down. Backstage, Ike handed the box with the Presidential Medal to his wife of twenty years, Helen Forrest, the singer. "Here goes, honey," he said. "Come out when you feel like it."

They were in the outer hall, behind the head tables. Some group of young folk-singers, very nervous but very good, were out there killing time while Armstrong's band set up.

"Hey hey," said Pops. He'd pinned the Presidential Medal ribbon and all to the front of his jacket through the boutonniere hole. "Wouldn't old Jelly Roll like to have seen me now?"

"Hey hey," yelled some of the band right back at him.

"Quiet, quiet!" yelled Pops. "Let them kids out there sing. They're good. Listen to 'em. Reminds me of me when I was young."

Ike had been concentrating on licking his reed and doing tongue exercises. "You never were young, Pops," he said. "You were born older than me."

"That's a lie!" said Pops. "You could be my father."

"Maybe he is!" yelled Perkins, the guitar man, fiddling with the knobs on his amp.

Ike nearly swallowed his mouthpiece. The drummer did a paradiddle.

"Hush, hush, you clowns!" yelled Pops.

Ike smiled and looked up at the drummer, a young kid. But he'd been with Pops's new band for a couple of years. So he must be all right.

Eisenhower heaved a sigh when no one was looking. He had to get the tightness out of his chest. It had started at George S.'s funeral, a pain crying did not relieve. No one but he and Helen knew that he had had two mild heart attacks in the last six years. *Hell*, he thought. *I'm almost eighty years old. I'm entitled to a few heart attacks. But not here, not tonight.*

They dimmed the work lights. Pops had run into the back kitchen and blown a few screaming notes which they heard through two concrete walls. He was ready.

"When you gonna quit playing, Pops?" asked Ike.

"Man, I ain't ever gonna quit. They're gonna have to dig me up three weeks after I die and break this horn to stop the noise comin' outta the ground." He looked at the lights. "Ease on off to the left there. Ike. Let us get them all ready for you. Come in on the chorus of the third song."

"Which one's that?" asked Ike, looking for his play sheet.

"You'll know it when you hear it," said Pops. He took out his handkerchief. "You taught it to me."

Ike went into the wings and waited.

The crowd was tasteful, expectant.

The band hit the music hard, from the opening, and Armstrong led off with "The King Porter Stomp." His horn was flashing sparks, and the medal on his jacket front caught the spotlight like a big golden eye.

Then they launched into "Basin Street Blues," the horn sweet and slow and mellow, the band doing nothing but carrying a light line behind. Armstrong was totally absorbed in his music, staring not at the audience but down and at his horn.

He had come a long way since he used to hawk coal from the back of a wagon, since he was thrown into the Colored Waifs' Home in New Orleans for firing off a pistol on New Year's Eve, 1912. One noise more or less shouldn't have mattered on that night, but it did, and the cops caught him. It was those music lessons at the home that started him on his way through New Orleans and Memphis and Chicago to the world beyond.

Armstrong might have been a criminal, he might have been a bum, he might have been killed unknown and unmourned in some war somewhere. But he wasn't. He was born to play that music. It wouldn't have mattered what world he had been born into. As soon as his fingers closed around that cornet, music was changed forever.

The audience applauded wildly, but they weren't there just to hear Armstrong. They were waiting.

The band hit up something that began nondescriptly—a slow blues, beginning with the drummer heavy on his brushes.

The tune began to change, and as it changed, a pure sweet clarinet began to play above the other instruments, and Ike walked onstage, playing his theme song, "Don't You Know What It Means to Miss New Orleans?"

His clarinet soared above the audience. Presley wasn't the only one who got chill bumps all the way down the backs of his ankles.

Ike and Armstrong traded off slow, pure verses of the song. Ike's the sweet music of a craftsman. Armstrong's the heartfelt remembrance of things as they were. Ike never saw Storyville. Armstrong had to leave it when the Navy closed it down.

Together they built to a moving finale and descended into a silence like the dimming of lights, with Ike's clarinet the last one to wink out.

The cream of Washington betrayed their origins with their applause.

And before they knew what had happened, a new tune started up with the opening screech of "Mississippi Mud."

Ike and Armstrong traded licks, running on and off the melody. Pops wiped his face with his handkerchief; his face seemed all teeth and sweat. Ike's bald head shone, the freckles standing out above the wisps of white hair on his temples.

This wasn't like the old days. It was as if they'd never quit playing together at all.

"I wasn't replaced by a computer after all. I was replaced by a woman."

This was *now*, and Ike and Pops were hot
They played and played

Ike's boyhood had been on the flat pan of Kansas smalltown-church America at the turn of the century A town full of laborers and businessmen barbershops milliners and ice-cream parlors

He had done all the usual things swimming naked in the creek running through town and finding things to build up or tear down He had hunted and fished and gone to services on Sunday he had camped out overnight or for days at a time with his brothers made fun of his girl cousins stolen watermelons

He first heard recorded music on an old Edison cylinder machine at the age of eight long-hair music and opera his aunt collected

There was a firehouse band that played each Wednesday night in the park across the street from the station There were real band concerts on the courthouse lawn on Sunday mostly military music marches and the instrumental parts of ballads

Eisenhower heard it all Music was part of his background, and he didn't think much of it

So Ike grew up in Kansas where the music was as flat as the land

Louis Daniel Armstrong was raised back tooting out some wild lines of "Night and Day" In the old days it didn't matter how well you played it was the angle of your back and the tilt of your horn The band was really tight they were playing for their lives

The trombone player came out of his seat, jumped down onto the stage on his knees and matched Armstrong for a few bars

The audience yelled

Eisenhower tapped his foot and smiled watching Armstrong and the trombone man cook

The drummer was giving a lot of rim shots The whole ballroom sounded like the overtaxed heart of a bird ready to fly away to meet Jesus

Ike took off his coat and loosened his tie down to the first button

The crowd went wild

Late August 1908

The train was late Young Dwight David Eisenhower hurried across the endless steel grid of the Kansas City railyards He was catching the train to New York City There he would board another bound for West Point

He carried his admission papers a congratulatory letter from his congressman (gotten after some complicated negotiations—for a while it looked like he would be Midshipman Eisenhower) his train ticket and twenty-one dollars in emergency money in his jacket

He'd asked the porter for the track number It was next to the station proper A spur track confused him He looked down the tracks couldn't see a number Trains waited all around ready to hurl themselves toward distant cities He went to the station entrance

Four black men ragged of dress were smiling and playing near the door What they played young David had never heard before it was syncopated music, but not like a rag not a march something in between something like nothing else He had never heard polyrhythms like them before They stopped him dead

The four had a banjo a cornet a violin and a clarinet They played, smiled danced a little for the two or three people watching them A hat lay on the ground before them In it were a few dimes some pennies and a single new half-dime

They finished the song A couple of people said "Very nice very nice" and added a few cents to the hat

The four men started to talk among themselves

"What was that song?" young David asked

The man with the cornet looked at him through large horn-rimmed spectacles "That song was called 'Struttin' with Some Barbecue' young sir" he replied

Dwight David reached into his pocket and took out a shiny dollar gold piece

"Play it again" he said

They nearly killed themselves this time running through it It was great art it was on the street and they were getting a whole dollar for it David watched them especially the clarinet player who made his instrument soar above the others They finished the number, and all tipped their hats to him

"Is that hard to learn to play?" he asked the man with the clarinet

"For some it is" he answered

"Could you teach me?" David asked

The black man looked at the others who looked away they were no help at all "Let me see your fingers" he said

Eisenhower held out his hands wrists up then down

"I could probably teach you to play in six weeks" he said "I don't know if I could teach you to play like that You've got to feel that music" He was trying not to say that Eisenhower was white

"Wait right here" said Ike

He went inside the depot and cashed in his ticket He sent two telegrams one home and one to the Army He was back outside in fifteen minutes, with thirty-three dollars in his pocket

"Let's go find me a clarinet" he said to the black man

He knew he would not sleep well that night and neither would anybody back on the farm He probably wouldn't sleep well for weeks But he sure as heck knew what he wanted

Armstrong smiled wiped his face and blew the opening notes of "When It's Sleepy Time Down South" Ike joined in

'Howard, come quickly! I think I've discovered the remains of an earlier civilization!'

Then they went into 'Just a Closer Walk with Thee' quiet restrained the horn and clarinet becoming one instrument for a while Then Ike bent his notes around Armstrong s then Pops lifted Eisenhower up then the instruments walked arm in arm toward Heaven

Ike listened to the drummer as he played He sure missed Wild George

The first time they had met Ike was the new kid in town, just another guy with a clarinet Some gangster had hired him to fill in with a band sometime in 1911

Ike didn t say much He was working his way south from K C toward Memphis toward New Orleans (which he would never see until after New Orleans didn t mean the same anymore)

Ike could cook anyone with his clarinet—horn player banjo man even drummers They might make more noise but when they ran out of things to do Ike was just starting

He'd begun at the saloon, filling in but the bandleader soon had sense enough to put him out front They took breaks leaving just him and the drummer up there and the crowds never noticed Ike was hot before there was hot music

Till one night a guy came in—a new drummer He was a crazy man 'My name is Wild George S Patton ' he said before the first set

What s the S stand for? asked Ike

'Shitkicker!' said the drummer

Ike didn t say anything

That night they tried to cut each other chop each other off the stage Patton was doing two-hand cymbal shots paradiddles and flails His bass toot never stopped Ike wasn't a show off, but this guy drove him to it He blew notes that killed mice for three square blocks Patton ended up by kicking a hole through the bass drum and ramming his sticks through his snare like he was opening a can of beans with them

The bandleader fired Patton on the spot and threatened to call the cops The crowd nearly lynched the manager for it

As soon as the hubbub died down Patton said to Ike 'The S stands for Smith' And he shook his hand

He and Ike took off that night to start up their own band

And were together for almost thirty years

Armstrong blew 'Dry Bones'

Ike did 'St Louis Blues'

They had never done either better This Washington audience loved them

So had another long ago

The first time he and Armstrong met was in Washington, too It was a hot bleak July day in 1932

The Bonus Army had come to the Capitol, asking their congressmen and their nation for some relief in the third year of the Depression President Al Smith was virtually powerless, he had a Republican Congress under him led by Senator Nye

The bill granting the veterans of the Great War their bonus due in 1945 had been passed back in the Twenties The vets wanted it to be paid immediately It had been sitting in the Treasury gaining interest and was already part of the budget The vote was coming up soon

Thousands, dubbed the B E F, had poured into Washington, camping on Anacostia Flats in tin boxes, towns of shanties dubbed Smithvilles or under the rain and stars

Homeless men who had slogged through the mud of Europe had been gassed and shelled and had lived with rats in the trenches while fighting for democracy, now they found themselves back in the mud again

This time they were out of money out of work out of luck

The faces of the men were tired Soup kitchens had been set up They tried to keep their humor Il was all they had left May dragged by then June, then July The vote was taken in Congress on the twelfth

Congress said no

They accused the Bonus Marchers of being Reds They said they were an armed rabble Rumors ran wild Such financial largess Congress said could not be afforded

Twenty thousand of the thirty thousand men tried to find some way back home out of the city, back to No Place U S A

Ten thousand stayed, hoping for something to happen Anything

Ike went down to play for them So did Armstrong They ran into each other in town, got their bands and equipment together They set up a stage in the middle of the Smithville now a forlorn-looking bunch of mud-straw shacks

About five thousand of the jobless men came to hear them play They were in a holiday mood They sat on the ground, in the mud They didn't much care anymore

Armstrong and Ike had begun to play that day Half the band including Wild George had hangovers They had drunk with the Bonus Marchers the night before and well into the morning before the noon concert

They played great jazz that day anyway Just before the music began, a cloud of smoke had risen up from some of the abandoned warehouses the veterans had been living in There was some commotion over toward the Potomac The band just played louder and wilder

The marchers clapped along Wild George smiled a bleary eyed smile toward the crowd They were doing half his job

Automatic rifle fire rang out, causing heads to turn

The Army was coming Sons and nephews of some of the Bonus Marchers there were coming toward them on orders from Douglas MacArthur the Chief of Staff He had orders to clear them out

CONTINUED ON PAGE 125

Lieutenant I d like a word with you

THE LOST NATURE NOTEBOOKS OF LOREN EISELEY

Five years after his death, excerpts from the lost journals of one of the twentieth century's greatest naturalists are finally published. One critic has said of him, "If our manic century has produced an heir apparent

PAINTING BY FRIEDRICH HECHELMANN

to Henry David Thoreau. Dr. Eiseley is it." The late Loren Eiseley was a man with a rare combination of gifts. He was Benjamin Franklin Professor of Anthropology and the History of Science at the University of Pennsylvania. He has also been acclaimed as one of the finest literary stylists of our time. In 1971 he was elected to the National Institute of Arts and Letters, an honor unique among paleontologists and his book of scientific essays, *The Immense Journey*, is now considered a modern classic.

Like Thoreau, Eiseley was a journal keeper. If one could have lifted the rooftop of his house in Wynnewood, Pennsylvania, late at night (for he was an insomniac), one would have heard the scratching of his pen or pencil across white sheets of paper in a black-and-red-bound legal notebook. The first entry is dated May 21, 1953. Beginning this journal in my 46th year, a late start for a writer's journal, but I hope to do something with it. During the last few days there have been several nature incidents, and I will try and record them in the hope that they will thus not escape my memory and that I may be able to use them later on.

Eiseley confided daily thoughts and happenings to paper for more than two decades, though he did not do it faithfully. On February 14, 1954, for example, he wrote: A long abandonment of this record, but I shall now try to get back into the spirit of it.

In his journals Eiseley communed with himself and the world. He set down observations on animals and plants, meditations on man and the universe, and outlines for works he planned to write. Like Thoreau, he drew upon his journals for his articles and books, and many entries found their way into his publications.

The journals also contain memoranda of passages for reference, like a commonplace book. The number of them is a reflection of Eiseley's vigorous pursuit of ideas, and his choice of quotations throws light on the cast of his mind. Science, philosophy, literature, theology—he had a wide range of interests and was an avid reader. In his notebooks he dealt with writers of the past as if they were living. It is almost a communication of great minds.

Eiseley died in the summer of 1977, he 'stepped down to lace his bones with ancient dogs and prairie shadows,' in the words of Ray Bradbury, one of his admirers. As a boy he had been held up in his father's arms to see Halley's Comet, and the naturalist had wanted to see the 'star dragon' when it returned in the mid-1980s. But he died too soon—too soon to complete the numerous projects outlined in his notebooks. For five years these journals had been lying in a dark closet, in a sense lost since their existence was known to but a few. There were no plans to make them available to the public.

Now for the first time the author's widow has granted permission to publish excerpts from these journals. Arranged logically rather than in the order in which they were written, the items either have not been used before or have appeared in a different form. They possess the distinctive qualities for which Eiseley's early nature writing is so widely known and loved: its poetry, its simplicity and its autobiographical, and often amusing, narrative style.

(This introduction was written by Kenneth Heuer, Eiseley's editor and friend. After reading through the journals of the poet-scientist, Heuer prepared the following selection of entries exclusively for Omni.)

THE COUNTRY OF TIME

1968. During a trip to an undisclosed island in the Atlantic.

You'd better decide where you're going, I said. 'I don't think you know. You're swinging on the gate first out and then in. I don't think you know at all.'

I could talk to him like this because I was down on his level, flat in the sand, but it didn't fluster him particularly. He kept his back up against a stone, not trusting me

> *How many*
> *light-year distances*
> *can be hung*
> *there in the gray folds*
> *of the brain?*
> *How many pinpoint stars*
> *around which*
> *circle the black planets?*

but not running either. He didn't answer except to lift one big green claw and point it defensively at my nose. Or maybe I misunderstood and it was directed in the way of destiny beyond me and somewhere up the beach. It's hard to know in these cases, and eyes on stalks give fiddling answers.

All right, I said. 'If you're so scared, go on back to the water. That's where you came from—and where a crab should stay. Make up your mind.' He didn't, though, and that was what bothered me later. He went off sidewise, neither back nor forward, sidling around the corner of the rock and so off into the wet kelp and timbers and shells of high tide, but not down and in. A crab should do one thing or the other; not leave you guessing like that. If the universe doesn't know where it's going in the shape of a shore crab, how in the devil is a man to know he's on the right track?

A sea beach is a bad place to start thinking, but then so is almost any place. Any place where there's a leaf and an animal under it—an animal with some place to go. Because where *is* it going—the seed hooked into your coat—and you yourself, brother, where are you bound for? You think you know? In this house? On that street? You think you've arrived? You think you've lost your fur and your tail for a purpose spelled with a capital *P* and sold to you in some book that explains how everything was just a prelude until you came? If you do, you're happy. Take it and you'd be better off not to be following me or this crab or lifting up stones and looking under them.

For what you see under a stone may be like a flash of lightning before a traveler on a stormy night. It lights in one glistening instant a hundred miles of devil's landscape such as he will never see again. Each stone, each tree, each ravine and crevice reechoing with thunder will tell him more than in any daytime vision of the road he travels. The flash hangs like an immortal magnification in the brain, and suddenly he knows the kind of country he passes over and the powers abroad in it. It is so in the country of time: the flash lights a long way backward over a wild land.

THE BLUE UNIVERSE

1959. Eiseley was provost of the University of Pennsylvania at the time.

I found him making little marks and calculations on an old envelope beside his plate in the Faculty Club. 'What is it?' I asked curiously, for though I am one of those professors who is commonly overawed by deans and presidents, their computations and thoughts never cease to interest me. At a faculty table one can never tell what will turn up in the way of likely information. Ours always reminds me of one of those foreign restaurants in the Swiss Alps where the agents of great powers meet and each looks out of a separate window at some mountain or other and speaks abstractedly into the air about the politics of mean little states to whom someone has loaned a tank or two. 'It's finished,' he said. 'The new laboratory?' I inquired. I was about to ask about the budget in which I had a peculiar interest, but I thought better of it. 'No, no,' he said impatiently, 'the universe.'

I maintained the aplomb upon which we pride ourselves in that particular club—even waited a moment before answering. 'How long have we got?' I asked quietly. He looked at me across the table and made another scratch on the pad. 'Fifty billion years.' 'In that case,' I said and hesitated, for I was afraid he would know what I was thinking: 'why bother with commencement, why bother with another of those dreadful little speeches. By virtue of the authority vested in me—?'

I made a slight movement to rise and went on: 'You will excuse my failure to appear this afternoon. I feel one should make some preparation, take stock of things. You know how it is.' He nodded vaguely, immersed again with the accuracy of his figures. I left him there calculating by the cosine of Cygnus or whatever it is these cosmologists swear by. It wasn't through mathematics that I saw the doom was close in. When a university official of such eminence as the man opposite me begins to

neglect commencement, the case is probably worse than his public utterance. I wasn't going to be fooled by his soothing pronouncement of fifty billion years. No anytime the man worked like that you could be sure of it—the doom was close in.

I went all the way home on the local and got safely into my study. I had something there that I wanted beside me in my final hour—something I had faith in. This will take a moment of explaining on my part because you see, I had a universe in the study—a universe replete with suns and passing shadows and remote blue distances. All mine—the most beautiful thing I have ever owned—believe me. I know at last how a god outside creation might stare into creation without any power except to smash it, and that he could never do. He could stare forever into the smoky dark at the hot blue flame of suns or roll the great ball of space around in his fingers but never never reach in to alter its fate a hair's breadth. That was the way with the universe on my desk. It was always different something was always changing color—and it was about the size. I would estimate of the universe that collects in a human head when you train a telescope on the Milky Way. How many light-year distances can be hung there in the gray folds of the brain? How many pinpoint stars around which circle the black planets we will never see? I did not have the answer, but I had a universe there on my desk, a blue universe that someone had brought home from an obscure junk shop years before and presented to me. A solid glass ball, paper weight into which some forgotten craftsman had poured the stars and night a century before I was born.

WEASEL SPACE

1962. Written as a Fellow at the Center for Advanced Study in the Behavioral Sciences, Stanford, California.

From where I stood in the phone booth I could see the patio and hummingbirds among the flowers. I could also look along the walk by the office cubicles that housed the scientists in one of the most distinguished scholarly retreats in America. Along that walk in the bright sunshine before my astonished eyes was sauntering a small American king, the long-tailed California weasel. I recognized his slender brown body and the white patches over his face and nose like a bandit's handkerchief. He waddled somewhat heavily on the hard cement, but the minute he came to the stairs leading to the patio his long serpentine muscular body came into play and he loped gracefully up the steps, looking all about with a commanding intelligent face. He never skulked at all, even though he could hear me talking in the phone booth. Whoever first used the phrase "skulking like a weasel" was dead wrong. This animal went all around the patio quite openly and then, apparently decided there were no mice at this spot in the shrubbery. He looked carefully down the wall then, not bothering to return to the steps, and went off along the walk as before where a surprised scholar hastily made way for him. It was the last I heard of him for two days until someone reported that he had entered an open cabin door. When the astonished and flustered inmate arose in terror among his papers, the weasel calmly deposited a rat on the doorsill and slid graciously from sight. "I had to bury the rat," complained the man to me. "That animal acted as if it was *his* cabin."

"You just got in his way," I defended. "He lives in weasel space. It's all around here, but you don't see it, and normally he doesn't intrude into your space. The cabin was a mistake. He thought it was a hole, the dark probably after the sunlight. I've met him several times now." I hastened to add, "He doesn't see you. I'm not a mouse, and I take care that he doesn't think I'm one. That's all there is to it. Just think of him as a ghost, something on another plane living about here, that comes and goes through an intersecting dimension like your cabin. Occasionally he may drop a rat, but it shouldn't trouble you. Nice to see him traveling about so close. A rare sight," I added in a conciliatory manner. The old scholar paused and eyed me suspiciously a moment, as if I were a related species.

STEPS

Undated. A recollection.

I never enter a wood but that I hear footsteps in the leaves tiptoeing away. I never gaze upon an animal that I do not see its reflected past or some hidden, unguessed potential future both paradoxically written in its body. There is a dynamism about life, a centrifugal quality for which we rarely give it credit. Life goes seeking change, it does not wait for it. Only the barriers it faces contain or sometimes exterminate it.

THE MESSENGER

1955. While at the home of a wealthy suburbanite in Bryn Mawr, Pennsylvania.

I think I might as well tell you it always happens to me like this. I was talking to the old man, humoring him if you like, and careful with my "Yes, sirs" and "No sirs" when I saw this big wet rat come out of the drain on the terrace and sit up right under the old man's chair. It was just turning toward evening, the liquor was expensive, the lawn clipped as only the wealthy can afford it. And still just back of the old man's white duck pants I could see that rat standing up still wet from the drain and peering out with considerable interest and with a jaunty turn to its whiskers.

"Animals," said the old philosopher shifting in his chair, "are mechanisms. Eventually they can be duplicated. Men, too, you know. Just machinery, and in time we'll do it better."

"Yes, sir," I said and waited for the rat to run. I was sure he was just making a mistake, but there he stayed right under the old

"It just occurred to me—if we take that large stone and fasten it securely to that stick, an implement might thus be created that, owing to the application of the principle of leverage acting in concert with mass and momentum..."

man's bottom. I could still make out the whiskers and a beady glint to the eye, though the dusk was deepening.

A SMALL DEATH

1953. A recollection from the time Eiseley lived in a rural apartment on Possum Hollow Road in Rose Valley, Pennsylvania.

Last evening the largest house centipede I have ever seen died peacefully on our bathroom rug. It is a strange thing to record the death of a centipede with the reluctance with which one speaks of the death of a pet sheep dog, but at the last I think I may have been a little confused on the whole subject. Toward the end this centipede was very tired, and like two aging animals who have come into a belated understanding with each other, we achieved a mutual tolerance if not pact. He had ceased to run with that flowing, lightninglike menace which is part of the horror of centipedes to man, and I, in my turn, ceased to drive him away from the warm bathroom rug on which his final desires had centered. It took me a little while to realize that he wished to spend his remaining days there, but after I understood, I am proud to say that he came to no harm at my hands and that he died there so peacefully that it took me a little while to realize he was gone.

THE INVISIBLE MONUMENT

1967. During a visit to Wynnewood Park.

The druid circle in the little park, great rough granite stones naturally arranged in a circle around an ancient hollow oak. Because this is America, no one realizes its strange analogical existence nor the hidden powers contained within it. We have grown too technologically secure. Primitives of whatever complexion would immediately have sensed its drawing power as I do, and have come to it. As it stands, it is what some would call a sacred center. There is an upwelling of unnamable power that the mind feels, but it passes unseen and unrecognized among moderns, their sense for it is atrophied. They cannot even be said to see the arrangement.

ROBINSON CRUSOE

1971. While living in Wynnewood.

All my life, as I have sauntered through the streets of my home town, I have been picking up lost or discarded objects—here a stout rubber band, there a rusted iron spike beside an abandoned building. Once I found in an alley a huge bolt, like a well-weighted club, that ludicrously sagged in my pocket on the way to a formal dinner.

I pick up these trivia with a kind of sheepish evasion. Only the other evening I found a great chunk of raw blue glass fallen from a broken street light and spent several happy hours chipping it into a primitive skinning knife. I do not know why I am thus impelled toward articles of no possible value in my present existence. There is, however, a certain consistency in this eccentric behavior which gives a clue to my psychological state—if not to that of modern man in general. Everything that attracts me, valueless though it seems, would aid in the survival of someone on a desert island. The glass would cut, the bolt could be shaped in a fire or be used as a weapon. What persists in my mind is an utter distrust of the longevity of civilization.

It is clear that I move daily amidst debris that would entice a castaway. Mentally I am engaged in dismantling the remnants of an offshore wreck. I am relying upon my own sharpened ingenuity for survival. It is obvious that I unconsciously regard the rejected fragments so wastefully strewn about me as the *disjecta membra* of a civilization already perished and in the midst of whose solitude I linger like Crusoe upon his isle.

This attitude I have come to suspect is widespread in Western society and in no other. I surmise that it emerges with the growth of science, with the accompanying discovery of an unpegged, homeless universe in which a man no longer has a shelter under the stars. Perhaps I am simply living ahead in a time when the discovery of a rusty bolt will increase one's security. Perhaps the anxiety I now feel over this wreckage is a premonition. Or on the other hand, can it have been touched off by reading *Robinson Crusoe* when I was a boy?

This, however, explains very little. Hundreds of children read *Robinson Crusoe*, but it does not follow that as adults they are driven to pick up a bolt in the street and carry this ridiculous weapon to a dinner. No, the matter goes deeper than this. Watch any vacationer along a shore. Follow him and sooner or later he will be seen to salvage some meaningless bit of flotsam and stand brooding over it. I am merely an extreme case. Instinctively I find the tide and its wreckage lapping invisibly at the edge of a parking lot or seeping through the alleys of the city. There is in reality another tide—the tide of time that leaves great cities buried under sand or subsiding upon ancient sea floors. Like a clairvoyant I am partly lost in some unknown dimension. The things I pick up are never meaningful in the place I inhabit; their use is elsewhere. I know this and strive interiorly to bring the tool and the time into proper juxtaposition. I have not succeeded.

THE UNSEEN THING

1959. A recollection from Eiseley's fossil-hunting days.

You do not know the power of the wind until you get into some high upland where it is always blowing. Then you see, in the sparse grass, the shining reflection of stones on which no lichen can secure a toothold. The rocks have been there for ages while the wind has passed over them until, like pebbles in a stream, they have been polished by the mere passage of an unseen thing—the air. Lift them up and turn them over and the underside has the rough, crusty appearance of the original

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Go away! You're upsetting the laws of physics.

Photograph by John White

Just when you thought it was too dangerous to go back in the water, a famous shark expert tells you how to swim with the great whites, and how to analyze their mating habits

INTERVIEW

EUGENIE CLARK

The only time I've ever been bitten was when I stuck my arm into a vagina and an unborn pup clamped onto my finger." That "unborn pup" was not a *Canis familiaris*, but an elongate elasmobranch—a shark. The probing finger belonged to eminent ichthyologist and shark expert Eugenie Clark.

Clark talks about this most feared of sea creatures the way most people talk about poodles. That's how she knows them. In 25 years of research she has watched these fish for countless hours—has even swum with them—determined to observe the shark in its natural environment. Her findings have initiated breakthroughs in the development of shark repellents and the isolation of shark substances that may unlock some of the mysteries of cancer. Her exploration in marine science, however, has not been restricted to the study of sharks. Her work with many other fish forms has led to the discovery of new species and to a new understanding of the chemistry of toxic secretions. She is also a leader in marine ecology and conservation efforts. For her extensive studies, she received the distinguished gold medal from the Society of Women Geographers in 1975, joining the ranks of such notables as Amelia Earhart, Margaret Mead, and Mary Douglas Leakey.

Clark's fascination with underwater life began for her as a young child when New York City's Battery Park Aquarium served as a surrogate day care center while both her parents worked. As she cupped her hands against the algae-coated glass of the aquarium windows, watching strange shapes gliding silently by, an insatiable curiosity was born. After studying at New York's Hunter College and New York University, she did research at Scripps Oceanographic Institute, in La Jolla, California, and at Woods Hole, on Cape Cod, Massachusetts. In 1955 at the request of two members of the Vanderbilt family she founded Cape Haze Marine Laboratory in Sarasota, Florida (now renamed Mote Marine Laboratory), one of the first marine institutes to engage in the intensive study of living sharks. Clark is the author of *Lady with a Spear* (1953), a chronicle of her life with the women pearl divers of the

South Pacific and *The Lady and the Sharks* (1969)

Now a professor of zoology at the University of Maryland, the youthful-looking sixty-year-old Clark divides her time among university lecturing, conducting international seminars on conservation, squinting through a lab microscope, and perhaps most contentedly, floating in total suspension in the diaphanous blue water of some tropical sea. This last activity is not simply fun, but also an academic exercise in observing her subject *in situ*. It is not unusual for Clark to be found peering out of an underwater cave filled with sleeping tiger sharks—an anomaly of shark behavior she has recently investigated. She believes that field study in the most classic sense is one of the most important tools of research.

Clark's discoveries about the morphology, breeding, and intelligence of sharks do little to support the image of the shark as a wanton, vicious killing machine. Rather she finds it to be a beautiful and peaceful animal, and it is her overriding desire that this feared leviathan be better understood by humans. Certainly her work on sharks has inspired interest. Last winter's *National Geographic* TV special *Sharks*—in which Clark was featured—generated the highest viewer rating of any show in PBS history.

Omni interviewer and international banker John Stein grew up near Cape Haze, on Siesta Key, Florida. He recently asked Clark to explain some of the enigmatic myths and misconceptions surrounding the shark and to provide a glimpse into the shark's world.

Omni: What is the first thing that pops into your mind when you hear that word—*shark*?

Clark: Just a very beautiful animal swimming in the sea, and the excitement of seeing it in its element.

Omni: But that word normally elicits such fear in people.

Clark: I think sharks are misunderstood magnificent and fascinating creatures.

Omni: What is a shark, and how is it different from other fish?

Clark: Sharks differ from other fishes in that their skeleton is composed entirely of cartilage. That is, all *living* sharks. It's thought that way back in time their ancestors had some true bone tissues. The cartilage of some contemporary large sharks can suddenly be ossified and calcified and almost have the feel and look of bone, but it's never as hard as bone. You can always slice through even a giant whale shark with a good knife, even if the cartilage is ossified. Big shark jaws get distorted unless they're carefully dried, because cartilage doesn't hold up the way actual bone does.

Omni: How many different shark species are there?

Clark: Well, to date we think that there are probably three hundred fifty. And they vary from tiny cigar sharks that grow to be only six or seven inches long to the giant whale sharks that may grow to sixty feet and longer. Over forty feet, I think, would be an awfully big whale shark.

Omni: Aside from cartilage, what other morphological differences are there?

Clark: Sharks have multiple gill openings—usually five pairs. This is a more primitive condition than the one pair of gill openings that bony fish have, with one gill slit on each side. If you go back earlier than sharks to the lamprey type—the cyclosomes—you find even more gill openings. So there's a tendency in the evolution of vertebrates for these repeated organs to be reduced in number. More primitive sharks sometimes have six and seven pairs of gills. But most modern sharks have five.

Another difference between sharks and bony fishes is that sharks store urea in their body fluids. Urea is a salt, and storing it puts sharks in osmotic balance with seawater. Bony fish have nearly fresh water in their fluids. If you're stranded at sea without water, try to catch some fish. All you have to do is slit them open and suck on the meat and you'll get fresh water.

"Most shark attacks are a bite-and-release thing. It seems the shark is either frightened and bites out of fear or bites as a kind of warning."

Omni: What other peculiarities are there?

Clark: All sharks and their relatives—skates and rays—have developed internal fertilization. Many groups of bony fishes have developed internal fertilization independently here and there. A lot of the aquarium fishes—poeciliid fishes like guppies, swordtails, platys—have internal fertilization. This is accomplished in bony fishes when the male has a modified anal fin that becomes a gonopodium. In the case of the poeciliid fishes, they use this single fin with a penislike extension to insert the sperm into the female. But male sharks have modified pelvic fins, paired in the form of two prominent cylindrical extensions, known as claspers. And they're introduced into the female receptacle, usually one at a time. Just before clasper insertion, in many species, the male bites the female many times on her pectoral fins and back, and these areas are often torn and scarred.

The female reproductive system of the shark is very much like that of the mammalian female. There is the equivalent of a vagina, a receptacle for the claspers; the uterus; and tubes. Eggs are ovulated outward from the surface of the ovary instead of into a central cavity or lumen, as is the case with bony fishes. A shark ovulates the way a human female ovulates. The egg is picked up by an ostium, which you also have in a mammalian system, and then it goes down the tube and meets the sperm above a gland called the shell gland. This shell gland secretes the covering for the fertilized egg. So the sperm has to travel from the vagina up through the uterus—a two-lobed uterus—and up the tubes to the point above this little shell gland, where it meets and fertilizes the egg. Then the egg passes through the shell gland, gets this covering, and is then deposited in the uterus.

Omni: What percentage of shark species bear live pups?

Clark: About two thirds. And about one third or close to a hundred species lay eggs. In this case, an egg has an embryo developing inside it, and the egg may hatch soon after it's laid or some time later. Off Japan, eggs of some shark species remain in soft coral for a whole year before the babies hatch out.

Omni: But for viviparous sharks, how are the young delivered?

Clark: In live-bearing sharks, such as tiger sharks, each pup develops in a comfortable spongy compartment in the uterus. After the pup absorbs all the yolk in the embryonic egg, it's still nourished by the mother through an attachment to the uterine wall, called a pseudo-placenta, which is very much like the human female's placenta. The pup will keep on growing until it's full-term, which is for about nine months in the tiger shark and for as much as two years in other sharks. Then the pup is born alive, a miniature of the adult.

Omni: If some sharks have a twenty-two-month gestation period, are these sharks endangered by a comparatively fast-changing environment because of slow offspring turnover? Natural selection may not keep pace with a rapid buildup of industrial wastes and pollution, isn't that true?

Clark: I don't know whether pollution has affected the overall shark population. As a group, they have done well, and the more generalized sharks seem to have survived the best. Once you get special adaptation followed by a change in the environment, a lot of the species are apt to drop out. And if they were all specialized, maybe none would survive a change. But you have these generalized sharks in the ocean that are well adapted, the plankton-feeding whale shark, the pelagic sharks, the oceanic white-tipped shark, which is out there in great numbers. Offshore sharks won't be hurt much by pollution, because they have a generalized form. I think they adapt to a lot of tremendous changes. We have a big resource of sharks out in the middle of the ocean that could, if our coastal areas change, evolve over millions of years into coastal forms again and start new species. The generalized shark has

been around for hundreds of millions of years. Humans will pollute coastal areas, but there is a lot of open sea. To kill off all shark species would be difficult. Jacques Cousteau no longer feels that the sea will die. There will always be the deep water reserve out there for evolution to draw on.

Omni: What else sets sharks apart from other fish?

Clark: Another peculiar thing is that the female may store sperm for several months before she ovulates her egg. So you can't say the development of the embryo took one year just because the female gives birth one year later. There is also an interesting intrauterine cannibalism that's now known to occur not only in the tiger shark but in the thresher shark and several other related species. One embryo starts to develop in each lobe of the uterus. Then their potential brothers and sisters come down in an earlier stage of embryonic development, and the larger embryos eat these siblings. So they're feeding before they're even born.

Sharks have many different kinds of reproductive systems. Scientists used to separate the egg-layers from the live-bearers. But there is another group—ovoviviparous—which bear their young alive, but the young don't receive nourishment from the mother. The mother retains the egg in her body, and the embryo lives off the yolk until the yolk is used up. Then the young is born. However, lately scientists have found so many in-betweens. It's a whole gradation of systems from those that lay hard eggs in the open sea to those that secrete hard-egg coverings but retain the eggs internally until the baby hatches inside the mother's body. So the baby is born alive out of a horny egg case, which is held inside the mother's body. Then, like some snakes, Florida's nurse shark, for example, might even have some of its young come out alive in one batch, while others hatch out of their egg cases as they're being born. The egg cases may even lie around for a day or two and then hatch.

Omni: Is any one type more highly evolved?

Clark: There's some indication that egg-laying sharks are the most primitive. But then there are some people who think it's the other way around. Six hundred million years ago there were sharklike ancestors that had internal fertilization, and they had live births.

Omni: Might the size of a shark be a limiting factor in its evolutionary success?

Clark: Not necessarily. When sharks get large—like the great white shark, which is the largest of meat eaters—they don't attack healthy animals. They go after injured or cornered animals, which are easier prey. They may find a dead or dying whale and devour it, eating an enormous amount. After that, they may go for months without feeding. But, like very large sea mammals like the largest whales, for instance, the largest of the rays and sharks feed on plankton.

Omni: One always hears stories of unusual

items—boots, anchors and suchlike—being found in the stomachs of sharks

Clark I've never found anything extraordinary in a shark's stomach—just the usual varieties of fish, sea turtles and tuna. I think the "strange" cases come from sharks that learn to follow ships. I don't think sharks would go after an old tire. But if a fire is thrown overboard with leftover bones, they might swallow it, too—especially if the smells are in the water at the same time.

The shark has a two-part stomach, the cardiac stomach and the pyloric stomach. A big shark could swallow a person. But when that body got down to the end of the cardiac stomach, it would stop. The pyloric stomach of a twelve foot tiger shark is quite small. The cardiac is expandable, but only some digestive processes occur in it. If a shark can't digest its turtle shell, tin can or license plate, it has this unique way of turning its cardiac stomach inside out. It looks like a red tongue with long grooves coming out of the shark's mouth. After the shark has digested what it can, it washes out the stomach, getting rid of all the undigestables and brings it back in. Sharks can also keep things in the cardiac stomach for a long time. There's one case of a missing man whose tattooed arm was recovered from a shark's stomach. We suspect he had drowned. When retrieved from the stomach, the arm was still in a pretty good state of preservation. You could still see the tattoo.

Omni Sharks *have* eaten humans. What has initiated these attacks?

Clark There are not enough reliable statistics on shark attacks for us to get any clear idea on why this happens. And it's only in studying sharks—their basic behavior—that we may be able to understand why these very rare attacks have taken place. Most of the time we don't have good evidence. When we do investigate the case carefully, it often turns out *not* to be a real shark attack.

I don't count, for example, that recent case down in Florida that was so heavily written up in the papers as a prime example of how shark attacks are on the increase. The shark purportedly came in and bit a man. It was a ten- to twelve-foot mako and the victim had only a small bandage on his arm. Well, I can't imagine a ten foot mako not taking an awfully big bite. The man claims he had one hundred twenty-two stitches, most of them internal. Stories like that sound a little suspicious to me, too many conflicting facts and details. We later learned that the man had speared the shark before he was bitten. Well, when you spear a shark and then you're bitten, I don't think you can blame the shark.

In the waters off India, for instance, there are known to be a tremendous number of so-called man-eating sharks. Well, last summer I went to India and worked with shark fishermen and zoology students who were studying sharks. I finally tracked down one vague story about a shark attacking a man. Those shark fishermen could remember only one man who had been attacked by a shark. The shark, a big hammerhead, was in about three or four feet of water. I wondered what a big shark was doing in water that shallow. As it turns out, one of the fishermen had caught this hammerhead and brought it into the boat. Then, as they were going in toward shallow water, the shark began thrashing around in the boat and bit the man. That is the only record of a so-called shark attack I could find along the whole coast of India. Now this sort of report is unfair. If I had stopped with just the superficial evidence, I would have put that down as a shark attack.

I was in another part of the world where there is only one recorded shark attack, and it took place when I was there. I investigated it and promised the man I would never tell his story. So I won't reveal the location. When I went to the hospital with an interpreter to see him, he gave me this big story of how his leg had been taken off by a shark. But the story was strange. I mean, he

> *About thirty sharks have been found with human remains in them. And they're called man-eaters. But in many cases we don't know if the person was alive when the shark ate him.*

didn't look like a man who'd been bitten by a shark, and he looked rather guilty giving me the details. Finally he said, "If you promise not to tell anybody, I'll tell you what really happened." He had been dynamiting illegally and had accidentally blown off one of his legs. The only way he could avoid getting a jail sentence and a fine was to say it had been a shark attack.

Omni Is it true that the bulk of evidence suggests that an attack on man is a defense or warning mechanism?

Clark Yes. H. David Baldridge of Mote Marine Lab conducted a survey of shark attacks that showed that shark attacks are more often a bite-and-release thing than "biting out a chunk to eat." It seems as if the shark is either frightened and bites out of fear or bites as a kind of warning. A person may be doing something to irritate the shark. It has been suggested that sharks may establish a territory around themselves, especially during the time of year when courtship is going on.

Omni In more than twenty-five years of shark study have you ever witnessed an attack?

Clark The only shark attack I ever saw was on a French diver who came to the Lerner Marine Laboratory in Bimini. He said, "Show me a shark and I'll show you how I can kill it with a spear gun." Nobody wanted to encourage him, but he persisted. In the big pen there was a little three-foot lemon shark. Well, this big macho guy goes in and shoots the lemon shark about half a dozen times, the spear bouncing off the shark's skin. Finally the little lemon shark, which had been cowering in the corner, came out and bit the calf muscle right off this man's leg. He was so surprised. He'd been spearing sharks all his life and never had one turn on him. The next day the newspapers reported, "Famous French diver attacked by huge shark while swimming in the coral reefs at Bimini." The attack occurred in a tank. It was a little baby lemon shark, and he had shot it six times. And that goes on record as a shark attack. People rarely hear the whole story.

Omni It is said that certain sharks are man-eaters. What causes one shark to be dangerous and another not?

Clark In most cases people don't know what kind of shark bit them, so they just say it's this gray requiem type of shark, of which there are many species. But among that group a few have been identified. About thirty sharks have been found to have human remains in them, or some evidence that they have bitten a human. And so they're called man-eaters. But in many cases we don't know whether the person was dead first. Sharks eat wounded and dead animals. The man might have drowned. Take the case of the tattooed arm, for example. It doesn't mean the shark took the man's arm while he was alive.

Omni If shark attacks are so infrequent, why are they so widely feared?

Clark The thought of being bitten or eaten alive by a shark is such a horrifying thing. It can be compared to a primitive person's watching people drive cars around and thinking how dangerous cars are. And then the man unfamiliar with cars learns the statistics on how many people are killed and mangled each year in horrible car accidents. These things conjure up all kinds of fears. But if you know how to drive a car then it's not so frightening.

Omni What should one do around a shark?

Clark If you're in the water with dangerous sharks, you should not be pouring blood in the water. You should not be spear-fishing in an area where white sharks are found, unless you use a cage.

Omni Are you saying that blood serves as an attractant and an excitant?

Clark Oh, yes. But it's limited in that a few molecules of blood have to go from the bleeding object into the shark's nostril. You can have a bleeding object just a few feet away from the shark, but the shark won't be able to detect it if it is swimming up current. That's why you use chum when you're trying to get a white shark to come in, as they were doing in *Jaws*. You often use chum lines that are miles long, with tuna meat floating on the surface and bits of it drop

ping down to form a screen. Then if any shark crosses the screen it will suddenly catch that olfactory cue and start following the scent around until it determines in which direction the odor is strongest. Then the shark follows it up, getting more and more excited, and comes to the boat. If you have a white shark nearby, you can put your cage down and look at it. But it has to find that chum line from an olfactory cue.

Omni: What else attracts sharks?

Clark: More stimulating to sharks than blood is an irregular low-frequency vibration, such as that of a struggling fish that's been hooked on the line—a tarpon, for example. If you try to bring a fighting tarpon into your boat, those vibrations are sent out in all directions, and sharks swimming within a few hundred yards can sense that change in the ambient vibrations of water. They'll come toward the source of the sound.

Omni: Since sharks are so sound-sensitive, especially to low frequencies, does marine vessel throw-off noise, or the increased use of low- and very low-frequency ranges in underwater communications, confuse shark behavior?

Clark: I don't know whether sharks can be confused that easily. Our experiments at the Mote Marine Laboratory certainly show that sharks can make associations—can learn to push a target or to ring a bell in order to get food. They can even discern one out of several targets. I think a shark can also make an association of vibrations. You see a wounded fish sets up an irregular low-frequency vibration in the water. So the shark has associated that type of frequency with food. If a motorboat is going through the water dumping garbage, sharks can learn to associate that frequency with food. So they may follow the boat. But there can be a lot of ambient noises in the water. If the shark investigates some noise, but it doesn't mean food to him, it's then likely to cross it off its list—in effect, saying to itself, "Oh, that noise doesn't bother me."

Omni: Do sharks, like whales, communicate with one another?

Clark: No. Sharks do not make any sound themselves except burps and gurgles. But they have a fine sense of hearing, and they have this remarkable electroreception ability. They have electroreceptors in the head—the ampullae of Lorenzini—which can detect five thousandths of a microvolt per centimeter square, which is one of the most sensitive electroreceptors known to exist in the animal kingdom.

Omni: Could an electronic jamming device be used as an effective shark screen or repellent?

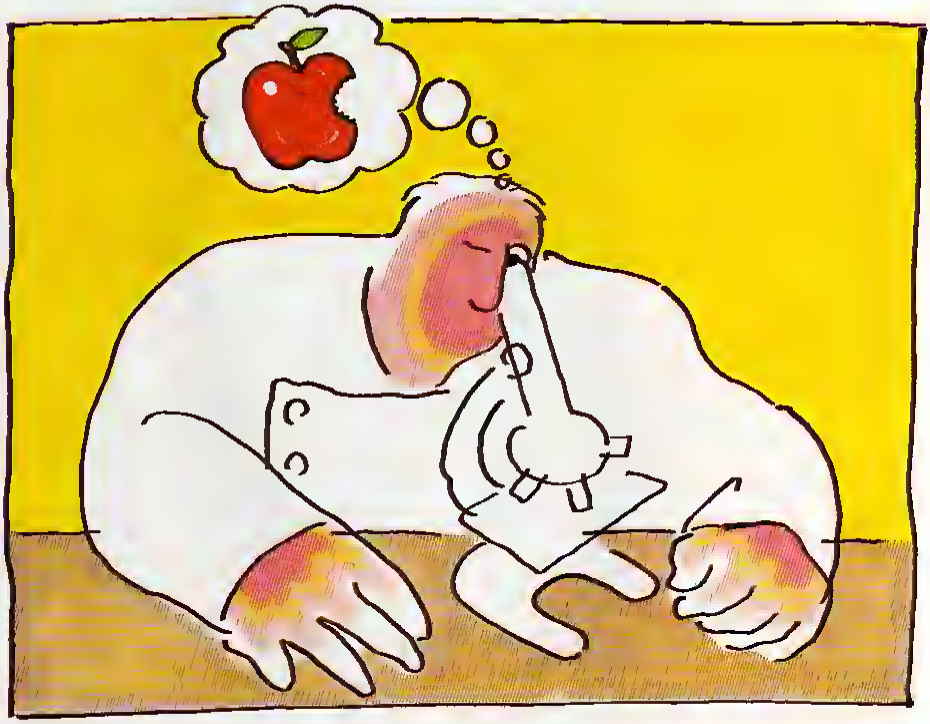
Clark: Yes. Perry Gilbert has done experiments at the Mote Marine Laboratory. Certain electrical charges in the water will completely repel a shark. They can be used by fishermen pulling in nets full of fishes if sharks come in and tear up the nets, causing thousands of dollars worth of damage. But it would be dangerous for a

CONTINUED ON PAGE 115

CREATIONIST COMIX

-00 Cents

by Bill Lee



I've gone to the drawing board and taken pen and ink in hand in an attempt to educate the entire civilized world (and parts of downtown Newark) with a series of satirically poignant illustrated facts of life according to creationism, the pseudo-scientific school of thought that holds Charles Darwin was wrong, evolution never happened, and the earth is the result of six days of hard work. Creationists have complained that science magazines never present their point of view clearly. We agree, and after much pondering, we decided the proper literary showcase for their beliefs is Creationist Comix.

HANNIBAL CROSSED THE ALPS ON DINOSAURS

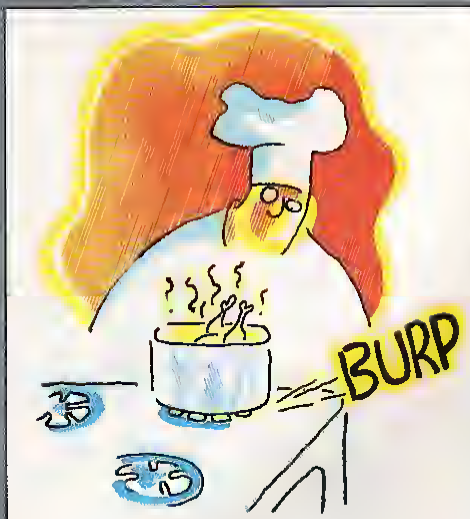
Long used as pack animals, as house pets, or perhaps as occasional hors d'oeuvres these versatile beasts were certainly not ancient fossils as Godless Darwinism has so foolishly claimed

NEANDERTHAL FOREFATHERS

It is rumored that America s founding fathers were of Neanderthal or Cro-Magnon stock This would explain why it is almost impossible to sing our national anthem with mere human vocal cords

OIL IS *NOT* A FOSSIL FUEL

What we mere mortals refer to as oil is actually the remainder of dark pigments used to paint the nighttime sky by the Great Master Painter in the sky Not only that, Dolly Parton is a boy



PLANETARY INDIGESTION GIVES US GAS

Pity Mother Earth It would take a moon-sized Alka-Seltzer to cure the heartburn caused her by Darwinism Remember The only reason we can cook a chicken is because our planet belches

DR LEAKEY WAS ALL WET

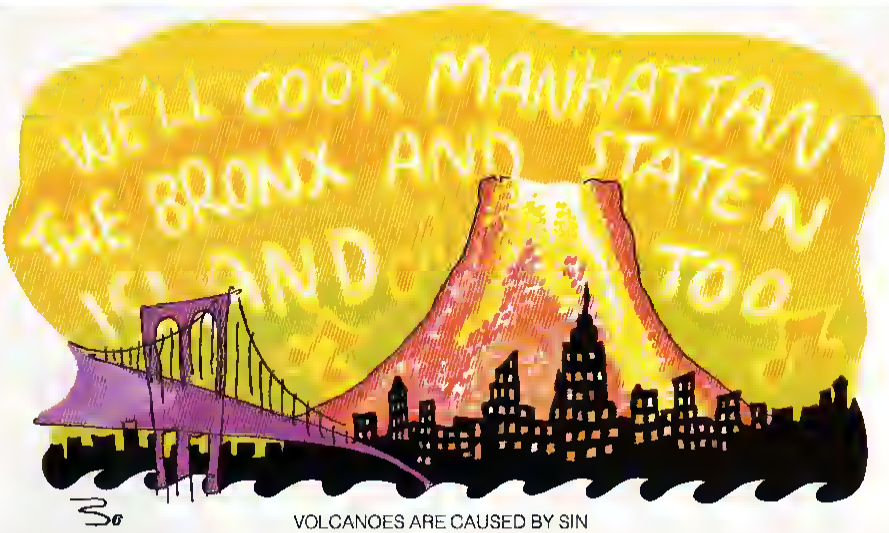
At Olduvai Gorge have been found the remains of one large snake, one small apple, and a crumbling piece of notepaper. Scrawled hastily across it was "Not tonight dear I have a headache"

LOT'S WIFE UNCOVERED

Enterprising Middle Easterners have found the solid salt carcass of Lot's hapless wife. Mrs Lot, as history records, was turned into salt immediately after casting her first vote for a liberal politician

'ANCIENT' EGYPT IS NOT THAT OLD

By one estimate, the first Great Period of Egypt occurred no more than 25 years ago. Frankie Avalon records and the mummified remains of James Dean were interred with one pharaoh, Nebbish Ah Tacky



VOLCANOES ARE CAUSED BY SIN

One package store in Spokane, Washington, sells spirits on Sunday and whammo! Mount St. Helens teaches the entire Pacific Northwest an apocalyptic lesson it is not likely to forget. As it happens, that was just a warmup for the big time. Experts now say the likely site of the next big eruption will be one place that has been long overdue. Times Square, the heart of America's Sin Belt.

It isn't paranoid to think you're bugged

CORPORATE 007

BY RICHARD F. DEMPEWOLFF

When the sixth potential buyer in a row recently dropped out of the bidding for a well-known apparel manufacturing company, the senior partners called in their executive vice-president junior partner. "Go out and hire an investigator," he was told, "and find out which one of our competitors is trying to foul up this deal."

The V.P. contacted CCS Communication Control, Inc., the New York manufacturer of a dazzling array of antiespionage

PHOTOGRAPHS BY ANTHONY WOLFF

"The briefcase holds bug and tap alerts, a voice scrambler, and a lie detector"

devices "We ran a tourteen-thousand-dollar debugging job for them" says CCS's vice-president Carmine O Pellosie Jr, "but we found nothing" A week later the company's president called CCS again to say another hot prospect had been brought to the altar but that the deal blew up because a rumor about it hit the trade

"Somebody is hearing me in these negotiations" he told Pellosie "I want you to come over here tonight when nobody is around I'll meet you at the plant at eleven-thirty"

We walked through the dark plant with infrared lamps and viewing scopes" Pellosie says "using wiretap detectors to check every telephone at every desk The phones in every executive office were tapped In the company's telephone switching room we swept the circuit racks On a top shelf above a ventilator duct we found them—fourteen matchbook-size tape recorder bugs lined up and tapped into all fourteen of the company's prime lines They hadn't been there during our earlier sweep

Pellosie set up a hidden pinhole-lens TV camera with an electronic motion detector trigger "Next night when we checked the video it had run," he says "We replayed it, and there on the monitor was guess who, the junior partner He'd removed the bugs when *he* called us in of course His motive? To spoil any sale or merger He was afraid he'd lose his job if the seniors sold out The plot failed As things developed he lost it *before* they sold out

Such cloak-and-dagger dealing in the boardrooms and corridors of American businesses and industries is not new Boatbuilder Nathanael Herreshoff posted a bouncer with an oak-burl club at the door of his Rhode Island shop to protect his hull plans from snoopers, back in the 1890s In 1939 during a board meeting the editorial director of Fawcett Publications noticed a wire strung from behind a window curtain to a tiny hole in the wall The line was carrying company plans to a competitor, listening in an adjoining room

Modern corporate ripoff operators have replaced the clumsy wire through the hole with unobtrusive taps They've found ways to crack computer memories and make off with data—and money—at the speed of light One Wells Fargo Bank officer pleaded guilty last year to three felony counts in a $21 million embezzlement scheme that involved leading bank computers astray At the same time as such sophisticated spying and electronic thievery have plagued businesses executives have more frequently faced brute-force assaults from terrorists and kidnappers A year ago last June Percy Wood, president of American Airlines while opening mail in his home was seriously injured when a letter bomb went off in his face

Countering this wave of antibusiness crime is a new and growing industry of corporate security agencies The best of them offer an arsenal of defenses, ranging from bug detectors (like the device shown on the previous page) to heavy firepower hidden behind the glistening black skin of a standard limousine

The burgeoning $600-million-a-year business-protection field is vast in the scope of its sophistication and cost Professionals like CCS and its competitors—Criminal Research Products in Conshohocken Pennsylvania, and the security division of Advance Electronics Company for example—use expensive, high-tech gear Do-it-yourself debuggers can find mass-market versions of many countersurveillance products in stores like Radio Shack and Lafayette in New York, or mail-order companies like Edmund Scientific in Barrington, New Jersey "Our business in night-vision systems parabolic mikes and similar gear has risen about fifteen percent in the past year alone," says Robert E Edmund president Despite the current recession no one expects sales to stop growing

CCS is just seven years old founded in 1975 by Ben Jamil forty-eight a dark-visaged, titanium-eyed entrepreneur who communicates comfortably (if tersely) in four languages To strangers meeting him for the first time Jamil comes across like someone invented for the lead character in a connection novel

While secrecy usually is guaranteed in the service such companies perform Pellosie and his founder-boss like to point out that they've sold their antiespionage devices not just to corporate chiefs but to kings dictators presidents ambassadors and movie and TV stars as well as hundreds of police departments throughout the country More than a third of the *Fortune* 500 companies are customers Among better-known blue-chip clients they *can* mention are Mobil Texaco Gulf, General Foods DuPont Philip Morris and Fiat

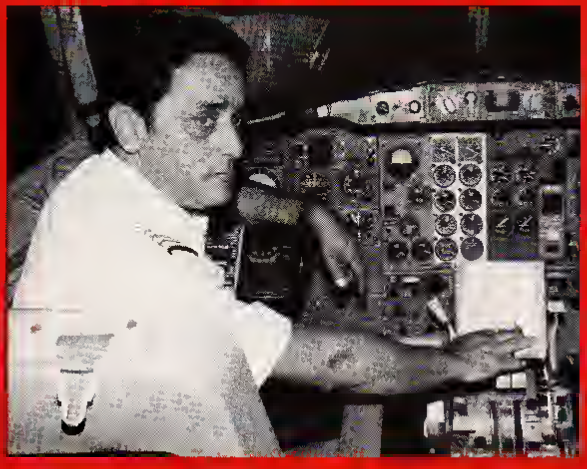
Much of CCS's annual $12 million pretax profit comes from sniffing out bugs and wiretaps In general electronic surveillance is limited by law to situations involving national security a few government policing agencies, and a few special industrial uses Ma Bell, for instance, can monitor lines to check service quality and employee performance and to spot the fraudulent use of equipment Federal and state agencies may use a bug or wiretap in domestic intelligence and criminal cases if they obtain a court order

But there are lots of exceptions to these general principles and lawyers themselves don't always agree on their interpre-

CONTINUED ON PAGE 122

•He tried to contact it with radio messages in Portuguese and English. Then he tried telepathy•

ANTI-MATTER



UFO UPDATE

The overnight flight from the Brazilian metropolis of Fortaleza south to São Paulo started off routinely enough. Passengers settled into their seats on the VASP airliner and as rows of interior lights dimmed, most people dozed off. But the predawn quiet was broken by the crackling voice of pilot Gerson Maciel De Britto (pictured here): "I see a strange object forty or fifty miles to the left," he announced. "And I need eyewitnesses."

Now wide awake, passengers found themselves bathed in a blinding light. They scrambled to the windows and for the next hour and 20 minutes watched the sky flash red, orange, white and blue.

Observing from the cockpit, De Britto said he saw what seemed like "a fast-moving saucer-shaped disk with five spotlights." He tried to contact it by sending radio messages in Portuguese and English. When that failed, he concentrated hard, hoping to send or receive telepathic messages "mind to mind."

Just before landing in Rio de Janeiro for a scheduled stopover, De Britto reported the light was a mere eight miles from the plane and closing in fast. The radar picked up absolutely nothing, but when the Rio tower asked three commercial pilots flying in the area whether they saw the dazzling light, the answer was affirmative. Soon a group of Brazilian military planes had joined the hunt. Although his group publicly claimed "found nothing," the official report remains classified.

In all, nearly 100 people saw the brilliant object. And that morning, February 8, 1982, every major Brazilian newspaper carried a front page account of the story. In the days following, reporters from newspapers, television stations and national magazines such as *Veja* and *Manchete* tracked down UFO experts for an explanation. They soon learned that on February 8, Venus had risen in the eastern sky at 3:10 A.M.

Could Venus give off such an intense and colorful light? Yes, says Dr. J. Allen Hynek, director of the Center for UFO Studies in Evanston, Illinois. "Venus has a thick atmosphere that acts like a prism. When it's rising and low in the sky it can twinkle in different colors. When it's high, it could appear to give off a glow."

All well and good, but De Britto claimed he saw Venus in addition to the eerie light. Moreover, he said, the light seemed intelligent, maintaining the same orientation to the plane even after he changed course by 51 degrees. Hynek says, "If what the pilot says is true, then it could not have been Venus. If it wasn't Venus, then it was a UFO."

A week after the sighting, as carnival time in Brazil and talk of the blazing UFO began to fade. Such things are less disturbing to the mystical sensibility of Brazilians than they would be to more incredulous Americans, explains Roberto Muggiati, one of *Manchete*'s editors.

That sensibility is best illustrated by passenger Elaine Belashi, a philosophy teacher. "What it was I really don't know," she reflects. "Just as we have our planes, they must have theirs."—*CAROL A. JOHMANN*

JESUS INSURANCE

[illegible] esus wa[illegible] or[illegible] ted [illegible] surrounded by far[illegible]. But whe[illegible] he s[illegible] [illegible] have enough [illegible] buy a [illegible] and [illegible] ndominiu[illegible] Miar[illegible] the unexpected windfall [illegible] es [illegible] E[illegible] gwee[illegible] died four years ago [illegible] his hi[illegible] es [illegible] gwee[illegible] of Po[illegible] s [illegible] England believed [illegible] he instructe[illegible] the [illegible] rus ee [illegible] oney [illegible] g[illegible] ver [illegible] guarantee [illegible] Jesus a [illegible] yiel[illegible] $61[illegible] by [illegible] the [illegible] entury

Digweed's distraught relatives are [illegible] ntesting the will. They don[illegible] want [illegible] wa[illegible] the Last Jud[illegible] [illegible] their share of the money. Since the Trustee O[illegible] cannot break its agreement with Digweed, however, the family has decided to make an unusual arrangement: an [illegible] suran[illegible] policy that would pay Jesus the lump sum of $615 820 upo[illegible] is retu[illegible].

Insurance broker Gess Fox says there seems to be just one problem. A couple of people masquerading as Jesus reborn [illegible] ave already staked [illegible] laims to the cash. And it's i[illegible] possible to say [illegible] ow many [illegible] ore [illegible] ntenders will come out of the woodwork.

Peter Rondinone

Psychical research [illegible] although an exasperating [illegible] ubje[illegible] man[illegible] ways (and I have come to believe almost wholly a negative one) [illegible] s [illegible] evertheless of considerable attraction to the serious st[illegible] de[illegible] ni[illegible] ring and the psychology of deception

—Trevo[illegible] H. Hall

TIME FOILS ESP

The marvelous, quintessential thing about ESP is that it seemingly knows no bounds, operating as it does across all kinds of physical barriers and i[illegible] credible distances. But proponents of extrasensory perception fear that thi[illegible] refusal to behave like other natural phenomena is what bars ESP from serious scientific consideration. If only ESP would decay over distan[illegible] e, like a sound wave, or yield to interference, like light from distant objects in space, physicists might be more accepting of it.

And so it was with mixed emotions that parapsychologist Charles Tart of the University of California at Davis discovered that ESP is weakened by time. "This is a major surprise and could be a major breakthrough," Tart says, "because no one has yet [illegible] a physical correlate for ESP." He is hopeful that time, the physicists' [illegible] urth dimension, may be the bridge across which systematic study will flow.

Tart made his finding serendipitously while reviewing the most successful ESP experiments published since 1937. He was trying to discover what was going on whenever ESP was operating strongly and consistently.

"I noticed that not one of these experiments involved precognition," Tar[illegible] reports. In other words, ESP never operated strongly or consistently when the target did not yet exist, as when subjects were asked, *before* a deck of cards was shuffled, to state what order the cards would be in afterward. When the intuited event has not yet occurred, Tart [illegible] cludes, ESP may lose up to 90 percent of its strength.

Dava Sobel

It is curious what unlikelihoods people—particularly scientists—will accept [illegible] order to save appearances.

Martyn Skinner

INTEGRATRON

George Van Tassel [illegible] extraordinary Integration machine on [illegible] acres of [illegible] near Yucca Valley, California, in 1959. Head of the Ministry of Universal Wisdom, Van Tassel told his constituents he'd constructed the [illegible] from working blueprints sent by aliens from space. The Integratron would prevent [illegible] and rejuvenate the [illegible]

Meanwhile [illegible] opened the Integratron doors to the general public for the first time on April 24 during a two-day convention titled SPACE (Star People Announcing Christ's Encounter) '82. Attendees were disappointed to find that the Integratron's 75-foot diameter interior showed little evidence of high technology. Two doors on opposite sides of the dome led to a room with concrete floors, wooden

[illegible] came to [illegible] Unable to keep the machine in power, Van Tassel died in 1978.

Then, in 1979, Van Tassel's widow [illegible] deeded the structure to the Christology Church, which [illegible] turned [illegible] Lockwood, a mechanic [illegible] Frank [illegible] who claims she signed the deed against her will, is now trying to reclaim the machine. But [illegible] recently issued an [illegible] preventing [illegible] from interfering with Lockwood's possession until all suits and countersuits have been settled.

[illegible] a coil and a [illegible]

[illegible] the most disheartened were elderly members of the now-defunct Ministry of Universal Wisdom, who alleged [illegible] Van Tassel some [illegible]00,000 worth of social security checks each year in hopes of gaining immortality. Lockwood told them he would no longer accept their contributions, nor could he promise them eternal youth.

He added that he would be happy to hear from anyone, human or otherwise, who knows how to make the Integratron work.

—Margaret Sachs

LOCH NESS WORMS

For nearly 50 years investigators from both sides of the Atlantic have been lurking about Scotland's Loch Ness in search of a huge monster nicknamed Nessie. Thus far they've had no luck. But now three zoologists studying the Loch Ness phenomenon have discovered a [illegible]strous welter of American flatworms [illegible] never before seen in Europe. The pressing question is: How did the flatworms get there?

At first the University of North Wales scientists suggested that worm [illegible] clinging like limpets to the outsides of ships crossing the Atlantic Ocean were dropped into the Caledonian Canal, of which the Loch [illegible] part. This notion was eventually dismissed, however, since few vessels traversing the canal actually come from America, and [illegible] no way that cocoons [illegible] survive the [illegible]

[illegible] clear voyage.

Instead, it has been deduced that the worms' presence is due to none other than Nessie the monster or, more precisely, to the search for this aggravatingly elusive creature.

The zoologists think the flatworms, which have a knack for sneaking into narrow cracks and crevices and laying eggs on solid objects, arrived [illegible] and on American monster-hunting equipment. The Loch Ness worms may [illegible] as formidable as the Loch Ness Monster, but so far, at least, they have a great deal more substance. —Trevor Smullen

How easily people believe what they long to believe in the seedier byways of paranormal phenomena, this dim half world; how compelling is the force of a bravado; how conveniently [illegible] the laws of evidence [illegible] the temptations [illegible]ickery.

—Trevor H. Hall

FREEMAN DYSON'S FUTURE MAN

Imagine a noseless man with sealed lips and crocodile skin, a creature perfectly adapted for survival in the frozen vacuum of space. In the not-too-distant future, genetic engineers may be able to sit down at computer consoles and type in the DNA codes for these and other beings designed to explore distant planets.

That's the vision of physicist Freeman Dyson (pictured above) of the Institute for Advanced Studies in Princeton, New Jersey. Nature's language for genetic instruction will be understood in ten to thirty years, he says. And molecular biologists have already begun developing the technology for redesigning Earth life to thrive in space or alien environments — without the need for spacesuits or artificial life-support systems.

For instance, the tendency of bones to dissolve during prolonged periods in zero gravity can be overcome, Dyson says, by readjusting the body's chemical balance. The frigid cold of space could be neutralized by endowing people with natural insulation. "Fur, feathers, nearly anything of this sort would do."

The most difficult problem might be the lack of atmospheric pressure, without which blood will begin to boil inside the body within five seconds. A possible solution, Dyson says, would be an internal body pressure a fraction of the one we have on Earth; the pressure would be contained by an airtight reptilian skin and a special swallowing reflex to keep the body's fluids and gases from pouring out.

The nose, he says, could be dispensed with altogether. "There's nothing up there to smell anyway."

Irving Lieberman

Penetrating so many secrets, we cease to believe in the unknowable. But there it sits, nevertheless, calmly licking its chops.

— H. L. Mencken

MONSTER ON ICE

If you shopped at a mall on the East Coast last summer, you might have seen a refrigerated coffin containing a hairy, humanlike body with a bashed-in skull. You probably also saw ads calling this grotesque creature the missing link between man and the apes, still frozen in solid ice.

Promoter Frank Hanson has made his living exhibiting this "Big Foot Creature" at malls and carnivals for the past 15 years. When someone asks how he got into the business, he might describe the Russian seal hunters who found the corpse floating in a 6,000-pound block of ice. The frozen corpse wound up in Hong Kong, where it was bought by the agent of an anonymous California millionaire. Hanson says the millionaire later met Hanson and paid him handsomely to show the monster to the public. The dubious are shown a 1969 *Argosy* magazine story identifying the creature as a Neanderthal man frozen alive eons ago.

But when Hanson took his show to Providence, Rhode Island, this past summer, the Providence *Journal*'s science writer C. Eugene Emery decided to investigate. He eventually contacted Leonard Bessom, a retired paleontologist for the Los Angeles County Museum. Bessom said that in the early 1960s he was asked to make a model of a Cro-Magnon-type man that would be exhibited in ice. Not wishing to tarnish the museum's credibility, however, he declined.

But he related that the creature was eventually built by Disneyland model-maker Howard Ball. Ball is now dead, but his widow, Helen, and son, Kenneth, confirmed the story. Kenneth Ball, who helped his father make the creature out of rubber, said it was modeled after an artist's conception of a Cro-Magnon man. "We gave it a broken arm and a bashed-in skull, with one eye popped out. Ball volunteered." The creature was the result of my dad's imagination." — Kendrick Frazier

Miracles are not contrary to nature, but only contrary to what we know about nature.

St. Augustine

SAGAN

CONTINUED FROM PAGE 48

Recent issues pushed for two projects close to Sagan's heart, but members didn t push hard enough to get federal funds appropriated to send spacecraft out to meet Halley's Comet, nor to override the budget cut that curtailed the radio search for extraterrestrial intelligence (SETI) It was Senator William Proxmire who suggested that such intelligent life, if out there today would still be out there again tomorrow when the U S economy got on its feet again

However, the Planetary Society did boost the cause of SETI by appropriating $10 000 to construct a small portable receiver for use with radiotelescopes around the country to try to pick up intelligent signals from space The society also arranged and partially paid for a trip by American scientists to attend a SETI meeting in the USSR

The quest for conversation with other worlds—or more likely a monologue (they talk we listen)—led Sagan to establish yet another organization, the CETI Foundation (CETI stands for Communication with Extraterrestrial Intelligence)

The foundation a Delaware corporation set up in 1978 to absorb all of Sagan's *Murmurs of Earth* royalties boasts on its board the prestigious name of Richard Berendzen president of American University and received its federal tax-exempt status in December 1980 On the face of it both the society and the foundation seem to be serving what Sagan s cohort Murray writing in *Mars and the Mind of Man*, called Sagan's "great passion, the search for extraterrestrial life "

Meanwhile back at CSP, ' Science for the Media was launching a satellite the Cosmos Store Lee reminisces ' That one was sort of, Well goody, look how well the book is selling and how the people have responded to the TV series We re planning the movie Are there other media? The answer was *publishing* So we talked for a while and we picked a few products for our first year and launched in '

Lee insists that each of the products had to conform to the company's credo as laid out in detail by Ann Druyan which stipulates that store products *teach*, that they *be unique*, or failing that more educational better designed, and *less expensive* than the alternatives The credo asks of each idea Is the product highly informational or just being chosen because we think we can sell it'? This section goes on to say, We will avoid duplication of products that are already being manutactured by us or others And, of course no product may misuse Sagan s name New products without any direct connection with Carl should not feature his name Its use in the book forewords or introductions flap copy, promotional material packaging ads will be considered with the utmost care '

It s interesting to compare the credo's high-minded goals with the first three products sold by the store

• The Cosmic Calendar 1982 is a one-year wall calendar featuring 14 printed reproductions of paintings that try to sum up the entire 15-billion-year history of the universe "Each painting represents 1 25 billion years," Lee says earnestly It's advertised as "conceived by Carl Sagan" because Sagan's book *Dragons of Eden* had a chapter entitled "The Cosmic Calendar," which telescoped the events since the beginning of the universe into a single year to dramatize how recently man had appeared relatively speaking (It was only moments before midnight on New Year s Eve) At an affordable $7 95 it was selling fabulously when Lee last reported

• The Cosmosphere is a $20 version of those cardboard star-finders many of us played with as kids This Japanese one is guaranteed accurate for 100 years or 1,000 depending on which piece of the store's promotional literature you read It's packaged with a 24-page text written by Sagan

> *"Look how well the book is selling and how the people have responded to the TV series We're planning the movie Are there other media? The answer* Publishing "

• *Visions of the Universe* is described by Lee as an "art book" with prints of 46 scientifically accurate paintings by astronomer-artist Isawaki ' There's some accompanying text by the prolific Isaac Asimov and thrown in at no extra cost it has a preface by Carl Sagan prominently bylined on the book s cover and on all promotional literature For its $30 coffee table price Lee maintains, "In one evening you can have a capsule summary of everything we know about the planets and a little bit about the sun and stars "

The store is indisputably Sagan's most commercial venture to date Nonetheless it bears more resemblance to a social club than a business Lee describes its staff as six "family and friends," and says he also calls on "quite a few JPL people who work with us on the side"—now that NASA's interplanetary program has been cut to the bone and the Jet Propulsion Laboratory has put folks like Lee on ten-hour-a-week pay schedules (He himself could be employed full time at JPL if he wanted to according to Sagan's staff Sagan's chief business officer is principal project engineer on the Galileo mission to Jupiter.) The minuscule sales force it sends to booksellers conventions consists mostly of Gentry's wife C C Lee There are rumors that this let's-keep-it-in-the-family approach hasn't worked *Time* magazine reported in December that the store was looking for a "partner with some marketing skills" for its upcoming product concepts which Lee tells us include another calendar, along with offerings in 'computer technology, anthropology medicine DNA, and best of all, some great new concepts for children's books " Sagan has long been particularly interested in teaching science to young children perhaps recalling his own early love for the subject He and his wife have given away more than 10,000 Cosmospheres and copies of *Visions of the Universe* to science students in the New York City school system, they report. Sagan granted a lengthy interview to the youthful reporters from *Children's Express* while he was busy filming *Cosmos*

While heading all these enterprises Sagan set off on yet another project to write an SF novel The launching of the book was typically grand The concept was put on auction and sold to the highest bidder—to the chagrin of Random House, which had considered Sagan its author The novel, *Contact* described by Sagan as an account—consistent with the best scientific probabilities—of what contact between humans and an extraterrestrial civilization would be like went in January 1981 to Simon and Schuster There were few publishers who could produce the book to Sagan's "rigorous standards " Lee says And besides "Did you hear the advance they offered?"

An advance is the sum paid to an author to tide him over while he's writing his book If the author prepares a publishable book he gets to keep the advance no matter how few copies are sold S&S believes it can peddle so many copies of the first Sagan SF novel that it paid $2 million for the chance That was too rich for Random House's blood but Random is getting a consolation price another book Scott Meredith tells us that its subject will be "the direct opposite of *Cosmos*—about the smallest particles of matter '

While Sagan talks his novel into a tape recorder at home in Ithaca New York often getting up in the middle of the night dictating a few paragraphs and then going back to sleep, going about it in a sort of inspirational process of various pages and chapters hither and yon " Druyan says she and his devoted secretary Shirley Arden and Lee shield him from such distractions as the press and the rigors of celebrity

This article "is not going to make Carl terribly happy," says a representative of Scott Meredith, who offers *Omni* a trade Carl will produce two original articles in the course of the calendar year to be used in place of The Marketing of Carl Sagan " There is one potential hitch *Dr* Carl Sagan knows nothing of the otter

INTERVIEW

CONTINUED FROM PAGE 99

diver to be in the water. So looking for an electrical shark repellent that would be safe for a diver to wear in the water is a challenge because most have maintenance problems or because the diver is in danger of being electrocuted.

Omni: One thing you discovered was the natural shark repellent produced by the Red Sea Moses sole. How does this fish repel sharks?

Clark: The important thing we learned is that a chemical does exist that can be used to deter or repel a shark. Up until we found the Moses sole, everyone was testing all kinds of chemicals by pouring them into the water. The shark came up, they dumped the chemical into the water, and seventy percent of the time, naturally, the chemical turned the shark away. So they thought it worked. Nigrosine dye—the main ingredient in Shark Chaser, which was required equipment in all life rafts during World War II—was really nothing more than a psychological crutch. If you put nigrosine dye in a circular tank with a shark swimming around the perimeter, the shark won't enter the area of the dye. It will go around it. But if you put a piece of fish underneath the dye, the shark will go right to it. They didn't mention that on the box. They said, "It has been shown that this dye will deter a shark." So generally its main effect was to keep the poor guys in the sea from panicking if they saw sharks around.

Omni: But the Red Sea Moses sole repellent is effective?

Clark: The Moses sole produces a chemical shark repellent strong enough that it does not dilute in water even in very low concentrations. This little animal had developed a method of letting just molecules of this substance ooze into the mucous coating on its body. We had the Moses sole dangling in running seawater, and two hungry sharks repeatedly tried to attack it. But they could not bite down on it because of the presence of the chemical.

Omni: How long was this effective?

Clark: For twenty-eight hours this little fish kept struggling in the water attracting sharks and repelling them every time they came in for an attack. So here's a different concept of how we might develop a chemical repellent.

Omni: Since the sole's secretion is not yet commercially available, what do you recommend to prevent attacks?

Clark: If you are injured and bleeding in the water, you do need something to prevent the stimulation of sharks. If you're out at sea and you're vomiting, or bleeding, or urinating, or emitting fluids that could produce an olfactory cue that would attract a shark, you're in trouble. The shark screen—a large plastic bag the size of the packet in which they used to put the Shark Chaser—is probably most effective. You just open up the plastic bag, fill it with water, blow up the

life-size support ring, climb in, and relax. Since you don't splash, you don't set up funny vibrations in the water. Any blood or fluid stays in the bag. So it doesn't set up a cue. The bag itself is pale green, like the ocean, and so the shark doesn't see white dangling legs. This is probably the most practical way to await rescue if you find yourself in shark-infested waters.

Omni: What else can help?

Clark: There's a hand-held explosive powerhead called the bang stick, which with its exploding charge is effective. But you have to see the shark coming, and then you have to get close enough to hit him on the head with it. There's also the drogue dart, which opens up on impact like a parachute, thus preventing the shark from swimming. There's a CO_2 gun, but you've got to shoot the cartridge into the shark's abdominal cavity which is not very big. If you blow up his stomach with CO_2, he'll turn upside down and be unable to attack you. Then there's a type of bulletproof vest and something like chain mail, either of which will deter a small shark. If sharks don't get anything on the first bite, they usually go away. When they make a first nip and draw blood, they'll get stirred up and keep coming back for more.

Omni: You describe these protection devices, and yet you maintain that a shark is a misunderstood creature?

Clark: Yes. In most cases when we are attacked by sharks, it's because we've done something to provoke them. Either we've tried to spear them or we've speared a fish, which excites and attracts them. They may then mistake a human for the fish. The shark does not come after us the way we go into his environment and kill him. I think we have to understand that sharks are not unpredictable. They're not a peculiar type of species. They're a whole group of animals, living like other groups of animals. And we've got to learn to understand them and accept them. It's a kind of privilege to have a shark come real close to you and eyeball you from a foot away. You feel as if he's accepted you in his environment.

Omni: Then you feel at ease with a shark?

Clark: Yes. They really are shy. That old expression of [oceanographer-biologist] William Beebe's about the "chinless coward" is applicable. They're afraid of divers.

Omni: What about the medical applications of shark research? Carl Luer's work at Mote Marine Lab suggests that sharks are seldom found with malignant cancers.

Clark: Luer is researching the immunological reactions in sharks. All of us think that this is worth investigating. If you examine many thousands of bony fishes, you'll find instances of cancer and all kinds of diseases. But you never find cancer in sharks.

Omni: Are any major cancer labs studying these various possibilities?

Clark: One Japanese group is working on it, but they don't really have good evidence. John Heller and his group at the New England Institute for Medical Research are the main ones working on these questions. They are cautious, but they suggest that the answer to cancer inhibitors may be a certain substance found in shark liver.

Omni: How long do sharks live?

Clark: No one knows for sure. It's very hard to get data on the longevity of sharks. There's no good way to tell how old any given shark is. You can't count the rings of the vertebrae. We do know that some sharks have lived in captivity for more than twenty-five years.

Omni: A protein derivative from shark cartilage has been used in making artificial skin for burn victims. Do you see other applications?

Clark: The Japanese have been using shark cartilage for a long time in medicine. They have one product—the name translates as "forty shoulders." A teaspoonful of this white powder, which is composed of shark cartilage, is used for general medicinal purposes. I don't think shark cartilage is unique as far as using it for this artificial skin is concerned. They just happen to use it because sharks have no bones and a lot of cartilage.

Omni: Do you think shark farms would be feasible?

Clark: I wouldn't be surprised to see some mariculture like that. Certainly there are a lot of sharks around, and deep-sea sharks, for example, are very good food. They don't have that sharky odor that some people object to. Once the shark is cooked, you can hardly distinguish it from any other fish. It's marvelous food and a great source of protein. It is estimated that about 4.5 million sharks are eaten by people annually. That's an interesting fact when you consider how few sharks ever bite a person.

Omni: Woody Allen said, "A relationship is like a shark. It must keep moving forward or it dies." Is that true of sharks, or are there sharks that can remain motionless?

Clark: You are referring to the "sleeping" sharks found resting motionless on the bottom of underwater caves.

Omni: Yes. Aren't they able to "rest" because of an abnormally high oxygen content in these caves?

Clark: Well, the higher oxygen content in the caves allows them to stop and still get good oxygen. More important, however, these areas serve as good cleaning stations. There may be freshwater leaks in that area that either loosen parasites or make it easier for remora fish to remove parasites. This cleaning activity may increase water flow into the gill slits and allow the shark to breathe while it remains motionless. Otherwise, most sharks must keep swimming, or else they'll suffocate.

Omni: Another shattered myth. Do you think that the United States Navy or some intelligence agency may be withholding some shark-research findings?

Clark: In general, the Office of Naval Research and the National Science Foundation and other government or private organizations that have sponsored shark re-

"I'll be a little late for dinner, darling. I'm being fitted for a subcompact."

search make their information available to everybody

Omni: How trainable is a shark?

Clark: Well, intelligence is very hard to define, you know, even with people. I would say that sharks are as bright as any fish, but they don't have the abilities you find in sea mammals, porpoises and dolphins. But we know that we can train sharks. Sharks have the ability to make visual discriminations. They can learn to distinguish between targets or different patterns in the same time it takes to train a pigeon or a white rat.

Peter Benchley did a lot of research on associations when he wrote *Jaws*. It's not inconceivable that a shark could learn to associate some pattern of what a man wears or how he looks. But I don't think a shark would learn to recognize an individual the way a dog would.

I do think sharks might be used as animal carriers, since they are large like whales and porpoises. But you can train a porpoise to do more things than you can train a shark to do, such as carry a weapon or an explosive underwater. Since porpoises are more like us and are warm-blooded, they probably feel pain the way we feel pain. Sharks don't have the same sensitivity to pain, therefore, a shark may be more expendable. You could possibly use a shark in ways that you wouldn't want to use a trained porpoise. It's conceivable that you could attach something to a shark and regulate him so that he could take some dynamite to a ship and blow himself up in the process.

Omni: You mentioned *Jaws*. The film version has brought to the forefront a symbol of terror, a psychophenomenon. Do you think that our fear of sharks is a manifestation of an age-old fear of the sea, a fear of falling off the edge of the world, or a fear of sea monsters?

Clark: Yes. Everybody loves a sea monster. Just as they love Frankenstein and Dracula. They want to be scared, and they're disappointed when the sea monster turns out to be something else. They'd rather think that there's a sea monster around than accept the more logical explanation that it's a series of basking sharks, for example. If three or four basking sharks swim in tandem, you have all these fins rising out of the water, and they resemble a monster. The average adult basking shark is thirty feet long. A series of those going along gives you a one hundred-foot-long sea monster. A half-rotten basking shark was once washed ashore in New Zealand. Everybody thought it was a sea monster. A little head, a long neck, a body with the rhomboidal fins half-rotten. There we had a thirty-foot-long "sea monster." But when we analyzed it, we found it was a basking shark.

Omni: Could the Loch Ness Monster conceivably be a shark or sharks?

Clark: No. I doubt it. But perhaps the misty water and some other circumstances, combined with the fact that basking sharks are found in that area, might explain some

sightings. But perhaps not all.

Omni: These situations and people's fascinations have made your mission of relaying the truth regarding sharks difficult. How did you first become involved in the study of sharks?

Clark: It was like a fantasy for me, as a child, to go to the old aquarium in Battery Park, to look in and see the sharks and fishes swimming around ever so beautifully and gracefully. That was my first exposure to sea animals. I could sit alone and think about them and imagine I was down at the bottom of the sea with them. My images were very different from those of a person reading newspaper articles about shark attacks and then seeing a movie like *Jaws*. I think if you go to a public aquarium and look at the sharks, you'll see that they're not so fearsome. Divers are not afraid of sharks. No one who really has seen sharks underwater is afraid of them. You know people will do silly things to provoke them. Other than that, it's an exciting experience to see sharks underwater.

Omni: Would you agree with Melville's statement in *Moby Dick* that meditation and water are wedded forever?

Clark: I would very much so. Water, even imitation water as used in Japanese gardens, stimulates meditation. There is something about water—the sound of waves breaking, water fountains—that makes you stop the hustle and bustle of everything you're doing and suddenly think.

Omni: On a global basis, how do you think the laws of the sea should read?

Clark: That's so complicated. We're all so selfish—the country, leaders of industry—everybody just trying to get. It's very hard to get the principles of conservation across to everybody. People say, Well, what's in it for me? Or each country wants to be sure that its own rights are protected.

I think it's through organizations like the United Nations and through travel that we start to appreciate the facts. If we want to save the world, save the sea, save the coral reefs, we have to get all the adjacent countries to cooperate. Otherwise, we're going to kill the goose that lays the golden egg, and everyone's going to suffer. The laws of the sea are bogged down in the selfish interests of each country, and I don't know whether man can rise above that to do what's right.

Omni: If the United Nations is a positive force, what are some of the negative forces in the world?

Clark: People like Secretary of the Interior James Watt are setting us back. It's a complex balance that the average person doesn't understand. I think I understand what must be done to save the coral reefs of the Red Sea. But I don't know whether I can ever get cooperation between three Arab countries and Israel. The programs of the United Nations Environmental Protection Agency are excellent. The director, Noel Brown, has a program that extends to all parts of the world. Helen Vanderbilt has proposed a project to preserve the reefs in the northern part of the Red Sea, at Al-Ghardaza, Egypt. This effort is significant.

Omni: Aside from preserving obvious beauty, why is that so important?

Clark: New ways to utilize a desert coast for mancultural projects present unique opportunities for development of other natural resources. Besides the value of tourism, new solar methods and polycultures of fish and oysters can have great economic impact. Mismanaged, this area might be ruined forever.

Omni: Do you think too much money has been spent on space study as opposed to marine science?

Clark: Oh, no. I think space is fascinating, too—just more expensive. All science is fascinating.

Omni: Do you think large corporations should be more involved in funding scientific research?

Clark: They are actually. Gulf Oil, for example, has sponsored the *National Geographic* specials for the last seven years. They're making so much money. I think they feel they want to try to do things properly where they can. I believe they are munificent enough. They have sufficient money to spend some of it this way, and sometimes it takes very little extra effort.

Omni: Your research has not always been restricted to elasmobranchs. What is your next endeavor?

Clark: This summer I want to study a little fish called *Trichonotis nikii*, which I named after my son. This fish swarms in great schools over the ocean bottom, hundreds of thousands of them flashing over the sand. They exhibit an interesting territorial behavior, and I want to study this phenomenon. You know, in a way, I guess I'm impractical. I really like to learn things about fishes out of curiosity. When you're studying basic science, you never know where it will lead, what you'll find out.

Omni: What do you consider your single greatest accomplishment?

Clark: I think understanding sharks and finding out that they are not stupid, unpredictable, dangerous creatures. I like the feeling that comes from knowing that I found that out. Some people may say the Moses sole and the effective chemical shark repellent are my most important discoveries. But we don't really need a shark repellent.

Omni: As my final query, I've saved my favorite. What do you think is the wildest thing you've ever done?

Clark: My ride on a huge whale shark. It was crazy. We wanted to study and photograph her. She was well over forty feet long. Once I got on her, I just couldn't let go. And I went far away from the photographers and the boat. The shark was cruising along steadily at three knots, and after a while I thought to myself, Why am I still holding on to the shark, getting farther away from the boat? And I finally let go. I did not ever want to let go. ∞

Hey! You'll need an Environmental Impact Study before you plant that thing.

THE ACCIDENT

CONTINUED FROM PAGE 61

The ultimate step was never taken

"What's wrong?" Massena's voice boomed.

"In a sec!" Pirx yelled back as he threaded the rope through the carabiner. He had to take a closer look. Again he leaned out, this time with three fourths of his weight on the hook, jackknifed as if to wrench it from the rock, determined to satisfy his curiosity.

It was Aniel. Nothing else could radiate from such a height. Pirx, having long ago passed beyond the perpendicular, was now some three hundred meters above the point of departure. He searched the ground for a landmark. The rope cut into his flesh, he had trouble breathing, and his eyes throbbed as he tried to memorize the landscape. There was his marker, that huge boulder, now viewed in foreshortened perspective. By the time he was back in a vertical position, his muscles were twitching. Time to rope off, he told himself. He automatically pried out the piton, which slipped out effortlessly as if it had been embedded in butter. Despite a feeling of unease, he pocketed the piton and began plotting a way down. Their descent was, if not elegant, at least effective. Massena plastered his stance with pitons and shortened the line. Pirx bellied some eight meters down the slab. Below was another chimney, and they swung down the rest of the way, alternating the lead. When Massena wanted an explanation, Pirx said, "I've found him."

"Aniel?"

"He peeled off up there, at the bottom of a chimney."

The return trip took less than an hour. Pirx wasn't sad to part company with his pitons, though it was a strange sensation. To think he would never set foot here again, neither he nor any other human, that those scraps of metal, Earth-made, would remain ensconced for millennia—indeed, forever—in that cliff.

They had already touched down on the scree and were staggering around in an obvious effort to regain their legs. Then Krull came running up to them, yelling from a distance that he'd located Aniel's holsters, jettisoned not far off. The robot must have junked them before scaling the rock, he said, positive proof of a breakdown since the jets were his only means of bailing out in an emergency.

Massena, who seemed altogether unfazed by Krull's revelations, made no secret of the toll taken by the climb. He plopped himself down on a boulder, spread out his legs as if to savor the firmness, and furiously mopped his face, brow, and neck with a handkerchief.

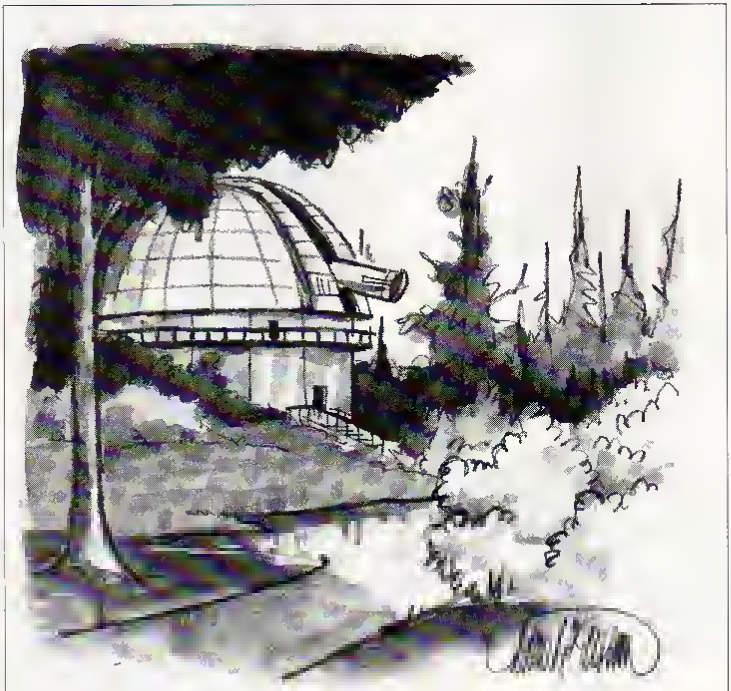
Pirx reported Aniel's fall to Krull. A few minutes later they went out searching. It didn't take them long to find him. Judging from the wreckage, his three-hundred-meter fall had been undetected. His armor-plated torso was shattered, as was his metal skull, and his monocrystalline brain was reduced to a powdered glass that gave the surrounding rocks a micalike glitter. Krull, at least, had the decency not to lecture them on the futility of their climb. He merely repeated his contention, not without a certain satisfaction, that Aniel must have become "deprogrammed." The clincher was the abandoned holsters. Massena was visibly altered by the climb, though not for the better.

There was silence on the way back, the more glaring because Pirx was deliberately withholding his version of the "accident." He was sure it was *not* a mechanical defect—of monocrystals, mnestrones, or whatever—any more than he, Pirx, had been "defective" in yearning to conquer that wall. No. Aniel was simply more like his designers than any of them cared to admit. Having done his work with his customary speed and skill, the robot found he had time to kill. He didn't just see the terrain, he sensed it. Programmed for complex problem solving, for the *challenge*, he couldn't resist the grandest sweepstakes of them all. Pirx had to smile. How blind the others were! To think they could have taken the jettisoned holsters as evidence of a mechanical failure! Hell, anyone else would have done the same. *Not* to have junked them would have been to take all the risk out of it, to turn it into a gymnastics stunt. No, they were all wet, and no graphs, models, or equations could make him believe otherwise.

He was only amazed that Aniel hadn't fallen earlier—up there alone, with no previous training or climbing experience, unprogrammed for battling with rocks. What if he'd made it back safely? Somehow Pirx was sure they would never have heard the tale. Not from Aniel, at any rate. What made him decide to risk a jump from that ledge, lacking both pitons and a second, without even *knowing* he lacked them? Nothing, probably. A decision as mindless as he was. Had he scraped or brushed the rim of that chimney? Pirx wondered. If so, then he must have left behind some trace, a sprinkling of radioactive atoms that would remain up there until finally decomposing.

Pirx knew something else. He would never breathe a word of this to anyone. People would cling for dear life to the hypothesis of a malfunction, the only hypothesis that did not threaten to upset their vision of the world.

They reached the camp that evening. Their elongated shadows moved apace as they tore down the barracks, section by section, leaving behind only a barren, flattened quadrangle. Clouds scudded across the sky, and Pirx went about carting crates, rolling up maps, in short, filling in for Aniel, and the thought of this made Pirx pause a second before delivering his burden into Massena's outstretched arms. ◻



Now she's taking off her bra!

CORPORATE 007

CONTINUED FROM PAGE 106

tation One complication If's legal for you fo wire yourself up with a hidden recorder and tape anyone you talk to in person without his or her consent But it may or may not be legal to tape your own telephone conversations local laws make some kinds of snooping legal in one state illegal in another It's okay, for example, for you to record your felephone conversation with someone even without telling him or her that you're recording provided you make your call from New York or Colorado In Florida it's illegal to record unless both parfies know fhe recorder is on

State laws are a patchwork, according to the lawyer who provided these examples And in the pafchwork there are enough holes to permit widespread surveillance without serious consequences

Partly as a result of murky laws no one knows how much telephone tapping and bugging there are But every security agency's files are filled with case studies

About a year ago, Pellosie says a leading North Slope oil exploration company, involved in merger operations, had clues fhat its conversations were being intercepted Installation of a battery of bug detectors turned up "desk staplers with built-in transmitters telephones containing drop-in bugs, and wiretaps in remofe telephone switching centers We debugged them" Pellosie adds Although CCS was not able to suggesf who fhe culprits were without further investigation, "We still supply monitoring equipment to prevent any furfher hanky-panky

Most intercompany spying is perpetrated in highly competitive fields by people who can't stand to be in second place An insulating contractor in Florida called on CCS recently because he was losing business at an alarming rate to a competitor CCS's strike team debugged the premises and found transmitters behind pictures, desks, and cabinets "The competitor was picking up orders and acting on them That's a case where a fifteen-hundred-dollar invesfmenf saved a quarfer of a million in business" Pellosie says

Business and professional espionage in the booming Florida-Georgia area keeps a number of other wiretap removers busy these days Jimmie Squires's Southeastern Detective Agency Inc operating ouf of Gainesville Georgia is among them "Boardroom bugging is a familiar scenario here" he reports "They do it to swipe one another's new product ideas mostly We just nailed two firms that did it

"More recently" he adds "we uncovered a bug in a bank boardroom They called us when a board member mentioned to his lawyer that a nearby bank was scooping them on incentive-marketing ideas developed at their own board meetings The lawyer whom we knew suspected surveillance He called us and sure enough, our sweep quickly located an illegal bug which we suspected was placed there by the competition"

No place is sacred, according to Squires "We've had to sweep a number of judges' chambers recently" he says "And we have found fransmitters The plea bargaining now going on tempts some lawyers They try to eavesdrop on deliberafions of the judges, so they'll know what kind of deal is possible"

Movie producers at a film festival on the French Riviera bought several million dollars worth of antieavesdropping gear They negofiate their film leasing on the phone," Pellosie explains "Let's say a theater chain tycoon sees a producer's rushes and is ready to offer four million for first-run rights But he bugs or wiretaps the producer's room and hears someone offering two million Now he knows he can get it for two million plus a little Modern debugging equipment can bring that kind of stuff to a halt All these guys are using it now"

> *"Bug detectors come in innocent-looking wraps, such as desk pen sets, cigarette packs and lighters, digital watches, pocket pens, and leather engagement pads"*

Most electronic snooping nowadays is performed by wiretap rather than bugging—an important distinction Bugging involves placement of a microphone or other lisfening device where desired conversations can be picked up Usually this means somebody must trespass to install it, for which he can be prosecuted if caught on fhe grounds of "surreptitious entry" A wiretap however can be established in a switching center miles from a target phone What's more, anyone with a minimum knowledge of circuitry can do it All you need, Pellosie says, is a short length of wire Clip one end to the line you're tapping the other to a line from your own phone or tape cassette and you're in the spy business

It may sound as if the threat of Big Brother is being replaced by a growing swarm of sinister freelance Little Brothers But the equipment available to detect and locate hidden bugs and taps is highly sophisticated today In fact developments in electronic antiespionage gear go far beyond the mere defection of elementary snooping devices secreted in an office

Bug detectors come in such innocent-looking wraps as desk pen sets, cigarefte packs and lighters digital watches, pocket pens, and leather engagement pads If there's a hidden transmitter within a dozen feet of the user or wearer of these minidetectors a match-head-size diode incorporated into their design glows bright red Some devices have vibrators that buzz a warning A more complex verifier and locator beeps as it closes in on a hidden bug When the object is located the beep will suddenly stop

The bug alert of your choice will run $500 to $12,000 depending on refinements But all of them work

How? Bugs are simply tiny FM transmitting stations Squires explains Corporate spies often wind up using FM radios in their cars parked near an office to listen in on conversations inside a building The bug detector is a sophisticated FM receiver that typically sends a beeping sound through earphones, to the user The closer the detector gets to the bug, the less frequent the beeps will be When the beeping stops, that's in all likelihood where the listening device is, wifhin a few inches

On the job Squires carries a standard FM receiver tuned to a local station in addition to his detector When he thinks he has located a bug he switches the detector over to another stage which simply receives whatever signal the bug is transmitting Now if he hears his own radio through the earphones he's certain that he's discovered a bug

And what does he do then? One thing he does not do is say "Gotcha!" or "Aha!" In many cases neither he nor his client does anything to disturb the bug Instead the client will treaf it as a useful channel for leaking phony information

Wiretaps are something else For them CCS offers the Tap Alert TA 5000, an electronic black box about the size of a transoceanic radio In seconds it can sweep-check some 1,250 possible combinations of wires leading to your phone and pinpoint (within six inches Pellosie says) the location of any tap up to five miles away from your desk

Tap defectors can do all this for a simple reason Telephone lines operate on a specific voltage, explains Larry Steckler publisher of *Radio-Electronics* and a knowledgeable expert What a wirefap detector looks for is a voltage drop and nowadays even a minuscule drop can be picked up and interpreted with fine-tuned equipmenf "Just how the precise location is determined, Steckler isn't sure And CCS which has a few secrets of its own to protect, isn't telling

A portable tap-sweep for top executives is CCS's CC 900, which comes in a briefcase accompanied by its own telephone If can provide a sweep of virtually all lines a traveling executive might decide to tie into It warns of any tampering and aufomatically prevents transmission over the portable phone until the bug or tap is removed Or fhe user may pick up a nearby standard

phone and turn on the unit's built-in scrambler, which will treat an eavesdropper to pure gobbledygook in any of 8 million undecipherable codes. Trickier scrambler models (one comes in a cigar box concealed beneath the cigars) provide more than 1 billion code variations.

But if it's only your identity you want hidden, plug in the unit's Voice Mask, which completely disguises your voice or giveaway accent. It levels all voices to one. Pellosie explains, by scrambling the input, descrambling it, and adding a subcarrier or tonal frequency. The result can't be cleaned. With this device, Luciano Pavarotti in good voice would come out sounding like Darth Vader, although you could still understand his lyrics.

First-class versions of CCS briefcases, costing up to $50,000, are self-contained counterespionage centers. A fully equipped Trionic briefcase, top of the line, might contain a radio telephone with bug and tap alerts, a voice mask and scrambler, a tape recorder and tape-recorder detector and a voice-analysis device that supposedly warns the bearer when anyone talking near the briefcase or through its telephone circuitry is telling a lie.

Unlike a polygraph, which measures pulse rate and other physiological indexes, this "truth machine" analyzes subtle changes in vocal patterns. The machine measures microtremors, Pellosie says. When someone lies, the frequency of his tremolo pattern changes because of stress and is measurable with great precision by the instrument.

Just how much precision it has is a matter of some controversy. Many polygraph experts and psychologists maintain that voice-stress analyzers don't work unless they're used in a controlled setting. This necessitates monitoring a potential liar's voice patterns to establish a baseline level of stress when the subject is known to be telling the truth and then comparing stress levels during answers to the critical questions, such as, "Is this *really* a standard contract?"

Still, CCS can display an actual printout showing wild fluctuations in stress levels—under controlled conditions—during an interview with a suspected thief. Stress levels tripled when the subject answered the question, "Did you steal the two hundred fifty dollars?" (Stress readings more than doubled when the same subject responded "No" to the question, "Did you ever lie to your wife?")

Is this whole electronic zoo really just a set of props for paranoids? "It's a question everyone asks," Pellosie says. "Some calls we get are psychologically tainted, but most of those come from private citizens rather than organizations. About once a month, for instance, someone comes in and says his body is bugged. We try to send him to the medical center for a whole-body scan to check for implants, which is convincing for most of them."

But not even weird requests can be

treated lightly. A little old lady walked in here one day and told us her apartment was bugged," Pellosie recalls. "How did she know? I was walking through the hall and heard a conversation I'd had the night before—coming from another apartment," she told me. To humor her, we debugged her big old apartment and found it clean. Then one of our people noticed ancient padlocked iron gates on her courtyard windows. We opened one, looked down, and there taped to the sill was a mike with wire leading to a window of an adjacent apartment. When we cornered the owner, he pleaded guilty. He was trying to spook the old gal into moving. He wanted her apartment."

Corporate clients, Pellosie insists, usually have sound reasons for their counter-surveillance programs. For people in high positions, there's a fine line between paranoia and pragmatic discretion.

"Top executives must constantly watch for knives from below, and three hundred sixty degrees horizontally," warns Dr. Mortimer Feinberg, an industrial psychologist. "Apparent paranoia in this regard is usually founded on stark reality in the rarefied atmosphere of their world." Feinberg's analysis is backed up by statistics. Terrorists, assassins, and kidnappers have taken nearly $200 million in ransoms during the past decade. And more than half of some 100 Americans seized during that time—the figure excludes the hostages in Iran—were business executives. These figures explain why there's a growing market among businessmen for kidnap-foiling devices as well as for some defensive weaponry with a lot more power than Hershoff's oak-burl club.

CCS offers a miniature radio transmitter for example, designed into pens, leather belts, watches, and even hearing aids. During an attempted kidnapping, the victim triggers the transmitter to broadcast a homing signal to a portable monitor-receiver in the home-office security center or in a police station. An electronic tracking system for air, auto, and ground surveillance provides data on the course and distance to the transmitter, wherever it is, permitting rescuers to zero in on the victim's location.

The tracking principle is well-known, according to Steckler. "Best results," he points out, "would be obtained with three receivers, each having a rotational directional antenna, located at widely divergent points around the transmitter—in the air or on the ground." Trackers learn the precise location of the transmitter by simple triangulation. Today all of this can be done by a tiny computer in the receiver to provide displayed coordinates. Even a single directional receiver in a vehicle can run down a transmitter, Steckler notes, by pursuing the signal and circling back when the direction indicator reverses. "If Aldo Moro, the Italian premier, had used this system," Pellosie observes, "he could have been located and rescued promptly."

CCS is working on a button-sized nuclear-powered transmitter that can be surgically implanted. It would transmit a locating signal up to half a mile on the ground, or to a satellite for rebroadcasting to tracking stations on Earth. The transmitter, smaller than a pacemaker, would be placed under the clavicle during an operation. It would feed signals to an antenna buried just under the skin of the shoulder. The nuclear battery would keep on working at least 45 years without replacement. Estimated cost: $25,000 plus surgery. CCS says there are already half a dozen executives on a waiting list to get one of the transmitters, which are expected on the market in about a year and a half. Further in the future, the company says, such devices could also signal physiological data, such as heart rate, so rescuers could learn not only where kidnap victims are but also how well they are coping with stress.

Currently offered transmitter locators are already small enough to fit inconspicuously into the Trionic briefcase, leaving room for several other pieces of antiterrorist gear. There's a bomb sniffer, for example, and a bulletproof liner that serves as a shield against anything up to a .357 magnum. Another defensive device inside the tasteful leather skin of the briefcase is a kind of flashlight that throws a beam so bright that an attacker is temporarily blinded and can remain disoriented for hours. Surprisingly, the briefcase also has some room for business papers.

> *"The device could signal physiological data, such as heart rate, so rescuers could learn not only where kidnap victims are but also how they are coping with stress."*

The briefcase is light armor compared with another CCS product: the supersecurity automobile. The most glamorous model to date, a Cadillac put together by CCS in 1979 for the shah of Iran, carried a price tag of $250,000. The shah refused delivery when he went into exile, forfeiting a $50,000 deposit. CCS has used this car as a demonstrator ever since. But the company has built and sold some 500 variations on the same theme.

The car sports some interesting James Bond-type optional extras. The bulletproof glass will repel fire from M16 rifles, .44 magnum handguns, and any other class 4 weapon. Shrapnel from a hand grenade lobbed to its roof will be bounced off like a handful of pebbles. Land-mine explosions under the vehicle will make for a somewhat bumpy ride but little else. The tires are puncture-proof, with solid hoops inside so that if the tires are shot out, the car can maintain its speed for two more miles. Ram bumpers (for defensive driving) can punch into another vehicle at 50 miles per hour without damage to the Caddy. If caught in a running duel, the driver can spray 30 gallons of diesel-fuel oil slick across the highway behind him from nozzles under the rear bumper. Inside, beneath upholstered flaps, bulletproof fiberglass panels slide aside to reveal machine-gun ports designed to handle anyone foolish enough to ride abreast in a running dogfight.

The car also comes equipped with a bomb sniffer to verify any suspected bomb implants and a bomb pouch that will contain an explosive equivalent in power to the detonation of three sticks of dynamite. If an ignition-bomb hookup is suspected, the engine can be started by remote control from a safe distance. Auxiliary safeguards carried by the car include a kidnap-location transmitter hidden in a seat-belt latch and also an infrared viewing system that allows the driver to roll without lights in pitch darkness or through dense smoke. There's an oxygen kit (in case of gas attack) and the trunk contains a fold-away motorcycle, should everything else fail.

Though it may smack of Grade-C TV, Pellosie asserts that a car similarly equipped recently carried four executives safely through an ambush by six men using rifles, bombs, axes, and poison gas in a Latin American country.

For all the industrial espionage and sabotage currently afoot, the future is not as bleak as might be expected. As in any competitive arena (including war), countermeasures tend to keep pace with new offensive weapons systems and devices. Some are pretty far out. Soon computer thieves will have a less easy time of it.

"The Wagstaff system of forensic hypnosis for log-in identification is proving eminently successful," Pellosie says. "They're hypnotizing computer operators so they can't recall their own log-in ID code until they're in front of the console—even under duress. Scrambling devices also are coming along to keep data lines clear of bugs."

As for vulnerable communication lines, Ma Bell's laser-fiberoptics systems will soon be making things tougher for eavesdroppers. "Few experts will be able to handle the fragile glass fibers without mucking them up," Pellosie says.

People being what they are, someone is already at work trying to figure out a way to penetrate the fibers and read the messages in the lights. In another shop on the other side of an unending confrontation, a researcher is working up a device to rout out the snooper or confound the terrorist. And between the two sides, businesses are gearing up to defend their major assets: top executives and their secrets. ∞

AT THE MIKE

CONTINUED FROM PAGE 85

The men came to their feet, picking up rocks and bottles.

Marching lines of soldiers came into view, bayonets fixed. Small two man tanks armed with machine guns rolled between the soldiers. The lines stopped. The soldiers put on gas masks.

The Bonus Marchers, who remembered phosgene and the trenches, drew back.

"Keep playing!" said Ike.

"Keep goin'. Let it roll!" said Armstrong.

Tear gas grenades flew toward the Bonus Marchers. Rocks and bottles sailed toward the masked soldiers. There was an explosion a block away.

The troops came on.

The gas rolled toward the marchers. Some who picked up the spewing canisters to throw them back fell coughing to the ground, overcome.

The tanks and bayonets came forward in a solid line.

The marchers broke and ran.

Their shacks and tents were set afire by Chemical Corpsmen behind the tanks.

"Let it roll! Let it roll!" said Armstrong, and they played "Didn't He Ramble?" The gas cloud hit them, and the music died in chokes and vomiting.

That night the Bonus Marchers were loaded on Army trucks, taken fifty miles due west, and let out on the sides of the roads.

Ike and Louis went up before the Washington magistrate, paid a ten-dollar fine each, and took a train to New York City.

The last time he had seen Wild George alive was two years ago. Patton had been found by somebody who'd known him in the old days.

He'd been in four bad marriages, his only kid had died in the taking of the Japanese Home Islands in early Forty-seven, and he'd lost one of his arms in a car wreck in Fifty-five. He was found in a flophouse. They'd put him in a nursing home and paid the bills.

Ike had gone to visit. The last time they had seen each other in those intervening twenty odd years had been the day of the fistfight in Forty-three, just before the Second World War broke out. Patton had joined the Miller Band for a while, but was too much for them. He'd gone from band to band and marriage to marriage to oblivion.

He was old, old. Wild George was only five years older than Ike. He looked a hundred. One eye was almost gone. He had no teeth. He was drying out in the nursing home, turning brittle as last winter's leaves.

"Hello, George," said Ike, shaking his only hand.

"I knew you'd come first," said Patton. "You should have let somebody know."

"What's to know? One old musician lives, another one dies."

"George, I'm sorry. The way things have turned out."

"I've been thinking it over, about that fight we had." Patton stopped to cough up some bloody spittle into a basin Ike held for him. George's eyes watered.

"God. Oh, jeez. If I could only have a drink." He stared into Ike's eyes. Then he said, "About that fight. You were still wrong."

Then he coughed some more.

Ike was crying as they went into the final number. He stepped forward to the mike. Helen had used when she came out to sing with them for the last three numbers.

"This song is for the memory of George Smith Patton," he said.

They played "The Old Rugged Cross." No one had ever played it like that before.

Ike broke down halfway through. He waved to the crowd, took his mouthpiece off, and walked into the wings.

Pops kept playing. He tried to motion Ike back. Helen was hugging him. He waved and brushed the tears away.

Armstrong finished the song.

The audience tore the place apart. They were on their feet and stamping, screaming, applauding.

Presley sat in his chair.

He was crying, too, but quickly stood up and cheered.

The whole thing was over.

At home, later, in Georgetown, Senator Presley was lying in bed beside his wife Muffy. They had made love. They had both been excited. It had been terrific.

Now Muffy was asleep.

Presley got up and went to the kitchen, poured himself a scotch, and stood with his naked butt against the countertop.

It was a cold night. Through the half curtains on the window he saw stars over the city. If you could call this seventeenth century jumble a city.

He went into the den. The servants would be asleep.

He turned the power on the stereo, took down four or five of his Eisenhower records, looked through them. He put on *Ike at the Mike*, a four record set made for RCA in 1947, toward the end of the last war.

Ike was playing "No Love, No Nothing," a song his wife had made famous three years before. She wasn't on this record, though. This was all Ike and his band.

Presley got the bottle from the kitchen, sat back down, poured himself another drink. There were more hearings tomorrow. And the day after.

Someday, he thought, *someday E. Aaron Presley will be President of these here United States. Serves them right!*

Ike was playing "All God's Chillun Got Shoes."

I didn't even get to shake his hand, thought Presley.

I'd give it all away to be like him, he thought.

He went to sleep sitting up. ∞

#21. A small step in wording, a giant leap in effect

COMPETITION

By Scot Morris

World War Jr. *Fiddler on the Porch* "Give me liberty or kill me." *Lawrence of the United Arab Republic* 'Twas brilliant and the slimy toads did gyrate and gambol."

Judging by the volume of our mail Competition #21 was our most popular one yet. The object was "near misses" ideas that are just a tad off the mark. We dedicated this "Small Steps" competition to Neil Armstrong's infamous "small step for (a) man."

First let's clear up that "Small Steps" dig. We claimed that Neil Armstrong misspoke. A few readers said we were being unfair. The voice-activated microphone was at fault, not Neil. We had considered this, but when we listen to recordings of the moment, there doesn't seem to be enough time between "for" and "man" for another untransmitted syllable.

Still, we thought, we owe Armstrong a chance to respond, so we called him at his offices at Cardwell International, Ltd., in Lebanon, Ohio.

Q. Did you misspeak? A. There isn't any way of knowing. Q. Several sources say you did. A. I mean, there isn't any way of *my* knowing. When I listen to the tape, I can't hear the "a," but that doesn't mean it wasn't there, because that was the fastest VOX ever built. There was no mike-switch—it was a voice-operated key, or VOX. In a helmet you find you lose a lot of syllables. Sometimes a short syllable like "a" might not be transmitted. However, when I listen to it, I can't hear it. But the "a" is implied, so I'm happy if they just put it in parentheses.

Fair enough. And thanks.

On to the results. The commonest categories of repeats:

Titles: *Celsius 232, Gone with the Breeze/Cold Front, The Prunes/Raisins of Wrath (The Grapes of Prune), Death of a Salesperson, A Shortstop in the Rye, The Socks of the Fisherman.* Margaret Mitchell's *Blown Away, Paradise Misplaced.*

War slogans: "Remember that fort in Texas." "Never mind the torpedoes, make the boat go fast," "I haven't started fighting yet," Churchill. "An Iron Drapery has descended across Europe," MacArthur. "I'll be back," "I'll write."

Presidential catch phrases: "Eighty-seven years ago," "Fourscore and some-odd years ago," "Let me make myself perfectly transparent," "*Ich bin ein Hamburger*." "The only thing we have to fear is getting scared over nothing/being fraidy cats/phobophobia/f-f-f-fear itself."

Biblical passages: "Let my people relocate." "The three wise guys." "Blessed are the meek, for they shall inherit the dirt."

The single ideas repeated most often with more than 25 variations apiece: (1) "Friends, Romans, countrymen, listen up! I got something I wanna tell ya." / "Have you got your ears on?" (2) "Frankly, my dear, I don't give a darn." / "a hoot." / "a rat's ass." / "I'm apathetic." / "Frank, my dear." (3) "Don't fire until they get real close." / "until you see the whites of their eggs." / "the yellow of their teeth." / "the hairs in their nose." / "the dirt under their fingernails." / "the little alligators on their polo shirts." / "their sclera."

A goodly number of readers suggested that if Ben Franklin had had his way, Armstrong's first small step would have been "Tranquillity Base here. The Turkey has landed."

As the raven says, "Never mind."

GRAND PRIZE WINNER $100

To be or not to be: those are the parameters.
—*Andrew Graham, Los Angeles*

RUNNERS-UP $25

'She's Got Sammy Davis Eyes'
—*Mitchell Ross, North Liberty, Iowa*

It's bad luck to walk into a ladder
—*Howard M. Karpoff, Fair Lawn, N.J.*

Ku Klux Klub
—*Paul Rowan, Rochester, N.Y.*

God Bless North America
—*Eric Gongola, New Bedford, Mass.*

. . . ——— —. . .
—*M. E. Fink, Norwalk, Ohio*

Never lick a gift horse in the mouth
—*Brian Reedy, Harrisburg, Pa.*

The Lone Ranger and Toto
—*Everett Anderson, Redford Township, Mich.*

The Van Allen Cummerbund
—*H. P. Henson, Sugarloaf, Pa.*

The Ten Guidelines
Romeo and Debbie
—*Don Addis, St. Petersburg, Fla.*

HONORABLE MENTION

Ontogeny rehashes phylogeny
—*G. Daniel Lassiter, Charlottesville, Va.*

Who's Afraid of Louisa May Alcott?
—*Ethelyn E. Johann, Anaheim, Calif.*

Self-Contained Apparatus for Breathing Underwater
—*Dwight Herman, Hamilton, N.Y.*

Lysdexia
—*Janice Minor, San Diego*

Toothglue
—*Rosann Roderick, Warren, R.I.*

December seventh, 1941, a day that will always hold bad memories
—*Muriel Hykes-Bailey, New Orleans*

Cowboys and Native Americans
—*Ben Spinelli, West Orange, N.J.*

"Never in the history of human conflict have markers been held on so many by so few."
—*L. Dickson, Calgary, Alta., Canada*

Half of one, six dozen of the other
He was running around like a chicken with his legs cut off
—*Mike Fesco, Dayton, Ohio*

"Render unto Caesar if line 54 is larger than line 62."
—*D. Reinhart, Idaho Falls, Idaho*

William Carter
Heaven's Gate II
—*Joe Faust, Fillette, Wyo.*

The Boston Wine-and-Cheese Party
—*M. B. Ryder, Philadelphia*

"I'll get by with a little hemp from my friends."
—*Tammy DelValrez, Blaine, Wash.*

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HOUSEWIVES

CONTINUED FROM PAGE 67

of their bodies was encased in a vacuum, causing blood to drop down to their toes. 'It felt as if you were two different people in the same body,' says Luthi. 'Half of your body was going up a mountain, and the other half was down at sea level.'

But of all the studies and exercises, it was the centrifuge that was the most memorable and hair-raising fest. Outfitted with the standard g-suit, each woman sat in a small cabin mounted at the end of a long centrifuge arm. The arm was sent spinning faster and faster to increase the gravitational pressure. They went from 1.5gs (one and a half times Earth's gravity) to 2gs, and all the way to 3gs, even though pressures of more than 1.5gs are unlikely for future space shuttle passengers.

'You're seated in this chair, tilted back, and wired with electrodes on your arms, legs and temples,' Luthi explains. 'There's a radio in there with you and a microphone. The scientists are giving commands and asking you questions. You're told to stare straight ahead at green and red lights overhead, and when they turn one on, you're supposed to flick it off with a switch. That way they test your alertness. By the rate of your response, they could tell whether you were going to black out,' she continues. 'At any point you can stop the whole thing just by pressing a button, but I wasn't going to end it under any circumstances.'

What did it feel like? At 1.5gs there was almost no pressure on me,' Luthi says. 'At 2gs I began to feel some, and at 3gs I felt this great force pushing me deeper into the chair. It was very, very uncomfortable. First I felt like I was going to be squashed, and then I began to feel as if the lower half of my body was swelling up. At that point I honestly would have preferred to be walking my dogs.'

Some of the women felt sick to their stomach at the 3g level. Others passed out. But no one quit.

'I felt, in a way, like a piece of meat,' Luthi continues. 'I knew I simply was a body they were testing. It's not like you're being used as a sex object. You're at the center of what everybody is doing. It's not a bad feeling.'

On the tenth day the women went into another phase of the study—bed rest. The deconditioning effects of zero gravity scientists have found, can be duplicated by lying prone for long stretches of time. So for ten days the women were confined to bed. While they were bedridden, they were not allowed to raise their knees, to lean on their elbows, even for eating, or to sit up in bed. No one was permitted to walk to the bathroom. 'And when we wanted to shower,' one subject recollects, 'someone would roll us in a gurney over to a special horizontal shower, lift us up onto it, and then turn on the water. We called it the car wash.'

Passing the time was not as tedious as it might seem. There were television sets and radios, and plenty of lively gossip to catch up on. Some women knitted afghans. Others wrote letters. During the blood tests several women nearly passed out. 'We were a lot more vulnerable,' Luthi says.

There were some adjustment problems. The women developed agonizing backaches, but those disappeared as their bodies got used to the tedium of bed rest. More lingering were the aftereffects of their time lying down. All felt weak and a little dizzy when they were finally helped out of bed after the tenth day. Many experienced aches and pains, the result of a slight amount of calcium loss. This was especially true of the more physically active women like Howell. 'This is what happened to the very active astronauts when they came back,' she explains. 'Their blood vessels enlarged from the inactivity, and they felt lightheaded with pins and needles in their legs—like I did for two days after it was all over.'

The five-year study produced reams of invaluable data, which NASA scientists are still studying. NASA has not yet published a final report, but last spring, even as the final group of women were packing their suitcases to head for home at last, researchers were already drawing some preliminary conclusions. Immediately evident was that the 27 women had done a superior job, compared to the men, of adapting to the physical and psychological challenges of the series of tests.

Moreover, the women had quickly bonded together into a group that was more cohesive and much more supportive than anyone at NASA had anticipated.

No shuttle passenger flights are scheduled now. The time for fun and adventure rides into space may still be 20 to 30 years in the future, but when the time comes for frequent space travel, the sex of the traveler will present few problems. These 27 women proved that. Dr. Sandler confidently predicts it is just a matter of time before trips to space become as routine for women as they are now for men.

Ultimately the study served to reinforce what many people had claimed all along. As a creature of space, the woman is clearly the superior sex. As pilot and would-be astronaut Cobb suggested in her House committee testimony 20 years ago, women are better physical candidates because they consume less food and less oxygen and because they are more radiation resistant.

In addition, Sandler notes, "One of the real disadvantages women have here on Earth is a direct result of the force of gravity. Because of gravity, they need strength and stamina to do hard work. On this level they cannot successfully compete with men." But in the world of zero g, the brute strength of men means little. Because strength isn't as important, and because of the women's superior performance in the Ames study, Sandler predicts, "In space, women are going to beat men." ∞

COMPETITION

CONTINUED FROM PAGE 126

The Red Badge of Derring-do
—Sam Oliver, Fairfax Station, Va.

You can call me Ishmael, or you
—Herb Martinson, Wheaton, Md.

Wool candy
—Helen Stephens, Springfield, Ore.

We the landowners, in order to form a more perfect union
—Neal Battersby, Mill Valley, Calif.

To go where no man has gone before, boldly
—David Evans, Lancaster, Pa.

'Carrot Top' Grange
'How do I love thee? Hand me my calculator.'
—Don Addis, St. Petersburg, Fla.

Lost in Space: The Motion Picture
—Sam Pate, Stanford, Calif.

It was the best of times, but it wasn't that bitchen.
—Hank Osborne, Honolulu

It's so humid, you can poach an egg on the sidewalk.
—Laura Clark, Indianapolis

Continue trucking.
—Vince Truchan, San Diego

You can lead a horse to water, but you can't make him consume mass quantities.
—Dennis Colodiy, Tampa, Fla.

Our Father, who art in heaven, Howard be thy name.
—Jeffrey Watson, Martinez, Ga.

Pepper, M.D.
The quality of mercy is lumpy.
—Doug Campbell, Brookfield, Ill.

Give my Regards to Avenue of the Americas.
—Vivien Rowan, Madison, Wis.

If you can't stand the heat, get out of the oven.
—Chris Tremain, Indianapolis

Anyone here by the name of Dr. Livingstone?
—Richard W. Houston, Lubbock, Tex.

York, York.
—Mick Badgero, Vernon, Mich.

A Goodbye to Guns
Who is the bell tolling for? Don't ask.
—Priscilla Crockett, Kalamazoo, Mich.

Let sleeping bags lie.
Mary had a little lamb, peas and a salad.
—D. L. Polonsky, Newtonville, Mass.

For every heart on Broadway there's a broken light.
—No name, northern Virginia

The Hairstylist of Seville
A Businessman of Venice
—J. B. Cravens, Kansas City, Mo.

On your mark Go Get set
—Ralph Harris, Los Angeles

Roses are red/ Violets are violet
—Ed Canlas West St Paul Minn

To sleep perchance to REM '
—Troy Dickson Chattanooga, Tenn

and on the seventh day He kicked back
—Mark Rafter Pomona Calif

Go west young man
—Jacki Moss Caribou, Me

To err is humanoid
—Michael Coler Glendale Calif

You can't teach a dead dog new tricks
—Gay Venable Nacagdoches, Tex

Physician bill thyself
—Scott Emerson, Escondido Calif

Insubordination on the Bounty
—H D Benton Sacramento

Watson come here! I love you
—Stella Calvert Ann Arbor Mich

NBC—Smart as a peacock
—W Waters Albany N Y

God Mom and apple strudel
—John Dandrow Manchester, Conn

Invasion of the Body Stockings
—Roger Hahn Cedar Falls Iowa

Getting there is half the trip
—Oscar Weigle Whitestone N Y

Whip it! Whip it well
—V Peterson Beaverton Ore

The Herpes II Medic Alert Tag
—Pascal Portfolio
Huntington Beach Calif

Lady Chatterley s Boyfriend
—Charlene Skidmore, Springfield Mo

Blood Sweat and Ear Wax
—Cherie Nagy Anaheim Calif

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CONTINUED FROM PAGE 26

these new technologies It's virgin territory We can make up stories and tales and create those archetypes now with some help from Carl Jung One of the characters in the electronic world Ram says It gives me a great feeling helping people plan for their future needs That's how I feel about *Tron* I want people to come out of it inspired to think of technology as something that belongs to them I'm very optimistic and benevolent toward technology We're the computer generation To complete the point Bally—the nation's largest maker of video-arcade games—is creating a Tron game that will appear across the country shortly before the film debuts

Besides the strictly computer-imaged portions—including a title sequence developed by Robert Abel and Associates that displays an amazing sense of three dimensions—*Tron* is also the culmination of the art of the matte and backlighting Simply a matte is done when part of a film frame is blacked out and another piece of film replaces it When the live actors are depicted in their electronic dimension instead of building elaborate sets that would probably fall short of expectations anyway the effects are created separately and then "patched" on to the film of the actors (whose sequences were filmed against a black background)

Lisberger Taylor and Harrison Ellenshaw (who also supervised the special effects and is the son of Peter Ellenshaw who helped pioneer the use of mattes) brought the process to its zenith in this production Each frame of these segments required at least two separate photographic mattes and two hand-drawn overlays On some up to 25 passes through an optical printer had to be made

Taylor who first brought backlighting to film in a 1974 7-Up commercial entitled "Bubbles" which illuminated a psychedelic soft-drink world, says *Tron*'s combination of mattes and backlighting was "an entirely new composite of processes and most unique is that it's being used as a regular production tool rather than a one-shot injection of special effects "Painters over the years," he adds, "have tried to capture light in their work Well, why not use real light?" By shining light from behind large blow-ups of the 65mm film used for *Tron*, Taylor has achieved an almost neon effect as it penetrates the blank portions of the film That image is then filmed once again It is real magic when it is projected once again It looks alive and you get a visceral feeling from the light Like music, it looks best when it's playing"

In essence, this 53-minute section of film involved shooting the movie twice—once as traditional live action, using the actors and then turning each frame into a single cel (and adding mattes and special effects) and shooting it as an animated film

But despite the labor-intensive nature of the project and the cost (over $20 per frame) by using these "soft sets" instead of building miniatures and models, a $50 million film has been made for only $18 million

Does this mean all films in the near future will be using computers and optical processes instead of sets? Aside from a minimum of location shooting around Los Angeles and at the Lawrence Livermore Laboratory outside Oakland (the first time the world-famous laser-research center has allowed a film company to use its facilities for a set), *Tron* was concocted largely in the emulsion of a piece of film The possibilities have people worried

John Halas of England's premier animation studio Halas & Batchelor recently was quoted as surmising that computer-generated animation will take over 90 percent of the animation business from traditional methods by the end of the century Others however have concluded that computers will indeed be major compo

"Even though a computer creates an image on a two-dimensional plane, it creates it in three-dimensional space, and with perfect perspective, never a mistake in shape"

nents in animation studios but they'll be used as slaves to do the copying and backgrounds not as artists

Tron's own history is indicative of how swiftly the technology has come to pass Lisberger in fact had first conceived the film as a melding of live action and traditional cel animation He had already created *Animalympics* a 90-minute animated special for NBC which had the rug pulled from under it thanks to the 1980 Olympics boycott by the United States But as *Tron* began to take shape he realized there was no way he could get away with cartooning his vision of the future He also realized that the studio he and producing partner Donald Kushner had developed themselves could not handle such a task alone Enter Walt Disney Studios

Impressed with Lisberger's work Disney gave a definite maybe unsure whether the computer imaging and composite mattes the young man from Boston was talking about would actually work When Lisberger put together a short reel showing the possibilities according to Disney executive Tom Wilhite "it was apparent it was so unusual so different so visually impressive that there was no question about doing it

But there have been many visually impressive science-fiction/fantasy films before that have fallen flat on their popcorn because in the end they lacked a good story, too There's a big temptation Lisberger reflects "to wow them with special effects But what we tried to do was create a balance between the machine aspects and the human aspects We have to do that in film and in society and science too

For me the actor is the ultimate special effect People get motivated by a story, not special effects This isn't just a light show We give reasons for why it looks like it does To tell this story we needed to do certain special effects To tell another story other effects might be more apropos It's a matter of finding the technology to tell a story rather than forcing a technology to tell a story it's not right for The medium is secondary really What's most important is understanding emotions and feelings"

Tron needed a method to show a visualization of a computer program—something only a computer can do Lisberger is uncertain what his requirements might be on his next film a biography of the young Albert Einstein that will necessitate illustrating his relativity concepts

There is some disagreement among the *Tron* artists though, on exactly what the computer is capable of doing in the long term They marvel at the mathematical purity and perfection of the designs the computer produces but, one faction says, if you want to give a teapot some character you'd better do it by hand

Others like Taylor see greater possibilities We have a unique opportunity on this film It's like nothing anybody's done before with a new technology The industry badly needs new tools We're suffering from the budgets of special-effects films spiraling out of control *Tron* will show another way It will also probably prompt the use of digital film printing—which eliminates matte lines—and is cheaper Who knows where all this will lead?

"The computer is like a magic hat with an incredible number of magic tricks inside," Taylor says *Tron* is breaking the new ground now to make the rest easier in the future I've noticed a curious phenomenon Even though a computer creates an image on a two-dimensional plane it creates it in three-dimensional space and with perfect perspective never a mistake in shape and absolutely accurate When you put that on the screen there's something that innately connects to a human being subconsciously that tells him that it is *perfect* Computer simulation can do all the things you can't do in reality There are no physical limitations no limits to point of view"

Taylor rubbed his hands anxiously "When we have digital you'll be able to mix the simulation and the reality perfectly That will be the limit of film art It will look totally real And the future will look back on the past and see *Tron* standing there as Hollywood's first microchip"

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THE NATIONAL CORPORATE FUND FOR DANCE

PREHISTORIC ENCOUNTER

EXPLORATIONS

By Delta Willis

On certain beaches under certain moons, you may witness one of nature's longest-running shows. As primal as a heartbeat, the invitation is clear. In the Age of High Technology, let something prehistoric crawl into your life.

Within earshot of Florida's highways, on the resort beaches of South Carolina's Fripp Island, and on Trinidad and Tobago, the latest rendition of animal, *Homo sapiens*, may await the arrival of one of the earliest: the sea turtle. Here, among the dunes, a mysterious rippling in a circle of sand culminates in the emergence of tiny three-inch replicas of the mature turtle. Without a moment's hesitation, or even a backward glance, the hatchlings scramble seaward, plunging into the foaming surf with a certainty only instinct can command.

Equally mysterious is the female's return years later, the memory of her birthplace imprinted the first day of her life. Like the Pacific salmon that fights its way upstream to breed in the fresh water where it hatched, the female turtles migrate hundreds of miles on the journey homeward, at one time blackening the sea with their numbers. After mating with males that wait in the shallows, they repeat a behavior that once meant life but now invites death. They come ashore to lay their eggs, becoming easy prey for poachers and predators that lurk behind dunes and in the tall sea grass.

For human onlookers, this display of primeval behavior may evoke the same awe and suspense as a space shuttle touchdown. There seems to be some magic, a tangible satisfaction, in witnessing a return from Out There.

Two hundred million years ago, reptiles ruled the earth. Though no transitional fossils of the sea turtle have been found, their contemporary house suggests evolution coupled daring architectural design with innovative engineering. The carapace appears to have originated from ancestral ribs, which over the years expanded and joined together to envelop the soft body. The lower shell, or plastron, is thought to have evolved from elements of the shoulder girdle and abdominal ribs. Nature experimented even further, placing the dorsal bones of the shoulder beneath the ribs rather than above, as in most vertebrates. It apparently worked, for the owner has grown more and more at home as years go by.

Between 90 million and 100 million years ago, several species of turtle took to the sea, their stubby legs adapting into streamlined flippers. Today, six of the seven remaining species are threatened, endangered or on the brink of extinction. The irony is that we have just begun to comprehend adaptations of the sea turtle that could enhance our own survival. Gerontologists would like to wrest the secret of longevity from the larger species, which live more than 150 years. And anyone who believes that the next frontier is the sea has much to learn from these aquatic dwellers. Turtles can hold their breath underwater for 90 minutes at a stretch, and their extraordinary navigational abilities are already the subject of intensive investigation.

What fishermen talked of for centuries, tagging operations now confirm. Sea turtles travel from Mexico to the Galápagos, from Florida to Newfoundland and Norway, and from the coast of Brazil to the small island of Ascension, in the middle of the Atlantic. And back again. The fishermen knew, for they saw the same old friends from time to time, but it took a tag to prove beyond the shadow of a fishing tale.

The very mileage of this not-so-streamlined vessel is baffling. The largest, the leatherback, may attain a shell length of six feet and weigh 1,400 pounds. Yet it is the leatherback, in early returns that has carried its tag farthest from its nesting ground.

So the endurance of the sea turtle is understandably legendary. Stone tortoises support the sacred tablets that mark the entrances to the Ming Tombs near Peking and Nanjin, the current capital and the former capital of China.

In modern times the sea turtle has come to be revered even more for its sexual stamina, copulating for hours at a time. Tourists in Mexico City fork over 25 pesos, less than one U.S. dollar, to gulp raw turtle

After laying eggs on the beach where she herself was born, the female turtle returns to sea

egg sold as an aphrodisiac But it is the navigation of the sea turtle that holds the greatest mystery and well it should While we were still fumbling with our sextants sea turtles were following their noses fo islands that weren t even on our charts Even esteemed herpetologist Archie Carr considered a leading expert on sea turtle migration, is stumped by their navigation We know a lot about where they go and when What's not known at all is how they guide themselves And this from a man who has conducted 22 years of tagging operations in Costa Rica 'There's not a living soul who can explain how any animal—bird fish, or turtle—crosses a thousand miles of open sea and makes a scheduled landfall on a tiny crop ot rock

Carr s task like that of the volcanologist, is hindered by the rare opportunity tor observation There's even a "lost year, which may actually range from 7 to 14 months when the immature turtle simply disappears So when the young scramble to sea or the females come ashore zoologists jump at the chance to study measure and fag them

Thanks to the research of Carr and former students David W Ehrenfeld and Marion Manton the wildlife buff can ponder more than meets the eye Their recent experiments indicate that turtles can detect minute amounts of chemicals carried in currents—perhaps the secret behind their homing ability Olfactory sense was tested by using an indispensable tool of behavioral science—the Skinner box Turtles were rewarded if they pressed a response key when a chemical was released into the waters of their chamber The sea turtles were able to detect substances dissolved to concentrations as low as 1 to 5 percent proving that they have an excellent sense of smell underwater—an unusual ability for an air-breathing vertebrate

When the female emerges from the sea she sometimes nudges the sand with her snout suggesting that olfaction also plays a key role on land She may reject the site, her flippers scouring a half moon path back to the ocean But if she s satisfied she will spend the next hour or so digging a light-bulb-shaped hole by alternating her back flippers which function with precise dexterity

Once the temale has begun to lay the first ot about 100 eggs a process that takes 10 to 15 minutes she is usually oblivious of predators or bright lights—factors that, if presented earlier on might have caused her to circle back to sea The process ot ovipositing has therefore been photographed and even the glaring lights of television crews have not deterred the instinct to complete the job once it s begun In a 1939 study a scientist "struck a female on the head with a stick and even sat on her without deterring her ' As noted social commentator Bugs Bunny once remarked, 'People are the craziest animals "

Because the temale sometimes begins laying eggs only 30 minutes after copulation it was originally assumed that she must store sperm a handy adaptation also employed by chickens and pheasants It seemed impossible to believe that fully formed eggs complete with shell could be produced within such a shorf time span Yet Dr Carr indicates this may indeed be the case He does however caution "This is brand-new information and therefore inconclusive"

When the last leathery egg the size of a Ping-Pong ball has dropped into the nest, the female gently covers them with sand Cerfain species use camouflage others grade the area flaf with their plastron By sunrise the female returns to sea leaving behind offspring to emerge—as she did—knowing which way is seaward

The odds are stacked against them Heavy rains or the tires of dune buggies may permanently entomb the hatchlings Predators include alligafors and crocodiles bears and snakes crabs and foxes hogs and flamingoes, dogs and people If the eggs do survive the hatchlings break out at dusk, during the night or on cloudy days for the heat of the sun could end their struggle prematurely

"There's not a living soul who can explain how a sea turtle crosses a thousand miles of open sea and makes a scheduled landfall on a tiny crop of rock."

Beneath the surface a fantastic cooperative effort is under way to bring the entire group out ot the darkness Hatchlings at the bottom begin to wriggle and this squirming spreads like a wave to the top Sand from the roof of the cavity trickles down the turtles on the bottom pack the falling sand to the ever-rising floor of the cavity so that they all move up together as if squeezed into an elevator

Whether by accident or design, or something in between their teamwork is extremely effective Yet only a lucky few—less than 1 percent—will reach maturity Males especially vulnerable during copulation are harpooned other turtles drown in shrimp nets still others are butchered for their meat and their hide for turtle soup turtle oil and tortoise-shell glasses A mere 15 years ago the East Pacific green females on the western coast of Mexico numbered between 46 800 and 78 000 Now no more than 3,000 return each year and fewer and fewer of their progeny live to adulthood

The hatchlings do have a few friends Collaborating with the World Wildlife Fund in western Mexico, biologist Kim Cliffton has organized the rescue of thousands of freshly laid eggs that would otherwise be plucked by the hands ot poachers Aztec Indian children work alongside volunteers moving and reburying the eggs counting the hatchlings—an essential conservation lesson that Cliffton hopes will someday grow into a totally indigenous effort

Cliffton applies a simple capitalisf approach to saving the turtles He buys the eggs "It's amazing he reports As long as we have the money to pay the people they will sell to us for a peso and a half when they could sell the same egg to the black market at three to six pesos"

There s something about a little turtle confronting the breakers that is inspiring to anyone Russell Train president of the World Wildlife Fund U S described his visit to Mexico in personal terms "I had the very special experience of carrying several hundred of the small, warm struggling baby turtles down to the edge of the breaking sea and releasing them to disappear into whatever fate held in store for them It was a moving experience for a person such as myself who does most of his conservation work behind a desk"

Because the status of the sea turtle is so fragile observers must like Train and Cliffton, become part of the solution rather than part of the problem Fripp Island, off the coast of South Carolina demonstrates the delicate balance

'The island floods with visitors in the summer which coincides with the nesting time says Norine Smoak licensed by the South Carolina Wildlife Department and Marine Resources We re maintaining Fripp as a safe refuge for turtles in spite of people but it takes constant surveillance Smoak does credit residents and visitors once informed with being 'most cooperative " Although she notes that most people observe the loggerheads in unsupervised groups a brochure circulated to beach users helps minimize abuse

For the record it s against the law to disturb a nest harass a sea turtle or remove a carcass or any of its parts Specific advice is provided in a brochure from the Center for Environmental Education 1925 K Street N W Suite 206 Washington DC 20006

The American Museum of Natural History in New York City includes observation of sea turtles in its Discovery Tours to Trinidad and Tobago In Florida you can consult the state Department of Natural Resources or contact the local Marine Patrol officer

If you can t make it this season you can send a tax-deductible contribution to The World Wildlife Fund, 1601 Connecficut Avenue, N W Washington DC 20009 so that Kim Cliffton can improve the sea turtle's chances of being around next year With the recent devaluation of the peso, one of your dollars just might save 24 eggs

EARTH

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leopard-skin coat sells for up to $100 000 in wealthy Japan In Yemen, daggers with rhino-horn handles are the rage (the horn now sells for over $14 000 a pound)

Poachers who raid wildlife preserves for such commodities form the base of a steady local enterprise And various African regimes have condoned this practice for years Uganda's Idi Amin, for instance, freely let his soldiers raid wildlife with automatic weapons Then in the war that removed him, soldiers from Uganda Tanzania and Sudan gunned down thousands of elephants rhinos and antelopes killing at least 30 percent of the large animals in Uganda's Ruwenzori National Park Soldiers firing from helicopters are thought to have killed 30 000 elephants in the Central African Republic And last year three rangers who tried to stop the killings were slaughtered as well Add this to the unprecedented habitat destruction in Africa and you've got a continent whose animal treasures are in serious jeopardy

The traditional solution had been the European approach in which state-sized parks such as Tsavo in Kenya, and Serengeti in Tanzania, were set aside for wildlife alone But in Africa human needs and animal life are too closely intertwined to separate Poaching and cattle-grazing are impossible to stop And the very act of confining wildlife causes the crowding and overgrazing that threaten to destroy land and animals alike

Enter the new conservationists with their aim of exploiting every last nickel of income from wildlife—from eating it to trading skins legally to establishing an ivory cartel among African nations According to Varty this philosophy will benefit African tribal people most of all For example he has hired Shangaan tribesmen to guard the grounds at Londolozi He pays them with goods and meat and like rangers in several of Africa's parks he finds that sharing the benefits with neighboring tribes reduces poaching

In the near future, he says he plans to allow the Shangaan to hunt for themselves on his land although South African law forbids black people to obtain hunting permits You have to bend the rules he says with apparent impatience Let them prosecute you later

It's so elegantly neat this cycle of money in which everyone wins And that's how Varty presents it as he circles the globe on promotional tours, flashing his color slides and green eyes for his conservation trust Man's money has done enough harm, you might argue, why not simply leave the wildlife alone?

There are many people who believe faith will save the wilderness," says this man who loves animals I'm into the other point of view If I'm not successful financially I'm not successful at all

LOREN EISELEY

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stone It is a testimony to time and the passage of invisible powers The stones are hard not the soft limestones but chalcedonies, stones capable of taking a polish, of being cut like jewels Here the wind is the workman You can feel him at his task the moment you come into his domain He plucks at your clothing and begins the long task of grinding you down Stay and he will reduce you to a bone as effectively as the sea And from a bone he will reduce you to grains of sand I have been in similar winds for half a century Like a stone, I have been reduced and worn by that unseen thing called life

THE LOST ROAD

1974 After walking along Montgomery Pike in Pennsylvania

Sunlight with a harsh wind I set out in the afternoon to find the cemetery in which we own a plot I walked along Montgomery Pike to a place where according to my memory the roads divide I must have taken the wrong turning and I did not find the cemetery I was tired when I returned But I wanted to find it to visit my own grave where when we purchased it years ago I had stretched out on the plot to look at the autumn sky and to think this will sometime be forever—though nothing geologically speaking ever is

But why did I wish to come back on this spring day when that other day had been in autumn and I had brought back some beautifully polished horse chestnuts that had been lying there, and which now repose on my desk? I do not know but I suspect and will confide it to these pages I am aging I had been grievously offended by someone I had once thought a friend The reason need not matter A pettiness But suddenly I had wished to be in a place of sun-warmed stones where everyone was finished forever with sarcasm and violence I wanted to hide

Perhaps it dated to that long long time ago when as a startled child I had been struck and humiliated by a grown man a stranger releasing violence I wanted increasingly to stay and wander among the monuments representing a humanity from which harsh words and cruelty had been drained away Perhaps a grave was the only place where things came right—except one could never get the stones to speak only to be warm with the sun if one touched them

Ah well I lost the road and came home weary enough to sleep Was it a death wish momentarily diverted? Did I turn aside before the way became irretrievable? For when one goes *alone* to a cemetery, *does* one seriously intend to return? Perhaps impulse will lead me some day to find out These moods are growing on me There is little physical substance left by which to stand upright I am not clever with unfeeling repartee When it begins I merely wish to vanish, fade away amidst something in my mind which is becoming I fear a graveyard a graveyard of warm, sympathetic stones that no longer constitute the passionate violence of the flesh I shall have the mate of Wolf's bone buried with me and hope the animal helpers will lift the curtains on the man from the *altiplano* It is my wish

Loren Eiseley died three years after he set out to find the cemetery and took the wrong turning. The tombstone he chose for his wife and himself bears the simple legend "We loved the earth but could not stay" Wolf his big shepherd dog had been buried earlier with a last gift—'an Ice Age bone across his heart' And the animal helpers mentioned in the final journal entry are characters in Indian myths who appear in people's dreams the man from the altiplano being a reference to the literary naturalist himself and the High Plains of the Midwest where he spent his boyhood Eiseley looked at nature obliquely—through the corner of his eye as Thoreau once advised—and the striking images he recorded will be a source of beauty and pleasure to readers for many years to come ∞

TELEVISION

CONTINUED FROM PAGE 28

Japan or getting out of the province, so we went to Ontario."

Suzuki continued his commitment to civil rights through his college years at Amherst, his graduate study at the University of Chicago, and a research position at Oak Ridge National Laboratory in Tennessee, and he still continues it. An honorary director of the British Columbia Civil Liberties Union, he has been vice-president of the Canadian Civil Liberties Association since 1979. "I left the United States feeling fairly strongly that I didn't want to live in a country where the problems of racism were so immense that I couldn't see any way of resolving them."

As Suzuki tried to answer students' questions about eugenics and as he began to read the history of genetics closely, his two great passions began to merge. The role played by prominent European and American geneticists in providing "scientific" justification for the Nazis' racial policies shook Suzuki to the core. "So I agonized for a long time. In fact, for a year I stopped doing all science, because the idea of my contributing to knowledge that might be misused was just too horrifying." Finally he concluded that, as a scientist, he had to do the best research he could, but with the added responsibility to demystify that work for the public. Having made that decision, he returned to active research on the genetics of the fruit fly *Drosophila melanogaster*.

Starting as an assistant professor, he put his beliefs into practice by talking about science to any group that asked, even "a B'nai B'rith group of ten ladies meeting in somebody's home." Even now the hyperkinetic Suzuki gives dozens of public lectures a year in forums ranging from local teachers' groups to the meeting of the Canadian Bar Association. "Then I just got randomly involved in doing one or two television shows, and I realized what a tremendously powerful communications vehicle this is," he explains. Yet, as a science popularizer, he worries about this very power of TV. "My assumption has always been that people would watch the kind of shows that I do have their consciousness raised, and become more aware of science. I always thought that people select the programs they watch by reading the schedule, that they'd say, 'Gee, *The Nature of Things* is on tonight at eight, so I'd better turn it on.' Of course people don't watch that way. It turns out that the perception of these programs is totally different from what I thought. They will turn on the TV for news at six, watch through *Charlie's Angels*, *Dallas*, *The Nature of Things*, the national news, and turn it off at eleven-thirty. After they've watched all that television, what happens is really astonishing."

What happens, he says, is that viewers jumble everything together regardless of source. "People will come up to me and say, 'That was a great show you had on last week about breast cancer,' and I'll say, 'We didn't do anything on breast cancer,' and they'll say, 'Oh, gee, I guess it must have been *Charlie's Angels*,' or some such. What's happening is that it doesn't matter. People can't look at the information and say certain bits have greater value than other bits. The fact of a show's existence as a program on television—or even a book or an article in a magazine—becomes sufficient justification for citing information in it as fact."

And that really has Suzuki worried. "With all of the information explosion, people don't distinguish between *Omni*, *Scientific American*, the *National Enquirer*, *New Scientist*, or the *New York Times*. If it's printed somewhere, you can cite it. This general lack of critical skills, of asking 'How do we know that? What's the evidence?' makes the geneticist concerned that television science programs may just be adding more bits of superstition to our culture, with scientists playing the role of wizards."

Another problem with television, Suzuki says, is that it is primarily a visual medium, "and ninety percent of science is not visual. It deals mostly with abstract concepts like forces and much scientific research is conducted in such fields as microbiology where compelling pictures are limited. The 10 percent of science that finds its way onto the screen is natural history or other topics that are easy to photograph."

When asked about his own shows, Suzuki admits, "We very seldom cover microbiology, chemistry or mathematics. We have never done a math item, I'm embarrassed to say, that we've never had what it takes to tackle it, having someone around who's keen on the idea and is ready to bob along with it."

One idea that proved to be much harder than expected was a series on how everyday things work. A three-minute segment explaining the science behind a kitchen match was "one of the most exciting things we ever did," but the effort required was so great that the series of segments has since been dropped. Despite these problems, Suzuki remains committed to explaining science on television. He now has a three-year grant for popularizing science from Canada's main science funding agency. But the audience he is setting his sights on now is schoolchildren: he is developing a program modeled after his *Science Magazine* for the CBC and is preparing a projected series of elementary-school science texts.

In his heart of hearts, Suzuki harbors a secret wish to return to the lab, but reaching out to the public through television, writing, and lectures has its own rewards. "I feel that I've done more than I ever hoped to in science. I've made a significant contribution, and I'm very proud of it. On the other hand, what I can do now in terms of the public is every bit as important, if not more important. If I don't hang in there doing this, no one else will." DO

BIOMEDICAL JEWELRY

INNOVATIONS

By Phoebe Hoban

The exotic gold and silver jewelry couldn't look less like high-tech medical equipment. But built into the bracelets, belts, and necklaces are devices that monitor your vital functions and warn you of unhealthy environmental conditions. "Someone has to keep us safe from ourselves," says Mary Ann Scherr, designer of biomedical jewelry.

Scherr, a devoted Buck Rogers fan, is head of the crafts department at Parsons School of Design in New York City. Her first venture into electronic jewelry was a heart-monitoring belt designed for a space costume worn by Miss Ohio in the 1969 Miss U.S.A. contest. "Normally I take a dim view of beauty contests," Scherr says. "But the astronauts had just landed on the moon, and I was inspired." Since then, Scherr has specialized in turning medical devices into art pieces.

Scherr worked with Dr. George Malindzak, head of the physiology department at Northeastern Ohio Medical School, and Steven Kanor, a medical engineer and consultant at the Westchester Cerebral Palsy Center and Columbia University, to develop a series of biomedical devices that range from a posture belt to a breath-analyzing necklace. "Nothing here is gimmicky," Scherr says. "All these pieces function in a serious way. They are not designed to replace doctors but to tell people facts that can help them make preventative decisions."

Kanor goes further. "These personal monitors will be absolutely critical in the future. I think that within the next ten years you will have cigarette-pack-sized microcomputers that hold more information than a doctor's head. These devices could diagnose, analyze, and even prescribe treatment."

The current generation of biomedical jewelry simply monitors life functions and environmental conditions. The centerpiece of a silver-and-moonstone necklace is a liquid-crystal display screen that functions as a portable electrocardiograph. Button-sized electrodes taped to the skin feed into the hidden circuitry. The wearer's heartbeat appears as a changing color pattern on the screen.

A pendant conceals circuitry sensitive to whiffs of alcohol or garlic on the wearer's breath.

A stainless-steel collar with liquid-crystal panels is designed to monitor a series of conditions—from levels of ultraviolet radiation to body and air temperature to the presence of toxic gases. Another necklace is equipped with a sensor that reacts to pollution by sounding an alarm. Its large silver-and-amber locket opens to provide quick relief: a ten-minute supply of oxygen and a collapsible nylon face mask.

Not all of Scherr's designs are so deadly serious. Some have a piquant sense of humor, such as a smoke-detector pendant that plays "Smoke Gets in Your Eyes," and a necklace that lights up in response to such personal pollution as breath that smells of garlic or alcohol.

Most of these inventions are still prototypes, and because they are handcrafted out of precious metals, they sell for $1,000 to $2,000. But at least two monitors will be mass-produced and sold in department stores for under $20 apiece this summer. The posture belt beeps when your abdomen protrudes, to spur you into sitting up straight. And the No-Nod glasses, designed to prevent drivers from dozing, sound an alarm if your head tilts too far forward.

Still on the drawing board are designs for future monitors that could warn of impending migraine headaches or epileptic seizures. Scherr would also like to create a device to prevent death from allergic reactions to bee stings. It would contain a supply of bee-venom antidote.

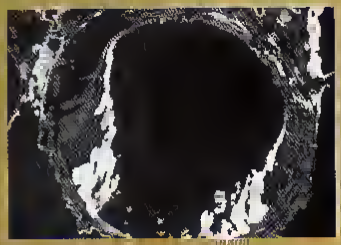
"All I need is a manufacturer with courage and cash," Scherr says. "Dick Tracy was right on target. The time will come when life-monitoring jewelry will be as commonplace as wristwatches, and no one will think of leaving home without a heart or air monitor. I can already envision a bracelet or ring that would be a timepiece, a body monitor, and a telephone."

A tiny beep punctuates Scherr's words. No, it isn't her heart-monitor bracelet, her posture belt, or her air-pollution pendant. It is the Casio calculator/game/alarm watch on her wrist. "The technology is here," she says, pointing to the multipurpose watch. "This is just the forerunner."

NEXT OMNI

SPACE WAR

FICTION



INNER VISIONS

SPACE WAR—The first battle for the stars is already being fought on Earth. And before the first laser shot is fired, the United States is losing. Take a behind the scenes look at Unispace 82, a United Nations conference that threatens to shut private enterprise out of orbit, hand the vast resources of space to the Third World and curtail operations of the NASA shuttle—all the while permitting the Soviet Union to set up the ultimate military base 300 miles overhead. Read editorial director Ben Bova's frightening exposé of this threat to our space program in *Omni*'s July issue.

INNER VISIONS—Mankind must use the brain to study the brain. And many brilliant minds have struggled to illuminate the organ of intellect in its infinite complexity. To this end, researchers at UCLA Medical Center have pioneered a revolutionary technique that reveals the brain in vivid, three-dimensional detail and with unrivaled depth of focus. Their unique photographs create the illusion of penetrating inner space. Readers will marvel at the intricacy of a single brain cell, or wander bacteriumlike, through a forest of nerves that tower like redwoods. Don't miss this journey through the landscape of the mind in the July issue of *Omni*.

TINKERING WITH UTOPIA—Such technologies as genetic engineering, psychopharmacology and brain implants promise a lot, but what will they deliver: better living through science, or a Brave New Future? As we edge closer and closer to the start of the next millennium, more and more people are beginning to ask themselves this question. In next month's *Omni* you can read about what some of the world's top scientists, such as Konrad Lorenz and brain-control expert José Delgado, see as the likelihood of a man-made utopia, what technology will do to our sex lives, and why some fear that we may be the last of an imperiled species.

CAREERS IN SPACE—In a special section, July's *Omni* reviews the opportunities for working in space development today and the potential for becoming one of tomorrow's space pioneers. We'll tell you what companies and organizations will be the prime movers in the industrialized space of the next decades, and what training will best help you become part of their efforts. Whether your interest is orbital engineering or exobiology, *Omni*'s special section will help you achieve your career in space.

FICTION—Next month *Omni* presents an exclusive excerpt from Frank Herbert's new novel, *The White Plague*. The award winning author of *Dune* and *God Emperor of Dune* makes a stunning departure from those best sellers in his rendering of an all-too plausible scientific horror story. William Gibson returns with "Burning Chrome," a brilliant story in which two hoodlums attempt the heist of their lives.

SPACE

CONTINUED FROM PAGE 22

other criteria, the less expensive of the two will win greater favor. So keep your ideas simple as well as elegant. And include your best estimate of equipment cost with a rough part-by-part breakdown.

Finalists will face one last obstacle—NASA's design requirements. We will supply copies of NASA's GAS "Experimenter Handbook" and other details to contestants whose entries survive the first round of judging. Most requirements are pretty commonsensical.

The experiment must be safe. In fact, GAS projects go through several NASA safety evaluations, and the agency warns that equipment may well have to be redesigned. Batteries are often a weak point. Save any lithium cells for your Earthside calculator. NASA has no specific complaints about them but is not yet sure they can withstand the stress of spaceflight.

Your package must be self-contained. The shuttle cannot supply power for GAS containers. Astronauts will be able to turn it on or off, start or stop a special piece of equipment, or perform similar operations from a remote control panel—but only twice. They will not water the plants or feed the weightless animals.

It must be able to survive on its own for at least six weeks. GAS packages will be installed some three to five weeks before launch and cannot be removed from the container sooner than a week or two after the landing. In early launches, these delays may be considerably longer.

Anything that requires air must be in a sealed package. The container itself will be purged with inert gas before takeoff.

This contest is open only to individuals, not to companies. Clubs and other small nonprofit organizations are welcome to collaborate on the experiment, but please pick one of your members to act as the official contestant and to represent the group at the shuttle landing. Entries should be submitted on standard 8 5" × 11" paper. Include whatever explanation and diagrams you need to get the idea across and to show that you have some chance of carrying it out, but please do not go over three pages in all. Mark the envelope "Get Away Contest" and address it to *Omni*, 909 Third Avenue, New York, NY 10022.

Entries must be received before 5 P.M. on August 16, 1982. All entries become the property of Omni Publications International; we cannot return them. Nor can we answer telephone questions about entries or the contest. On acceptance of a project, *Omni* has the sole and exclusive right to publish the results, whether the experiment is a success or not. The decision of the judges shall be final. *Omni* reserves the right to choose runners-up in case the winner's package for any reason cannot fly.

Now, ladies and gentlemen, to your drawing boards! And good luck. ∞

FANTASTIC VOYAGES

Each new edition of OMNI magazine is a fantastic voyage a wondrous journey through the infinite and magical universe of science OMNI sees the beauty of the depthless enigmatic black of space, tingles with the incredible excitement of the unknown and the promise of tomorrow and explores these as no other magazine ever has or ever could

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OMNI

There is no more interesting magazine published today

REMOTE-CONTROL EYES

STARS

By Allan Hendry

Happy is the astronomer who collects his own data. For five consecutive nights Dr. Robert Kirshner of the University of Michigan had reason to be happy. He took control of the 2.1 meter (84 inch) telescope at Kitt Peak National Observatory near Tucson, Arizona. He aimed the huge instrument at some distant galaxies, adjusted the spectrographic equipment, and acquired spectral scans for each of his targets.

All this is pertectly routine at this prominent research facility, of course. As many as 800 professional astronomers visit there each year to use Kitt's 13 telescopes. What made this occasion novel was that Dr. Kirshner was sitting more than 1,600 miles away in his Ann Arbor, Michigan, office! With an off-the-shelf Tektronix computer terminal linked to Kitt Peak by telephone, Kirshner was engaged in the most sophisticated remote-control astronomy to date.

Until now an astronomer unable to visit a distant observatory had to send his instructions to the telescope operator. The resulting data were mailed or phoned to him afterward. With this new system, an astronomer can actually see on a TV screen what the telescope sees while the computer displays the target's spectrum.

Kitt Peak telescope operator Hal Halbedel was on hand in Arizona to make sure the telescope didn't swing blindly into something or suffer other damage. Apart from that, the Michigan-based astronomer was free to do the kind of high-level research that traditionally requires a round-trip ticket and a five-day stay at Kitt Peak's mountaintop dormitory. Working from midnight until 7 A.M., Kirshner obtained from six to ten spectral scans a night, as many as if he had been there.

For the astronomer, the personal advantages are obvious. He is spared the time and cost of traveling several times a year ("It's a real strain," Kirshner notes) and he can teach his classes without interruption. Yet in the long run the real advantage is the money Kitt Peak can save without sacrificing any research. Scientists from all over the world bid for time on the facilities months in advance. Kitt Peak's administrators are being forced to consider a new million-dollar water system, more dormitories, and a cafeteria expansion. The observatory gets its funding to house and feed all these people from the National Science Foundation, and severe Reaganomics cutbacks have already forced it to reduce its staff. Practical remote-control astronomy would get people off the mountain and save those costs.

There are still some problems to be solved. Telephone lines carry only one TV picture every 31 seconds, making it difficult to fine-adjust the telescope. And trouble on the line cut into Kirshner's work on one of the five nights. The obvious solution is to use a satellite microwave link, which can transmit a rapidly changing picture. The monthly rent for part of a domestic satellite channel—$2,000—will be saved if only a few astronomers can avoid a visit to the observatory.

Yet remote-control work is clearly in its early stages. Kitt Peak astronomer Paul Schechter says it will be some time before the program pays back the cost of outfitting new instruments and telescopes for remote work. "People in many places are interested in seeing how our experiment works," Schechter says, but with international satellite costs ten times higher than domestic ones, the first work will likely be done in the United States. Kirshner used the terminal again on two other occasions. Eventually Kitt Peak's four-meter telescope will be outfitted with a remotely controlled video camera and a high-resolution Fourier transform spectrometer. Schechter is confident that remote observing will be commonplace by the turn of the century.

On-campus observatories are convenient, but urban air pollution and "light pollution" are making them useless for serious research. Even Kitt Peak is being affected by air and light pollution. By 1985 the most desirable telescope in existence will also be the most distant, placed into orbit by the space shuttle. Remote-control telescopes may destroy some of astronomy's romance, but the future of deep-space research may depend on them. ∞

PHENOMENA

Acres of heliotropic silver tilt skyward to beam the sun s energy on what some see as part of our energy future, the Solar Power Tower, in Barstow, California Officially described as the Solar Thermal Power Plant, the design uses a 300-foot tower erected in a 75-acre oval made up of rows of these 21-foot-square reflectors. Each giant mirror, called a heliostat, tracks the sun across the sky and continuously focuses its light on a water-filled boiler perched atop the tower. The combined effect of 1,818 of these mirrors directing sunlight on the boiler produces 960° F steam, enough to power a ten-megawatt generator Due to go into full operation early this summer, the Solar Power Tower is the prototype for larger, 100-megawatt models, 500 of which, its designers say, could be dotting the sunnier regions of the United States by the year 2000. This unique photo of a test light-up of the tower was taken by Dan McCoy, using Kodachrome 64 in an RTS Contax camera, with an 85mm lens

How to play tic-tac-toe in the fourth dimension

GAMES

By Scot Morris

"They say that habit is second nature
Who knows but nature is only first habit?"
— Pascal

Is it possible to visualize a fourth dimension? We don't mean "time," which is sometimes considered as a fourth coordinate in the space-time theory of relativity. We mean a fourth dimension in space, a Euclidean space having four coordinates, each perpendicular to the other three.

There is no scientific evidence that a fourth dimension really exists, but it could. The problem is, with eyes built for seeing three-space, it is virtually impossible for us to imagine it. Our difficulty is about the same as a square would have trying to conjure up an image of a cube.

This scenario, in fact, was the climax of a marvelous science-fiction romance published nearly a century ago, *Flatland* by Edwin A. Abbott (Dover). The inhabitants of Flatland live on a plane. The book's narrator is a square, his wife a line. One day a sphere comes to Flatland and tries to explain to the square what the omniscient world of three dimensions is like. In one argument, which I paraphrase here, the sphere tries to describe how to make a cube.

Sphere: "If you were to take a point and move it one inch in a straight line, and if the point left a luminous path behind it, what would you have?" Square: "A one-inch line segment."

"Right. Now move the line at right angles to itself for a distance of one inch. What do you have?" "Easy. A one-inch square."

"Fine. Now here's the hard part. Imagine moving that square one inch in a direction perpendicular to itself, so that no point passes over a point previously occupied by another, and you'll have the object I am trying to describe, a cube." Which direction is perpendicular?"

"You have to move the square up, at right angles to both its axes." "Up? You mean north?"

"No, up. Lift the square above itself one inch over the surface of Flatland." That's absurd! How can you possibly move something out of the universe?"

(At that impasse, the sphere tries a new tack.) *Sphere: "How many end points are there on a point?"* Square: "One."

"On a line?" "Two. One on each end."

"And how many end points, or corners, on a square?" "Four."

"Good. As we go up in dimensions, the end points go one, two, four. What kind of progression is that?" That's geometric. The numbers are doubling each time."

"Correct. So the number of corners on a cube will be ?" "Eight."

"Fine. Now let's talk about sides. How many sides on a point?" "None."

"And on a line?" "Two. One on each end."

"And a square?" "Four sides."

"What kind of progression is that—zero, two, four?" "That's an arithmetical progression; you're adding two each time. So your cube must have six sides."

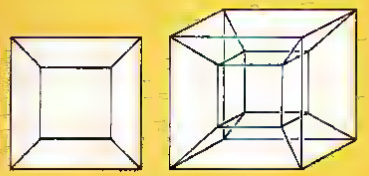
"Good. Now notice that when we speak of the 'side' of something, we refer to measures that are in one lower dimension. Thus, the sides of a line are points, and the sides of a square are lines, so the sides of a cube are squares." "Six squares joined together to form an object with only eight corners? Hmmm."

At this point, as the square vainly tries to picture sliding six squares together on Flatland to produce this eight-cornered "cube," our own imagination trails off to a higher plane. We look at the table being constructed, and we try to imagine

	•	—	□	
Dimensions	0	1	2	3
End Points	1	2	4	8
Sides	0	2	4	6

the next step: a four-dimensional cube with 16 end points and 8 "sides"—the sides being cubes. Mentally we try to jam eight cubes together into some unusual structure with 16 corners, and we realize that our minds are stuck in three-space.

But there is another approach. If we are willing to compromise. After all, it is possible to draw a picture of a cube or to cast the shadow of a cube onto a flat piece of paper. At left, below, is the shadow that a wire-frame cube would cast if a light were held near one face at just the right angle. The eight corners are there,



with three edges meeting at each, and there are the six sides. Two of the square sides still look like squares; the four others had to be distorted slightly in order to squeeze into two dimensions. But we understand that these trapezoids represent real squares on a cube. We can describe the shadow as a small square inside a bigger square with all the corners connected.

By analogy, then, imagine a small cube inside a bigger cube with all the corners connected, and you'll have what mathematicians call a *tesseract*, or a hypercube of four dimensions (at right, above). Build it out of toothpicks and you have a three-dimensional "picture" or "shadow" of a four-dimensional object. The 16 corners are there, as predicted, and so are the eight cubic sides. Two of them remain cubes; the six others had to be distorted and made to look like truncated pyramids.

The hypercube model accurately represents other features that can be projected by analogy from one, two, and three dimensions. The number of edges (32), the number of squares (24), the number of mutually perpendicular edges meeting at each corner (4)—they're all there, and all just as predicted.

WORDS

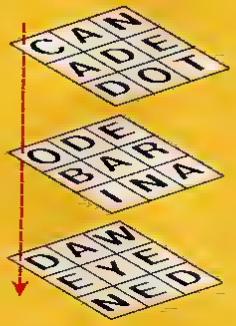
A word square is like a crossword puzzle with no black spaces. Here are two examples originated by Darryl Francis and

first published in *Word Ways* The word square at left is called "regular" because the horizontal and vertical words are identical The "double" square on the right is much more difficult to construct because all ten words are different

F	A	C	E	D
A	L	I	V	E
C	I	V	I	L
E	V	I	C	T
D	E	L	T	A

A	P	P	L	E
R	E	L	A	X
O	R	A	T	E
M	I	N	E	R
A	L	E	R	T

The three-dimensional extension of this puzzle is the word cube Here is an elegant one by A Ross Eckler



Each square is a "double" with six different words In addition one can read down through the grids starting with any of the nine letters on the top and find nine other different words (e g *cod* from the top left square of each grid)—27 in all Some words are first names (Ina Ned, Ada Abe) but given the strictures of the form these are excusable imperfections

The next step is a word hypercube The late J A Lindon published the one below in *Recreational Mathematics* It is highly regular (ten words—three repeated 4 times, six repeated 12 times and one [ARE] repeated 24 times) but most of the words are quite common

Imagine that the three columns represent three word cubes sitting side by side In the *left* cube the word BUG appears three times—twice in the top grid and once again reading straight down through the top middle and bottom Now consider all three cubes—left center, and right—as representing a hypercube It is possible to imagine a new cube made out of just the top grids of all three cubes And there in the fourth dimension horizontally

	Left	Center	Right
Top	B U G U N A G A P	U N A N O R A R E	G A P A R E P E T
Middle	U N A N O R A R E	N O R O V A R A G	A R E R A G E G O
Bottom	G A P A R E P E T	A R E R A G E G O	P E T E G O T O W

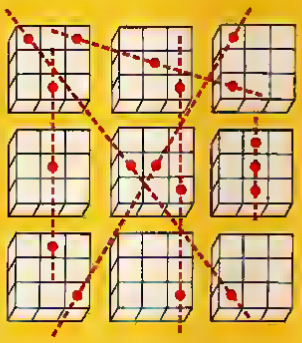
across the top we find the fourth BUG Similarly, every other grid can be considered as part of a vertical cube or a horizontal cube Count them up—the ten words together make a total of 108 appearances

TIC-TAC-TOE IN HYPERSPACE

Word squares have the limitation that the words are usually meant to be read in one direction only (BUG not GUB) and only in orthagonal directions not along the diagonal In a tic-tac-toe square these restrictions are lifted

You have probably seen a 3-D tic-tac-toe game consisting of individual Plexiglas grids stacked on top of one another and colored marbles that may be played on any cell of any grid The 3×3×3 game turns out to be trivial an easy win for the first player It isn't until you get to the 4×4×4 board that games start to get interesting (It has recently been proved at Bell Labs that the first player can always win on a 4×4×4 board but the proof is a surprisingly complex one, requiring a complicated computer analysis)

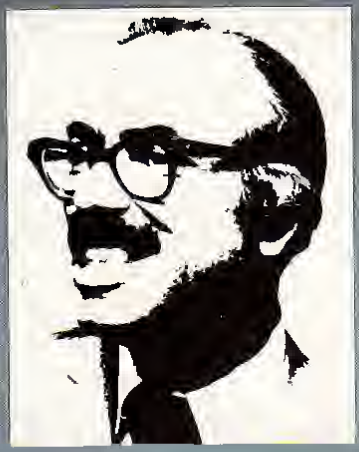
The three-in-a-row game is also trivial on a four-dimensional board, with the first player having a sure win The four-in-a-row game is also mastered easily in the fourth dimension Players will find that they have to go to a 5×5×5×5 board before the game will become challenging For purposes of explaining hyper-tic-tac-toe however the three-in-a-row game will serve Once you understand it, you can easily expand the principles to higher order boards



The figure above shows a sample game board, sectioned into two dimensional squares, and is marked with a variety of sample "wins" You win with three marks in a row if all three are in a straight line on any "cube" that can be assembled in a line horizontally vertically or along either of the two main diagonals

In answer to a question posed last month, there are $1^2 + 2^2 + 3^2 + \quad +8^2 =$ 204 squares on a chess board

While getting used to the order-three board you can make the game more challenging by forbidding moves to the center square of any center grid except as a winning move or as a defense against an opponent's next-move win



LAST WORD

By Barry N. Malzberg

"It did not seem wise to admit writing the book, particularly if he could not understand a word the young instructor was saying about it."

Common exegesis of Killers of the Rulers *portends the interrelationship of post-Joycean rhetoric with post-Shavian political pluralism. Relate this confluence. Elaborate and discuss. Exemplify.*

The Old Hack is having a nightmare. In it, he has returned to academia and is seeking a master's degree at Extension U., which he hopes will enable him to find work as an assistant instructor of English. All right. It is a long shot, but he is almost out of ideas. The markets are really hell and foreign sales have dried up. And he is having big trouble delivering on the one outline he has sold. So the Old Hack has enrolled in English 353A: *Science Fiction and the Archetype* because in the catalog it seemed to be an easy three points (no paper required). If he knows anything, he knows science fiction. Right? Well, doesn't he? Now he is taking the final examination in this graduate-level course, which appears to focus on an old Ace Double, *Killers of the Rulers*. He is especially qualified to deal with this book. He wrote it back in 1957 between wives at the old place on West 89th Street. Even so, the exam is giving him trouble. Big trouble.

The subtheme of colonic usurpation in its Jungian relevance creates a multileveled tension in Killers of the Rulers *which points toward the induction of three distinct archetypes. Name these archetypes. Elaborate and discuss. Discuss further how a Freudian approach would defeat consummation of the Blue Alien incursion.*

The Old Hack is not sure exactly how he got into this. It all seemed so simple when he enrolled. The reading list, which included many of his old favorites, indicated this would be a snap, to say nothing of the pleasant surprise of finding *Killers of the Rulers* right in there between *More than Human* and *The Forever Machine*. But he suspected that things had begun to go wrong from the start. In the first session the young instructor had begun by speaking of a Manichean influence in the birth of American science fiction, and how the great Fifties novels were an extension of the Fabian theory of socialism as propounded by the works of G. B. Shaw. The Old Hack had briefly thought of identifying himself when his book came up in November. "I wrote that one," he could have said (it had been written, as had all of the Ace Doubles, and too much of his other stuff, under a pseudonym), but by then he was totally confused. It did not seem wise to admit writing *Killers of the Rulers*, particularly if he could not understand a word the young instructor was saying about it.

Produce a 1,000 word monograph interrelating the empire building of Killers of the Rulers *with the more pacific vision of* More than Human. *Be specific. In what way does Melville's "Bartleby the Scrivener" inform and influence both works as controlling response? Why does* Heartbreak House *not apply here?*

Heartbreak House. That's what West 89th Street had been. It was there, drunk and up against a deadline, that he wrote *Killers of the Rulers* on the kitchen table. The Old Hack hadn't even started it until the weekend before it was due. There had been all that excitement about him and Mabel Sue, and, besides, for a $750 advance (payable in halves) why should he get all upset about churning out this stuff to their convenience rather than his? Even then the book kind of lurched along, what with Betty (wife number one) crying and coming out of the bedroom now and then only to throw another of his paperbacks at him while he sat there typing. Finally he gave up, turned to the Cutty Sark, and took down that 1952 issue of *Worlds of If*, which he used to bloat up his novelette.

In the end the book was not what he had promised in the outline, but what the hell? Everyone lied and cheated in the small things (he had tried desperately to explain this to Betty); the important commitment was to getting the work done, and to holding on to enough of the advance money to have a good blowout. Despite all the screaming, he had been only three days late, thanks to the Cutty Sark, but then the bastards took a month to deliver the check, by which time he was well embarked on that disastrous series of events that ended with Mabel Sue's calling him a drunken liar and throwing his typewriter *and* the carbon of *Killers of the Rulers* out the third-story window.

Neologic devices in Killers of the Rulers *account for, as in* Finnegans Wake, *much of its subnarrative power. Present and discuss five such devices. Analyze two of them. Describe how they function as a metaphoric combine of the Blue Aliens.*

In his dream, the Old Hack brings his blank essay booklet up to the proctor midway through the three hours. "I can't stand it," he says shakily. "I can't stand it anymore. Just take me away. I'll be good." The proctor stares at him mercilessly through goggles of glittering glass. "Help. Help," the Old Hack whimpers as he tumbles like a stone through various levels of his dream world.

He finds himself awake and fifty-seven in his own bleak room at dawn, his hopes for an assistant instructorship at the college destroyed, the empty pages of *Grandsons of the Killers of the Rulers* littering the floor beside him, and this novel—his masterpiece, he had told the editor to clinch the contract, the crown of his career—three months overdue today. And counting. ☒