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APRIL 1981

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This month's cover is the creation of Ludwig Schwarzer, a Vienna-born, fantastic-realist painter. Schwarzer came relatively late to this imaginative genre after studying at the Akademie der Bildenden Künste. His style is described as objectified Dutch art enhanced by surrealism.

FIRST WORD

By Ben Bova

Phase 2 of the space program will see us begin to use these resources to make life better on Earth for all humankind

When the *Voyager 1* spacecraft sailed past Saturn last November, many media commentators proclaimed that it was "the end of an era" in space exploration. After *Voyager 2*, due to pass Saturn in August, NASA has no further interplanetary probes under development.

It is, indeed, a special landmark. But, in the words of Winston Churchill, "This is not the end. It is not even the beginning of the end. But it is ... the end of the beginning."

The *Voyagers* breathtaking reconnaissance of the outer reaches of our solar system marks the end of Phase 1 of our space program. The first launch of the space shuttle *Columbia* marks the opening of Phase 2.

We have not finished the exploration of the solar system, by any means. But the explorations that began with *Sputnik*, *Explorer* and *Vanguard* and that continued with *Pioneer*, *Surveyor*, *Apollo*, *Venera*, *Viking* and *Voyager* have taught us enough about the solar system that we can now begin Phase 2 with confidence.

Thanks to these explorations, we know there are natural resources in super abundance throughout the solar system: energy and raw materials for every industry on Earth, along with the new industries that will be started in orbit. Phase 2 of the space program will see us start using these resources to make life better on Earth for all humankind.

It will not be an easy task. There will be false starts, delays, accidents. The key to it all is the long-awaited shuttle. It is the basket into which we have put almost all our eggs. If *Apollo* and the other spacecraft of Phase 1 can be compared to hand-built sports cars, used once and then discarded, the shuttle is a sturdy pickup truck, ready to be used over and over again to lift industrial-sized working payloads into orbit.

The shuttle program has been a sobering reminder of the fact that our space efforts were maltreated throughout the 1970s by the White House and Congress. Even at the peak of the Apollo program's success, politicians pitted space funding against social programs aimed at alleviating poverty and at combating pollution. They posed a cruel either/or dilemma: Either you are for social welfare and a clean environment or you are for space, you cannot be for both. This either/or fallacy almost killed the American space program.

Now, after years of budget cuts and schedule stretch-outs, the shuttle is at last ready for orbital testing. But what happens if the shuttle does not immediately succeed in its tests? What happens if *Columbia* crashes?

It is not an easy craft to fly. The shuttle reenters the atmosphere from orbit with no fuel remaining for its main propulsion engines. It glides from several hundred miles' altitude and a speed of some 18,000 mph to its landing field. And it has only one shot at the runway: there is no chance for a go-around if the first approach is not precisely right.

There has hardly ever been a test program of a "hot" new aircraft that did not see at least one serious accident. The X-15 rocket plane of the 1950s had several. If a multibillion-dollar shuttle crashes, it might mean the end of the manned space program. That's how close to NASA's jugular the knife is. That's why the shuttle astronauts spend thousands of hours in their simulators, learning all there is to learn about flying the bird before lifting off from Cape Canaveral.

If a shuttle crashes, much more than the lives of its crew and a billion dollars of hardware will be lost. Confidence in the entire future of manned space operations will be shattered. Cries of despair will ring through the land, amplified by the media, to echo down the corridors of power in Washington.

A similar calamity befell Apollo during its testing program. The first manned *Apollo* module suffered a disastrous fire during a ground test. Astronauts Gus Grissom, Edward White (the first American to "walk" in space) and Roger Chaffee were killed. The media screeched that NASA was pushing for the moon too hard, going too fast. Congressional committees convened to investigate the situation. The Apollo program was set back 18 months. But the engineers determined the cause of the fire and developed protective measures for subsequent spacecraft. We buried our dead and kept moving forward. We reached the moon.

Now we are involved in a new space race – not merely a competition between two nations, but a struggle that involves the whole human species in a contest against time. This new space race is, in reality, a crucial struggle against humankind's ancient and remorseless enemies: hunger, poverty, ignorance, and death. We must win this race, for one brutally simple reason: survival.

Phase 2 of the space program can bring us the lunar mines, the prospector ships sailing out to the asteroids, the orbiting factories, the L-5 colonies, the expansion of the human spirit that transforms us into a truly spacefaring people. The shuttle is the key to unlock all this, the first step that begins every journey.

No matter how many steps we must take, no matter how many times we falter, it is essential to remember that the goal of this long journey is not merely survival. It is peace and plenty for all humankind. *This* is the true importance of the shuttle. ☒

Adapted from The High Road, *by Ben Bova, to be published this fall by Houghton Mifflin Company, Boston.*

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OMNIBUS


NAHIN


SCHWARTZ


WOLFF


MICHENER

As we go to press, the launch window for *Columbia* is sometime in April. But that might change. Pinning down a date for the world's most spectacular spaceflight is tricky. All conditions must be perfect until the moment of liftoff, including the weather. No one can appreciate this more than *James A. Michener*, who worked on the PBY amphibian and several other aircraft during World War II. His knowledge of engineering combined with a passion for the spirit that strives to conquer new frontiers makes Michener a rare space enthusiast. The world-renowned novelist graciously accepted to fly on *Omni*'s behalf to Houston, where he met and talked with the daring young pilots who will guide *Columbia*'s maiden voyage.

That Michener now turns his attention to the saga of the space shuttle in "Manifest Destiny" (page 48) is a signal to the world that we are at a crucial moment in our development. We can either seize this opportunity or let it go.

Michener's most recent novel is *The Covenant*; his next book, tentatively scheduled for 1983, will deal with the space program.

In writing "High Fashion," *Anthony Wolff* who has worked with *Omni* since its inception, traveled to the Ames Research Center, near San Francisco, and the Johnson Space Center, outside Houston, to create an exclusive picture essay about wardrobes for space explorers. Get a glimpse of the beautifully handcrafted space clothes that Commander Robert L. Crippen and Captain John W. Young will wear aboard the first shuttle flight. Other exotic designs for deep-space missions and nearer orbits complete the cosmic eyeful that begins on page 60.

The Mobius Group, founded and headed by *Stephan A. Schwartz*, is an exceptional team of researchers who attempt to demonstrate the effectiveness of psychic phenomena as a scientific tool. Schwartz's "Deep Quest" appeared in our March 1979 issue. It recounted the first archaeological deep-ocean dive conducted by psychics and researchers in which a previously unrecorded ship was located. "The importance of this research ultimately has nothing at all to do with archaeology or the psychic," Schwartz affirms. "Our work poses questions about the nature of humans." Such questions are vividly raised in "Psychic Search" as the Mobius Group goes out to unearth a Byzantine city beneath the Egyptian desert (page 76).

Cynthia Morgan makes her *Omni* debut with "The Hitmaker" (page 52). Morgan, whose SF short stories have appeared in *Analog* and *Galaxy*, free-lances as a rock music critic. Joining Morgan are *Paul J. Nahin* ("The Infinite Plane," page 84) and *Warren Brown* ("Last Waltz," page 70). Nahin, whose SF appears frequently in this magazine, has published short stories in several anthologies, including Volume 2 of *The Best of Omni* and Volume 1 of *The Future at War*; one of his stories has appeared in an edition of *Analog Yearbook*.

Christopher Simpson began working on "Silicon Valley Spies" when he came across newspaper clippings on East/West smuggling. It occurred to him that much of the illegal trafficking in high-technology items was neither reported nor prosecuted. As a Chicago-based investigative reporter specializing in corporate and technical research, Simpson had covered espionage in the computer industry for *Computerworld*, a leading industry weekly, and for many of this country's leading newspapers. "These smugglers are respectable people, well-groomed, and highly educated," Simpson notes. "They are the sort of persons you meet at a cocktail party or a trade convention." And where are these high-technology spies coming from? Mostly the Soviet Union. Even more startling are the facts gleaned by Simpson from interviews with prosecutors, corporate people, enforcement agency officials, and the accused. A special report on computer espionage in California begins on page 44.

This month's Space column is by *Robert Guccione, Jr.*, who traveled to California, Texas, and Washington, D.C. to find out what the Mercury, Gemini, Apollo, and Skylab veterans think about the future of space exploration. For some revealing notions about how our pioneer astronauts view the next phase of America's space effort, turn to page 24. ∞

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APRIL

LETTERS

COMMUNICATIONS

Back-Pocket Politics

Living next door to the not-yet-completed Palo Verde nuclear-power plant, I have a lot to lose if a leak or spill goes undetected in the environment.

As suggested in Forum [December 1980], I read the General Accounting Office's reports concerning the Nuclear Regulatory Commission. These reports are scary, to say the least. The NRC has been incompetent since 1975.

The petroleum and nuclear-power industries have politicians in their back pockets, and the ones who lose because of their greedy ways are the people who can't afford solar collectors.

Jordon Bluestein
Phoenix, Ariz.

Recyclable Energy

The interview with Robert W. Bussard, of International Nuclear Energy Systems Company, in *Omni*'s January 1981 issue, was simultaneously appealing and profoundly disturbing.

Appealing, because the image of the basement inventor making monkeys out of scientific bureaucrats is always a root-for-the-underdog kind of thing, and also because the application of E. F. Schumacher's small-is-beautiful principle to fusion energy is radically unexpected and potentially beneficial.

Disturbing, though, because of Bussard's throwaway attitude, or more accurately, his indifference to whether his spent machines are discarded or recycled. He speaks offhandedly about burying the used machines in an old mine shaft. I submit that the "old mine shaft" way of thinking is precisely what has contaminated our environment with toxic wastes.

If Bussard is indeed driven by motives that transcend profit, he will give thought to the garbage end of the use cycle first. The choice between discard and recycle makes a difference.

Garrett A. Smith
Pelham Manor, N.Y.

Schmoomania

As beautification coordinator for the city of Melbourne, Florida, I am interested in the adaptability of the schmoo tree [Continuum, January 1981] to our climate. Are there any programs currently studying the tree, and where do I obtain the results of the experiments?

Dan Porsi
Melbourne, Fla.

The potential uses for Stuart Diamond's schmoo tree are mind-boggling. I have rangeland on a ranch in New Mexico that might benefit from this tree's introduction. Tell me more about this miracle tree.

Michael Powell
Los Lunas, N.M.

Cultivation programs for Leucaena leucocephala, *"the schmoo tree," are often experimental, but the tree appears best suited to tropical climates.*

The National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161, for $10 offers a book about scientific research concerning this tree.

Information on cultivation programs in various nations can be obtained from the U.S. National Arboretum, 24th and R Street, N.E., Washington, DC 20002. —Ed

Perpetual Ripoffs

Fraud buster James Randi wasted his time investigating the claim that William C. Lucas invented a perpetual-motion machine [Last Word, January 1981].

Lucas might just as well save his patent money until he can arrange for the repeal of the basic laws of physics. Doesn't the U.S. Patent Office have a policy of rejecting any and all claims for perpetual-motion devices? I cannot understand how this application could be pending.

Ripoffs by unscrupulous patent attorneys are nothing new, but to accept a wild claim such as this one tells us something about the profession.

William H. Watkins
Gainesville, Va.

Bradbury's Approach

Recently I read a passage from "The God in Science Fiction," by Ray Bradbury [October 1980], to our Quaker meeting. Even though Bradbury took quite a different approach to religion, all of us were inspired by the part about the robot priest speaking to the astronauts.

Susan Saltiel
Philadelphia, Pa.

CONTINUED ON PAGE 125

DIALOGUE

FORUM

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

Atomic Veterans

I read with interest the article in *Omni*'s November 1980 issue on the veterans of the nuclear tests ["Atomic Veterans," Earth, by Eleanor Smith]. It contained errors in fact as well as some important omissions.

First, the Defense Nuclear Agency (DNA) does not refuse veterans information. Actually, just the opposite is the case. Hundreds of documents have been declassified and made available to the public through the Department of Commerce's National Technical Information Service. More than 40,000 veterans have contacted DNA on our toll-free telephone line, 800-336-3068, and have received information from us. Any veteran who asks receives all information we have on his test participation.

Second, DNA manages for the Department of Defense a high-priority program dedicated to identifying participants, their activities, and radiation exposures. As a result of three years of research involving hundreds of people and nearly $20 million, more than 175,000 veteran participants have been identified, and it is known that their exposures were very low, that is, the average exposure was less than 0.5 rem.

Third, such internationally prestigious organizations as the National Academy of Sciences, the United Nations Scientific Committee on the Effects of Atomic Radiation, and the International Commission on Radiological Protection have addressed the health effects of low-level radiation. These organizations have published reports well-known throughout the scientific community. The findings of these groups are inconsistent with the statements of the small group of scientists cited in your article.

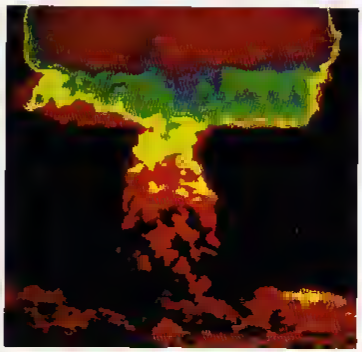
We know that the exposures of the participants were very low—more than 99 percent received less than five rems, the current federal guideline for allowable annual dose to radiation workers—and we believe the possibility that adverse health effects are related to the testing is slight.

Lt. Gen. Harry A. Griffith, USA
Defense Nuclear Agency
Washington, D.C.

Although well written and interesting, Eleanor Smith's article is at odds with the opinions of the overwhelming majority of health physicists and radiation biologists. The "experts" cited—Drs. John Gofman and Thomas Mancuso—are not held in esteem by most radiation scientists; indeed, they are nearly unanimously criticized for using nonrepresentative data bases and incorrect methods of statistical analysis. They publish their "findings" solely in the mass media, rather than in scientific journals that require peer review prior to publication.

A less biased view, and one that does not confuse soldiers' high-level radiation exposures to weapons with the low-level exposures of nuclear-industry workers, should be sought from *respected* scientists. I suggest that you contact someone from the Health Physics Society, the American Medical Association, the National Academy of Sciences, the National Society of Professional Engineers, or members of the scientific community who have *not* forfeited the respect of their professional peers.

Philip A. Anderson
Public Information Committee
American Nuclear Society
La Grange, Ill.



Nuclear tests. How much harm was done?

Eleanor Smith replies: *Contrary to what Lieutenant General Griffith states, far too little is "known" about the veterans' exposure levels. Records are incomplete; some are lost. Even the DNA's own fact sheet admits that radiation may have been inhaled, although it was not measured. And radiation experts agree—regardless of their position on its risk—that the film badges of the 1940s and 1950s were not the dosimeters of today.*

All the experts cited have published their findings in respected, peer-reviewed journals, including Health Physics *and the British* Lancet. *Most of them have had government contracts to study radiation's health effects; Dr. Glyn Caldwell headed the U.S. government's Center for Disease Control study of the Smoky test veterans.*

These scientists should not be discredited for their unpopular positions. All scientific progress begins as a minority opinion. Thus, disagreement with the majority should never be allowed to contravene the search for scientific understanding.

Space Interest Group for Students

An intercollegiate student society, Students for the Exploration and Development of Space (SEDS), has been formed, and its first chapters have been established at MIT, Princeton, and Yale. The steady deterioration of the U.S. space program's goals and budget endangers our future and demands an organized response from our nation's campuses. The society has as its ultimate goal its establishment as a national student pro-space organization. We invite you and the other students at your college to begin a chapter and join us in our cause.

We see as our primary goal the en-

lightenment of our government, private industry, and the general populace regarding the benefits of a strong space program. SEDS will provide a forum for the discussion of space-related issues, make plans for the future, and spark the interest needed to develop this new frontier and to secure our future.

Our immediate plans include submitting petitions to Congress and the President urging the restoration of the solar-power satellite research budget. If you are interested in forming a chapter at your college and in helping these efforts, write to us for further information.

Peter H. Diamandis
MIT Chapter of SEDS
372 Memorial Drive
Cambridge, Mass.

On the Right Track

"Odd Man Out," by Philip Hilts, on Dr. Julian Jaynes's bicameral-mind theory [January 1981], made every particle of my consciousness tingle. Jaynes may not have all the details right, but the possibilities are exciting and fascinating. As a psychologist, I am intrigued by the theory's explanation of the past and application to the present. As a science-fiction writer, I am tantalized by its extrapolation to the future. Might not the next evolutionary step be the universal consciousness, the awakening of the Oversoul? Jaynes's academic ostracism makes me suspect he is on the right track.

Shari Prange
Boulder Creek, Calif.

Value Received

I agree with Carl Rutz [Forum, December 1980] that ideally any endeavor, including scientific research, should be able to return value for value. Indeed, history proves that most research that has no apparent practical application or commercial value when it is performed eventually "pays off" in one way or another.

As you say, pure science must depend on patrons such as schools, corporations, or individuals to obtain financial backing to conduct research that has no current commercial value. I disagree, however, with government financing of nonmilitary research. The only proper functions of government are police and fire protection, military defense, a system of justice and laws to protect individual rights, and a monetary system.

Having an avid interest in most fields of science, I will contribute gladly to the support of research and exploration. However, those individuals who do not feel as I do about science should not be forced to contribute to it through government taxation, nor should I have to support the many nonessential (and nonsensical) government programs that I disagree with.

Carl Sagan's Planetary Society (of which I'm a member) is one of many voluntary agencies through which the private sector can finance and support such things as space exploration and other nonmilitary research.

Lou Balleweg
Reseda, Calif.

I would like to call Carl Rutz's attention to the fact that what he calls a profitless venture into space could, if NASA only bothered, make more money than the television, radio, and calculator industries combined.

What would happen if the transistors in your radio were patented by NASA? What would happen if NASA had a patent on the microprocessors in your calculator? I'll tell you what would happen: NASA would become an industry with its own separate funds.

For your information, transistors and microprocessors are merely some of the many products created as side effects of the space program. Another is epoxy glue. How do you like them apples?

Richard Bellamy
Sebastopol, Calif.

Drilling oil wells is very expensive. Can you imagine going as a private citizen to an official of your local department of energy to borrow money to drill a wildcat? In fact, too many oil wells are drilled using private money, with no demonstration of commercially justifiable results. But you still have progress, and there are no oilmen reverifying one another's results, or "name oilmen" getting money on the basis of past success and then sneaking off to drill in a location that was not approved, in order to break new ground. The independent oilman has never depended on patrons—governments, schools, corporations, or individuals—willing to invest in the future of oil production in America by paying oilmen to drill as many dry holes as they must before they finally complete a producing well.

Carl W. Rutz
Dallas, Tex.

Drilling an oil well is not research, and drilling many wells is not progress. Even independent drilling companies are merely taking a calculated risk for a proven, profitable outcome. Often the results of basic research are commercially useful, but the connection isn't made until centuries later. That's why there is a difference between an inventor and a scientist. The scientist tells you what happens and why; the inventor tells you what to do to profit from it. —Ed

Awakening to the Alternatives

Having just read Paul J. Nahin's article "For Your Eyes Only" in *Omni*'s December 1980 issue, I recall the book *Report from Iron Mountain*, published in 1967, with conclusions from the Special Study Group that included: "The war system must be maintained since it is essential to the stability of our society; . . . medical advances are viewed more as problems than as progress; . . . poverty is necessary and desirable, and there is a need for . . . the deliberate intensification of air and water pollution . . . as part of a program leading to peace."

When the mid-Seventies arrived with massive economic and energy problems, the age of revolt seemed to come to an end. The questioning of traditional values and authority diminished as a concern for society eclipsed the concern for self. Millions and billions of dollars was readily expended (with little objection from our society) on massive programs to develop solar power, promote space exploration, seek medical technology to eradicate the major diseases still remaining on Earth, and develop new machines that eased the burden of mankind to the extent of even thinking for him.

CONTINUED ON PAGE 136

Basic scientific research pays for itself when its discoveries are used to make new products.

SOLAR SISTERS

EARTH

By Patricia Seremet

Two days before the opening of the largest solar conference in the world a series of panels and workshops was held for women only Angered that the solar energy movement is being dominated by men the women wanted to find their own place in the sun But one observer said, "They did everything but rename the sun 'the daughter' "

As the lights went down on the opening event Women in Solar Energy (WISE) began its convention with a screening of a film called *X-Rated Solar M E O W* (an acronym for moral equivalent of war) The main action of the film depicts the spilling of vivid, red blood in an X across the bodies of two female bathing beauties wearing the banners "Miss Solar" and "Miss Energy"

For the 500 women attending the WISE conference the significance of the film was explained by the event's organizer Leslie Hill, a "free-lance philosopher and artist of ideas" It was a protest against the exploitation of women by solar-interest groups "Please" she pleaded with the women seated on the stage her voice choking with emotion, "tell me about different ways to organize women around truth, respect, security and the earth"

But rather than plot solar strategy the opening speakers paid homage to their sister-in-the-sky "Women and the sun are both bearers of human life" said Gail Burke a solar-program analyst from Michigan, "and as women we are hypersensitive to actions upon Earth Women are backers of solar energy because of its benign nature"

At the main office of the American Section of the International Solar Energy Society (ISES) officials were unsure what exactly was being accomplished "We are all very curious about how it will turn out" said Nancy Salmon, the membership chairman of the ISES whose organization, along with the Center for Renewable Resources, the Solar Energy Research Institute and other solar-energy groups supported the October WISE conference at the University of Massachusetts at Amherst "We are open to the concept of letting them have their meeting in conjunction with ours" she said, acknowledging that an all-female environment would benefit "certain women with specific educational needs, particularly those women who have been in the home"

But some women at the conference regarded this sexual distinction with derision While the men attended workshops to learn such concepts as 'double-shell air envelope' design the women were engaged in philosophical discussions of spiritual issues

In one address the speaker took hold of the microphone and at close range emitted loud chawnking noises "If you're wondering what I'm doing," said Andrea Frank cofounder of Solar North, Inc "I'm trying to chew up the bullshit I've been fed all my life about the limitations I have just because I am a woman" Frank chawnked some more then continued, "And I'm in the process of spitting it out"

"Uh-oh," cautioned Eileen McMahon, a member of Mid-American Solar Energy, "we're talking to ourselves again"

In contrast to many women who wore dungarees or bib overalls, one woman dressed in a suit and heels looked down from the ladies' room window to the canopied tent where a session called "Builders and Remodelers '80' met for lunch "You know it makes me so mad," she said "I want to be down there with the men"

"There we were" said Margie Harris, a director of the Western Solar Utilization Network in Oregon "the earth mothers in one group and the men the builders in another" Women will never make a real impact on the solar-energy movement, she said, until they work through their feelings of socialized inferiority "and become solar professionals"

A handful of women professionals at the conference delivered presentations without antimale diatribes Their diverse talents and expertise demonstrated the new, progressive roles women are taking in the sun-power movement There was Kathryn Chewey for example, an associate scientist at the Solar Energy Research Institute, in Colorado, who discussed the most recent advances in

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Sexual solar politics Women fluctuate between hands-off rhetoric and hands-on experience

LIFE

By Dr Bernard Dixon

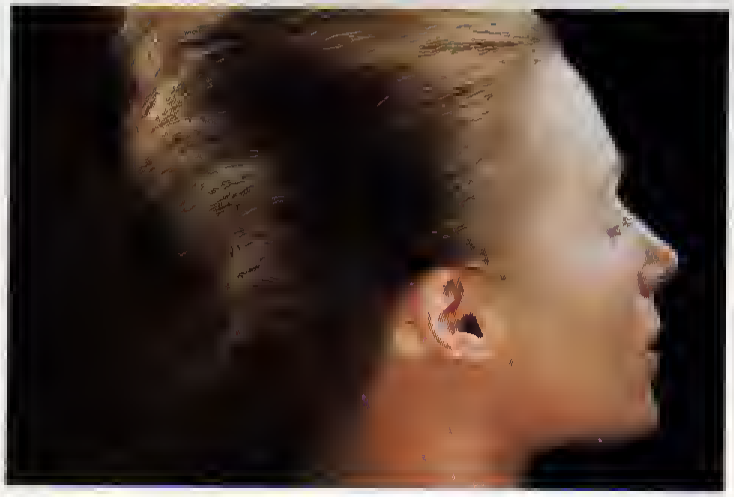
The Eighties may be destined to witness a revolution in the techniques for administering existing medical remedies

- Ciba-Geigy recently marketed a tiny disc that, when fixed behind your ear, delivers a drug to relieve travel sickness
- A diabetic wears a miniature pump that infuses insulin into his bloodstream via the skin, thus maintaining a normal level of blood sugar
- Progestasert is an intrauterine contraceptive, devised by the Alza Corporation, that releases progesterone steadily from microcrystals inside a polymer membrane

These are just three examples of products that mark a radically new departure in medicine: the invention not of better drugs but of vastly improved ways to exploit old ones. First conceived over a decade ago by Alza's Dr. Alejandro Zaffaroni, this approach is now beginning to show impressive results.

Ciba-Geigy's motion-sickness device (developed by Alza) illustrates one motive behind this twist in tactics. The active substance in the Transderm discs is hyoscine, long known to be a potent antinausea drug, but effective only in doses that cause unpleasant side effects. Delivered through the skin, however, from a little patch behind the ear, the hyoscine works well and with only minimal side effects. One disc lasts for three days, and tests on 5,000 people have shown a 75 percent reduction in nausea and vomiting.

Transderm circumvents a major obstacle facing many medical treatments: the destruction of drugs by the body. Hyoscine does work when taken by mouth, but only when huge doses are administered, because stomach juices break down most of it. A similar problem also reduces the effectiveness of pilocarpine, used to combat glaucoma. Pilocarpine administered by itself is carried away rapidly through the circulation and is destroyed. But delivered continuously, exactly where it is needed, the drug functions superbly. This is accomplished by Alza's first commercially viable invention, Ocusert. Placed behind the patient's eyelid, this membrane releases pilocarpine for several days.



By releasing its drug slowly, this tiny disc combats motion sickness without side effects

The insulin pump, now being tested at Guy's Hospital in London, was conceived with two goals in mind. Its inventor, marine engineer Bob Channon, is a diabetic who set out to devise a method of avoiding his morning injections. The resulting gadget, about the size of a cigarette lighter and likely to cost about $500 when marketed, is worn on a belt around the waist. But convenience is not its only merit. The pump also maintains sugar levels much nearer to normal than can be achieved with one daily insulin shot. This is possible because the wearer can press a switch to deliver a unit of insulin before each meal—more before an extra-large feast. By stabilizing blood-sugar levels, the device may also help prevent many complications of diabetes, such as retinopathy, which can cause blindness.

Tiny artificial cells called liposomes are another means of ensuring that potent drugs reach the right target in the body. They are now under fiercely competitive development by such companies as Hoffmann-La Roche and ICI. Composed of membranes, liposomes can be injected into the bloodstream and are highly effective in delivering substances into the liver and spleen. Liposomes containing Pentosam, developed by Wellcome, are currently on trial in the United States for the treatment of leishmaniasis, a tropical disease that afflicts these very organs. Preliminary tests at Cambridge University, in England, have shown that encapsulated Pentosam is 200 times more effective than when administered by itself.

A major international conference on drug-delivery systems will be held next June at Cape Sounion, in Greece. Topics on the agenda include the use of liposomes in cancer treatment and the targeting of drugs by linking them with pure antibodies. But the overall theme is vividly defined: the formidable opportunity to step up warfare against disease not by developing greater firepower but by delivering existing missiles more accurately. The military analogy is further enriched by a strange irony: NATO, not WHO, is sponsoring the June conference. ∞

PIONEERS PONDER

SPACE

By Robert Guccione, Jr

It's a shock to recall that it has been almost 20 years since Alan Shepard made America's first flight into space. And for those of us who remember the glamour of Mercury, Gemini, and Apollo, it is almost as surprising to recognize how workaday spaceflight is about to become. The first astronauts were a breed apart, fearless and larger than life. They opened up the final frontier. Every flight was High Noon, a showdown with the Russians at the O.K. Corral. By contrast, the "mission specialists" who will now go into orbit are settlers on the high frontier, building permanent space stations and establishing profitable, new industries.

When settlers built homes in the American West, the frontiersmen were left behind, lost in a world that had changed in ways to which they could not adapt. The pioneers of space have escaped that fate. The early astronauts, it turns out, are a good deal more excited by the NASA shuttle program than most of their less well-informed fellow citizens. And they are uniquely able to understand where their work on the High Frontier has led.

Like all the astronauts at the Johnson Space Center, in Houston, Navy Captain Alan Bean has an enchanted aura about him. Now in charge of the astronaut candidates, Bean has an indefatigable light in his eyes long after the flesh is weak. It proclaims the spirit will be not only willing but also determined. Sitting behind his conservative, glass-topped desk in a fur-collared leather flight jacket, he is a striking combination of articulate philosopher, accomplished test pilot, and space jock. As he sees it, the shuttle is a major advance not just in American space technology but also in human history.

"There's been very little serendipity in space," Bean points out. "Almost every thing we've tried has been planned. And as we know, many of the great discoveries on Earth were unexpected. The shuttle's going to allow that serendipity because we've got a tremendous payload and we can take many more people than we probably need for most missions.

"Let's say, for example, you've put your payloads out the first day and you can stay up another week or two at little extra cost. The scientific community is going to come up with a lot of ideas that may not sound good at the moment. Most probably won't be. But some of the ideas we now get to follow up will be incredibly productive. We're going to see a lot of change because of this."

But if it is so important, why has space exploration lost so much of the public support it once commanded? "Going to the moon was presented as a race with the Russians," ex-astronaut John Glenn, once the most exalted of space heroes, says. "That's one reason interest in the space program went down so rapidly after the lunar landings."

Bean agrees. "The American people respond to challenges," he says, "particularly if they are worried that their technology is falling behind someone else's. Once that element of fear went away, there wasn't as much enthusiasm for just adding to the general progress of mankind."

And, as Deke Slayton points out, it isn't easy for NASA to sustain the drama of the space program's early days since there hasn't been a manned American flight in more than half a decade.

Delays in shuttle development have also contributed to the problem. The program's troubles have been financial as much as technical. NASA receives a bit less than 1 percent of the national budget. "It might have been better if we had spent a lot of money in a short time instead of dragging the program out," says Vance Brand, who joined NASA as a civilian test pilot for the Navy and, along with Slayton and Tom Stafford in *Apollo-Soyuz*, was one of the last Americans in space. "In the long run it might have been a lot more cost-efficient."

Jack Lousma concurs. "I think we could have been in space by now if we had been able to keep pace with inflation and spend money to cope with the problems that came up," says Lousma, who flew in *Skylab 3*. "Our budget in the space program has been like your budget at home. If you're not independently wealthy and have to replace your refrigerator, then you have to wait a few months for that new set of tires. When we had to divert money

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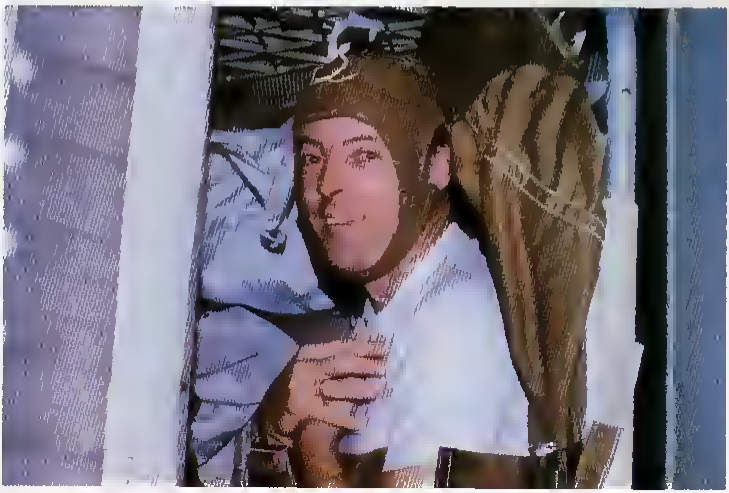

Joe Kerwin: "I think of the shuttle as a railroad, but we sorely need a station at the other end."

THE NEW BIOFEEDBACK MIND

By Bob Kall

Biofeedback, the hip fad that promised cosmic consciousness and panacean answers to human ills, is dead. But rising from its ashes is a new, practical biofeedback, an electron microscope of inner space, that has been validated by thousands of published research studies. NASA astronauts already use it to overcome zero-gravity motion sickness. Stroke patients use it to reactivate paralyzed limbs by mentally activating muscles, one nerve cell at a time. It helps epileptics abort their seizures and headache sufferers ease their pain without drugs. Athletes fine-tune their movements to the new biofeedback, and people learn to hear sounds beyond their normal hearing range.

Feedback can be applied to almost any measurable behavior. It's an added tool that allows more information to flow between the mind and the body. Biofeedback simultaneously isolates, magnifies, and feeds back information about tiny, normally imperceptible behavior changes as they occur. This amplified information helps the individual to influence those inner changes.

Practical biofeedback requires the combined application of effective hardware and a subject willing to practice long and hard on the machine. It is no miracle, not even a mystery. In the past, biofeedback was seen as impractical because the required equipment was expensive and laboratory-bound. But technological advances have reduced size and cost to the point where the techniques are beginning to have importance in real life.

A good example of this is NASA researcher Pat Cowling's pill-sized, swallowable stomach-activity monitor. It emits a radio signal so she can check gastrointestinal reactions to "zero gravity sickness syndrome," which, she says, is the space program's highest-priority biomedical-research problem. Working with such devices, researchers at the Ames Research Center in California have developed a training program centered on a highly choreographed BF course that teaches space travelers how to minimize the physical effects of zero gravity.

Subjects are taught to control their heart and breathing rates, blood flow to the face and hands, the activity of key muscles and electrical conductivity of their skin. Then they have to perform a coordinated pattern of these maneuvers while sitting in a centrifugal chair that spins faster and faster, subjecting them to ever greater stresses.

Cowling says modestly that it looks as if biofeedback is getting better results than such alternatives as drugs and attempts to simulate the effects of movement under zero gravity. The drugs have negative side effects, and simulations such as spinning the astronauts in centrifugal chairs are slower and do not seem to transfer to real zero-g conditions.

Soon she plans to try BF training to lower astronauts' oxygen requirements and control their core body temperatures during emergencies.

Back on Earth, Keith Sedlacek, M.D., director of New York's Stress Regulation Institute, predicts that with employee health-care costs going sky high, BF will soon be adopted for on-the-job stress control. "It's cost-effective preventive medicine. Executives will get BF access included with their key to the executive washroom. Blue-collar workers and middle-management executives will get group training. You'll wear telemetry equipment while you work so that high-stress activities encountered on the job can be detected and dealt with," Sedlacek says. He has already begun training executives to reduce high blood pressure and reduce stress.

Tom Budzynski, clinical director of the Biofeedback Institute, of Denver, who never read Larry Niven's description of fictional "autodocs," gives a pretty close description of what real ones might be like. "You'd wake up in the morning and plug yourself in to a device that would tell you what in your body would need to be adjusted to maintain optimal health. You could wear the device like a wristwatch. It would sound warnings whenever a physiological system went out of a preset normal range. Using telemetry, the monitor would produce computer-generated video

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THE ARTS

By Paul M Sammon

The metamorphosis from novel to film can be more traumatic than Gregor Samsa's mutation into an insect It s a process whose first step usually severs the autho from his work The novel is then subjected to various compressions deletions or outright revisions deemed necessary to transform the fictional material into a motion picture format And in the end people grumble Defenders of the novel are invariably disappointed When was the last time you heard someone say that the movie was better than the book? Loyalists of the screen version maintain the novel was only "inspirational"— this from viewers who probably haven't read the original

The nuts and bolts of screen adaptation is fraught with Byzantine complications a cast of wily, fast talking deal makers, and a torrent of checks and contracts A case in point is the upcoming $15 million science-fiction/mystery film *Blade Runner*, to be released later this year by Filmways Pictures With Ridley (*Alien*) Scott directing, Michael (*The Deer Hunter*) Deeley producing, Douglas (*2001 Close Encounters*) Trumbull handling the special effects and a promised *Heavy Metal* look *Blade Runner* portends a prestige picture More important scenarist Hampton Fancher adapted the film from a prestigious source Philip K Dick's 1968 novel *Do Androids Dream of Electric Sheep?*

Dick has been called 'the most consistently brilliant science-fiction writer in the world' by fellow SF novelist John Brunner he s been named "the Herman Melville of the twentieth century" by a Boston critic But *Androids* is the first of his many works to become actually committed to celluloid Dick s book at one level details the adventures of Rick Deckard a futuristic bounty hunter tracking down a cadre of murderous androids At further remove *Androids* is an impassioned examination of modern mankind's emotional sterility How then was this marriage of a prominent and fiercely idiosyncratic writer and Holly wood product consummated?

In the beginning, of course was the author Dick who has written nearly 40 books (he won both the Hugo and the John W Campbell awards for *The Man in the High Castle* and *Flow My Tears the Policeman Said* respectively), was especially fond of *Do Androids Dream of Electric Sheep?* "I liked that book very much " Dick declares "Although it s essentially a dramatic novel the moral and philosophical ambiguities it dealt with are really very profound *Sheep* stemmed from my basic interest in the problem of differentiating the authentic human being from the reflexive machine, which I call an android In my mind *android* is a metaphor for people who are physiologically human but behaving in a nonhuman way

"I first became interested in this problem" he continues "when I was doing research for *High Castle* I had access to prime Gestapo documents at the closed stacks of the University of California at Berkeley, and I came across some diaries by S S men stationed in Poland One sentence in particular had a profound effect on me 'We are kept awake at night by the cries of starving children' There was obviously something wrong with the man who wrote that I later realized that what we were essentially dealing with in the Nazis was a defective group mind— a mind so emotionally defective that the word *human* could not be applied to them

"Worse" he goes on "I felt this was not necessarily only a German trait I thought this deficiency had been exported into the world after the war and could be picked up by people anywhere at any time When I wrote *Sheep* — which was written during the Vietnam War when I thought we had become as bad as the enemy— I was revolutionary and existential enough to believe that these android personalities were so lethal so dangerous to human beings, that it might ultimately be necessary to fight them The problem in this killing then would be Would we not become like the androids in our very effort to wipe them out?'

Heady stuff for Hollywood But since the genesis of the *Sheep/Blade Runner* film is as labyrinthine as any Dickian plot it's also an object lesson in the hallowed Hollywood rite of "closing the deal " Key to

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Syd Meade s preproduction artwork for Blade Runner *a first step in turning a novel into a film*

THE ARTS

By Bill Moseley

You're walking down the street lost in thought, when suddenly your reverie is shattered by 200 decibels of Donna Summer's "Love to Love You Baby" blasting out of a monster-sized radio/cassette player carried by a swaggering teen-ager. Your eardrums throbbing, brain frazzled by the auricular onslaught, your first impulse is to wrench the box from his hands and smash it to bits on the sidewalk. Then you recover your wits and walk on by, gritting your teeth and heading for sonic sanctuary.

Boom boxes, disco machines, ghetto blasters, Third World Briefcases, BFRs (for Big F--king Radios)—these sobriquets all refer to the portable AM/FM cassette recorders that, since their introduction by the Japanese in the early Seventies, have spawned a cultural phenomenon of global dimensions. The U.S. Department of Commerce estimated that, in 1980 alone, Japan would export 3 million to 5 million of these portable sound systems to the United States. These figures represent as much as a 50 percent increase over 1979 exports, and the end is nowhere in sight.

The history of the radio/cassette portables is an interesting marketing tale in its own right. According to Jon Strom, product planner for the Sony Corporation, the first manufacturer to marry the radio and the cassette recorder was Aiwa, around 1970. Aiwa's unit was monaural and expensive, and it didn't sell well in Japan. But the product was a uniquely Japanese invention and, as such, provided a remarkable morale boost for the Japanese electronics industry, which had previously gained fame only as able copiers of American inventions.

Despite Sony's introduction of the first stereo radio/cassette player in 1971, unit sales remained lethargic at home. So the Japanese targeted the Middle East as their first export market. Since much of the Middle East is plagued by sandstorms, unreliable electric power, and torrid temperatures that turn record albums to goo, the Japanese saw their product as the perfect answer to the problems of unhappy music lovers there. They were right. From Baghdad to Bahrain, people were toting battery-operated units on their camels and in their cars. The radio/cassette player was there to stay.

Meanwhile, back home, the Japanese kept improving the boxes, and with Sanyo, JVC, and Panasonic getting in on the action, competition drove down the prices. In 1977 radio/cassette players embellished with four-speaker stereo and high fidelity components became a hit with young Japanese. It was this domestic success that prompted the marketing of the boom boxes in the West.

And what timing! When the first Japanese portable radio/cassette players hit U.S. shores, Americans were in the throes of disco fever. The hills were alive with that boogie beat, and what better way to turn the beat around than to tote your own portable disco machine! The box suddenly became a must for all self-serving discophiles: they insisted on playing their music loud and proud, even if it meant blowing out the eardrums of folks who'd rather listen to the soothing strains of *The Well-Tempered Clavier*.

Although it may not sound like it on the street, the vast majority of American radio/cassette-player owners keep their music to themselves. Many have found the boxes an economical alternative to expensive home stereo systems and the spiraling cost of record albums. Even though a young married couple of our acquaintance recently purchased a radio/cassette player so bulky that it requires both of them to carry it down the street, the real mover right now is a little box, no larger than a paperback book, called the Walkman. Recently marketed by Sony, it is a miniature stereo cassette player with headphones instead of speakers. It sells at discount stores for about $160, and people can't get enough of them. In fiscal 1980 Sony sold half a million Walkmen, and the Walkman plant in Japan is running on round-the-clock shifts to meet the world demand, which is three months backlogged.

The snowballing popularity of Walkmen, however, has not yet overshadowed that small group, composed mainly of urban males aged fourteen to twenty-four, who use their portable boxes as sonic

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Boom box affixed firmly to ear, author Moseley defends his sonic turf and "turns the beat around."

THE ARTS

By Alexei Panshin

For 40 years Robert A. Heinlein has been the premier writer of modern science fiction. During the same time he has always been an intensely private man, one who closely guards his personal thoughts, his business, and even the facts of his life.

Expanded Universe (Grosset & Dunlap, 1980, 582 pages, $12.95) is a fascinating collection of Heinlein's marginalia. It presents aspects of his writing that we have never before been privileged to see. Crucial details of Heinlein's career are placed in perspective for the first time. Most of all, however, *Expanded Universe* allows us the opportunity to hear Heinlein speaking as directly and personally about his opinions, his ambitions, and his work as he is ever likely to.

Almost half of this hefty book is fiction — by no means all of it SF — much of it unreprinted until now. There are essays and magazine articles, an encyclopedia entry, a tribute to E. E. Smith, an ad, a speech to the U.S. Naval Academy, and a new 30,000-word concluding essay on the state of contemporary American society. And all of this rare material is presented in chronological order with notes by Heinlein. If you grew up on Heinlein, if the Future History or the Scribner juveniles or even *Stranger in a Strange Land* was your basic education, if you are one of those who have followed Heinlein through his entire career marveling, if you really care about Heinlein, then *Expanded Universe* is a book that you might save pennies from your lunch money in order to buy.

You might buy it. But be forewarned. *Expanded Universe* is a deeply unhappy book, filled with Heinlein's most trivial and peripheral work. Here are to be found failures, unheeded cries of warning, hearty denunciations, and deep and grievous wounds. *Expanded Universe* is Heinlein very occasionally at his best, and far more often at his worst.

Heinlein's best has been his hunger to break free from all the limitations of his turn-of-the-century Bible Belt Missouri background. His engineer's pragmatism and exactitude, his naval officer's dedication and discipline, his willingness to think and think and rethink, and his readiness to educate the young in necessary survival skills are also part of his good side. Heinlein's bad side has been his arrogance and egotism, his manipulativeness and his concern to have the upper hand always, and, worst of all, his misplaced morality.

Misplaced morality? Yes. In a speech to the midshipmen of Annapolis, Heinlein raises the issue of moral behavior and ties it firmly to survival.

"We have two situations, mutually exclusive: mankind surviving and mankind extinct. With respect to morality, the second situation is a null class. An extinct breed has *no* behavior, moral or otherwise. Since survival is the sine qua non, I now define *moral behavior* as behavior that tends toward survival."

This has to be false. If morality did lie in mere survival, then the hard-shelled defensiveness of the clam, the sharp-toothed aggressiveness of the shark, and the playacting of the opossum — survivors all — would be moral models for mankind, as they so often are models for Heinlein in this book. What have been rational and pragmatic survival behaviors to Heinlein must seem, to us, like actions and attitudes unworthy of such an able and superior man.

In the interest of survival, Heinlein has sought dominance. "I don't like servility any more than the next American — but if there is any groveling to be done, it won't be by me."

He has used pressure and manipulation for personal advantage, as he recalls doing with the great editor of *Analog* magazine, John W. Campbell. "I'll send you a story from time to time . . . until the day comes when you bounce one. At that point we're through. Now that I know you personally, having a story rejected by you would be too traumatic."

He has used veiled threat. "[. . .] the record shows that it is not healthy to hate me."

And when subtler tactics have not worked, he has been willing to pound on his chest and swell to three times his size. "In a bully-boy society often nothing but bullying will work. . . . Shake your finger

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CONTINUUM

Edited by Dick Teresi

THE STEALTH AFFAIR

Last year's uproar about the new invisible bomber, code-named Stealth, has now died down, and a look back may be instructive. It's significant that the noise had nothing to do with technology, but only with politics.

Some said that former Secretary of Defense Harold Brown revealed the existence of the supposedly top secret Stealth in open congressional testimony to boost the poll ratings of his boss, then-President Jimmy Carter. That's possibly true, but it's not really the major issue. No one stopped to ask the obvious question, *How* can a bomber be made invisible to an enemy's long-range surveillance radars?

The usual means for frustrating one's enemy's radar (called ECM for electronic countermeasure) don't try to make the plane invisible. Rather, an airborne ECM tries to *mislead* the ground-based radars that search for hostile targets. A World War II ECM trick was to dump strips of metal foil that protected the plane in a cloud of false targets, and radar screens would blossom with hundreds of misleading radar echoes. There are still other techniques that can do even more amazing things. But none of them achieve invisibility.

Can something really be invisible? Certainly a clean piece of glass can, and now and then somebody walks through a sliding glass door, thus proving this. Air is tough to see, too, unless you live in Los Angeles. But bombers aren't made of glass or air, and in any case these two things are only transparent to us because we see them in the visible-light portion of the electromagnetic spectrum. Whether something is invisible depends not only on the something but also on the way we 'illuminate' it. So perhaps a bomber can be invisible at radar frequencies, which are much lower than those of visible light. In fact, the Germans tried to make their U-boats invisible to radar and they nearly succeeded. What the Germans almost did in 1944 may be what Stealth is doing in 1981.

The Germans covered their submarines with a material called *Sumpf*, a sandwich of rubber impregnated with carbon granules. This technique, code-named *Schornsteinfeger* (chimney sweep), allowed a U-boat to absorb radar pulses instead of reflecting them, thus rendering the sub "invisible." The subs were still visible to humans in the usual part of the spectrum, but where the radar operated (in that part of the spectrum called X band, around ten gigahertz) it was blind to the rubberized U-boats.

Fortunately for us, salt deposits quickly destroyed *Sumpf*, and so *Schornsteinfeger* failed. But the idea was technically valid. Might this old idea be the principal concept behind Stealth? Two recent letters to the editors of the *Wall Street Journal* seem to indicate that this may be so. The first one, appearing in the September 18, 1980, issue, was written by physicist and H-bomb inventor Edward Teller.

In his letter Teller asserts that whatever Stealth might be, it most likely can be easily defeated by the Russians. He claims he knows one simple way to do this—Teller calls it "obvious"—but he feels restrained by security from saying more.

The second letter, printed in the issue of October 2, 1980, was written by a reader who described himself as one who has been involved since 1942 with 'questions of radio detection, and *absorption*." He congratulates Teller on having the guts to assert publicly that the Carter Administration's claim of a technological breakthrough is "as phony as a three-dollar bill."

These two letters, along with the German work, make it clear, I think, just what Stealth is. It's a rubber-coated airplane! Possibly it's applied in a more sophisticated manner (with latex paint?), but it's the same idea. And what might be the simple way to "see through" this coat that Teller hints at? My guess is that all that's necessary is to change the frequencies of the ground radars. Not a trivial task, but not a very hard one, either.

Since Harold Brown told all in Congress, I'm sure the Soviet Union is taking the necessary steps. And this brings us to the basic question. *Why* would the military make such a fuss over something that's been around so long? One answer is provided by a friend of mine, a scientist at a Midwest Air Force laboratory.

Some of these guys classify *everything*, because they can't tell the difference between the obvious and the new. If one of them stumbled across the concept of the wheel, he'd classify it. And then, upon observing all the automobiles running around, he wouldn't admit his blunder. No, he would accuse all the drivers of revealing state secrets to the enemy!'

Still, some good probably came out of the Stealth affair. There must be at least a few eighty-year old German naval scientists around who enjoyed a chuckle or two over it. And why not? They earned the right—four decades ago.—*PAUL J. NAHIN*

CONTINUUM

FLOOD WATCH

Flood damage costs $3 billion to $5 billion yearly and floods take a terrible human and animal toll. As the winter snow melts and the spring rains come, the millions of people who live in the 20,000 U.S. communities built in the floodplain along rivers are girding for the next onslaught.

Now new technology is helping in the age-old battle of man against water. The U.S. Geological Survey uses microwaves to measure the total snowfall on mountain sides to gauge runoff and to plan necessary protective measures.

Its 9,000 monitoring stations calculate water flow and the level of rivers. Data are being forwarded by satellites and processed by computers. Satellites also track erosion, drainage patterns, and flood paths.

Each method is designed to buy time, giving people in the path of possible floods an earlier warning. One of the most innovative methods is a sensor installed on riverbanks or on bridge abutments. When water reaches the sensor, an alarm sounds at the local police station, much as a burglar-alarm system does.

In one instance, a sensor triggered an alarm in Brattleboro, Vermont, near midnight on April 9, 1980. The high water was miles away. Brattleboro got three hours of valuable warning time. Critical areas were evacuated without injury.

The initial cost of the system is about $40,000; annual maintenance costs $1,000. Yearly savings in flood-prone areas are estimated at more than $1 million.

Of course, the best way to be safe is to stay out of the way. Satellite data that precisely define areas of probable flooding are increasingly being relayed to local officials. — Stuart Diamond

Springtime flooding. New technology gives people early warning.

LASER PAP SMEARS

Cervical cancer has now been detected with two variations on a laser technique. One, developed at the University of Rochester, in upstate New York, is an improvement in screening Pap smears. The other, developed by a Chinese clinic in Shanghai, could replace the Pap smear altogether — if it proves itself to be safe.

Early diagnosis is essential for effective treatment of cervical cancer, one of the commonest types in women. Because it permits early detection, the Pap smear was thought to be a breakthrough. However, the Pap smear is not without problems. Every tissue sample taken must be analyzed in a laboratory by a skilled technician, and sometimes the test cannot make the critical medical distinction between severe inflammation and early cancer.

At Rochester, Dr. Leon Wheeless mixes the cellular sample with a fluorescent dye that is selectively absorbed by cancer cells. A stream of liquid containing the cells is then passed through a laser beam, and fluorescence produced by the cells is monitored to detect abnormal cells. Only the samples containing abnormal cells must be examined by a technician.

The Chinese use the same type of dye, but it is administered in capsule form. Several hours after a woman swallows the pill, her cervix is scanned with a low-power laser. A concentrated fluorescence indicates that cancer is present.

The Chinese technique appears readily adaptable to mass screening in physicians' offices without taking tissue samples. But there's another problem. The family of dyes generally used is mildly carcinogenic and may not be suitable for human consumption.

Nevertheless, visiting American physicians were

— often depicted as a weapon, is a b[illegible] to medicine

impressed by what they report is an extensive Chinese program in the medical uses of lasers. And lasers seem likely to find a role in screening for cervical cancer in the medical lab, if not in the doctor's office. —Jeff Hecht

"I could have gone on flying through space forever."
—Yuri Gagarin

ZIP-UP FRACTURE

A new polyurethane splinting-and-casting system currently being tested in England may force the traditional cumbersome plaster of paris cast into welcome obsolescence.

Called Neofract, the new system creates a cast that is lightweight and partially water-resistant, best of all the cast can be unzipped.

Neofract was reportedly invented by a German surgeon who, while working on his boat, trying to increase its buoyancy with two polyurethane components that foamed to three times their initial volume, realized their potential in replacing plaster of paris.

The brown and blue components are stirred together to form a smooth, light green fluid that is poured into a knitted cotton stocking. After 85 seconds the stocking is wrapped around the broken limb and fastened in place with a zipper.

The polyurethane continues to foam until it meets the surface of the limb. The resulting cast conforms exactly without looseness or troublesome pressure points. The cast is weight bearing in 30 minutes, as opposed to 48 hours for a plaster-of-paris cast. It's also 75 percent lighter. A below-the-knee cast weighs about one pound.

Thanks to the zipper, the polymer cast can be removed for hydrotherapy and other treatment. While it is theoretically possible to swim, shower or take a bath wearing one of the casts, it isn't recommended because of possible water seepage. The cast would probably have to be removed and dried inside with a hair drier.

Neofract, manufactured in England by American-owned Johnson & Johnson Ltd., is currently undergoing clinical trials at Charing Cross Hospital, in London. The cast is expected to be marketed in Europe no sooner than the middle of this year. —Mike Hutchinson

Neofract. Complete with zipper.

"Thought is action in rehearsal."
—Sigmund Freud

NOW . . . MUZAK FROM OUTER SPACE

It was only a matter of time before research and communications satellites yielded to more mundane endeavors—like the transmission of Muzak, the ubiquitous background music of modern times.

The company that takes the peaks and valleys out of music has recently installed satellite receiving dishes at 200 locations in this country. Its special brand of environmental music is played simultaneously in thousands of restaurants, offices and factories. Previously Muzak's tapes traveled from location to location—a costly and time-consuming procedure that meant some of its customers got new tunes weeks later than others.

But now, after recording the music at its Manhattan studio, Muzak computers encode the tunes and send them to a Western Union communications satellite hovering above the equator. From there, beams of Muzak stream down to franchises.

Muzak, the world's largest background music purveyor, reaches more than 100 million people each day. A team of scientists and psychologists carefully selects five tunes for each 15-minute segment. "We take out a lot of the spikes, rounding the edges," said Bill Werner, Muzak vice president. The pattern is designed to relax workers and increase productivity.

Muzak Earth station. Terminal receives blandness via satellite.

The music has been criticized for blandness and behavior control. But Muzak contends its music masks unwanted sounds and increases worker alertness. It is used in 24 industrialized nations in Europe, South America, and Asia. The new satellite system will enable Muzak to expand to remote locations wherever there is a receiver. "Our goal," Werner says, "is to establish a presence just about everywhere we can." —Stuart Diamond

CONTINUUM

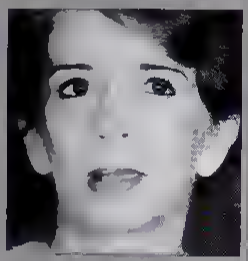
EXPRESSION THERAPY

Aging causes some faces to droop into hangdog expressions. Other people simply are born with grim and fixed features that mask a contented psyche. Now such troubled expressions can be easily corrected, a Canadian plastic surgeon claims, by a new kind of surgery he calls expression plasty.

Nabil Fanous, assistant professor of plastic surgery at McGill University Medical School in Montreal, believes that most plastic surgeons focus too much on ideal features and wrinkle-free skin at the expense of expressions appropriate to someone's true personality. Patients, he says, usually end up with an artificially younger-looking skin tone and the same old unfortunate imbalance of features.

Unwanted expressions involve the action triad of eyebrows, eyelids, and lips; a downward cast suggests sadness and an upward one produces a look of anxious surprise. Simply shifting the eyebrows up or down or perhaps trimming just the tip off someone's nose, or even removing fat from the lower lip, Dr. Fanous says, can alter an entire face for the better.

The expression plasticist combines precise surgical skill and scientific know-how with a knack for the artistic and understanding of basic psychology. "I always consider a person's abilities, mood, intelligence, and sex before deciding on the course of surgery," Fanous told *Omni*. "I'm certainly not going to give the expression of, say, a fifty-year-old politician to an eighteen-year-old ballet dancer."



Before (left) and after photos of expression therapy patient.

Long before the U.S. presidential election, Fanous predicted Ronald Reagan would landslide into the White House. "Fifty percent of our impressions of people come from their expressions, and fifty percent from what they say and do. In campaigning, Reagan and Jimmy Carter didn't sound that much different, but Reagan had an expression of confidence, charm, and aggression to beat Carter's serious, droopy-faced, and desperate look."

In order to put on a wanted face, patients have surgery one day and go home the next. Fanous asserts that since extremely thin and absorbable sutures are used within a week no one can tell that an operation accounts for what friends would interpret as a personality change. — Caroline Rob

"I wish I didn't know now
What I didn't know then."
— Bob Seeger

SUPERSTAR

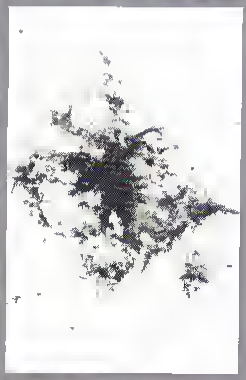
It's a superstar even in cosmic perspective. Astronomers believe they have detected a star tens of times more massive than any star previously known. The star, R136a, located in the Tarantula Nebula in the Large Magellanic Cloud, a companion galaxy to our Milky Way, is estimated to be 3,500 times as massive as our sun. The previous record holder for mass was a star roughly 120 times the size of the sun.

R136a is extraordinary in other ways as well. It is too massive to be stable, according to current theories and observations concur. It is apparently expelling mass at a phenomenal rate, the equivalent of all the matter in our sun every 1,000 years. This stellar wind of ionized carbon is racing outward at a rate of 3,500 kilometers per second, or 7.5 million miles per hour. Even with R136a's colossal mass, the rate at which it is shedding its own material means that its lifetime will be only 1 million years, compared with 10 *billion* years for our sun.

It is also very hot, with a surface temperature of 60,000° C, and its radius is 120 times that of the sun. All in all, it is pouring out 150 million times as much energy as the sun.

These are the conclusions of University of Wisconsin astronomers Joseph P. Cassinelli, John S. Mathis, and Blair Savage. They made use of spectroscopic evidence and of observations with the International Ultraviolet Explorer satellite. They found that to fit the data there had to be either 40 stars each equal to the very brightest stars in our galaxy within a volume only one light-year across — a highly unlikely idea — or one super-super-massive star. The latter idea fits both the data and theoretical calculations that match those data.

The discovery is intriguing. It also poses some puzzles. Cassinelli says, "It is not entirely clear how such a massive star could form." — Kendrick Frazier



Reverse-negative photo of Tarantula home of R136a.

FERTILITY CRISIS

Human sperm counts in industrial societies are lower than ever, and here in the United States mattresses may be partly to blame. Seminal fluid donated by students at Florida State University has been found to contain traces of Fyrol FR2, a flame-retardant chemical used on foam mattresses.

Dr. Ralph Dougherty, in charge of testing the Florida State semen samples, says Fyrol molecules migrate through bed linen and into the skin. Dr. Dougherty is convinced that Fyrol is reducing male fertility, but he has yet to prove his case with conventional study trials.

Nevertheless, scientists throughout the world have found toxic chemicals such as PCBs and chlorophenyls in semen samples at the same time they have reported a dramatic drop in sperm. An average American male today produces less than a quarter of the sperm an average male produced half a century ago.

Toxic chemicals seem to be the worst offenders, though the frequency of sexual activity, alcoholism, smoking, and drug use also affect fertility. Even air temperature has an influence. Men who live in colder climates tend to have higher sperm counts, as do men who wear loose-fitting underwear that allows air to circulate in the groin area (a case for boxer shorts over jockey shorts).

Dougherty advises anyone sleeping on a polyurethane mattress to cut off a small snip and put it to a match test. If the sample doesn't burn when you take the match away, write to the manufacturer and ask whether Fyrol was used.

—Caroline Rob

Men wearing boxer shorts may not be a turn-on, but they're fertile.

SPACE AGE TURTLE

A 212-pound sea turtle named Dianne had a curious companion during a recent eight-month migration: a satellite that tracked her night and day.

During the 800-mile journey from Mississippi to Louisiana, Texas, and the Gulf of Mexico, a transmitter attached to Dianne's back beamed her location to a satellite normally used to track ships.

The experiment has far-reaching potential for the preservation of endangered species, because it can enable scientists to identify feeding, nesting, and mating areas. Stocks could be better managed and protected.

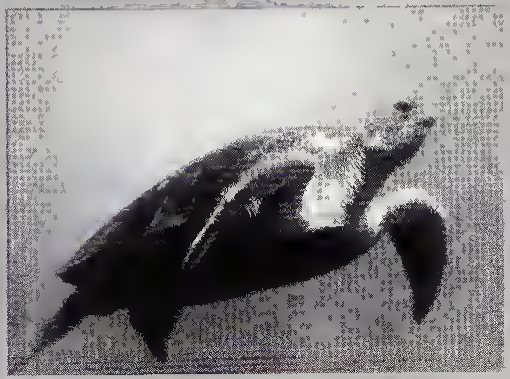
Obviously, the satellite does what humans would find almost impossible. It follows a single animal through the water, perhaps into a swamp, under logs, through mud, and over a wide-ranging area continuously.

"With humans, it would be extremely expensive and messy," says Robert Buchanan, of the National Oceanic and Atmospheric Administration, which conducted the experiment. "It would be easy to lose the animal. The presence of humans might upset the animal's natural migratory habits."

Dianne started her journey on October 16, 1979; the signals stopped off Brownsville, Texas, in the Gulf of Mexico, on June 15, 1980. Inexplicably, the signals began again a few days later and moved inland, to the middle of Kansas—far from Dianne's habitat.

The satellite traced the transmitter to the home of a fisherman. Apparently Dianne had shed the seven-pound transmitter on June 15. The fisherman found the $5,000 device on a beach 30 miles from Port Arthur, Texas, took it home, and was using it as a doorstop.

—Stuart Diamond



Space Age mystery: How did Dianne, a 212-pound sea turtle carrying a satellite transmitter, end up in the middle of Kansas?

CONTINUUM

ANIMAL TRIVIA

Some tidbits to brighten up your table conversation courtesy of the National Wildlife Federation

- The sooty tern a sea bird may fly continuously from the time it's born until it is old enough to breed five years
- An anteater can devour as many as 30,000 ants a day It can flick its tongue 160 times a minute
- The blue whale is the biggest animal that has ever lived on Earth It can grow to be 100 feet long and weigh 150 tons And some of its multiton cousins notably the humpback whale and Bryde s whale can leap completely out of the water
- The oldest living tree is a bristlecone pine in California It began growing about 4 600 years ago predating ancient Greek civilization
- The world s fastest growing tissue is found on the moose, which grows seven foot antlers in ten weeks each year Then it sheds them
- A porcupine doesn t shoot its quills It smacks them at an attacker with its tail They are barbed making it painful to extract them
- The world s thickest tree is a Montezuma bald cypress that grows outside of Oaxaca Mexico Its trunk measures more than 110 feet in circumference
- One of the most grotesque creatures is the starfish It eats by pushing its stomach through its mouth surrounding its prey and digesting the food outside its body It also has an eye at the end of each arm and can grow its arms back

—Stuart Diamond

'Declare the past, diagnose the present, foretell the future.'

—Hippocrates

The amazing anteater takes a bow It can catch and devour 30 000 ants a day and can flick its tongue 160 times a minute

SUPERMARKET LASER

After years of being an experimental laboratory toy, holography—the technique of creating three-dimensional images with lasers—will soon be making its debut in a more mundane setting your local supermarket The IBM Corporation has now incorporated holography into supermarket checkout stations to scan and read the Universal Product Code (UPC) those zebra price stripes on product labels The new scanner should speed up the line at the cash register

Presently checkout clerks have to be precise when showing the UPC to older-model scanners The stripes must be facing down over the scanner window and be within a half-inch to an inch of the window before the price is registered and rung up by the computer

The new design used in IBM s model 3687 scanner is much more forgiving The clerk has only to come within four to five inches of the scanner and can be anywhere within 180 degrees of its view

As soon as a package with a UPC code passes by the scanner window the laser automatically goes on and, by a special two-mirror setup, the light is reflected out through the window En route the beam is broken into distinct light patterns by a spinning holographic disk The pattern of light is played across the UPC, and the variations in the light are picked up by a mirror and reflected back into a photodetector that translates the light into

Laser beam wraps around package to read the product code

electrical impulses These are 'read' by a computer that lights up the price on a display board and prints it on a receipt

The beauty of the system is that besides reading any shape of item it also uses a new silicon memory chip that IBM developed About a quarter inch square the chip can store information on 390 supermarket items

The new checkout terminals that use the lasers can keep a running inventory of goods can be programmed to print out specialized store information and can even be connected to other checkout counters in other stores in a store chain

—Douglas Colligan

DEATH BLOW FROM SPACE

Was two thirds of all life—including the dinosaurs—killed off 65 million years ago by the impact of a giant asteroid? This question now quite popular has gotten

support from the work of David Milne of Evergreen State College in Washington, and Chris McKay of the University of Colorado

The asteroid impact could have thrown a dust shroud around the earth, cutting off most sunlight. Plant photosynthesis would have stopped and caused a massive die-off of marine plants and animals. On land, the collapsing food chain might have led to the dinosaurs' demise.

But how long would the darkness have had to last to destroy the food chain? After a thorough search of the marine-biology literature, Milne and McKay suggest an answer.

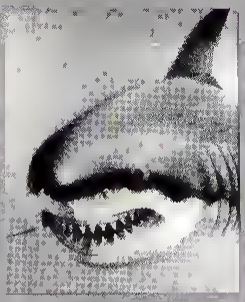
"If sunlight were reduced to only a hundredth or a thousandth of normal levels," Milne says, "the oceanic phytoplankton would begin disappearing within one week.

"Those microscopic creatures are at the bottom of the food chain, and as they went, the rest would soon follow. Zooplankton, two weeks later, small fish; two to four weeks following that, and larger fish, within two months.

"Sharks," Milne adds, "could last five months or more."

Some scientists suggest the blackout lasted for several years, but McKay and Milne think it lasted less than six months. Sharks, they note, are still with us.

Dinosaurs are not. But there are great complexities involved in the die-off of land creatures. Since dinosaurs were already in decline,



Shark: Hardier than a dinosaur.

there must have been other factors besides the great blackout that claimed *Tyrannosaurus rex* and *Plesiosaurus*. —Joel Davis

"The only reason some people get lost in thought is because it's unfamiliar territory."

—Paul Fix

KILLER KLEENEX

The American base at McMurdo Sound, in Antarctica, is best known as a haven for geologists, glaciologists and other scientists interested in the constitution and life of the icecap. In recent years, however, this base has also become an ideal laboratory for testing the effectiveness of Killer Kleenex, a viricidal tissue designed to break the transmission of cold viruses from one nose to another.

Eliot Dick, professor of preventive medicine at the University of Wisconsin, developed the anticold tissue with help from Johnson & Son Inc., best known for its floor wax. At one of its plants in New Zealand Johnson impregnated 500,000 tissues with virus-killing iodine for Dick to take south to McMurdo. The tissues are khaki-colored, very slightly damp, and perfumed to offset the strong odor of iodine.

McMurdo's isolated population of 60 men makes an ideal "test tube" for analyzing the transmission of colds. At the end of the Antarctic winter, 200 men carrying germs from the outside, are flown into the base to open it for the summer's research activities. Dick and his epidemiological team have joined this group to study the effects of the Killer Kleenex on the health of the overwintering group.

Dick and his associates patrol the base's mess hall and bars each night, making sure everyone is supplied with the cold-killing tissues. Before going through the mess line, every man on base is stopped and asked whether he is using the tissues and whether he has experienced any cold symptoms.

"The tissues are apparently very effective at breaking the transmission of colds," Dick says. Both the National Science Foundation and the National Aeronautics and Space Administration are providing Dick with funds not only to study the effectiveness of the tissues but also to produce ones that are so aesthetic that even children will use them.

"Once the idea is perfected, there will be a scramble to patent the product," Dick says. —Caroline Rob

"Nothing is rich but the inexhaustible wealth of nature. She shows us only surfaces, but she is a million fathoms deep."

—Ralph Waldo Emerson

Using Killer Kleenex. Every man at Antarctica's McMurdo Sound base was stopped in the mess line and grilled about cold symptoms.

CONTINUUM

BETTER LIGHTS

Thomas Edison's light bulb, which changed modern life, is also very inefficient. Less than a tenth of the electricity used by an ordinary bulb produces light, the rest escapes as heat.

Nowadays new bulbs emit as much light on far less energy—and less money. One of them, introduced in 1980, is a circular fluorescent that screws into an ordinary socket. It can produce as much light as a 100-watt incandescent bulb while using less than half the power. General Electric calls it the "Circ-lite." The new bulb costs about $10, but it can save three times that much

Circ-lite. Uses half the power

over its five-year life.

Another device is the electronic ballast, which cuts energy use in fluorescent tubes. Traditionally, fluorescents have used electromagnetic ballasts, which boost the tube's voltage, exciting the gases inside and causing the tube to glow. The electronic ballast, operated by a computer chip, does the same job more efficiently by operating at a higher frequency.

A new fixture developed by du Pont automatically senses the natural light in a room and adjusts the light-bulb levels accordingly. Marriott Corporation estimates the fixtures are cutting its lighting bill by 40 percent.

Light-bulb manufacturers are introducing new electronic bulbs, resembling incandescents, that approximate their soft lighting but use only a third as much electricity. They are called arc lights. Their base contains sophisticated electronics; the bulb has both a tungsten filament and an arc tube that glows.

The average U.S. family spends $100 a year on lighting; businesses often spend more than half their electric bill for light bulbs. The possible annual saving from new lighting is projected to be more than $10 billion.

—Stuart Diamond

'Our scientific efforts to make things right sometimes seem like rearranging the deck chairs on the Titanic.'
—W. Norman MacFarlane

'The religion that is afraid of science dishonors God and commits suicide.'
—Ralph Waldo Emerson

FRIENDLY COMET

Comet tails, commonly millions of miles long, behave as if they were wind socks in a gentle breeze. Occasionally there may be a long, slow flutter or even a wave down the streamer.

But three astronomers report that early last year they observed Comet Bradfield suddenly performing like a friendly dog. It astonished them with a swift, unprecedented wag of its tail.

Comet tails occasionally flutter, but they hardly ever wag

NASA observers John Brandt and Malcolm Niedner Jr. along with John Hawley of the Joint Observatory for Cometary Research, in New Mexico, saw the inner regions of the ordinarily straight tail suddenly bend 10 degrees in 28 minutes. The speed and extent of the tail-turning exceeds that of any known movement of the kind.

Comets—which are like dirty snowballs, consisting of meteorlike particles embedded in a large frozen mass of water, ammonia, carbon dioxide, and hydrocarbons—can and often do have two tails. The sun's heat evaporates the comet's icy surface, creating a bright cloud of gases and, sometimes, dust. A plasma tail forms as ionized molecules are blown out of the cloud by the solar wind, the sun's continuous outward rush of ionized atomic particles. Dust tails are formed when solar photons accelerate the dust particles. Although the tails stream away from the sun together, they soon fork into a short dust tail and a long plasma tail. When the geometry is just right, both tails can be seen from Earth.

But never before has a comet been seen wagging its tail. The scientists speculate that the wagging was caused by a sudden encounter with turbulence in the solar wind. It could have been located either on the leading edge of a high-speed stream sweeping past the comet or on the shock front caused by a solar flare.

—Charles P. Boyle

"The vitality of thought is in adventure. Ideas won't keep. Something must be done about them. When the idea is new, its custodians have fervor, live for it, and, if need be, die for it."
—Alfred North Whitehead

SILICON VALLEY SPIES

The Soviet Union has spent more than $100 million to steal American microcomputer technology that would give it military superiority

BY CHRISTOPHER SIMPSON

Austrian physicist and businessman Rudolf Sacher is middle-aged, well educated, and worth over $1 million. The only thing that stands out about him is his heavy, black handlebar mustache. He is also a secret agent for East Germany, according to Werner Stiller, a former colonel in the East German security service who defected to the West in 1979.

Stiller's defection touched off a chain of arrests that has resulted in the conviction of 12 West German government officials and NATO personnel. Austria is a nonaligned country, and its attitude toward Soviet Bloc agents is somewhat less hostile than that of West Germany. Sacher and his business associate Karl Heinz Pfnudl, who was also named as a spy, remain free to do business and to move about at will.

Sacher denies the charges leveled against him. Stiller made up the story, he says, to gain credibility with West German intelligence and the CIA.

A growing number of facts, however, suggest that Sacher has been a very successful agent for East Germany, one whose specialty is securing technical information on microcomputers, integrated circuits, and other electronic wizardry from the United States. Sacher, it seems, has been financing Peter T. Gopal, who in turn allegedly has been stealing the most advanced electronics secrets from such top American companies as Intel, National Semiconductor, and Zilog.

Peter Gopal is on trial for the theft of trade secrets from Intel, a leading microcomputer manufacturer, for conspiracy, and for bribery of employees of various microcomputer-research firms.

PAINTING BY GOTTFRIED HELNWEIN

According to grand jury testimony, Gopal was running a sort of black market operation in stolen technical information. Computer tapes and equipment used in manufacturing microcomputers had been purchased and illegally sold to the highest bidder. At least some of it apparently has ended up in the hands of the East Germans and the Russians.

Gopal's luck ran out in 1978, when he allegedly offered Tom Dunlop, an executive at National Semiconductor, a suitcase full of the latest Intel equipment for $200,000. Dunlop turned him in.

The Gopal case is only one episode in a vast Soviet effort to beg, borrow or steal U.S. microcomputer technology—a task on which the Russians have spent well over $100 million since 1971. The espionage campaign ranged from simply buying U.S. technical magazines to a bizarre plot to obtain information and financial leverage by buying up American banks through an Asian front man going under the pseudonym of Amos Dawe.

The KGB has always paid special attention to international trade. Few major Soviet trade deals are settled without direct participation by the KGB's Industrial Security Directorate. The first deputy chairman of the Soviet Chamber of Commerce, for example, is Yevgeni P. Pitovranov, a KGB general. Pitovranov, who frequently represents the Chamber of Commerce at international trade fairs, was KGB chief of station in Peking during the early 1960s.

At least two other KGB agents have recently been active in the United States in the guise of trade representatives. Vasili I. Khlopyanov, who works out of the Soviet consulate in San Francisco, was expelled from Thailand in 1971. Vladimir Alexandrov, the commercial vice-consul in San Francisco, was expelled from Italy in 1970 for spying. Both have aggressively sought out contacts in the electronics industry.

In all too many instances the Russians can simply buy sensitive high-technology equipment on the open market. They have purchased radar, computers and lasers from willing Western businessmen.

Some sensitive technology, however, has always been barred from export. Equipment and know-how for the manufacture of microcomputers and integrated circuits, for example, have always been controlled, even in the heyday of detente.

In such cases the Russians' most effective tactic has been to employ unscrupulous import-export traders, some of whom work for prominent American companies, to buy high-technology products, disguised as washing machines, air conditioners or other large appliances, for shipment to Eastern Bloc countries.

Few such white-collar smugglers have been apprehended, even though the Commerce Department, the Customs Service and the FBI all agree that the practice is pervasive. One reason is that no one is concentrating on tracking them down.

Still fewer smugglers have been punished. In five cases of illegal electronics exports, originating in California, where the exporters were caught red-handed, not one prosecution resulted in a jail sentence. Fines have been slight compared to the profits involved. One Canada-based buyer for the Russians recently was fined only $1,500 for the illegal export of electronic test instruments worth $1.5 million. Most of those companies caught with the goods are still in the electronics export business.

Russian electronics espionage is aimed primarily at the Santa Clara Valley, a cluster of suburbs between San Francisco and San Jose. Despite some competition from Japan and Texas, the valley remains headquarters to the most sophisticated electronics manufacturing and research operation in the world. More than 40 "Top Secret" projects are under development there, according to the FBI, and 400 more require Secret clearance.

Silicon Valley's chief products are the tiny chips used in computers—the hottest thing in electronics today. Controlling everything from automatic corn poppers to ICBM guidance systems, this new technology distills the power of a computer into a sliver of silicon the size of your fingernail. Twenty years ago a computer this powerful would have filled a room and would have cost millions of dollars. The cost of many standard chips is well under $20 and headed down.

"Fines have been very small, compared to profits. One Canada-based buyer for the Soviet Union was fined only $1,500 for the illegal export of electronic test equipment worth $1.5 million."

The Russians—and the Japanese, the Germans and just about everybody else—want to skip the billion-dollar investment in R&D it would cost to create their own chip-building methods. Instead the Soviet Bloc has concentrated on reverse engineering or, when necessary, stealing U.S. chip-making technology.

Furthermore, Moscow has a particularly strong motive to keep an eye on Silicon Valley. Because the new microcomputers dramatically boost the capacity of American radar, missile-guidance systems, communications, spy satellites and other military hardware, Silicon Valley is a vitally important source of intelligence on our military capabilities and on possible countermeasures to these weapons.

"About ninety percent of Soviet microcircuit production goes directly to the USSR's military effort," says strategic trade expert Dr. Miles Costick, who heads the Institute on Strategic Trade in Washington, D.C. He argues that the Russians are eight to ten years behind the West in microcircuit technology and that this is one of the few areas where the West still has a decisive military advantage. Obtaining these technologies, Costick says, ranks among the highest priorities of Soviet intelligence.

Rudolf Sacher has made a fortune in recent years by reverse-engineering U.S. electronics products, according to the Austrian business magazine *Profil*. His company, Sacher-Technik, specializes in peeling back the microscopic layers of a computer chip to see whether slight modifications could yield new products not protected by existing patents.

The practice is legal. In many cases, however, reverse-engineered products are technically inferior to the originals, says Chuck McLeod, a U.S. Customs agent who specializes in electronics-smuggling cases. "The main market," he adds, "is the Eastern Bloc, which is prohibited from buying the originals direct."

Sacher is quite candid about his relations with the East Germans. "We have developed a method whereby we can place electronic circuits in one tenth the space required previously," he declares proudly. "East Germany gave us the order and financed it." Sacher also admitted in an Austrian court that in order to get that contract he had provided the East German intelligence service with a 74-page report on the state of the art in microelectronic technology—a practice he claims is common among companies that deal with the East.

Sacher denies obtaining secret information from Gopal, his man in Silicon Valley, and Gopal denies buying or selling microcomputer secrets. Gopal says he is being framed by National Semiconductor for the theft of computer tapes that National Semiconductor had stolen from Intel.

But the evidence—if it gets into court—would seem to indicate that Gopal is guilty. In a conversation that one National Semiconductor engineer, Larry Worth, secretly recorded, Gopal allegedly offered to sell him the Intel tapes and remarked that he had "just returned from Europe," where he sold similar stolen data. Gopal also offered to buy "anything you can get" from National and said that he had a fund of $1.8 million specifically for buying American microcomputer equipment.

Gopal's business had just received a $1.8 million order for electronics parts from a Swiss company with close ties to Pfnudl, Sacher's partner. Shortly after Gopal's arrest, the Swiss company was liquidated.

The details of Gopal's foreign connections are unlikely to emerge at his trial, which has to do strictly with the issue of Gopal's alleged offer to sell trade secrets to National Semiconductor. Santa Clara County District Attorney Douglas Southard

said "I think this case is clearly related to international espionage, but I don't have any need to spend my county's money prosecuting that. And the case has already become very expensive. Southard thought the FBI might be interested in the investigation but the case had been under way for two years before he heard from the FBI. A spokesman for the FBI comments that his agency "lacks jurisdiction. It has never been an active case."

Conflicting jurisdictions and lack of support from the top consistently undermine attempts to control white-collar smuggling in high-technology goods, according to one Customs agent whose job takes him from one nondescript office to the next along the California coast. It's a problem faced by his colleague Agent McLeod, who spent years tracing the activities of Gerald Starek and Carl Storey, two executives who eventually pleaded guilty to shipping circuit-manufacturing equipment to the Soviet Union through phony companies in Canada and West Germany.

"There is really nothing to stop them" from illegal exports, McLeod says. All it takes to set up an export company is a telephone, some stationery, and a Dun and Bradstreet number."

The Customs Service is understaffed, he complains, and currency smuggling, drugs, and arms sales have higher priorities. "When was the last time you were searched leaving the country?" he asks.

The Commerce Department maintains an Office of Export Administration (OEA) which has primary responsibility for regulating high-technology exports. Although some Commerce Department investigators are considered the best in the field, the agency itself has a poor reputation.

The well-publicized sale of computers, automated welders, and other sophisticated equipment to the Soviet Kama River truck plant—one of the factories that provided trucks for the Red Army's invasion of Afghanistan—is only the latest in a long list of questionable sales to the USSR permitted by OEA. "With only eleven investigators working on the problem nationwide," notes one insider, "Commerce can't find a pay toilet in a men's room."

Despite its involvement in several recent, highly publicized antiespionage cases, the FBI does not seem to put a high priority on ending white-collar smuggling of electronics. At least judging from court records and from interviews with prosecutors, the FBI has not entered into the investigation of illegal-export cases originating in Silicon Valley. One agent who counsels electronics executives who have received threats relating to espionage activities was apparently unaware of several companies that maintain records of illegal exports to the USSR, even though those cases have been well publicized in the local press.

This may be changing, however. The FBI participated in the arrest of André Marc DeGuyter, a Belgian who made his fortune by selling classified computer codes to the

CONTINUED ON PAGE 98

America's leading novelist counts down the moments to our epoch's greatest challenge

BY JAMES A. MICHENER

In America's exploration of space, three flights have been of supreme importance, for each proved that a major spacecraft was efficient.

On February 20, 1962, John Glenn piloted his *Mercury* in a three-orbit passage around the earth, demonstrating that Americans could duplicate anything the Russians had accomplished in space up to that time.

On March 23, 1965, Gemini astronauts Virgil Grissom and John Young made their three orbits, in which they proved that human beings could take personal control of a space ship and change its orbit if necessary.

On October 11, 1968, the three astronauts Schirra, Eisale, and Cunningham took *Apollo 7* on an 11-day faultless flight whose significance lay in its timing. Some 20 months earlier a disastrous fire had destroyed a predecessor *Apollo*, killing Grissom, White, and Chafee. At that time critics charged that Apollo was basically defective and would probably never take off. Schirra and his men proved exactly the opposite, and we were on our way to the moon.

Thirteen long years after the last of these flights America is about to launch the next in line, in some ways more vital than any of the others. The space shuttle *Columbia* is scheduled to blast off from the launching pad at Cape Canaveral as this issue goes to press, inaugurating a radical new system of space exploration. Tremendous consequences depend on this effort. Our entire space program may well be determined by what happens. Astronaut Joe Kerwin, a veteran who spent 28 days aloft in *Skylab*, says, "On this one we're mortgaging the ranch."

If it succeeds, which is very likely, it will open vast new possibilities. The heavens will be explored as never before. The military will have a reliable base from which to launch their own experiments. New materials will be fabricated in a weightless environment. A reusable platform will exist. And Americans, men and women alike, will once again be voyaging in space after a period of six years during which we surrendered leadership to the Russians.

If it fails, and some ultracautious experts are

MANIFEST DESTINY

PHOTOGRAPH BY
JAMES L. LONG ASSOCIATES

suggesting it could Congress and the public might be tempted to close down major space efforts for several decades Financing would certainly become more difficult Emotional support would wither And the vital energy required for any kind of exploration would be provided not by America but by Japan Germany and of course Russia The vast space centers at Huntsville Houston and Cape Canaveral would retrench or go into mothballs and the brilliant engineers and scientists who built our space program would be scattered

If such enormous consequences ride on the shuttle what kind of vehicle is it?

Robert F Thompson project manager for the program says "In 1971 when we could see that Apollo must grind to a halt following the dramatic moon explorations a group of experts convened to decide what to do next Trips to Mars? Settlements on the moon? Assembling of space stations? We had the know-how to do any of these exciting things but we realized that the politicoeconomic base had changed dramatically Supreme and costly efforts like these would no longer be supported by public taxation But at reasonable cost we could provide an excellent alternative a space shuttle that would become our basic building block for the future

"It had to have four contrasting capabilities It must take off like a rocket go into orbit like a space ship return through the 2 500°F heat caused by friction with the atmosphere as if it were the blunt end of a landing capsule and return to Earth like a powerless glider Also it must be aerodynamically sound able to fly at any speed from one hundred miles an hour to Mach twenty-five And unlike Apollo and the others it must be reusable"

The solution was admirable in its conceptual simplicity horrendous in its technical complexity As it waited on the launching pad the three-part craft stood 154 feet high tall as a 15-story building capable of doing many diverse things Today it has become a reality standing in Florida ready to fly Its three parts should be understood

First is a pair of long sleek rockets responsible for giving the entire assembly a mighty initial thrust upward These solid rocket boosters don't burn on ordinary fuel but on a composition of aluminum powder, perchlorate and iron oxide with a polymer binder They will burn synchronously for about two minutes then detach and fall back into the ocean from which tugs will retrieve them for repeated use in as many as 20 later flights

Next comes the external tank a gigantic fuel repository with two compartments one for liquid hydrogen the other for liquid oxygen This massive tank carries no rocket engines it feeds its fuel into the main engines of the third component and after eight minutes of flight at an altitude of 70 miles it seperates falls into a remote part of the ocean and sinks It is not reusable

The third component is called the orbiter and is the ongoing part of the shuttle a kind of blunt-nosed heavy airplane as big as a Boeing 707 With only a minute fuel supply of its own to be used for delicate maneuvering it coasts in an orbit some 100 miles above the earth at a speed of 18 000 miles an hour It carries a crew of three pilots (two on the first four test flights) and a working staff of four to six nonpilots

The crew rides forward in what would be the cockpit of a transport plane the vast bulk of the orbiter being given over to working area for cargo and scientific experiments After three to seven days in space the craft comes back through the atmosphere and with no engines to propel it glides safely to a preselected landing strip to be checked cleaned refueled and sent aloft once more This part of the system should be good for at least 50 flights

"The space shuttle had to have four contrasting capabilities It must take off like a rocket go into orbit like a space ship, return back through the atmosphere like a capsule and land like a glider"

It is this third component the orbiter without its fuel canisters that creates a unique problem How can a craft that looks like an airplane be brought back through the tremendous heat caused by friction with the atmosphere? What's the problem? We and the Russians have brought scores of space vehicles safely back to Earth But all previous craft have come back blunt end first to dissipate the heat over a broad crude surface The blunt end has been protected by the ablative principle whereby a specially composed material say a mixture of asbestos invented fibers and a specifically fabricated epoxy shields the leading face and ablates or slowly wears away carrying the heat with it

I recently inspected a piece of the *Skylab* that fell on Australia and could scarcely believe what I held in my hand The forward edge of this piece had been coated with an excellent ablative which had burned at 2 500°F It was totally charred but its capacity to lead heat away as it burned was so efficient that material that stood one thirty-second of an inch behind the burned edge was untouched

Ablation is one of the miracles of the Space Age it works every time with such perfection that not a single space vehicle so far as we know has been lost because of excessive heating Quietly gently the heat has been dissipated

Unfortunately ablation cannot be used on the orbiter since it does not come back through the atmosphere blunt-end-to Nor can its components be allowed to burn off since they will be used again and again The orbiter must use an alternative system the heat-sink Normally this is a metal preferably an alloy that accepts heat leading it away in various directions especially inwardly where it dissipates Since the metal does not ablate a heat-sink can be used repeatedly

A metal heat-sink would be perfect for the orbiter except that it would weigh far too much If the *Columbia's* exposed areas were so protected we would not have rockets big enough to blast it into Earth orbit So a remarkable tile has been invented light as a feather reliable like the best ablative material and reusable through repeated missions

More than 32 000 of these tiles each made to its own peculiar specification and size have been attached to the exposed areas of the orbiter and they will be responsible for protecting it as it comes plunging back through the atmosphere Fabricating the tiles and finding a proper adhesive for holding them onto curved surfaces was such a frustrating task that the shuttle fell years behind schedule and billions of dollars above original estimates

Criticism has been severe but Thompson believes that much of it is ill founded "The best brains in our business made those estimates back in 1971 Total cost five point one billion dollars Ready to fly in 1978 But they warned everybody This is research-and-development work and overruns or delays will be inevitable"

So what do we find? Our cost is now eight point three billion dollars but most of that is attributable to inflation The original estimate was phenomenally good

As to the time delay I admit we have lagged by two years even three depending on how you count But old-timers like me expect delays in an R&D program And if the tiles hadn't delayed us something else would have done so

Obviously when the shuttle lifts off it will carry with it a tremendous burden other than its fuel and its scientific instruments Personal reputations ride with it National policies Military capabilities The outreach of science and exploration If so much depends upon a single flight what kind of men do you ask to fly it?

NASA has chosen as commander the man best qualified in all the world John W Young is a short wiry Navy captain, fifty-one years old come September On the day Young assumes the left-hand seat in the shuttle he will have passed eight of the most stringent weeding-out processes known These requirements were outlined by Deke Slayton, one of the original seven

CONTINUED ON PAGE 102

Overleaf Bathed in floodlights the space shuttle Columbia arrives at Launch Pad 39A Kennedy Space Center at Cape Canaveral on December 27 1980 after its four hour crawl from the Vehicle Assembly Building 3 5 miles away

FICTION

THE HITMAKER

BY CYNTHIA MORGAN

The town was perfect. Jordan Barrett had sensed it when he saw the spec films, and his first visit to the town had confirmed his feelings. Now a month later, standing beside the network limousine parked across the center line of the highway bisecting the town, he felt the same

PAINTING BY GRANT WOOD

certainty There were none of the doubts that sometimes cropped up after he'd made a decision irrevocably committing the network's money and his own reputation. The town could go public. It was perfect for a CV series.

He was glad he'd waited. He'd been looking for over five months, the longest search ever for a location for a continuous-viewing series. There'd been some pressure from Carl Martinson, ATN's programming chief, during the fourth month, when the other networks began to announce their CV locations for the new year. But Barrett had ignored the memos, the hints that he was setting his standards too high, and after a few weeks they'd stopped. Barrett had given ATN five successful CV series in a row; all Martinson could do, finally, was sit back and hope that the producer would deliver again.

He wandered away from the limousine, walking on the shoulder of the road to avoid a pickup truck that drove slowly past and turned down a side street. There'd been no other traffic in the past half hour, the barricades had gone up when construction began on the liaison center two kilometers outside of town. Twenty meters down the highway Jordan stopped and looked around indecisively. There wasn't much to the town: fewer than a hundred houses, one tiny general store. A service station stood at one end of town, a fast-food joint at the other, stapling the community to the two-lane strip of blacktop that linked it to the rest of the country. But he didn't have any idea where his director, Sharon Pettet, had gone for the interviews she'd scheduled this morning, and the town was too large for him to go door to door looking for her. He should have waited at the liaison center until she returned, but he'd felt useless, superfluous, at the liaison center. Once a location was selected and the locals' approval had been won, he had little to do but take care of administrative details. Things ran too smoothly now. The first years of CV broadcasting had been chaotic, but he'd been more involved then. Happier. Almost as happy as he'd been in film school, two years earlier.

"Hey! Hey, kid! Can you lend me a hand?"

He turned. The pickup truck was parked in a driveway half a block away. A burly, middle-aged man stood beside it, watching him.

Jordan glanced back toward the limousine. The driver was standing outside, smoking; he'd overheard the request and was grinning. Jordan shrugged, laughed, and went to help the man.

There was a large console television in the back of the pickup. By the time they had it inside and set in a corner of the living room, the older man was sweating and red-faced. He stood leaning on the television while he caught his breath. Finally he looked up at Jordan.

"You're from the network, aren't you?"

Jordan nodded.

"Some of your colleagues gave me a hell of a lot of trouble about bringing this set home. Had to show them proof that I'd ordered it two months ago, before any of you people got here."

"They were only doing their job."

The man snorted. He pulled out a wallet and opened it. Jordan retreated, shaking his head.

"No? Well, can I get you a drink?"

"Thanks, but no. I can't stay."

The man looked disappointed. Jordan knew that in a moment that expression would change to one of hurt, then anger at the aloofness of network people. "Some other time."

"Sure." He followed Jordan as far as the door. "Hey, thanks for the help."

"Anytime."

The heat was brutal. By the time Jordan reached the highway he was regretting not having accepted that drink. Sharon was still nowhere in sight, but he spotted a soft-drink machine, the squat, red shape tucked into a corner of the service station. He started toward it.

"She'd voted against the town's accepting the network contract. But she couldn't leave—not if the town was to keep the contract, and the millions of dollars that went with it."

He could understand the man's anger at being forced to prove when he'd ordered the television, but Jordan's sympathies were with his staff. Despite the contract stipulations that no essential changes were to be made in life-style or environment during the year of the contract, locals were always trying to improve their image. The early changes were usually obvious—new furniture, home repairs, painting—and easy to catch. Things got worse after the locals began to take the vacations guaranteed by the contract. They came back with designer clothes, expensive cars, jewelry, and other new luxuries that had to be confiscated at the liaison center for safekeeping. But what really gave the continuity people headaches were the inappropriate mannerisms they picked up, the expressions, the accents. Jordan sometimes wished they could return to contracts that restricted residents to location. They'd had such contracts for the first two years of CV, but during the second year there had been two deaths in one town during the contract period. It had been another network's show, but the resulting brouhaha, over the couple's never having enjoyed the financial rewards they'd sacrificed their privacy to obtain, had forced all the networks to guarantee vacations, giving up a crucial degree of control.

Ten years from now, Jordan thought, the locals would be running the show. But he wouldn't be doing television then. This was only a stepping-stone.

He fed a dollar into the machine. The can of pop that rolled out was warm, he set it on top of the machine without opening it. The light breeze didn't reach him here, but the shade gave some respite from the heat. He shoved his hands into his jeans pockets and looked around. A van bearing the ATN logo was parked two blocks away where a technician was installing a camera beneath the eaves of a house. Jordan watched for a few minutes before he became aware of someone staring at him from inside the station.

It was a girl, eighteen or so. Long, dark hair. Tanned, but so lightly she seemed pale in comparison with the other natives. Pretty in a way. Maybe a bit stocky. It was hard to tell, since she wore heavy coveralls.

He gave her his best smile while he ransacked his memory for her name.

By the time he found it, he realized there was nothing friendly about the way she was staring at him. He dropped the smile.

Marianne Fisher.

She'd been one of the five who'd voted against letting the town accept the network contract. Usually dissidents moved away after the contract was signed. It made things easier for all concerned. Sometimes, though, they couldn't leave—not if the town was to keep the contract, and the millions of dollars it meant. Certain key people, identified by the preliminary studies, had to stay, but surely that didn't apply to her. Of the general population, a certain percentage was free to leave. He wouldn't have thought that five people were too many, but the town was very small. He'd have to ask Sharon about this.

Her gaze hadn't wavered. He studied the tense, unyielding set of her shoulders and jaw and decided it would be a waste of time to try talking to her. He shook his head and went back to the limousine.

The driver had opened the door, and Jordan was ducking inside before he realized Sharon was already there, talking to someone on the phone. She said goodbye and hung up, then smiled at Jordan.

"I see you've changed your policy about mixing with the locals."

"Mixing?"

"I saw you come out of Joe Meyer's house."

"Oh. I was just helping him carry a TV inside."

She nodded, still smiling. Her amusement nettled him. He wondered again whether it had been such a good idea to let her supervise all dealings with the locals. He'd sensed resentment beneath her mockery before this; she'd come to regard

the territory as her own But he couldn't deny that she handled the area better than he ever could It had been three years since he'd heard any *Wunderkind* remarks from industry people success finally silencing the same comments it had inspired But the locals didn't know his reputation It didn't help that he looked younger than twenty-seven

Sharon had no such image problems She looked several years younger than her actual age, thirty-five, but her demeanor was so thoroughly professional that not even the oldest locals had ever been heard referring to her as a girl She was treated with more respect than that And she was liked The most frequent comment was "She understands us."

She should, Barrett reflected, thinking of her doctorate in psychology and six years' experience as a clinical psychologist She'd never worked with actors, but that had not proved to be a handicap when it came to directing a CV series Jordan's director for the first CV series, a man with more than twenty years' experience in television, had quit after a few months, leaving the producer working blind He didn't delude himself about how much of that first year's success had been due to the novelty of continuous viewing Matters had changed completely after Sharon arrived, with her ability to prepare a CV script, an in-depth study that delineated the locals' relationships and forecast their development The other networks, entering the game later, had learned from his mistakes and Sharon's four counterparts were also psychologists Resident wizards, a rival producer had labeled them Jordan suspected that the man, like himself, was often baffled by his director

The limousine's engine came to life quietly A minute put the town behind them Jordan stared out at the drab west Texas landscape There was something he'd meant to ask Sharon, but he couldn't remember it now

"I'm sorry I kept you waiting," Sharon said

"It's okay"

"The last interview was going so well, I hated to end it It's the third marriage I've run across that's breaking up Two of the couples don't know it yet, but the signs are there"

"You don't think that's too much?"

"It might be, if they all broke up at the same time but they won't The couple I interviewed this morning works the night shift"

"Good." Small towns were the most popular locales for CV but they were the least likely to show the right twenty-four hour profile of activity Fortunately there was a plant nearby that employed several of the locals on its evening and night shifts

"Martinson thought so That was him on the phone just now He wants us back in L.A tonight, for a party He thinks we have reason to celebrate"

They celebrated again in late October when it was apparent they'd won the ratings race. This time, instead of a dozen people at Martinson's Bel-Air home, there were several hundred, and the party was held atop the ATN Building in Los Angeles. The weather was so mild, the translucent panels that usually shielded the rooftop garden had been removed. The music was just loud enough to cover the din of traffic twenty stories below.

Jordan hated these parties, but he was expected to attend. He'd made his obligatory speech and listened to the others. There'd been praise for him and for Sharon and the usual bows toward Carl Martinson. No one had mentioned the main reason for their success this season, as in past years. The opposition had dealt themselves out of the game early. CBS had opted for scenery, a picture-postcard Vermont hamlet so dull that the sponsors had demanded its cancellation before three weeks were out. It was replaced by game shows and movies until a new location could be found. ABC, with its choice of an urban neighborhood, had misjudged the importance of conflict in CV television. It was next to last. NTS, which had selected a Florida Gulf Coast village, had led the ratings for a few weeks. Then it was discovered that the eight beachcombers sharing a house that had been the site's main attraction were actors and actresses sent to the area two years earlier at network expense; they were gone now, and so was the threat that the series had posed. ATN had a forty-five share of the CV audience. NBC's Utah mining town ran a poor second with a thirty share.

Jordan stayed as long as he thought was necessary, then began to make his way toward the elevator. He was nearly there when Martinson stopped him.

"Jordan, you're not leaving already?"

Caught off guard, Barrett mumbled something about not feeling well, but Martinson remained standing in his path.

"I thought you looked tired," the programming chief said. "I'm amazed at the amount of work you and Sharon put into these series."

"The worst is over for the year. The script's done. There haven't been any problems. We can take it easier now."

"For the rest of the year."

Barrett nodded, suddenly wary.

"Then you have to start searching for a new location in January."

The producer shrugged. "So it goes."

"Have you thought about extending the series for another year?"

Jordan stared at him. NTS had tried it two years before. The show had sunk without a trace a week into the new season, not even retaining its old audience.

"It's been done before. It didn't work."

"You mean at NTS? But their show wasn't as popular as ours."

"I'm not sure that would make any difference once it came up against fresh competition from the other networks."

"We won't know for certain unless we try."

"So you're going to ask for an extension of the contract?"

"Not if you're opposed to it, Jordan. It's your decision. But I hate to see you and Sharon putting so much time into the series each year. I'd like you to think about it at least."

And shoulder the responsibility for it if it fails. Jordan thought, but his anger was held in check by pity. Martinson, while superficially jovial, was a frightened man. He saw the viewing audience as a giant maw—a maw that had to be fed and constantly. If it wasn't fed the right programs, people—even programming chiefs—might have to be sacrificed.

What held Jordan's pity in check was the knowledge that Martinson had overseen more than a few of those sacrifices himself.

"All right," he said reluctantly. "I'll think about it."

He started for the elevator again as soon as Martinson, looking pleased, ambled off. He was reaching for the button when a hand closed on his wrist.

"What did Martinson want?" Sharon asked in a low voice.

The location resident's who never saw her in anything other than the tailored suits she called her business uniforms, wouldn't have recognized her tonight. Dressed in clinging wisps of an iridescent fabric that revealed more than it concealed, her pale gold hair falling free to her waist, she looked more like a starlet than a director.

"He wants to extend the contract."

"And?"

"And what?"

"What's the official party line?"

"I told him I didn't think it was a good idea."

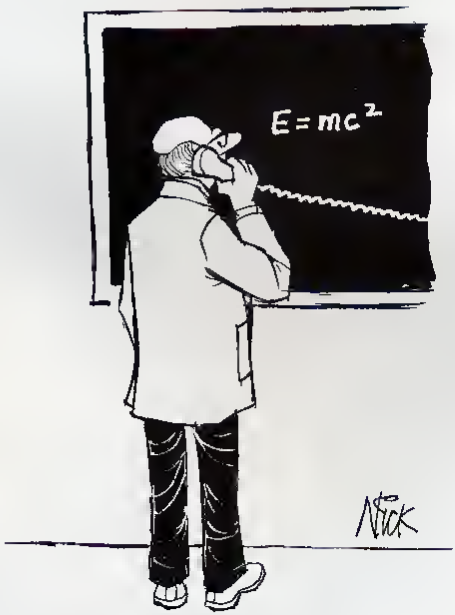
He watched her face for a reaction, but there was none. She'd released his wrist. He pressed the button, and the elevator doors opened.

"Going home already?"

He nodded. For a second he thought she was going to offer to go home with him. For another second he thought of asking her. When she'd asked him about Martinson, she looked very young. Uncertain. Vulnerable. But the moment hadn't lasted. He was too much in awe of her ability to understand people better than they understood themselves. He'd been attracted to her as long as he'd known her, but five years ago the age difference had held him back. Now it was too late. How could you take a resident wizard to bed?

He said good-night. She was turning back to the party before the elevator doors closed.

Knowing that he would be free much of November and December, Jordan had begun mentioning, as early as August, that he'd be interested in producing a documentary. War had broken out between Chile and Bolivia; he'd let people know that he was following the situation. But he met



"Yes, I've got that. Edith wants me to pick up two pounds of mozzarella cheese."

with no response. The network apparently wasn't going to give the war anything more than the standard news coverage. He was disappointed but he'd made other plans, just in case.

There was a vacation in Mexico, then three days in Chicago at a national conference of social scientists. He'd been delighted when he was asked to speak, not least because Sharon was jealous, convinced the invitation should have been extended to her. He spent Thanksgiving with relatives in Massachusetts. In early December he was back in Los Angeles. A friend was teaching at UCLA's film school, and Jordan had promised to be a guest speaker. It didn't turn out the way he'd expected. The students weren't impressed by his title or salary. They wanted to talk about artistry, and they brushed aside everything he'd learned about the sociological merits of CV television in Chicago two weeks before. They hit him with the same questions he'd been asking himself at 3 A.M., the nights he couldn't sleep. He left for Aspen four days earlier than he had originally planned.

He was still there December 20, when Sharon called him.

"How's the skiing?"

"Terrific. We had two inches of powder last night, on a forty-inch base. But I thought you hated snow."

"I do. I'd still rather be there than here."

He looked more closely at the phone's tiny picture screen, examining the office behind her. She was at the liaison center. "What's the problem?"

"One of the locals isn't following the script."

There was a trace of indignation in her voice. It was hard not to smile. "Who is it?"

"Marianne Fisher. And she won't talk to me. She won't talk to anyone on my staff. She says she'll talk only to the person in charge."

Despite himself, he laughed. She frowned but said nothing.

"I'm sorry. It really isn't funny."

"No, it isn't."

"You could just pay her off and ask her to leave." There was a clause in the contract providing for such cases, though they'd never had to use it.

Sharon laughed. "She'd love that, after we told her that we couldn't offer the town the contract unless she stayed. No." She shook her head. "There are too few locals in her age bracket now. We'd risk losing viewer identification if she left. We'll have to think of something else." She hesitated, frowning again. "Should I tell her you're too busy to see her?"

He realized she was asking the question only as a formality. It was what she'd already planned to tell the girl.

"No. I'll talk to her. How soon can you have the plane here?"

"Sometime this afternoon, I suppose. I'll have to check. It will only cause trouble. Are you sure you want to talk to her?"

"Positive."

She nodded, looking unhappy. "It'll take a while to find out about the plane. I'm not even sure where it is right now."

"I'll wait."

It was dark when he finally reached the town after meeting with Sharon for an hour at the liaison center. The weather was cold, but there'd been only a little snow already, wind sorted into grimy drifts along the curb.

The girl's hours at the service station had changed; she worked until midnight now. As they drove down the highway, Jordan was conscious of the cameras mounted where they would observe the limousine's passage. The camera crew advised of his plans would be directing the viewers' eyes away from him; he didn't exist in the world they saw. It was something he was always aware of, but tonight the thought depressed him. He must be tired.

There was only one car being serviced at the station, a small electric import, and it drove away as the limousine pulled in. Marianne was back inside already at the cash register. She stood there watching him as he got out of the limousine and hurried inside.

Hi." He'd tried to sound cheerful, but his voice rang hollow in his ears. It was ominously silent in the station, without the ever-present wailing of a radio that he'd come to associate with such places. "I heard you wanted to talk to me."

"Not really. It was your people who wanted to talk to me."

"Whichever."

He looked away. There was the usual service-station clutter. Cans of oil and transmission fluid, work gloves, batteries, miscellaneous junk food. He took a few steps away, rounding the edge of the counter. She turned to follow him with her eyes. He noticed a handgun lying on the shelf below the cash register, wedged between the stacks of credit forms. There'd been a wave of station robberies in the area a few years ago. He thought of how clear a target she'd been from outside, standing here in her bright orange uniform. The thought angered him, until he realized the glass would be bulletproof.

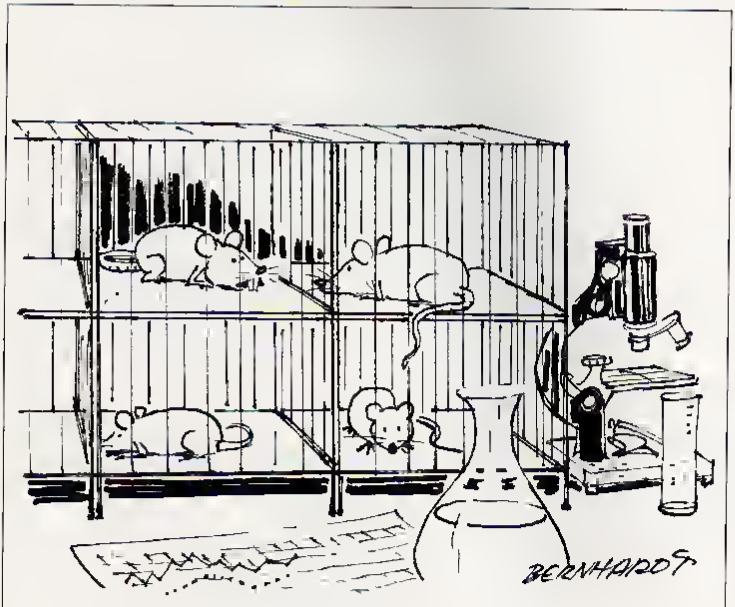
"You're here about Bill Morrisey," she said.

He nodded. He'd never heard the name until an hour before, but Sharon had told him all she'd thought he would need to know. The kid was a high-school football hero, mature for his age, very attractive to the high-school girls, but himself attracted to Marianne, who'd graduated the year before. There was an eight-month age difference. "Which makes her an older woman," Sharon had said, with a laugh.

"I heard you haven't been terribly friendly to him lately. You used to be close friends, before the contract was signed."

She shrugged. "So?"

"We need this relationship," Sharon had told him. "There aren't that many romantic



"Me, too. There must be something going around."

CONTINUED ON PAGE 107

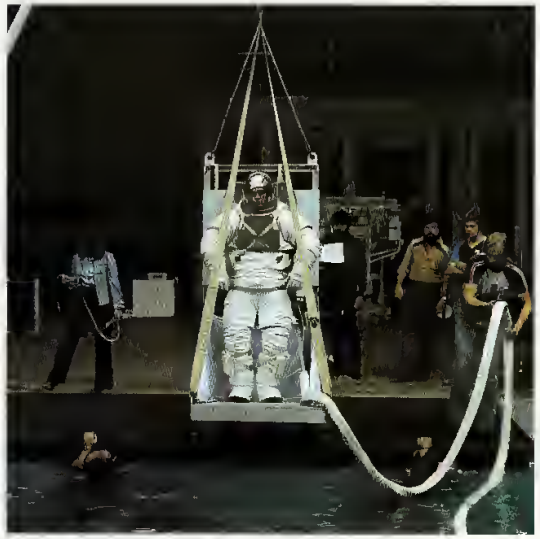
HIGH FASHION

NASA's wardrobe boasts the right suit for every mission, from hard-shell, custom-made coveralls for long adventures in deep space (below) to soft, sensible, ready-to-wear outfits for orbital commuters on the space shuttle

TEXT AND PHOTOGRAPHS BY ANTHONY WOLFF

The AiResearch Advanced Extravehicular Space Suit (preceding pages, right) was intended for *Apollo 18*, *19*, *20*, and *21*, the prolonged lunar missions that were scrapped. Covered in fire-resistant fabric and jointed with rotary bearings, the 62-pound soft suit offered more mobility and metabolic efficiency than earlier Apollo suits. For protection against hard radiation during longer sojourns in space, a head-to-toe carapace, the AX-2 (preceding pages, left), features metal stovepipe joints in the limbs and a six-ply stainless-steel bellows at the waist.

NASA's top advanced-space-suit engineers, Hubert C. Vykukal (left, background) and Bruce W. Webbon (foreground), fashion future spacewear in a basement laboratory at Ames Research Center, near San Francisco. Their latest prototype, the AX-3, has a hard torso with built-in ducts and fittings; the rest of the suit is soft, for comfort and mobility. Pressurized to 8 psi, the AX-3 will allow astronauts to transfer directly from spacecraft atmosphere to space vacuum.



Designed for routine space shuttle assignments, NASA's all-purpose, unisex work clothes feature a hard upper torso that comes in five standard sizes. Two sizes of soft sleeves and leggings can be custom-fitted with laced-in inserts. The innermost of the suit's nine layers is an inflatable neoprene bladder, to simulate atmospheric pressure. The outer layer, a tough, white fabric of Teflon-coated fiberglass, reflects solar radiation and resists fire. In-between, alternating layers of Mylar and gauze insulate and protect against micrometeorites. Complete with backpack air conditioner, the suit weighs 250 pounds. The chest-pack computer monitors all life-support functions, eliminating most of the familiar long-distance chit-chat with Mission Control. Labels, printed backward, are read in a mirror on the astronaut's wrist. Total immersion (above), to simulate weightlessness, and baking at 260°F in a thermal vacuum chamber (right) were essential aspects of the Houston preflight testing program for both astronauts and space suits.

Photograph by Dan McCoy

The father of the solar-power satellite, besieged by bureaucrats and naysayers, comes forth to defend his baby

INTERVIEW

PETER GLASER

Back in 1968 Dr Peter Glaser probably had the readers of *Science* magazine flipping back to the front cover to make sure they were reading the right magazine. The reason? An article of his, modestly titled "Power from the Sun," elaborating a literally far-out scheme to build gigantic satellites and place them in geosynchronous orbit 22,300 miles out in space. There they would absorb solar energy and beam it as microwaves to antennas on Earth—large skeletal circles miles in diameter. Each satellite could be designed to deliver 5 billion watts, or five gigawatts, to power networks here on the planet.

Although the idea has overtones of Jules Verne, the man who conceived it is anything but an impractical dreamer. Glaser is a businessman-scientist, a vice-president at Arthur D. Little, Inc., a Boston-area-based engineering consulting firm. His scientific background and much of his career have been science-to-order. Fresh from Columbia University with a doctorate in engineering—specifically in the esoterica of the thermal properties of evacuated materials—Glaser joined Arthur D. Little in the mid-1950s. One of his first assignments was of a most earthly nature: to design a more compact insulation for Whirlpool refrigerators. "What I did was take a three-inch wall thickness and reduce it to half an inch," he recalls. "I was very proud of that."

In the early Sixties he helped create a reusable heat shield for the Dynasoar, a suborbital "skip" bomber developed for the Air Force. Half-plane, half-rocket, it was designed to soar up and out of the thin outer layer of our atmosphere and shoot swiftly to a target point somewhere else on Earth, where it had to survive the intense heat of reentry. And it had to do this over and over again. Though the Dynasoar was never used, it is considered to be a forerunner of the space shuttle. Glaser's shield, with very effective high-temperature insulation, passed its tests superbly. "I'm sorry that Rockwell never bothered to look at history," Glaser laments, referring to the space shuttle's notorious tile problem.

When the Space Age arrived, Glaser contributed his efforts to

the theory and practice of getting on the moon. Contrary to other expert opinion, he did not think the lunar module and astronauts would sink into an ocean of dust but would merely dirty their feet a bit. (He was right.) The lunar-heat-flow probes used on just about every moonshot and an ingenious laser-ranging experiment to measure the Earth-moon distance are other Glaser brainchildren.

He is also a passionate believer in solar energy—in nearly all its forms. A director and president at various times of the International Solar Energy Society, he has worked doggedly on his ideal, the Solar-Power Satellite (SPS), slowly making converts as he goes. In 1973 the U.S. Patent Office thought his idea original enough to grant him Patent No. 3,781,647 for a "Method and Apparatus for Converting Solar Radiation to Electrical Power." And in 1977 the U.S. government was finally convinced enough of the SPS's merits to undertake a three-year, in-depth study of the technical, economic, environmental, and societal issues of the SPS concept. Conducted jointly by the Energy Department and NASA, the Concept Development and Evaluation Program, as the study was called, pronounced, in April 1980, that no identifiable obstacles argued against beginning ground-based research-and-development efforts. Glaser was instrumental in founding the Sunsat Energy Council, a nonprofit organization of academics, industry leaders, and scientists, dedicated to keeping the SPS idea alive.

When Glaser began his engineering studies, neither space nor solar power was uppermost in his mind. Survival was. A native of Czechoslovakia, he fled the Nazis with his parents and landed at Leeds College of Technology in England. Later he returned as a tank commander in the Free Czechoslovak Army. The war over, he studied at Charles University in Prague, until the Communist takeover forced him to move on to Columbia University.

Glaser, described by one colleague as "extremely courtly and self-effacing," is far from the common mold of the humorless pro-sun advocate in a "No Nukes" T-shirt. Relaxed in a subdued gray three-piece suit, Glaser frequently flashed a sun-brilliant smile as he pressed home his points. He was interviewed in his offices at Arthur D. Little by *Omni* reporter Douglas Colligan.

Omni: Solar energy is a fashionable idea today, but that was not the case at the time you first proposed the SPS. How did you arrive at it?

Glaser: Well, one of my first assignments at Arthur D. Little was to do high-temperature research—around twenty-five hundred to three thousand degrees. At that time the only way to do it was with a solar furnace. So I constructed one right here on the spot where this building is. Having worked with the solar furnace, I became aware that perhaps there were industrial uses for solar energy. Because I was forced to interrupt my experiments when the sun wasn't shining, I also became convinced that if we had to rely on solar energy for industrial purposes, like the solar furnace, it would be tough to do.

I had also become very much involved with the International Solar Energy Society. I served as its director for seventeen years and in 1968 I was elected president. Those days were the nadir of the solar-energy business because of public disinterest. Financially, the society was in hot water. In fact, there was a lot of pressure on me to dissolve it.

As I became more deeply involved in the space program, I grew aware of the opportunities space presents and realized that the solar-energy problems I'd faced on Earth could be reduced, or perhaps even solved, by moving the solar-conversion hardware into an orbit where sunshine is continually available.

Omni: And so the Solar-Power Satellite was created?

Glaser: Yes. In those days I called it the SSPS, for Space Solar-Power Satellite. I realize I'm not the only guy to think of this. Back in the 1920s, in Germany, Dr. Hermann J. Oberth proposed that giant mirrors be orbited around the earth. Such ideas tend to disappear and then resurface periodically. For example, the solar-power tower that was rediscovered in this country in the 1970s. I discussed that with Dr. Vladimir Baum, head of Soviet solar research back in the 1960s. He had actually designed one in the Fifties.

Anyhow, I said to myself, What is the technology we really need for this satellite? We need solar cells. But these are already in wide use in many other satellites. We need a space transportation system. And if you recall, one of the projects back in the mid-1960s was called the Big Dumb Booster, or DUMB. It was a sort of offshoot of the Saturn program, and it was to carry five hundred tons, an enormous payload. So I thought, Well, we have a possible space freighter. But how do we get the power back to Earth?

I was very fortunate because down the road from here was a laboratory that had started experiments in 1963 with microwave power transmission with the purpose of using microwaves to power a helicopter. While I was working at Columbia, I had already stumbled across the works of Nikola Tesla, the Yugoslav scientist, and found that he had tried to convert microwaves to power in an experiment on Long Island in 1912. I thought, My God, this isn't new either. It turned out that microwave transmission is probably one of the earliest known technologies for this whole scheme. So you can see how various things fell into place.

Omni: What kind of reaction did your article in *Science* receive?

Glaser: That set off a terrible storm. Here was a respected publication like *Science* obviously publishing science fiction. There were a lot of people who felt I was absolutely out of my gourd, that somewhere I had a screw loose. In a way that turned out to be a positive thing, because after reading the article, Professor Meinel at the University of Tucson said, "I'm going to show that I can do the same thing on the ground." So he proceeded to design a concept for a "solar farm," which he has since abandoned. It was one of the progenitors of the solar-power tower.

Omni: We noticed that your 1973 patent outlines the idea of the Solar-Power Satellite but doesn't go heavily into technical detail. Why was that?

Glaser [pointing to an artist's rendering of an SPS, a single large, rectangular panel with a circular rectenna beaming power from space to Earth]: Whenever I show this one picture to people, I always emphasize, Please look at this concept carefully, because it is just like a painting by Picasso. You may recognize a woman in one of his abstract designs, but it does not represent a portrait of a specific woman. This is not a specific design for the solar-power satellite—we don't know today what the satellite will look like twenty years hence. Another thing that I tried to get across to people in the early Seventies was not that we *should* build a satellite. What I was advocating was that we start to study *whether* we should build one.

Omni: At the time you published your article, did you have a specific timetable in mind?

Glaser: My timetable has never varied. Once people stop smiling about the concept, it will take us twenty years. And that twenty years ain't gonna change. If we had started in 1970, let's say, we would be pretty far along. If we start in 1981, we could have it by the year 2001.

Omni: Have we made any dent in that twenty-year timetable?

Glaser: Let me say that the DOE program of the last three years has been very important. I feel that DOE and NASA have done a good job, not only in the technical area but also in the economic and—particularly—the environmental and societal assessments. The SPS Concept Development and Evaluation Program [CDEP] has made major contributions. Had DOE done as exhaustive a job in laying out the environmental, societal, and economic issues of nuclear power as it has for this new technology, I'm not sure we'd be building nuclear power plants. Perhaps not even synthetic-fuel plants.

Omni: The Energy Department has wrapped up its CDEP just about. What did it conclude?

Glaser: It has shown that, based on all the work done and on our present knowledge, there is no single constraint preventing us from continuing to the next phase of the SPS R&D [research and development] program. I've testified before Congress that we should spend a total of two hundred million dollars over a period of five years to

do the R&D and ground experiments verify the technology and carry out more detailed economic, environmental and societal studies.

Omni: What happened to the Solar Power Satellite Research and Evaluation Bill that was introduced to allocate twenty-five million dollars each year for SPS studies?

Glaser: It passed the House but the Senate never got its act together. What needs to happen is that the senators must become better acquainted with what the SPS concept is and what its benefits are, and that takes time. The House has already twice demonstrated what its intent is. Does it have to show it a third time?

Omni: The DOE has also lopped from its 1981 budget the six million dollars allocated for the SPS feasibility study. Does that mean that the Energy Department's interest in the idea has cooled?

Glaser: I don't believe so at all. I think the flip-flopping is really political. The SPS program difficulties are symptomatic of the malaise we have had in Washington.

There is opposition in DOE's Office of Energy Research, primarily because of the myopic views of the nonsolar part of the DOE. If you look at who are in charge of the office's research projects, they're fusion people. Well, if you've spent thirty years working on fusion, and somebody comes along and says, I've got another option, you might say, Why the hell should I allocate money to something that, first of all, takes money away from my program, and then, God forbid, may be successful? I suggest it is very difficult for the SPS program to be managed by people whose primary interest is the development of fusion or fast-breeder reactors, of even small-scale solar. They have different interests.

Omni: President Carter signed into law the Magnetic Fusion Energy Engineering Act, authorizing a big jolt of money for fusion research. Do you feel frustrated when things like this happen?

Glaser: I'm for doing exactly what they're doing in fusion on the scale that it is being done. I think we need to pursue all kinds of energy alternatives. I can't even persuade myself to be against nuclear power. I don't see any reasonable alternative over the near term, but I'm hesitant about the breeder program.

Omni: Why haven't you gotten more support from solar advocates in DOE?

Glaser: Essentially they were, and probably still are, against solar power satellites, solar power towers, and ocean thermal energy conversion because they're centralized technologies. I've never understood that position. I've never thought we would proceed to develop only centralized technologies. Because we are such a multifaceted civilization, we need to develop the most appropriate technology for a specific end use. If distributed solar water heaters are appropriate, then that's what we ought to develop. If solar satellites are appropriate for baseload power, then *that's* what we ought to develop.

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PAINTING BY WOLFGANG HUTTER

FICTION

Alvin Menlar's newest lady friend was beautiful, graceful, and perfect on the dance floor—she was programmed that way

LAST WALTZ

BY WARREN BROWN

Alvin Menlar loved toys. He loved them because he loved playing. *Homo Ludens* was his motto, and through it he had managed to acquire a vast and interplanetary fortune. Since he first held a toy rocket in his hands as a child, he had dreamed of having space and planets to play with. He became one of the first great space entrepreneurs. His companies mined the moon and farmed Mars. His satellites beamed lasered solar power to an earth made affluent and peaceful by cheap and abundant energy.

He would never have called himself a cruel man, and certainly not a tyrannical one. He did not even think of himself as a manipulator. As far as he was concerned, he was simply a player better than most other players. He thought humans were the best game of all, for they were not only players but also pieces in the game. *Morality* was a word he occasionally found a place for in crossword puzzles. Beyond such use, morality itself was meaningless to him.

His latest toy sat facing him across a table of Oriental pattern, upon which sat two glasses of pure crystal, filled with rare wine. She was tall and graceful, with a flawless Grecian face and eyes an emerald green set off by the pale yellow cascade of her curly hair. Her dress was rose silk, and it was diaphanous.

Menlar was dressed in white as something between mandarin and sheikh. He wore a fabulous jeweled, curved dagger. With his close-cropped, curly white hair and pale blue eyes he most resembled some cruel and haughty prince of an ancient and decadent civilization. He was pleased with the effect; he thought it rather playful. He hoped it would make an impression on Margret when she came. And she would come if he had moved correctly.

As if to confirm the rightness of his move, a soft chime sounded through the penthouse, followed by Margret's voice asking permission to come up. He rose

and extended his hand to his beautiful companion who stood by attentively

"Would you get that, love? Take my hand."

She took his hand without replying and rose gracefully. Sweeping past him with a whisper of silk, she went to the elevator cove and placed her palm on the access-permission plate. The machinery acknowledged her palm-print code with a soft warble, and the floor indicator showed that the elevator was starting up. It would take nearly a minute to ascend the two hundred floors to the penthouse.

Menlar placed his palm at his throat as he watched the floor indicator's soft lights. He had noticed a slight distortion in his speech a moment before and wondered whether the speech synthesizer that made up for his birth defective vocal cords was malfunctioning. He thought of going to his bedroom for the spare, but he dismissed the idea because he wanted to be present when the elevator doors opened. It would be the playful thing to do.

"Smile at our visitor when she steps out of the elevator," he said to his beautiful companion. "Hold out your hand and wish her a good evening."

The woman regarded him for a second with bright emerald eyes and then turned silently toward the ornate mosaic of the elevator doors. The floor indicator lit its last light. The guest had arrived. The doors hissed open, and Margret Lewis stepped into the room. Menlar's companion held out her hand to the new arrival. "Good evening," she said.

Margret reached out for the offered hand, but she turned toward Menlar as if to speak to him. In that brief moment her eyes adjusted to the subdued light of the penthouse alcove and she saw she was shaking hands with herself. She pulled back her hand as if it had been burned. Stepping backward, she found herself against the elevator doors. Menlar heard her quick intake of breath and laughed. Margret stared at the android; the android stared back.

Menlar laughed again and moved to stand beside the beautiful twins, the real in business dress, the duplicate in rich evening clothes. "What's the matter, Margret? Haven't you ever looked in the mirror before? Surely someone as attractive as you must use mirrors."

Regaining her composure, she turned to her host, her eyes narrowed. "What the hell is this, Alvin? Another one of your sick games?"

"Why, Margret," Menlar purred, "that's no way to speak to your employer."

"Ex-employer," she hissed.

He took her arm. "Yes, well, that's one of the matters I called you here to discuss—your resignation."

She pulled her arm away. "So this *is* one of your jokes. I should have known you were lying when you called to say Harris was in some kind of trouble. I'm leaving." She turned and started toward the elevator.

"Stop her," Menlar ordered the android.

Faster than a human could have moved, the automaton's arm shot out to bar the way. Margret threw herself against it. She was a strong woman, but the arm that blocked her exit might have been stone. Menlar thought the sight of Margret trying to get past Margret was worth the high price of his new toy.

"I'd say you're beside yourself, sweetheart," he chuckled.

Seeing escape was hopeless, the woman turned to face him again.

"You won't get away with this," she spat, her voice burning with anger.

"Get away with what?" Menlar replied softly. "You're free to leave. I just thought you might be interested to know what's in store for your lover."

Margret froze.

"Let her pass," he ordered the android, whose arm still paralleled the floor. The arm lowered. Menlar shook his head. "She's beautiful, but so literal. No real intelligence. Not like you, Margret."

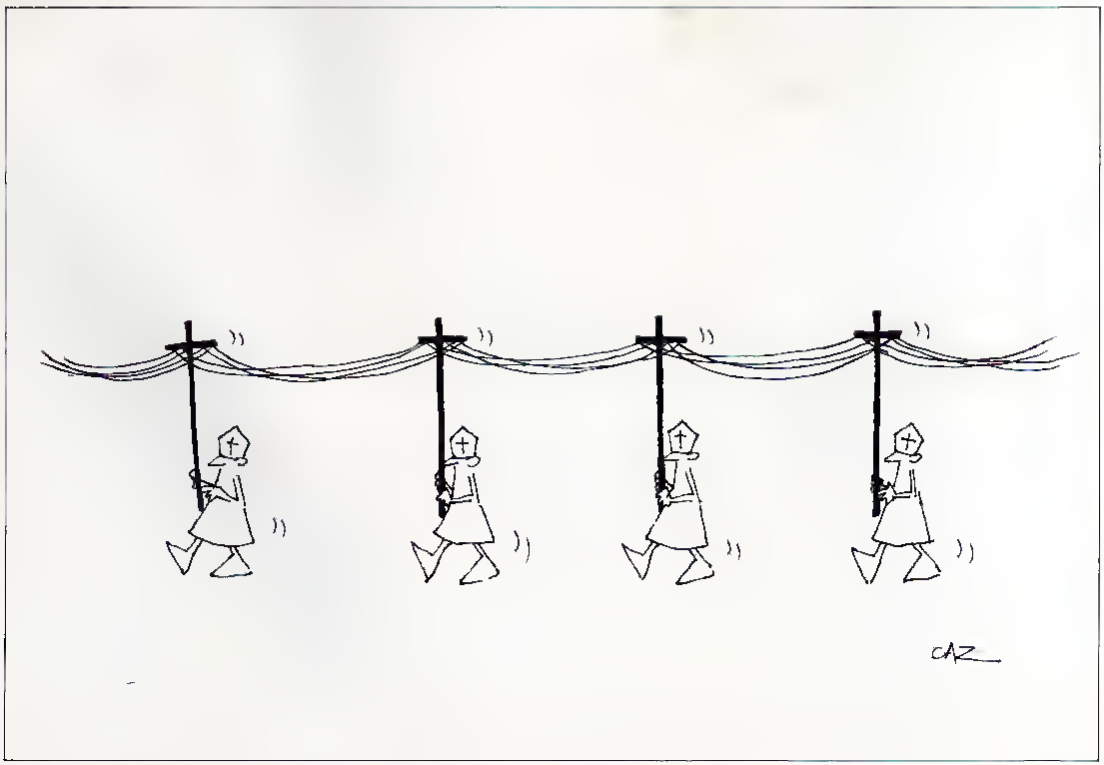
Margret stared at him, unmoving.

"Well, aren't you going?" he said.

"What have you done?" she asked, ignoring his question, an edge of panic in her voice. "Where's Harris?"

"Would you like to come in and talk about it?" Menlar inquired, smiling. "We can have a drink for old times' sake."

Her shoulders drooped. The life seemed to go out of her. Menlar swept his arm to-



ward the living room in an expansive gesture of hospitality She followed him in numbly

"Why can t you leave me alone? she whispered

"Because the thought of you alone is a tragic one " Menlar replied

"I was always alone with you " she shot back, standing stiffly as he seated himself in a deep, soft chair

And I thought you cared for me once," he said in a voice filled with exaggerated hurt

"What have you done to Harris?" she demanded

"He's one of my best engineers Why should I do anything to him?"

"But you said "

"I didn t say I asked I asked you if you wanted to know what s in store for him

Menlar watched the play of emotions on her face indecision, fear for her lover anger It was a cool anger Menlar liked that, he had always appreciated her control

I hate you " she said flatly

"I don t hold that against you Many people do

"You can't play any more games with me I'm leaving Harris is leaving There are plenty of positions for good engineers

"With good work records " he said smoothly

Try to blackball us That would be just like a recommendation to some of your competitors

"Perhaps true My competitors do want honest people though "

What do you mean?"

"Simply that your lover Harris, has padded his research-and-development account rather thickly

"You bastard You wouldn't dare "

"I can make it appear that he s stolen quite a lot from me "

"You'll never manage a frame-up like that

"I have proof in my safe " Menlar said pointing to an ornate wooden cube "Invoices receipts that sort of thing "

"You re a monster"

I'm a player And I keep what I ve won You In this case

"What do you want?"

"I want you at work bright and early every day and here afterwards every night— until I say otherwise "

"What about Harris?"

"He can do as he pleases It's you I want

"You can t intimidate him "

"You misunderstand me Margret " Menlar stood up "I'm not trying to intimidate anyone I've simply made a move You may reply to it in any way you choose

Margret's eyes flicked to the camouflaged safe then back to Menlar He caught the furtive movement

"The safe is dunte, ten centimeters thick with a self-powered tamper alarm beamed straight to police central It s molded to the floor and palm-keyed to one person only The alarm will sound at anyone else's im-

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PSYCHIC SEARCH

A man and a woman transcend time to locate a city buried beneath the desert

BY STEPHAN A. SCHWARTZ

Whether any psychic phenomenon can reliably contribute to a scientific endeavor is a hotly contested issue among proponents and detractors of the paranormal. Skeptics claim that every feat of psychic ability can be debunked under rigorously controlled experimental conditions. Yet psychic supporters claim the phenomenon is genuine. The Mobius Group seeks to substantiate paranormal applications by adapting conventional scientific methods to control, document, and evaluate psychic phenomena. Only then, Mobius founder Stephan Schwartz asserts, can the paranormal be truly authenticated. Whether the following experiment proves Schwartz's hypothesis is left to the reader to decide. —The Editors

"What do you see, George?"

"A wall," he replies casually. "Well ... it's most of a wall."

We are standing in a desolate region of northern Egypt, 40 miles from Alexandria, atop a baked expanse of rocks and shrubs known as Marea. Once a thriving port city, Marea has long since succumbed to the forces of wind, sand, and the centuries. The only visible clue to Marea's ancient prominence is a stone dock crumbling into a sheet of knee-high, bitter alkaline water. But the wall George McMullen describes is buried three feet under the desert's surface.

On behalf of the Mobius Group, George and one other psychic have arrived in Egypt to participate in an unusual experiment that will reach back a thousand years. The procedure calls for psychic location of a buried city in Egypt, then a single building within that city. All predictions are later to be authenticated or invalidated by actual archaeological excavations. Now 22 men and women, including parapsychologists, a film crew, and two psychics, gather in the desert to test the hypothesis that psychically derived information can lead to scientific discovery.

It wasn't the first time.

Since its founding in 1976 the Mobius Group has conducted numerous similar experiments in South America, the United States, and the Middle East, assisting in the archaeological recovery of forgotten cultures. Psychic sensing, for example, had made possible the location of specific artifacts 300 feet beneath the ocean's surface [see "Deep Quest," March 1979]. These previous attempts at psychic archaeology were encouraging. But here in an Alexandrian setting, where for over two millennia an ever-changing spectrum of cultures has taken turns in positions of power, the Mobius Group faces one of its most formidable challenges in probing the past.

From a historical point of view, our psychic target was especially intriguing. Buried under layers of sand, Marea was once a freshwater port with a beautiful lake. Goods from numerous empires passed over its quays, coming from the sea by way of a series of canals. Through the centuries, however, the lake dried up. The city died. By the end of the sixteenth century the last hangers-on were gone, leaving Marea to the desert.

PHOTOGRAPH BY PETE TURNER

"The psychic was to pinpoint a few hundred square feet in an area seven times the size of Manhattan."

This site was especially attractive since there was no clear-cut agreement among archaeologists as to what was known about the location. Little excavation had occurred in Marea. None of the members of the experimental team had been to the Alexandrian area before, and consequently there was nothing the psychics could glean from us telepathically.

Here, then, was the true triple-blind experiment so critical in substantiating the utilization of psychics for scientific research. Only after all the predictions came in would an excavation determine their accuracy.

Normally, we send out a map of an area to multiple psychic respondents far in advance of the experiment itself and request that they first locate sites, then provide reconstructive and cultural details relating to those sites. In parapsychology this technique is known as psychometry or map dowsing. Some researchers theorize that the psychic is picking up undefined "vibrations" from the map, although I think that they are using the map like a lens, to focus the intuitive mind on the problem.

But after a two-week search the only map we could find with Marea on it proved to be totally inadequate. The scale was so gross that Marea appeared as a medium-sized dot on the page.

Right from the start problems surrounding this unique endeavor were beginning to crop up. Luckily, our two psychics were among the most experienced in the field; they had worked with the Mobius Group on previous occasions.

The psychic abilities of George McMullen, a fifty-nine-year-old hunting and fishing guide from Canada, have been authenticated by such presti-

With no visible cues but rocks and sand, both psychics perceived a tiled floor three feet below the desert. They correctly described the tiles as Byzantine (right), contradicting the belief that the site was Roman. Succeeding excavations unearthed bathroom tile (above), which confirmed psychic predictions of "baths" and "washing." (coin is for scale)

gious excavators as J. Norman Emerson, a senior professor of anthropology at the University of Toronto. Professor Emerson used McMullen's talent in archaeological research in Canada. George had correctly sensed the presence of Africans in the Canadian Far West, which virtually rewrote a chapter of British Columbia's history.

The other psychic, Hella Hammid, a fine-arts photographer, whose found art photos appeared in the windows of Tiffany's, has an equally impressive psychic record. Hella's abilities have been exhaustively tested by SRI International (formerly Stanford Research Institute, in Menlo Park, California). Her psychic accomplishments are reported in *Mind Reach* (Delacorte/Friede, New York) and *Mind at Large* (Praeger, New York) by physicists Harold Puthoff and Russell Targ.

Shortly after arriving in Egypt, we polled our psychics for the first time. Their predictions, based only on the knowledge that they pertained to an area near Alexandria, were encouraging, but far from conclusive. "Buried buildings . . . a sense of time in a pattern." Not an overauspicious beginning. What we were asking them was tantamount to identifying a card from a freestanding deck. They would have to tell us not only what we were likely to find, but where to look and how deep down to dig.

Permission to excavate in Egypt is not given lightly. The country has been raped repeatedly by the West, as the Cleopatra needles that stand in New York and London demonstrate. These and other valuable artifacts were carted away from their rightful owners in Alexandria during the nineteenth century. For the Mobius Group, permission to dig came without a hitch, principally because of a valuable inside connection. We met an Egyptian specialist in Marean archaeology, who had obtained the necessary permits for Mobius to excavate. This man was Professor Fawzi Fakharani, an archaeologist on the staff of the University of Alexandria, who had already been working in the vicinity of Marea for several years. Since Mobius specializes in the location and reconstruction of archaeological sites, leaving the excavation in the hands of an independent archaeologist, such as Fakharani, was an ideal solution.

Yet, of all the delicate variables in this experiment, Fakharani worried me the most. The night before we set out for the desert, as we wrapped up the experimental protocol, I detected a tinge of ridicule in the archaeologist's comments. Soon afterward I asked Hella what she thought of Fakharani. She cautioned me not to trust him. When I asked her to elaborate, she warned, cryptically, "Just be on your guard, Stephan. Be careful of him."

The morning of the experiment, Fakharani drew me aside.

"Are you sure you want to try this?" he asked as we stood in the Alexandrian desert. "I don't see how McMullen can possibly locate Marea just by walking around out here. Why don't you let me show you a good spot? Then Hella and George can try to describe what is beneath their feet."

It is well documented that strong negative expectations can lead to a negative result, creating a self-fulfilling prophecy. Nobel laureate Werner Heisenberg termed this influence the "observer effect," and its impact on the subtle processes of extended sensing could be devastating.

It was too hot and uncomfortable to argue. I simply indicated that we would follow the experimental protocol to which we had both previously agreed. Fakharani merely shrugged, satisfied that he had warned me and content to let me make a fool of myself.

Now, with Hella sequestered (the protocol stipulated that the psychics remain separated at all times during the experiment), we began the first phase. Fakharani followed me over to where George was standing, and together we reiterated his instructions. In an area more than seven times the size of Manhattan, he was to locate the buried city first and then focus on a building of his choice within that city. Furthermore, he was to identify any other artifacts or conditions at the site, specify their function, and describe the culture that produced them.

> *"There was agreement among archaeologists as to what was not known about Marea. Little excavation had been done. Here, then, was the true triple-blind experiment, so critical to psychic research."*

George listened carefully to these instructions. Without comment, he turned to the head of the film crew. "You ready?"

This was the part of the procedure George loved the best. He rushed out into the desert, over the shrubs and hillocks, to get the feel of the land, ignoring the 100-degree-plus temperatures.

"Byzantine," he said, pronouncing it Biz-on-tyne. "Culture of grave robbers, people who lived off earlier peoples' achievements . . ."

The film crew and I followed George as best we could over the dry bushes and mounds of rock. Emerson, the Canadian archaeologist who had worked with George, once observed that when George's limp disappeared, he was on to something. The slight limp, which I had noticed in Alexandria, was now gone.

Three hours passed, and again I began to have doubts about the experiment. George had not yet sensed a significant "hit." Was it reasonable to take a man way out into the desert and ask him to locate a few hundred square feet out of several hundred square miles?

As if reading my mind, George suddenly turned and said, "Okay, Stephan, I know where I want to go."

He knelt down in the sand and proceeded to sketch a crude map of a place he had never seen. "I want to go where there is a big hill, a little hill, and a dock." And," pointing to Fakharani, who had since rejoined us, he said, "you are digging here," and he pointed to his map.

Since I had never been to Marea, the accuracy of what George was saying eluded me, but the effect on Fakharani was extraordinary.

"Yes!" he exclaimed. "You're right. It is just as you say."

We drove for some three miles, mostly off the road, with George directing the driver. At a small, blue-and-white Bedouin, clay-brick house, we picked up a rutted track and drove another half a mile. There we found, quite clearly, a big hill, a little hill, and a stone dock. Nearby we could see the obvious foundation of an excavated building. George had located Marea.

He leaped out of the car, followed closely by Fakharani, the film crew and me. He went over to the foundation of a buried building that Fakharani's people had already unearthed. "This was a warehouse," he said. "They stored olives here."

By now Fakharani was caught up in the process, every now and then interpolating a phrase. "Yes, that's correct, exactly." As a parapsychologist, I had to keep reminding myself that George could possibly be pulling all this telepathically from Fakharani's mind. We still had not established the triple-blind conditions called for by the experiment.

To this end, I interrupted George's hour-plus description of our surroundings and asked Fakharani to reiterate the psychic's critical charge. "Locate an important building—one with tile, fresco, or mosaic—something representative."

"If I were looking for something real good," George responded, "I would dig here. But," he added mischievously, "I know a better site."

"Show me," Fakharani commanded. Without delay George strode up a nearby hill, the Egyptian following cautiously at a slight distance.

Suddenly George stopped in his tracks. "This particular building is only part of a much larger complex," he said, pacing out the dimensions of the structure he was psychically "seeing." "It's Byzantine," he repeated, predicting that the west wall of the building could be found three feet below the surface. Green was the color most strongly associated with the site. "Approximately six to ten feet below the surface," he continued, "we should come across a floor." In some distress George kept repeating, "I can't see it clearly."

So intense was this whole experience, I

forgot completely about Hella, who had been waiting at the starting point for some word of our progress. According to the original plan, the next step called for a repetition of the entire process. But physical discomfort and emotional distress are the two strongest inhibitors of psychic functioning. And since Hella had been waiting in the sun for hours, she was probably both uncomfortable and irritated.

My worst fears were confirmed. She had been in the heat so long she felt ill and was furious with me for not sending back a message. It was decided that we should take her directly to the site George had pinpointed.

After warning me that her abilities might be compromised, Hella agreed to continue. I took her to the hill George had picked. There was nothing in evidence at the site to cue her to George's predictions, and she had no contact with Fakharani. I asked her to select a spot and describe what she saw.

After walking about for several minutes, Hella sat down. After a brief pause she described her impressions.

There was an important building, she said, with more than one room. It had "tiles, possibly green, on the walls," outlining the northwest corner. The floor was "of smooth polished stone, possibly marble, with color laid in a design. A bathroom, perhaps—something to do with baths and washing."

And her strongest perception: a small "alcove sort of room" containing what looked like a "broken column or statue... something round... and freestanding, but not complete."

Her final remarks were quite surprising. As she had demonstrated on previous Mobius Group experiments, Hella had the special ability to describe objects that were ordinarily not to be expected at the site.

With the site now localized, and the descriptions recorded by the team, the next segment of the experiment began.

As planned, George again exchanged places with Hella. This time he was asked to mark the boundaries of the building he had "seen." He pounded a wooden stake into the ground at each corner of the still-buried building, securing a final stake where the doorway would be found. All that now remained was archaeological confirmation.

The final task of the day was to present the psychics' general conclusions to Fakharani. Although he had witnessed all of the proceedings that day, he seemed both amused and annoyed. The site selected was Roman, he asserted; it could not possibly be Byzantine. In fact, Egyptian archaeologists had previously identified the area as being the Roman acropolis of Marea. Furthermore, he said, walls could be found throughout Marea. When I pointed out that a 1976 magnetometer survey had shown nothing for this area, he responded by saying that the likelihood of anyone's being able to outline walls accu-

rately was quite preposterous If there were any walls, he continued, they almost certainly would not coincide with the stake pattern laid out by George

It was evident to me that our tenuous relationship with Fakharani was rapidly deteriorating He was suffering from what might be termed "reality vertigo," a classic psychological bind What the psychics were predicting couldn't be possible, but if it was it couldn't be right I resolved to wait and see what the excavation would unearth when it commenced in six days

In the interim Hella left for France, and George, the experimental team, and I speculated about what the actual dig would turn up Here at last were the true triple-blind conditions that would put psychic archaeology to the test I spoke with Fakharani by phone and we agreed nothing would be touched until we arrived at the site the next morning

The next day, as we rounded the final curve of the dirt track we could see signs that digging had already begun George bolted out of the car, and we followed him up the hill "He's moved them!" George called back "Fakharani has moved the stakes!" When we inspected the site I saw that the stakes had been skewed from their original position and the western and eastern sides had been extended The original holes where the stakes had been placed were still visible in the dry sand

When I confronted Fakharani he simply shrugged "They aren't right anyway," he said blandly "And, besides, if there are walls there, I want to see both sides Remember, I control the digging!"

I walked over to George and the two of us examined the site to determine whether the experiment should be invalidated As he walked around George told me that although certain sections of the excavation would be off by as much as 30 inches from his original demarcation, everything else would still hold The digging had reached a depth of only three inches, and since nothing had yet been exposed I decided that the experiment should continue Then almost as if to repay Fakharani for his duplicity, George began to work on the site again

He rapidly sketched small floor tiles, which, he said, would be marble, smooth on one side and rough on the other He told me they had been laid in a chalky substance on a bed of hard clay He believed they were square, about five eighths of an inch across, and one color each At one time, he surmised, they had been laid in a pattern About eight to ten feet below the surface he "saw" a ledge running around the walls Concurring with Hella—of whose comments he was not aware—George felt that we would find something associated with baths or bathing

The following day Fakharani did not show up For the next six weeks unanswered phone calls and absenteeism would become commonplace Fakharani was unlike all other Egyptians in my experience, who were generally very friendly and cooperative Nonetheless, the excavation progressed little by little

Oh April 25, two weeks after they were first psychically identified, walls began to emerge Furthermore, they were found at three feet, four inches, within George's prediction of three to four feet Shortly thereafter the northwestern corner that Hella had "seen" was uncovered, as was the door George had described These discoveries were particularly elegant hits A corner gives very little latitude for error, since it is an intersection of two lines Most important, the walls were within the margin of error established by the stake relocation As predicted, several rooms were uncovered, too

During these initial phases of the excavation Fakharani continued to insist that the site was a Roman one But as the excavation went on, the unearthed building material and construction techniques clearly suggested that the building was, in fact, Byzantine, confirming George's prediction

"It was clear that the archaeologist was suffering from "reality vertigo." What the psychics were predicting couldn't be possible, but if it was, it couldn't be right"

At a depth of about five feet the workers began to turn up substantial chunks of what seemed to be a green glazing substance I wondered whether their roughly rectangular shape implied that these were the "tiles" Hella and George had seen Of all the questions raised by our psychics, it was the only one never answered

But on the morning of April 26 the excavation revealed the single most impressive hit of the entire experiment Hella's column was found The workers unearthed a small alcove in which stood a low-grade unglazed, cylindrical piece of pottery

In subsequent days this column became our greatest enigma When he first saw it George said that the column had something to do with heat and fire However it was obvious that it wasn't originally part of the building, and neither Fakharani nor the other archaeologists with whom we conferred could make a positive identification Our best conjecture was that it resembled a simple Bedouin oven Coals could be piled around it until the clay was hot and then they would be scraped away so that dough could be laid on the column

Workers in another quadrant found George's "ledges" and resolved the question of the floor It would eventually be revealed that a chalky subfloor was all that remained of what must have been the original finished floor of the building The ledges were not ledges in the sense of something to sit on; they were the ancient architects' method of binding the walls and floors together All these findings corroborated the predictions of the psychics, and the mood among our party was jubilant However there still was concern for the tiles predicted by George and Hella

On a clear, bright Sunday a shout from the youngest worker brought everyone running In the largest of the three rooms, intermixed with the chalky subfloor, were small, round marble tiles Eleven were found in all, one color each, smooth on one side, rough on the other Although he had inaccurately described them as square (they were round), George was only five eighths of an inch off in guessing their size But neither George nor I, nor even Fakharani was disposed to carp It was perhaps George's proudest moment Out of 225 square miles, he had pinpointed the location of an object about the size of a quarter

Our work at Marea now completed, we left Egypt, believing that the comments about "baths" and "steamrooms" would remain unanswered I assumed that this was an example of analytical overlay The effect occurs when a psychic perceives something intuitively and then attempts to analyze it intellectually—an act that almost invariably produces errors My presumption had been that the perceptions of tiles naturally led to rational conjectures about bathrooms and steamrooms by association It made a tidy conclusion at the time

The epilogue of the experiment was written some five months later Back in Egypt on another project, I discussed the site with a Polish archaeologist who had just gone over Marea, including our site He asked me what I had thought of the steambath debris found inside our building

"Steambath debris!" I exclaimed

"Yes Weren't you notified?"

He explained that down the hill from our excavation a major public bathhouse had been discovered It turned out that the debris predicted by the psychics—which we later found—had come from those baths

In the months following the Marea experiment we painstakingly reviewed the material our research had produced To me, the experiment demonstrates not only the refinements this new science will have to undergo but also the impact that psychic ability can have on archaeology and other sciences where an intuitive leap is required for problem solving

Psychic ability is not a cure-all, but neither is it a fraud Rather, it is a little-understood new tool to be used with, not in replacement of, traditional scientific research The contribution it makes ultimately will be determined by how honestly it is explored unencumbered by preconception and false perspective DO

FICTION

THE INFINITE PLANE

Shot from the sky, Sergeant Mackley lost all sense of reality as he hurtled down toward the unknown

BY PAUL J. NAHIN

The North Korean MiG-15 swept up from below and behind on a negative-g attack run, its twenty-millimeter cannon flickering red. The intercom circuits crackled with the tail gunner's shout of "Single bandit, six o'clock low! He's hot, oh baby, he's hot!" The enemy fighter arced smoothly out of its climb—its pilot was *very* good—and a stream of red-hot shells, each a demon's fireball as big as a man's fist, stitched through the tiny world of Sergeant Richard Mackley and cut him free from the B-17.

He began to fall, plummeting toward the Sea of Japan, twenty-five thousand feet below.

He had been tucked into the underbelly ball turret, his knees pushed up into his chest, with his eyes pressed to the gunsights. His hands had been above his head on the position controls, and his feet flat on the gun pedals. He had been trying very hard to kill the enemy pilot with the turret's twin fifty-caliber machine guns.

The Sperry turret had twisted him around and up and down at a dizzy rate as he'd tried to direct the double stream of bullets into the MiG's canopy. Just like he used to shoot the garden hose at butterflies while watering the lawn when he was a kid. He'd been pretty good then at washing butterflies out of the sky. But that'd been a long time ago, and he was twenty-two now. That had been a child's sport. This was war and death, and for real.

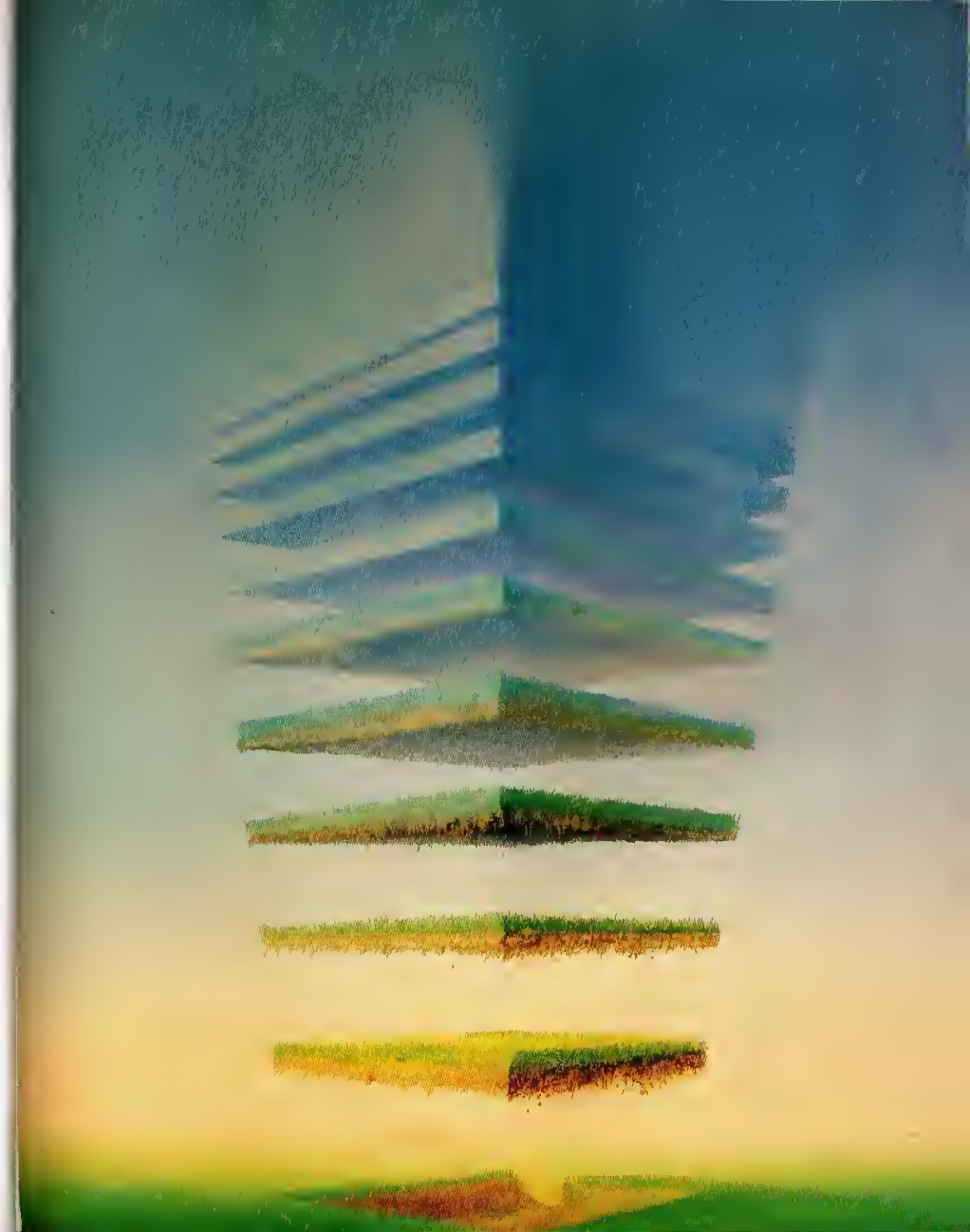
And this time he lost. This time *he* was the butterfly washed clear of his bomber and falling clean through the crystal-pure, thirty-degrees-below-zero air. Only his flight suit and both lungs full of one last deep, lucky gulp of pressurized oxygen saved his body and mind from instant destruction.

Richard Mackley's first thoughts as he fell away from the machine that had protected him from gravity were remarkably concise, calm.

Shit! That bastard sure got lucky. One more second, just one, and I would've put some rounds in 'im.

His lack of fear surprised him. He had always been sure that, if faced with violent death, he would scream. And he was surely about to die unpleasantly, since the turret was far too small for the gunner to wear a parachute. Maybe it was because he'd long ago resigned himself to the belief he'd never live through the war anyway. What *did* bother him was the foolishness of it all. He shouldn't even be here. It

PAINTING BY ERIC PAETZ



wasn't the MiG pilot's fault. The whole mission had been a wild-goose chase. It was the fault of that cocky, high-struttin', steel-rod-up-the-ass intelligence major! Listening to him at the preflight briefing that morning had nearly made Mackley puke.

The major was glorious in his freshly pressed uniform and Clark Gable mustache. He was pointing at a map of Japan and Korea with a thin metal rod that projected a small, bright spot of light. Mackley looked around the room and saw his crew and the major. A relaxed, neatly turned out by-the-book gentleman officer and ten war-weary airmen wondering just what the hell was going on.

"All right, men. Let's go to it. I know you must be wondering about this surprise mission. We've just learned the Red Chinese have moved a large number of men, possibly of divisional strength, across the Yalu River and into Chosan. We *think* they may be getting ready for a big thrust into the Iron Triangle here, a bit west of Kumsong." The spot of light held steady on the map, illuminating an area just above the thirty-eighth parallel.

"Division HQ wants a photo-recon to back up their recommendations to the brass in Tokyo. That's where you fellows come in."

Captain Lynn had stuck his hand up then. Sergeant Mackley liked the captain. respected his common sense. He was a tall, almost emaciated man, but with a deep, booming voice that sounded out of place coming from a throat where the Adam's apple bobbled in plain sight.

"Why us, Major? Why a slow-movin' B-17 that's already had more than her share of grief, when a Sabre with a hot jockey could roar in there and out a lot faster than we possibly could?"

Yeah. Mackley sure liked the captain. That was the question on his mind, too. Why indeed did they have to fly baby-bare-assed into enemy airspace, lumbering along at less than three hundred miles per hour, daring speed-smoking, cannon-firing MiGs to come up and shoot their brains out?

The major looked peeved. He'd had to deal with these damn combat types before, and it pained him to have to explain why things were being done as they were. Actually, it was none of this pilot's goddamn business why, but the major answered anyway, although his expression showed he considered the captain's question out of line. The major held up a hand and began to flick fingers up, one at a time.

"There are several reasons, Captain. Let me go through them, one by one, for you."

Flick

"First, it will take too long to fit a camera mount to an available Sabre, and HQ wants those pictures ASAP."

Flick

"Second, the Commies maybe won't think much of a lone, low-speed radar contact, while a fast-moving fighter is much more likely to provoke a response."

Flick

"Third, if you do get a reception, a heavily armed bomber can keep right on boring in, able to defend itself with its guns without taking escape maneuvers that'd ruin the photo run over the target."

Mackley felt the sweat running down his back. Lone radar contact. That meant no fighter cover. He saw Captain Lynn stare hard at the major, but say nothing. The captain knew it would do no good, would only cause trouble. Mackley understood that, too, and felt pride at serving under such a cool-headed leader.

If anybody could get them in and out in one piece, it would be the captain. And the bomber was a lucky machine. She'd been shot up before, but she'd always come back. Captain Lynn had said it had flown over Berlin just before the end of the last war, when the German air defense had been desperate, and still it had survived. Maybe that luck would bring her and her crew back from this mission, too.

"The enemy fighter arced smoothly out of its climb and a stream of red-hot shells, each a demon's fireball, stitched through the tiny world of Sergeant Richard Mackley's B-17."

Mackley's thoughts came back to the present, and he realized he was tumbling. He couldn't actually see the sky and water rotating about him, because the cloudless sky seemed to be a blue that matched the color of the ocean. It was the same blue all about him. He knew he was tumbling, because there was a strong centrifugal force pressing him flat against his back, onto the cracked Plexiglas of the turret.

The sudden realization of the ruptured nature of the turret housing made him wonder why he was still alive. He should have passed out from lack of oxygen, since his breathing hose had fed him from a pressure tank in the bomber. And the tank was a long way off, connected to the other half of the severed hose.

The bomber had to be a long way off by now, didn't it? He'd been falling for—how long? Mackley tried to figure how long it had taken him to remember the morning events, but he couldn't. It must have been at least thirty seconds, though. How far could you fall in thirty seconds?

Let's see. What's the formula from physics? Mackley had been a good science student in high school and the two years of college he'd finished before dropping out to join the service. Then he had it.

Falling from rest, in a vacuum, it was acceleration multiplied by the time squared. Divided by two. Forget air drag for now. *Jesus Christ! I can't believe I'm so calm!* So that'd be thirty-two feet per second per second, times thirty seconds squared. And that'd be, say, thirty times nine hundred, or twenty-seven thousand feet. Divided by two. He'd fallen over thirteen thousand feet, over two miles. That was half the way down! He'd wasted more than half of the precious seconds left to him thinking about that goddamn major! His sudden anger made him panic.

He had to get out of the turret!

Mackley struggled to turn around, so he could thrust himself headfirst out of the hole in the turret. There wasn't enough room to do that. So he pressed himself, rump first, through the busted opening. For a confusing instant his pistol holster tangled on something and then broke free. Mackley wished he'd worn a parachute instead. Just before he popped himself out, he remembered to put his flight goggles on, to keep the wind blast from punching his eyeballs back into his brain.

He was still a dead man, but he had to get out of that turret!

As he pushed free of the wrecked sphere, Mackley was surprised to see it fall away from him. He felt the slip stream alternately blast into his face and his back as he tumbled, but when it slapped him in the face he knew he was looking down. And then the turret was below him, and it was moving farther away. The turret was falling faster than he was, quietly fading away out of sight, into the universal blue that engulfed him.

Then he remembered the air drag and terminal velocity. *Terminal velocity*—the speed at which the force of gravity pulling him down was exactly counterbalanced by the air drag. The still fairly round, aerodynamically shaped turret had a terminal velocity greater than his flapping, sprawling body. That meant he hadn't fallen as far as he'd figured. He had more time left. It was crazy, but the temporary stay of his death calmed Mackley, soothed him.

What's the terminal velocity of a human body? Mackley had heard it could be as low as a hundred twenty miles per hour, say a hundred eighty, two hundred feet per second. *If* it was spread out flat. That'd give him—a quick calculation—maybe two minutes, until his body splattered into a big, thin pancake. *What a crappy way that would be to die!*

Maybe, Mackley thought, *if I make myself into a vertical shaft, I can knife right into the water.* He laughed at the idea—he'd heard that suicides off the Golden Gate Bridge in San Francisco, a mere few hundred feet up, were often found with their heart in their lower gut. Or in their throat. It all depended on whether they hit feet- or headfirst. The body decelerated fast when

it smashed into the water, but the soft internal organs obeyed the law of inertia faithfully and kept right on going, ripping free of their supporting tissue.

Would his brain turn to puree and squirt out of his ears? Would his eyes pop out like marbles?

He remembered the forty-five pistol strapped to his waist. *Maybe I can slow myself with the recoil by shooting downward—yeah, if only it were a howitzer!* Mackley wondered whether he was losing his mind.

He laughed again, hysterically, as he recalled a childhood nightmare: falling free in an elevator car that had broken its cables. For a long time he'd wondered whether you could survive such a fall by timing the impact so perfectly that you jumped upward at the instant of collision. *Maybe I can jump up just as I hit the water.* He started to scream, and kept screaming until he had to stop to suck in more air. Mackley screamed for a long time.

And then a death-defying thought. *I should've hit by now! Christ, I'm still alive! What's happening?*

He was falling facedown, eyes open, the howling wind blowing his hair straight back, his body all spread out. All prepared to set the world's record in the high-dive belly flop. Mackley twisted his head around, peering, straining his vision through the flight goggles into the pure-blue nothing all about him. *Nothing, no waves, no clouds, no horizon. There's nothin' down there! God damn it, there's no water below me. I should see waves or whitecaps by now. There's nothin' but that damn blue. Where the hell am I?*

Understanding came to him slowly. He fought against it, unwilling to dare hope he might really have a chance. He might actually live! But there was no other explanation: it *had* to be the answer! He scanned his memory for the long-forgotten idea. It *had* to be the answer! Richard Mackley was falling toward Professor Hightower's infinite plane!

Professor Hightower was in his customary position before his freshman class, leaning against the blackboard. His hands and pants and coat were covered with chalk dust. His neatly trimmed beard was the same color as his reddish glass frames, making the glasses look as if they grew right out of his head.

"Yes, ladies and gentlemen, the infinite plane is not generally appreciated for its fantastic properties. You all know what a mathematical plane is, of course. It's a flat surface with zero thickness. The sort of thing they make desk tops out of."

The class laughed. Maybe it wasn't all that funny, but he was one math prof who at least tried to keep his students interested.

"But a desk top isn't an infinite plane. It is merely a segment, an isolated part of the amazing whole. Nobody has ever seen an infinite plane naturally, but we can imagine it. That is the beauty of mathematics and

the human mind They can imagine what nature herself for some reason has seen fit not to make

And why would nature make such a sad decision? Ah, but you must remember that *infinite* means just that Not big, not huge, not spectacularly enormous, but infinite It would stretch from one end of the universe all the way across and beyond It would *divide* the universe into two separate parts and nothing on one side could go around this majestic membrane to reach the opposite side

The professor pointed at Mackley sitting in the front row "Tell us, young man, why is that so?"

Mackley answered immediately He found the idea of the infinite plane strangely fascinating Because Professor, since it's infinite, it has *no edge to go around!*"

"Correct! The infinite plane would, in effect, create two universes where there had previously been just one Each isolated from the other The only way to leave one and enter the other would be to punch through it to rip a hole in the infinite plane

"But that, alas, would ruin its perfect beauty

The students chuckled again at the professor's mock grimace at the horror of his suggestion

Professor Hightower leaned forward from the board, eyes gleaming, and spoke now in a hushed tone "But I haven't yet told you the most incredible part You all know how objects change their appearance as their distance from us varies To be completely trivial about it, the closer something is, the bigger it looks

"Now let me ask you the penultimate question Suppose you were, somehow, suspended a thousand miles above such a plane How would its appearance change if you then dropped to a distance above it of a mere one mile?"

The class sat stunned Boy, the professor had really flipped out this time! The old geezer must be nuts How could you possibly figure out how something that didn't even exist would look?

Only Mackley thought seriously about the question, and finally he raised his hand The professor seemed both surprised and pleased to have a response He jabbed a finger toward Mackley

"Yes, yes, young man, let's hear from you again"

"Well, Professor, I'm probably wrong, but it seems to me that if it's infinite in extent and if it's perfectly flat, then—well, it would look the same, no matter how far or close it actually was."

"Correct, once again! Very good, excellent How, indeed, could it look different? It couldn't look bigger just because it's closer since it already is infinite There is no edge to the thing So there'd be no horizon, nothing to serve as a depth cue for your eye Therefore, it would look the same QED, as we mathematicians like to say

As I said, that was the penultimate question Now here's the hard one to answer, and just in time as the hour is nearly gone If you could, that is, if you really were on one side of an infinite plane, would you have the will, the sheer, raw nerve, to rip through it and see what was on the other side? Think carefully about that one, ladies and gentlemen Think carefully!

"Remember, closed-book exam on Monday Class dismissed!"

It all fitted together so perfectly It was an infinite plane, not the hard ocean, that was below him But how had he gotten here? He'd been in a heavy bomber, his body jerking to the booming vibrations of the turret guns, and now he was—where? As the professor had said, he could be a thousand miles above it, or maybe just a thousand feet There'd be no way to tell until he punched through it

Mackley had heard his professor in introductory physics talk once about alternative universes, places outside the one they lived in Maybe that was where he was But how had he gotten here? He struggled with the question, yearning to know the answer to what had saved his life

> *"What if this fall never ends? What if I'm already dead and gone to Hell! Maybe that's my hell—to bounce forever on the infinite plane that's the Devil's goddamn trampoline!"*

He recalled part of an overheard conversation between two Air Force scientists when he'd been in gunnery school There had been a research symposium at the training base, and once while on an errand to the auditorium building, he'd walked for a minute or so down a corridor behind the two men

They'd been working on the problem of accurately measuring the path of a high-velocity bullet, hoping to find ways to improve the lethality of airborne guns And they'd been talking about how bullets create an intense electrical plasma of hot gases around themselves as they rip through the air

So maybe that was it Maybe those MiG cannon shells had those plasma clouds too, and when they tore the turret loose, the interacting electrical fields had been just right somehow to rip him from his ordinary universe and to transport him to this goddamn torture of a fall that just never was going to end and—

Mackley's heart skipped a beat as he pursued that thought *Jesus, what if this fall really does never end? Or what if the infinite membrane doesn't rip? What if I just bounce off? Maybe I'm already dead and gone to Hell! Maybe that's my hell—to bounce forever on the infinite plane that's the Devil's goddamn trampoline!*

Mackley gave up *To hell with it!* The wind blast was still tearing at his clothes, the blue was still all around, he was still alive and to hell with it He was going to make it!

Mackley felt exhilaration sweep through him He was tired of the damn war, it had been getting boring, just waiting to get blown away Here was something new and exciting, and he was free of the war What would be on the other side of the infinite plane? Wouldn't old Professor Hightower give *plenty* to be here with him!

Mackley remembered a hallway conversation he'd had with the professor a few days after the infinite-plane lecture He'd been walking down a corridor on his way to another course when Professor Hightower had come out of a nearby classroom The professor had a sharp eye for faces

"Hello, young man! Mr Mackley, isn't it? I want to congratulate you on the fine exam paper you wrote last Monday Excellent piece of work, and I could see from it that you'd been thinking about what we discussed in class concerning the infinite plane I wish all my students were as diligent as you"

Mackley blushed with pride and embarrassment The professor, a naturally exuberant man, had spoken loudly and other students in the hall, hearing his praise, were staring at them Startled Mackley replied, "Thank you, Professor, but it wasn't anything special It's just that the infinite plane is so interesting" The professor smiled, and Mackley felt encouraged to continue

"Professor, I've been wondering What do *you* think would be on the other side of the infinite plane?

Professor Highfower laughed "Oh, my dear young man, that is the question! My speculation is no more profound than anyone else's, but I do, of course, have my own theory about it Nature, you see, loves simplicity and symmetry It is Occam's Razor, the law of parsimony that says it best The simplest possible explanation of nature is the true explanation"

Mackley must have looked confused, for the professor smiled again and said "You are taking physics, too, aren't you?" As Mackley nodded, he continued with "Yes, of course you are, and it was that great physicist Isaac Newton himself who said it so well

" 'Nature does nothing in vain, and more is vain when less will serve For Nature is pleased with simplicity and affects not the pomp of superfluous causes Thus we too are to admit no more causes of natural things than such are both true and sufficient to explain their appearances' "

Mackley was still confused by all that and now the professor sounded a bit exasperated with him. "Well, don't you see it yet, young man? The simplest thing for nature to do would be to have one side be the image of the other, an exact reflection. The infinite plane would separate two duplicate universes. To penetrate the infinite plane would be like somehow passing through the surface of a mirror, like Lewis Carroll's looking glass, and entering a replicated world."

Mackley didn't like that theory. To have gone through all of this just to fall into a universe identical to the one he'd been in—it wasn't fair. *There has to be more to all this. There just has to be.*

There might be a primitive world on the other side—a world with people who would think his advanced technical knowledge to be magic. He would be a god in such a world. Or maybe it would be a universe where all the physical laws are different, where everything would be wonderfully strange. Mackley wasn't sure he'd like that kind of world.

But it might be nothing like that at all. Of course. Professor Hightower had been right about the infinite plane's existence. So maybe he was right about the mirror-image universe, too.

Mackley couldn't wait to tear through the blue barrier and see what was really there.

He spread-eagled himself as far as he could, arms held at right angles to his body, legs extended stiffly. He stared straight down into the deep, featureless blue that seemed to go on forever and yelled, "Here I come, you beautiful infinite plane. Here I come, and oh, man, am I going to blast right—"

Mackley hit the membrane, and time seemed to slow to a crawl. It was only now as he pushed into the blue that he could see how slowly things were happening. It was like falling through molasses. *Could that be why the fall took so long? Is the time flow different here? But if that's so, why aren't my thoughts slower, too?* Mackley knew that if he was thinking slowly, there would be no way to perceive the slowness. *Am I going mad?*

He could feel the infinite plane's resistance to his slowly hurtling body, sense its stretching, see the depression he was making. Now that he was actually in contact with the membrane, it did have a texture, a cool, smooth surface to it, and he could see the flatness of it curve inward beneath his body. And yet somehow he knew it wasn't a material object. It was a force fabric, woven from the fibers of space-time. He caressed it lovingly with his hands and legs.

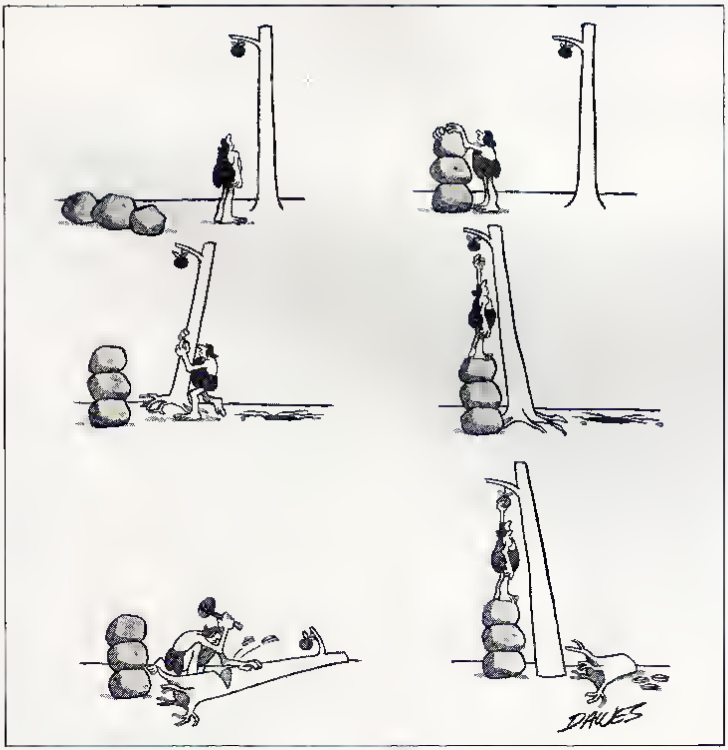
And nearby, only a few meters away, he could see a mirror-image bubble forming from the other side.

As he slowly sank inward, the other bulge, equally slowly, pushed outward. Deeper, deeper, he penetrated in one direction, and further, further outward the mirror-image bulge grew.

Something was trying to break through from the other side. That meant there was a world there, that the professor had been right. The infinite plane, and the region of space-time around it—it was the interface between two universes, a gateway between two halves of reality.

He ripped through, and there was just a glimpse, a mere flash in the corner of his eye, as the mirror-image bubble ruptured simultaneously. The shock made him yell, but the sound was lost in the muffling of the infinite plane. It was himself—his other-world twin. And then it, or he, or something was gone, whipping away into Richard Mackley's lost world just as he was falling into the new one.

Now he was rushing through the air again, and it was like a film running backward through a projector at high speed. The wind blast tore at him from above as he streaked upward, and the surprise of what he'd seen left him stunned.



The intercom buzzed through his mental haze, and the voice of Captain Lynn jolted him back to alertness. It wasn't possible, but he was back in the turret, back in the bomber! "Mackley, Mackley, you there, boy? Come on, answer!"

"Mackley here, sir. I'm sorry. I musta gotten disoriented with that last firing pass."

"Well, snap to it, Mackley! God damn it, boy, this ain't no time to crap out."

Fortunately there were no more MiG attack runs as Mackley collapsed against his turret controls, almost in a faint. *Jesus. I dreamed the whole damn thing! I gotta see the doc when we get back. I must be cracking up, heading for a section eight and the psycho ward!*

After the plane landed safely back in Japan, Mackley and his crewmates walked to the intelligence shack for their flight debriefing. He avoided joining in with the tension-releasing banter of the others. His legs were still wobbly, and he was on the verge of throwing up.

In the shack they took pencils and paper from the waiting clerk and began to fill in the standard postmission question sheet. Halfway through, Mackley froze, and sudden understanding hit him, numbing him with fear. He hadn't dreamed it. It hadn't been a hallucination. It had been real.

He had misinterpreted the professor's explanation of a looking-glass world. Reflected worlds *wouldn't* be the same!

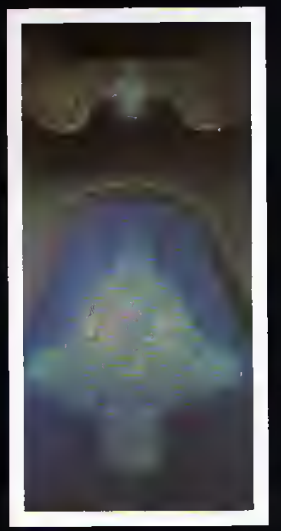
Everything looked normal on the surface, but he knew now that he was in an alien place. Was it just his imagination? Or were the others glancing strangely at him? Could they sense that he was different, and that he knew he was different?

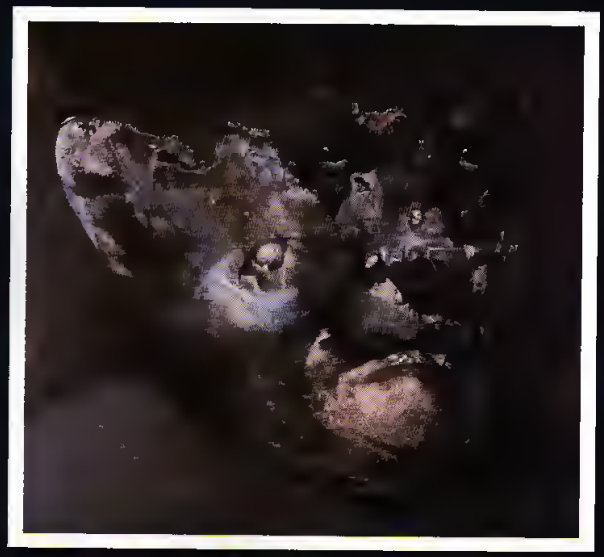
He stared now in horror at his pencil, held tightly in his left hand. That was simple enough, wasn't it? But it told him that things were never going to be simple again. When Mackley had begun the mission, he'd been right-handed. ◻◻

TRANSFORMATIONS

BY ROBERT SHECKLEY

Man into animal, flesh into spirit; something mysteriously becomes something else. Uncanny images of the imagination are shown here in the works of Michel Henricot, Marshall Arisman, and Bob Venosa.





Transformation—its prediction, its control, its meaning—has always been the province of the priest, the shaman, and the artist. Magic itself, the precursor of science, is essentially the study and control of changes. Alchemy, the study of magical transformations, metamorphoses into chemistry, the study of transformations in substances. Scientists look to artists for insights into the nature of the world. Art delineates the processes of the imagination, creating syntheses of fantastic and factual elements too complex to be explained in words.

"We shuffle things and arrange them, not as they are, but as we want them to be."

"Transformation is the key to dreams, which become future insights."

The greatest revolution in art has been the freeing of the artist from the stringencies of literal representation. Visionary artists increasingly feel the need to deal with inner experience, to portray their perceptions of mood, their terrors and hopes, their visions of this world and the next. Fantasy thinking brings us into contact with the oldest layers of the human brain, concealed beneath the tumult of everyday consciousness. The images of fantastic art are metaphoric references for complex psychological states and experiences. The viewer resonates with these grotesque representations. We understand the world by means of metaphor. It is the basic transformation

SILICON SPIES

CONTINUED FROM PAGE 47

Soviet Union's intelligence service.

DeGuyter was arrested last May at Kennedy Airport when he turned over a $500,000 check to a federal agent posing as a computer company executive in exchange for what were supposed to be computer tapes containing the "Adabas" source code, a sophisticated program for translating computer languages at high speed. Documents seized from DeGuyter at Kennedy included a $450,000 letter of credit from Techmashimport, a Soviet trading company. The FBI asserts that DeGuyter was also trying to buy the same Intel equipment that Gopal allegedly was seeking through his "consulting" business.

One of the most common electronics smuggler's tricks is "B Listing." The Commerce Department keeps two lists of items of equipment that are commonly exported. Equipment on the "B" list can be sold to the Soviet Union or other Eastern Bloc countries with few restrictions. Items on the "A" list, however, can be sold only with a special license, or in some instances not at all. The problem is that most items on the "A" list—special ovens for drying microscopic computer parts, for instance—have some kind of cousin on the "B" list—a regular industrial oven, in this example.

Electronics smugglers who know the ropes have an easy time switching the paperwork and loading the embargoed equipment on a plane bound for a nonaligned country such as Switzerland or Austria. From there the shipment sometimes with another set of phony papers, is simply loaded on a jet bound for Moscow.

The case of Starek, Storey and II Industries is McLeod's favorite example of how ineffective export control is. II Industries is a Sunnyvale, California, firm producing ovens, spinners, sorters and other equipment used to mass produce silicon chips. Sale of such equipment to the Soviet Union has always been banned.

Gerald Starek, president of II Industries, began cooperating with the Russians in 1974, when a Soviet agent named Richard Mueller promised him a $1.5 million sale. At the time, II Industries was in a serious slump. What the Russians wanted, according to trial testimony, was a complete assembly line for the mass production of microcomputers. They were willing to pay a total of $35 million to obtain it.

Starek contacted John Marshall, a consultant who designs integrated-circuit and microcomputer assembly lines, and sent him to see Mueller in Germany. Marshall was being paid $5,000 down and $500 a day, plus expenses, for his services. Mueller sent Marshall to Moscow. "They were very secretive about what they were doing," Marshall commented later. "They wouldn't really tell me anything. It sounded like they were setting up a factory in Russia, in fact, a number of factories."

The CIA tipped off the Commerce Department about Mueller in 1975, and Commerce officials called II Industries to inform the company that they believed Mueller's order was headed straight for the Soviet Union. II Industries officials replied that they didn't know anything about illegal shipping of electronics, but they promptly canceled Mueller's order.

OEA's policy of informing suspects that the government thinks they might be committing a crime is intended to help businesses that might inadvertently have broken a minor rule. It can happen easily. The Commerce Department's manual of export regulations is two inches thick. When a smuggler like Starek is being dealt with, however, the practice is like phoning a house that's being ransacked to let the thieves know that the police are on their way.

Instead of filling Mueller's original order, Starek set up two paper companies under new names in Montreal. The equipment Mueller had ordered was then shipped by plane to Montreal, from there to Zurich, then on to Techmashimport in Moscow. The shipment was labeled as washing machines, industrial ovens and air conditioners.

"CIA warned Commerce about the illegal deal, and Commerce notified the smugglers. So the computer-making equipment was routed to Montreal and Zurich before going on to Moscow."

Even today no one knows just how much electronics equipment Starek smuggled out after the Commerce Department's warning. What is known, however, is that Starek and two other American electronics executives involved in the scheme—Storey and Robert C. Johnson—are each worth well over $1 million now, thanks at least in part to their sales to Soviet buyers. Although the U.S. government eventually caught Starek, Storey and Johnson, their profits from smuggling were never seized. After three years of court battles, the three executives and II Industries were fined $25,000 each with three years' probation.

"This is the standard," McLeod comments bitterly. "This is the worst that has happened to any of these guys. If you can make a million dollars and all you face is a twenty-five-thousand-dollar fine and probation, that's not a very bad deal, many people would say."

II Industries has been sold to Cutler Hammer Corporation, a manufacturer of top secret electronics equipment for the Defense Department. Starek is in business again as head of Silicon Valley Group, which also builds microcomputer-manufacturing equipment. The new effort is financially backed by Storey. Starek's lieutenant in the Russian scheme, Storey's export license has never been revoked.

Mueller, for his part, faces arrest if he returns to the United States, but he is rumored to be living in Europe. He too has not been barred from export or import trade with American companies.

The Russians are still trying to obtain equipment for their microcomputer factories. Not long ago agents in Boston seized yet another shipment of Moscow-bound wafer scrubbers and other microcomputer equipment, including some built by II Industries. This time it was being sent by way of London.

In a similar case, William Bell Hugle was caught in 1975 using false export declarations to ship a microcomputer assembly line to Poland through a bogus company that was supposedly going to manufacture digital watches in Singapore. Hugle is the head of an electronics export firm known as Hugle International. He was never prosecuted. Customs agents say partly because they were unable to fund a trip to collect statements from Singapore officials.

Hugle International went bankrupt after the sale to Poland was blocked, the Commerce Department believes, and OEA dropped efforts to bar Hugle from the export-import business. However only the California office was liquidated. Hugle International continues to do business from Tokyo. The company's Tokyo address is still listed on the Commerce Department's Foreign Traders Index, a computerized service meant to encourage international trade. Hugle is listed as an "agent handling semiconductors and related devices."

The Soviet effort to obtain a factory to mass-produce integrated circuits is much more serious; most experts agree than simply smuggling a few sample chips out in the false bottom of a suitcase. The Russians thoroughly understand the theory behind microcircuitry and have the laboratory ability to reproduce anything the West can build," one Pentagon expert who specializes in technology-transfer problems says. "But they lack production know-how and the technology to mass-produce it."

They might have caught up already if one incredible espionage plot had panned out. Aimed at Silicon Valley, the $70 million banking scheme was masterminded by the Moscow Narodny Bank (MNB), using a Hong Kong-based land speculator named Amos Dawe. Dawe, formerly a Chinese postal clerk whose true name is Law Sheng Moh, built a financial empire worth tens of millions of dollars out of some lucky land investments and a mountain of credit from the Singapore branch of the MNB. That empire collapsed in the mid-Seventies when it became known that Dawe and several other prominent East Asian busi-

nessmen were in fact cut-outs, or front men, for the MNB. That collapse left a string of lawsuits from Singapore to San Francisco as Dawe's business partners and the MNB fought over the wreckage. It is from those records and an interview with Dawe himself that the following account is drawn.

The Singapore branch of the Soviet state bank played a very aggressive role in Asian financial affairs during the early Seventies. By 1973 Dawe and his holding companies were already more than $60 million in debt to the MNB. According to Dawe, the MNB frequently promised him $70 million or more in new credit in a scheme to buy up a number of small U.S. banks. The scheme, Dawe was to testify later, was called the American Plan.

The CIA took the Moscow bank and Dawe quite seriously, according to documents obtained through the Freedom of Information Act. A hundred pages of heavily censored cables and CIA reports trace the path by which Dawe bound himself to the MNB.

Late in 1973 the MNB sent Dawe and its Singapore chief executive to look over available banks in the United States. The MNB needed Dawe, it seems, to take advantage of what was at the time a loophole in American banking regulations. Although the rules then required an examination of foreign companies buying American banks, no such probe was required of a foreign individual. Dawe could, to all intents and purposes, simply walk in, lay the money on the table, and buy a bank.

The MNB guaranteed the purchase and hid its interest in the deal by issuing letters of credit, which were laundered through two other banks. Dawe used the money to make down payments on the Peninsula National Bank, a small bank in the Santa Clara Valley, and two other California banks.

It is reasonable to assume that Dawe and his MNB advisers did not choose the Peninsula Bank only by coincidence; they paid almost twice the institution's book value in order to gain control of it. The MNB, acting through Dawe, by 1975 had paid off 80 percent of the bill for the Peninsula Bank and owned a controlling interest in the two others, according to the CIA. Negotiations were even under way for purchase of two more banks in the valley.

Dawe refuses to talk now about just why the Russians were so interested in those banks. "What if I were to tell you that this is done by both of them [the KGB and the CIA] all around the world?" he asks rhetorically. "What do you think is in it for them?"

The attorneys who later prosecuted Dawe for bank fraud are somewhat more forthcoming. "The Russians wanted easy access to U.S. dollars," says former U.S. Attorney John Lockie. "Dawe wanted the stability and reputation that come from owning an American bank."

But why the Peninsula Bank? And why pay almost twice its value when stronger banks were available at a lower price? For one thing, the bank would have given them detailed financial records of hundreds of American scientists and engineers and the companies they work for. In the world's most concentrated center of secret electronics production. Such records, one industry source says, "provide a clear picture of people's vices and weaknesses, their family life, political views, and sometimes even medical history." Bank records usually paint an equally clear picture of high-technology companies and their contracts, product plans, and financial health.

Whatever the Russians' plans were, they were shattered in 1975 when a Hong Kong financial paper, *Target* (which is said to have close ties with the British intelligence service), blew Dawe's cover in a series of articles exposing his ties to the MNB. Shaken by the disclosures, the California State Banking Department finally began asking questions. The MNB cut off his credit. Dawe fled to Thailand, and his empire began to crumble around him.

Today Dawe keeps a low profile, using unlisted phone numbers and apartments rented under assumed names as he plots his return to the world of international finance. Agents of the KGB, he says, beat him within an inch of his life in the hallway of a posh Thai hotel when he turned on his Moscow backers and sued them for withdrawing the credit he had been promised.

Dawe is apparently out of the espionage business, at least for the moment. It is clear that the Russians are not. The arrest of De Guyter and seizures of microcircuit-manufacturing equipment in Boston are proof that the American microcomputer industry is still very important to Soviet agents.

"This is a rampant phenomenon right now," says Charles Letch, whose Advanced Computer Technologies Corporation was one target of DeGuyter's effort. Peter Schnell, of the West German firm Software AG, says, "People working for the Eastern Bloc attempt to obtain this technology almost weekly."

Soviet progress in missile guidance systems, in particular, warns of the impact that Soviet advances in microelectronics production would have. Despite the use of integrated circuits that are ten years out of date in the West, despite their equipment's added weight and lower reliability, Soviet scientists have developed systems that can place a MIRV warhead within 0.1 nautical mile of American Minuteman missile silos. Strategic trade analyst Miles Costick says, "The SS18 missile has emerged as the most lethal ICBM in the world. Mass production and application of microelectronics to military systems portend a qualitative advance in Soviet arms."

"We're going to see this stuff coming back at us," Lockie predicts. "They're not making automatic popcorn poppers with it, that's for sure." OMNI

"Our testing shows that right about here for some reason our product stops being food!"

Research assistance provided for this article by Kathleen Prendergast

DESTINY

CONTINUED FROM PAGE 60

astronauts and a close friend of John Young's since the early Gemini days.

"First he passed the rigid tests to enter the Naval Academy. Later, as a young graduate, he had to prove that he was fit for flight training. Sixty percent fail. Next he had to pass flight training, and twenty-five percent don't make it. Secondary flight school is tough and washes out about forty percent. After that he moved into an operating squadron, which loses about fifteen percent through death or disabling accident. He applied for test pilot school with eighty percent rejection and another five or ten percent failing it they do get in. He has more than six thousand hours in the most advanced planes and holds world records in various types of flight.

"Now the hardest test of all. He wants to be an astronaut. Top men in the nation apply. Out of a hundred and twenty in his group, nine were selected. Two were killed, six others, fine men like Armstrong, Borman, and Conrad, left the program. And now we come to the final selection. Who is to command the shuttle on which so much depends? Now we have only Young."

What makes him especially qualified is the fact that he has been four times in outer space—*Gemini 3* and *10*, *Apollo 10* and *16*—for a total of 533 hours and 33 minutes. He is far more experienced than any other astronaut flying today, American or Russian. In each of his two second flights he served as commander, and he once spent 20 hours and 14 minutes working on the surface of the moon.

"In 1972 I was told that I was assigned to the first shuttle. Since then I've done nothing but try to master the job." Pointing to a stack of manuals almost four feet high, he says, "I keep that pile to remind myself of the mental work we have to master."

"How do the shuttle and Apollo compare in difficulty?" I ask.

"Apollo required us to know a massive amount. The shuttle is a whole magnitude more difficult. But because we've worked so long, I do believe we're better prepared than we ever were for Gemini or Apollo."

Young is not easy to know. Astronaut Mike Collins, who shared the cramped quarters of *Gemini 10* with him for three days, observed, "Mysterious. The epitome of the nonhero with a country boy's Aw shucks, tain't nothin' demeanor. Delightful wit and a keen engineer's mind."

He is full of surprises. After going out of his way to impress you with a modest appraisal of himself, he lets you into his study and goes off to answer a phone call, and there you find a collection of astronomy books that would grace the quarters of a professor in that subject. His knowledge of flight is awesome. And his physical condition, which he maintains by jogging and attention to what he eats, is remarkable. Slayton recalls that the most important test Young ever had to face came in his first Gemini flight. "We handed him a paper bag and asked him to demonstrate that a man could have a bowel movement in outer space. When he succeeded, we knew we were home safe."

Young lives on a quiet back street near the Johnson Space Center in Houston with his lively, outspoken wife, Susy. In days when he did not have to concentrate exclusively on the shuttle he was in charge of the 80-odd astronauts, a kind of Dean of Men. Now he keeps to his corner office, crowded with material pertaining to the flight.

I say to him, "Suppose I've been a red-hot test pilot. I'm selected as an astronaut. How long before I can fly the shuttle?"

"Half a year mastering the local lingo, the basic structure, the navigational stars, digital processing. Then we'd want you to spend a year and a half tracing out the systems, especially the five on-board computers, our forty-nine different engines, twenty-three antennas. When you knew all that, we'd put you in the simulators for about six months. Then you'd be ready to start the hard work of preparing to fly."

> *"If the space shuttle succeeds, Americans will once again be voyaging in space after a period of six years. If it fails, the exploration of space may close down for several decades."*

"How do you feel when you hear that during the six years we've had no men aloft a Russian cosmonaut like Valery Ryumin has spent three hundred four days in their *Salyut 6* space station?"

"Poor guy. Their craft was unbelievably crowded, compared to ours."

"But they're up there and we aren't."

"You're right. And it's damned worrisome. There's sure a lot to be learned up there. They've got to be mastering something. They've said that their long-range goal is manned flight to the planets."

"Any clues as to how far along they are?"

"Difficult to assess. But they're probably far ahead of where we were when we ended Apollo."

What do you think America should be doing?

"We must keep our men in space. It's amazing what the human eye can detect from one hundred miles up. What the human brain can absorb. It would be incredibly silly for us to abandon space to others. Especially when we're developing master capabilities."

"Is the shuttle one of those capabilities?"

"You bet it is. With this machine we can accomplish miracles. When it becomes functional, the world will experience a surge of excitement."

"I'm fascinated by one aspect. Here we have three components. Each has been tested by itself. But never as a united trio."

"They can't be. Until we put them together and actually take them up."

"Does that concern you?"

"Of course it concerns me! But we're test pilots. This is our job. We're ready to give it a go. And remember this: The shuttle may be more complicated than a new airplane used to be, or an Apollo. But it's not inherently more dangerous. It's just one more flying machine to be tested."

Young's copilot on his first flight will be Commander Robert L. Crippen, USN, a tall Texan, forty-three years old and the handsome kind of man Hollywood might have chosen to play copilot in a movie in which John Wayne was the gruff senior. Well trained as a test pilot, Crippen served as support crew for the Russian-American joint effort *Apollo-Soyuz*, which gave him an opportunity to inspect the Soviet space effort.

"They struggle to build systems that work, then stay with them. The basic message I got was that they're determined to succeed. Technologically we're still in command, but we won't be for long if we rest on our laurels. Looked to me as if they were closing fast."

"How about their budget?"

"I'm told they spend seven billion dollars a year. Many times what we do. Whatever they have, they use elegantly. They're up there flying, and we aren't."

Crippen is an excellent complement to Young, outgoing where Young is taciturn, philosophical where Young tends to be engineering-practical. Crippen says, "We're very excited about the shuttle's future. Look, we already have complete payloads signed up for our first sixty-eight flights. We're a going concern, an eventual money maker. All sorts of participants want to work with us: European nations, China, Arabsat, Indonesia. Scores of universities want to send experiments aloft. And many of the big industries. This isn't an experiment. It's the real thing."

He is especially pleased by the possibilities of Flight 16, scheduled to blast off on January 12, 1984. "We're going to haul this huge telescope to an orbit three hundred twenty miles up. Weighs ten tons, is forty-six feet long. It'll be like lifting Mount Palomar three hundred miles up in the air, above the smog. Who can even guess what wonders that scope will reveal?"

An outsider who visits either Houston or Cape Canaveral is overwhelmed at first by the enormous gamble America is making on this first flight of the shuttle, but once he has a chance to talk with men like Young and Crippen, he becomes aware that the

orbiting of *Columbia* is merely a first step. The true wonder of this venture lies in the intellectual variety of the payloads that will ride in subsequent flights.

At various points across the country pallets are being assembled. The size of small rooms, these will house the varied scientific instruments with which outer space will be explored and the surface of our earth analyzed. Each pallet will contain from four to six totally different devices, which will be attended by scientists who fly as passengers aboard the orbiter. (Young scientists from Europe are already in training at Houston to fly in the orbiter when their countries' experiments are aboard.)

When assembled, the pallet is hoisted bodily into the bay of the orbiter and carried into space. Some self-governing will be lifted off their pallets by a gigantic articulated arm developed by Canadian scientists and will be thrown out into permanent orbits of their own. They will send their data back to Earth by radio signal.

A wildly diverse scatter of experiments has already been allocated to the 68 flights. For as little as $3,000 a device requiring little space can be sent aloft. On certain flights room has been set aside for high-school wizards, and at repeated intervals the manifest for an entire flight says simply DOD. That's Department of Defense, which looks to the shuttle for help in its major scientific experimentation. One would-be user had an ingenious plan. Send up stamped envelopes, then sell them at whopping prices as "authentic space mail." His proposal was rejected.

It is obvious that Young and Crippen cannot possibly fly all the shuttle missions already scheduled. Who are the other astronauts in training for these flights?

The second crew and the men who will take over the first flight if anything incapacitates Young or Crippen are two delightful military test pilots, Joe Engle, a Kansan in the Air Force, forty-eight years old, and Dick Truly, Navy man from Mississippi, forty-three years old. It's fun to hear them

Engle: Look at this pile of manuals we have to know by heart. Hydraulics, propulsion, communications, digital processing, life-support systems, environment control.

Truly: That's so you don't cook or choke.

Engle: Orbital maneuvering, reaction controls, navigation, guidance, mechanical functioning, big arm manipulation, reentry data, glide control.

Truly: Merely the dues you pay for belonging to the club.

Engle: I was back-up pilot on *Apollo 14*. Had to master all that material. Shuttle is much more complex.

Truly: We don't worry about geopolitics or the philosophical importance of the flights. Our task is to fly this machine as skillfully as possible.

Engle: And we have flown it. Dick and I are the men who took the orbiter aloft on that Boeing 747, cast it loose, and proved that we could glide it back to Edwards Air Force Base. We did it twice. A marvelous machine.

Truly: In a real flight, when we decide to land, we make our decision over Australia. We glide across the entire Pacific and have ahead of us a pattern about a thousand miles left or right into which we can land and somewhat more fore and aft.

Engle: This matter of direction is important. If we take off to the east, we pick up the thrust of the earth's rotation in that heading, say one thousand extra miles an hour. That means we can carry a payload of sixty-five thousand pounds. But if we take off north-south, we lose the earth's lift and can carry only forty thousand. And if we're stupid enough to take off east-west, we actually fight against the earth's rotation, and we're limited to twenty thousand.

Engle: Which is why we take off from Florida and land in California.

Truly: How do we get the orbiter back to Florida for the next take-off? We'll bring it home piggyback on top of our 747.

"It would be silly for us to abandon space to others," says shuttle commander Young. "With this machine, we can perform miracles. When it's functional, the whole world will feel a surge of excitement."

Engle: All of us are committed to this venture. We're determined to make it work.

Truly: When Joe says that, you must remember that as a test pilot he flew a plane straight up to an altitude of two hundred eighty-three thousand feet. He knows what test piloting is. We're testing the machine of the future.

I've spent the last three years closely associated with the space shuttle. I've observed it in California and Florida. I've flown in some of the simulators to get as much feel of the craft as a nonengineering layman could, and I believe I appreciate the strengths and weaknesses of the adventure. I respond especially to the wonderful promise it holds for the future.

As an old naval workman on the maintenance of aircraft, I could never have approved the intricate and fragile system of using tiles as heat-sinks. Delays could have been anticipated. But now I see that the tiles are marvels of engineering. I think they have an excellent likelihood of working.

Delays due to engine problems are generic in the development of any aeronautical or space machine. In World War II, I was in charge of paperwork on the PBY-5A, an amphibious plane subject to many problems because of salt water. After this plane had been absolutely certified by both the manufacturer and the Navy as seaworthy and had gone into operation as a rescue plane out of Guadalcanal, we ordered 516 major alterations before it was truly flightworthy, and no one thought the number excessive.

The shuttle is a daring experiment, precisely the one we should be making now.

As a writer who wrestles with words, I am dismayed that this tremendous adventure should have been stuck with a name as drab as space shuttle. NASA appreciating this has taken to calling it the STS [Space Transportation System], which is worse. Back in 1971, when the plan was bruited, some genius should have invented one of those words that captivate the imagination, like Kodak, Xerox, *Time*, or TV. Wordsmiths play their own role in civilization.

I wish to add one comment of my own. I have spoken to no one in NASA about what I am about to propose, but I suspect that many experts have been speculating along these lines.

The first four shuttle flights will be handled by only two crewmen, Young and Crippen on the first, Engle and Truly on the second. These will be experimental flights without significant payload. After that, flights with crews of four or more will be normal.

I judge that by the time Flight 17 blasts off on January 31, 1984, it would be practical for the shuttle to carry fare-paying passengers. For something like $25,000 each, up to six civilians could be lifted to an altitude of about 150 miles above the earth, where three days would be spent in orbit at a speed of about 18,000 miles an hour. Windows would provide a good view of sky and Earth, the latter showing about 1,100 miles of surface in all directions.

Experts assure me that the ordinary civilian in good health could be prepared for such a flight in less than three weeks. You'd want to take them up in a T-38 to adjust them to air sickness. Check them out in six or seven simulators. Use the water immersion facility to acquaint them with weightlessness. Maybe the Low Gravity Wall at Langley. They'd have no problem with gravity really. At takeoff they'd pull at most three g's, eyeballs in. No worse than jumping off a low stool. Reentry they'd have to handle less than two g's, eyeballs down. After the first experimental flights, of course, the crew won't wear space suits. Just regular military-type flight suits. Civilian passengers would wear business suits."

Three men I know have already signed up for the first businessmen's special, Lowell Thomas, Walter Cronkite, and I. If the flight takes place, as I think it might, as early as 1984, Thomas will be in his nineties, I in my late seventies, and Cronkite in his late sixties. When we three elder statesmen blast off on a routine flight, the world will awaken to the fact that it has truly entered the Space Age. ∞

"I was making a minor adjustment to the mass accumulator when I dropped a screwdriver into the antimatter core."

HITMAKER

CONTINUED FROM PAGE 58

relationships possible in a town this size. The boy really isn't the problem, since he's still in school. But there isn't anyone else for the girl. Not locally, anyway. And we want this particular relationship. The age difference makes it more interesting."

"Do you think you're being fair to Bill? After all, he didn't vote for the contract."

"That's not it."

"Isn't it? You're punishing him."

"You don't understand."

"I understand that you're hurting him. And yourself, too. If you care for him. If you weren't merely pretending to like him, until a few months ago."

"I wasn't pretending. It's just that the contract—the cameras—" She broke off, averting her gaze.

"I know you don't like the contract. But since you chose to stay'—he hesitated, seeing her mouth harden—'you have to live with it. It has almost ten months to run. Do you think you can treat Bill this way for ten months and then start over when the contract period ends? Assuming he's still here then."

He hated himself for playing that last card, but Sharon had told him to use it. "The boy will be graduating from high school in May. He'll be free to leave the town then. She knows that, but it won't hurt to remind her of it."

Whom wouldn't it hurt? The girl was on the verge of tears, and he didn't feel much better.

"I have to go back to the liaison center now," he said, "and I'll be leaving there tomorrow morning. But I'll tell my staff that they're to relay your calls to me from now on, without any delays. I want you to call me if there are any other problems."

Her eyes turned toward him again. He waited for the angry response he felt he deserved, but she simply nodded.

He left without saying any more, knowing he'd said too much already. The wind was stronger now, and the night seemed colder than it had a few minutes before. He turned up the collar of his parka, then kicked at a sandwich wrapping that had blown down the highway into his path. He gazed silently at the bleak countryside on the way back to the liaison center, ignoring the driver's attempts at conversation.

Jordan returned to Aspen, and three days later Sharon called him again, this time from Los Angeles.

"Congratulations," she said. "Marianne's following the script again."

He said nothing. She regarded him for a few seconds, one eyebrow raised, then looked down at a piece of paper in her hand.

"There's a memo circulating that says you're willing to talk to her personally whenever she calls. Is that wise?"

"It seemed like a good idea at the time."

"You've always limited your contact with the locals."

"I doubt she'll take advantage of it."

Sharon shrugged. "If you say so. I called because I thought you should know that Martinson had a survey done of three thousand of our viewers. More than ninety percent liked the idea of keeping this location more than one year."

"That's meaningless. It's too early in the season. August would be too early. The only findings that matter will be Nielsen's when the new season begins."

"I know that."

"Did you tell Martinson?"

"He didn't ask for my opinion. He hasn't talked to me about it at all. I didn't even know he was doing the survey until the results were published in the newsletter this morning."

"Great."

"I thought so. You wouldn't believe the rumors flying around here."

"They'll die down."

"Sure. But I think you should cut your vacation short. It might help put an end to those rumors if we started the search this week."

"Before the holidays are over? We've never started this early before."

"I know. But you should see the studies my staff has prepared on next year's possibilities."

"That bad?"

She nodded and made a face.

"I promise I'll be there this afternoon. I'll have a drink ready. You'll need it."

Barrett saw more snowbound small towns that winter than he'd thought could exist. He came down with a mild case of influenza and suggested to Sharon that they confine their search to the Sun Belt until spring. She told him they couldn't afford the luxury. They couldn't afford the two weeks he spent in the hospital in March either, recovering from the pneumonia that had developed from the flu, but his doctor didn't ask Sharon for a second opinion.

Martinson paid him a visit after he'd been in the hospital a week. The programming chief made small talk for a few minutes, then told Jordan the network had decided to do a three-part documentary on the war between Bolivia and Chile.

"We've decided to let Dave Youngberg produce it. I was wondering what you thought of him."

Youngberg. Barrett remembered him from film school: they'd graduated the same year. Unlike Jordan, who'd been blessed by the Academy with an Oscar for a student film, Youngberg had had to work his way up from mailboy to story analyst to assistant producer. He hadn't made producer until this year.

"He's competent," Jordan admitted. *Competent, but with no real creative flair.*

"I'm glad you think so. I'm really sorry that we can't use you on this project, but the team will be leaving for South America to-

morrow. Besides, you're still looking for a new CV location.'

He changed the subject then and rattled on cheerfully for some time, seemingly unaware that Jordan was unusually quiet. For a long while after Martinson had gone, Jordan lay staring at the television, not really seeing anything on the screen.

Youngberg

Jordan received a get-well card from Marianne the next day. She'd called him several times during the past few months. There were no further problems, and she had nothing in particular to say; he sensed she was testing his promise. He didn't mind, though. The calls were a welcome break. He'd watched the series from time to time before his illness, and he had the set on almost constantly while he was in the hospital. She was usually smiling now. Bill Morrisey was happier, and so, Sharon told him, were the viewers. The only people unhappy with the relationship were Morrisey's parents, and their opinions couldn't count against those of thirty million viewers.

There had been only twenty-five million in December, but the CV option had been marketed last year as a Christmas gift. Martinson claimed he wasn't surprised by the jump in ratings. ATN gained five new affiliates the same month, four of them switchovers from other networks. In February the ATN newsletter had printed a note from one of the station owners, explaining that his switch had been motivated by the success of the CV series. The rumor mill ground even faster. But Martinson hadn't brought up the subject of contract extension again with either Jordan or Sharon. Barrett felt as if he was living in the eye of a stationary hurricane, and not even Sharon could forecast when it would move. He was almost reluctant to leave the hospital.

It was the worst spring Jordan could remember. Sharon quoted T. S. Eliot on the subject of April and disappeared into her office for days at a time, sifting through the preliminary studies her staff sent in for any sign that a site might work. Out of sheer desperation, they'd taken options on four towns, but Barrett didn't want to think how they'd do in the ratings. Two other networks announced their CV locations in April, and they seemed no better than those ATN had optioned, but Barrett found little comfort in that. It was beginning to look as if CV's success was limiting its life span; it had become impossible to find a town where the locals weren't already picturing themselves on television.

Youngberg's documentary aired in late April. Both the reviews and the ratings were good.

Barrett was in Louisiana in May, looking over a sleepy bayou fishing village, when the liaison center contacted him. Marianne wanted to see him in person. He would have welcomed any other excuse to leave the village was another washout. But he had a pretty good idea why Marianne wanted to see him. He postponed leaving until after midnight, and when he finally reached the liaison center he decided to try to get a few hours' sleep before driving into town.

She was standing outside the door of his suite at five o'clock that morning.

He was still half-asleep when he opened the door, groggily wondering who the hell had taken his memo so literally they'd given her directions to the suite.

"I didn't know you got up so early.'

She glared at him, saying nothing. Then her gaze fell to the ATN monogram embroidered on his silk robe; she grimaced and stalked past him, stopping in the middle of the living room.

'Can I get you a cup of coffee?'

No answer.

"Do you mind if I get some for myself?'

She'd turned to stare at him again, but she still didn't speak. He had the eerie feeling that the past months had melted away, that they'd never spoken at all since that first time he'd seen her inside the service station.

He went into the kitchen and came back with a cup of coffee. Gesturing toward a chair, he invited her to sit down. She remained standing. He sighed and sat down on the couch.

'I know you broke up with Bill Morrisey." He also knew she'd been dropped for a girl three years younger, but he decided it was safer not to mention that.

"You knew it was going to happen, too," she said. "Well, didn't you? You knew in December." She was crying openly, not trying to hide her tears.

'Marianne, it was a possibility. It's always a possibility.'

She stared down at him, her hands clenched into fists. He set the coffee aside and took her wrists, gently drawing her down to sit beside him.

He opened his mouth to speak, then shut it again. He was going to tell her that Morrisey was only a kid, that she'd get over him, that she'd find someone better, but the words were banal, and they didn't negate the truth she suspected. He had known in December that there was a good chance Morrisey would leave her after a few months. The only thing that had surprised Sharon was that the relationship had lasted so long.

"The contract period's over in a few months,' he said at last. "You can leave then. You can afford to move anywhere, do anything you want. You'll be able to meet new people.'

She looked away. He turned her face back toward him and kissed her. Her lips tasted of salt.

Sometime later she pulled away, suddenly tense.

'What's wrong?'

'There are cameras here. Are they on?"

He hesitated a moment, then nodded. The system was semiautomatic, activated when the door was opened. He'd shut the cameras off last night, but Marianne's entry would have reactivated them.

"Please ..."

He stood and crossed the room to the mirror concealing the controls. The system was designed to record meetings between locals and network staff. No one ever saw the films anyway, they were stored in case they might be needed in a contract dispute but they never had been. He slid the mirror aside and touched the controls. The red indicator light went out.

When he turned back toward her, she was taking off the rest of her clothes.

The weather in early July was torrid. Barrett and most of his staff escaped Los Angeles over the Fourth, but they were back on Tuesday, irresistibly drawn back, like people converging on the scene of an accident.

It had been a depressing morning. He and Sharon had reviewed the search to date, ticking off the forty-three towns that had been studied closely out of more than two hundred considered, reexamining the seven communities under option. Several minutes had passed since either of them had spoken. Sharon sat at her desk, shuffling papers. Jordan sat at the window, his hands tucked in his pockets, his eyes half-closed against the glare of the sun-battered streets.

"Martinson called me this morning," he said when he couldn't stand the silence any longer. "Publicity's after him. They want a firm decision on the new location. They're afraid they won't have time to get their campaign in gear."

"*They're* afraid." She laughed, but the sound was humorless.

A minute later she said, "I ran into Jim Orton the other day."

Barrett nodded. Orton was Sharon's counterpart at NTS.

"You wouldn't believe how jealous they are of us."

"Jealous?"

"The ratings."

"Oh." The ratings had been climbing, slowly but steadily, all year.

"He kept asking me about next year's series. They're worried that we'll come up with something better."

"They must know we're still searching."

"I had the impression they're not sure our search is genuine. Their own luck was bad—Orton was willing to admit that—but your reputation scares them. They're expecting you to perform another of your magic tricks at the last minute, pull another winner out of your hat—" She broke off, eyeing him while he shook his head. "Well?"

"Hmm?"

"Are you still in the magic business?"

He stared at her. The words had mocked him, but her tone had been almost pleading. The way she was looking at him both surprised and worried him.

He shook his head again.

"I didn't think so." She glanced down at her desk. "Martinson has asked me to direct another series. It's only an hour a week, but it's prime time. A drama. I'd have to

start working on it next week. I could still keep an eye on the current CV script, but I wouldn't be able to help you with the search or draw up a new script for you."

"Are you going to take it?"

"I'd like to. It's a transition I've been wanting to make. A lot of industry people still treat me as an outsider. Working in CV has done wonders for my bank account, but I still don't have any credibility as a director. There's no way I could go back to the clinic." She paused. Jordan watched silently as she toyed with a pen. "I don't know when I'll get another chance like this. If I don't—"

She stopped suddenly, but she didn't have to finish the sentence for him. If she stayed on, and the next CV series wasn't a hit, she might never get another chance as a director.

"You should take it."

"Alan could help you with the search."

"Sure." But Alan Stein, no matter how competent as Sharon's assistant, could never replace her. She knew it. And Martinson had certainly known it when he made her the offer.

He wished her luck with the new series. As soon as she'd left, he placed a call to Martinson.

"What can I do for you, Jordan?"

It wasn't like Martinson to be so brusque; his usual style was one of indirection. But the programming chief knew Barrett would call. He would have no other choice.

"I'd like to talk to you about extending the contract with the current CV location."

Martinson spared Jordan the trouble of securing the locals' approval of the extension by assigning that chore to someone else. He sent Jordan to South America, to produce another documentary on the war there. It was a top news story again, now that Peru had entered the conflict. Jordan was there most of the remainder of the summer. When he returned in late August, his secretary told him there'd been several calls from Marianne Fisher.

"Why didn't you relay them?"

"To Bolivia?"

There was no point in berating her. So he dropped the subject. In a way he was glad that Marianne hadn't reached him. Still, he should call her. Not for a day or two, though. The footage they'd shot for the documentary hadn't been edited yet, and there were a million other matters to attend to.

He was in his office the next afternoon, talking to Sharon on the phone, when he saw Marianne on television. The set was always on and tuned to the CV series, but he rarely paid any attention to it. Now he stared at the screen.

"I'll get back to you later, Sharon," he said abruptly and hung up.

Marianne was walking down the center of the highway. Luckily, traffic was light; she seemed oblivious of the cars that went by. Jordan leaned forward, his eyes narrowing.

The cameraman must have recognized the object in her hand at the same time as Jordan did, because he zoomed in, suddenly focusing on the pistol. She raised her arm, then the shot had been so tight that Jordan lost sight of the gun. He heard it fire, and the screen went dark.

A second later Marianne reappeared, seen from a different angle. The cameraman tracked her relentlessly as she made her way down the road. He switched cameras from time to time as she hit yet another lens. Jordan thought the man had to be locked into the same detached fascination he'd recognized in himself a few minutes earlier, when he'd caught himself wondering where she'd learned to shoot so accurately.

Marianne stopped for a few seconds to put a fresh clip into the pistol. She had an audience in the town: white faces could be seen watching from windows and doorways. But none of them ventured out as she continued down the highway, faking out more cameras as she went. There was no one within fifty meters of her when she turned the gun on herself.

He was still facing the screen, too numbed to move, when Sharon came in a few minutes later. He didn't hear the door open. He didn't know she was there until she spoke.

"I've talked to our lawyers." Her face was pale, her voice low but shaky. "They say we aren't liable for this incident. If the girl's neighbors pressured her into signing the contract, the network can't be held responsible for that."

He looked away, sickened.

"I know you met with her at the liaison center in May. You didn't say anything to her then about not extending the contract, did you? Jordan, please answer me. This is important."

"I said something to her about the contract being over in a few months, that she'd be happier then."

"That's all right. We didn't know then that we were going to extend the contract. But you're sure you didn't give her any guarantees? You didn't promise her that we wouldn't extend her contract?"

He shook his head.

"Good. Then with the film of your meeting to back us up, we shouldn't—" Her voice trailed off as he turned to stare at her blindly.

"Oh, no, Jordan. You didn't—" She whirled and ran out of the office.

He looked back at the screen. The ambulance finally arrived. It nudged slowly through the crowd that had gathered. Jordan watched as the body was placed on a stretcher and then lifted into an ambulance. The doors slammed shut, and the people scattered, clearing out of the way as the vehicle started moving.

His phone began to ring, the noise soft but insistent against the background of the wailing siren.

He let it ring. Finally it stopped, leaving only the sound of the siren, fading. ◻◻

LAST WALTZ

CONTINUED FROM PAGE 73

print. So think before you act, Margret."

Margret's hand moved smoothly into the pocket of her business suit. Menlar smiled. He knew what she was reaching for, he had given it to her.

"Before you try to coerce me with that elegant little weapon you carry, I think you should know that it isn't my palm that keys the safe."

Her hand came out of her pocket empty. "What do you mean?"

He shrugged. "I mean only someone very close to me can open that safe. Get that person to open it and you win what's inside."

"You have other faked records hidden somewhere."

He shook his head.

"You'd make up others."

"Ah, no. Scout's honor. This is my only play against Harris."

"Does that mean there's one against me?"

Menlar liked her quickness. It made for a good game.

"Just something in reserve." He handed her a holograph viewer. "Here's a holi you may have missed. You never much liked the blue scene."

Margret looked through the eyepiece for a few seconds, gasped, and flung the viewer at Menlar, who sidestepped adroitly.

"Where did you get that filth? I've never done—"

"What's the matter? Not for public consumption?" He grinned. "The master is in the safe."

She stared at him speechlessly, hate in her eyes.

"It's a little something your twin participated in." He swung his hand toward the android standing silent and beautiful beside the elevator. "She even dances as well as you." He beckoned to the android and opened his mouth. No sound came out. He tapped the jeweled disk of the speech synthesizer at his throat. "Technical difficulties," he chuckled distortedly. "Come here," he directed the android, which silently approached.

Menlar keyed a waltz on the penthouse's sound system.

"Will you have the first dance?" He bowed to Margret.

"Go to hell."

"Then perhaps the second." He smiled at the android as it joined him. "Waltz with me," he ordered the machine. "Margret has something to decide."

The man and the machine were soon gliding around the polished wood floor before the tall windows that formed one wall of the penthouse. It was a Cinderella scene: the gallant handsome prince and his breathtakingly beautiful love dancing in a magic ballroom high above the lights of the city. Margret, ignored by both of them, watched with icy eyes.

"You'd like to kill me, wouldn't you?" Menlar sang out over the music as he and the counterfeit Margret swept by to Viennese time. "But your Harris would be blamed." The music carried them to the far corner of the spacious room. "Embrace me, love," he cried, and the android put its arms tightly around him. "You see," he shouted as a great swell of music swept them past Margret again, "your loyal twin would never let me go."

His voice was distorted by the faulty synthesizer. It had a devilish wavering ring. Margret turned her back on the scene. Menlar watched her as he whirled across the floor in the android's embrace. The waltz merged into another and still she kept her back to him and his tireless partner. He knew at that moment he had won. To be sure, he'd have to be on his guard forever after. But what was the game without excitement? As that distressing thought crossed his mind, Margret turned to look at him. "You win!" she shouted over the music. "You win, damn you!"

"The man and the machine were gliding around the polished floor. It was a Cinderella scene, the prince and his love dancing in a magic ballroom. Margret watched with icy eyes."

Menlar opened his mouth to say, "Of course," but nothing came out. He caught a puzzled look on Margret's face as he and the android swept by her without missing a beat.

"You win, I said," she screamed out. "Stop that obscene dancing."

Menlar opened his mouth to command the android to stop and release him, but nothing came out. *Damn synthesizer,* he thought, trying to get his hand to his throat to tap the disk. But the android's embrace held him too closely. A stab of fear shot through him as the dance went on. He gave a mighty wrench of his body; the dance barely faltered. A new waltz merged with the fading of the old one. "The music," he silently mouthed to Margret, "you must stop the music."

He saw her step toward the sound-system controls. Her hand hesitated over them. Then her eyes locked with his, and she suddenly pulled her hand away. Instead of working the controls, she angled toward the dancers, matching the motion of the waltz.

Her arm shot out, and he felt her fingers around the disk at his throat. With a mighty yank she savagely ripped the synthesizer from his neck.

The waltz whirled him around, and he lost sight of her momentarily. When the android swung him back, he saw she had opened the wooden cabinet enclosing the safe. The dull black durite surface had no dial, no visible hinges, only the gray square of the palm-key plate. Margret stood in front of the safe, her small laser held steady in both hands.

Fire it, Menlar thought as the android swung him breathlessly around. *It'll bring the police.*

But she lowered the weapon and stood through a whole waltz, then another, then another. Menlar's legs were starting to cramp. A haze of burning sweat filled his eyes. *Fire it,* he thought desperately. *fire it, fire it, fire it.*

The android swung him to the far end of the room. He tripped, and the automaton's foot crashed down indifferently on his. He felt bones snap, and red pain flashed behind his eyes. They danced closer to Margret. She had put the laser away and was very close to the safe, her palm held out tentatively.

She can't have guessed who it opens for, he thought. His injured foot tripped him up, and the beautiful machine trod on it. A spasm of nausea hit him with the pain, and he felt vomit rising in his throat. Choking it down, he swung around just in time to see Margret's palm press firmly against the key plate of the safe. The door clicked open. He glimpsed her carefully examining the contents, putting them in her handbag. Then he was yanked around again and waltzed toward the glass wall. The lights of the city whirled dizzily below. The music played on.

He began to beat at the android, pounding his fists into the resilient plastiflesh, pounding and pounding until his hands were bruised and bleeding from impacting the durite skeleton beneath the almost-human skin. He tried to let himself fall into the encircling arms, to rest. But his smashed foot was pummeled again, and he pulled himself up with his bloody hands and tried desperately to keep time with the interminable waltz.

Through a haze of pain he saw that Margret was standing over the music controls, watching him and her twin intently. *She can't go through with it,* he thought.

As her hand went down to the controls, he was pulled smoothly around by the robot. He felt a surge of strength in the thought of release and the thought of rematch. *No one beats me twice,* he thought. Swinging around, he saw that Margret was still at the music controls. *Stupid for an engineer,* he thought in pain. *can't even work it. The green button,* he mouthed soundlessly. Then he was dragged again across the room.

When the android turned him once more in the dance, he saw that Margret was gone. When he heard the music speeding up, he opened his mouth and tried to scream.

Small Connecticut Firm's New Golf Ball Flies Too Far; Banned by U.S.G.A.

GOLFERS LOVE IT

"No more par 5's?"

NORWALK, CT—All golf balls are not created equal. At least not any more. A small Connecticut company has introduced a controversial new ball it guarantees will out-distance all legal balls, including Hogan, Top Flight, MaxFli and Titleist. The new ball is so "hot" it threatens to pull the rug on par, as we know it, and that might have the United States Golf Association worried.

For thirty-eight years the U.S.G.A. has strictly enforced the rule that a golf ball may not exceed a velocity of 250 feet-per-second off the club head. Without this and other restrictions, high-powered super balls would soon outmode most golf courses. Par fives could disappear, and even an average player could regularly blast 300-yard drives. So far major U.S. manufacturers have observed this speed limit and other U.S.G.A. rules designed to keep all balls created equal.

But now, a little-known company called H & L Labs is distributing a ball that violates nearly every rule in the book, and the result is a ball that flies down the fairway like a Ferrari on the run.

The ball has provoked heated controversy because it looks, sounds, and feels exactly like a regular ball. H & L refuses to release the ball's name to anyone but a buyer—they simply call it "The Hot One"—so about the only way another player can tell he's playing against one is to keep a radar set in his bag.

And while golf prides itself on being a gentlemen's game, it seems that more than 40,000 gentlemen—and ladies—are carrying these innocent-looking buzz bombs in their bags. Some say if the U.S.G.A. ever approved the engineering in this ball, pros might start shooting in the 50's.

What's special about the illegal ball? John McGuire, the director of H & L told me this: "We've doctored up the ball's aerodynamics so that it has less drag than conventional balls. You can tell the difference with your first drive. What's more, the special design could help keep tee and fairway shots straight down the middle ... 'bites and sits' with more authority ... putts with a steadier roll ... and is virtually cut-proof." McGuire believes that more money is going to change hands with this little white bandit than all the tournament purses put together.

So far most pro shops don't dare carry it, but if you want to "test drive" the world's longest ball, H & L will send you one FREE. Just order a dozen balls and they will send you thirteen. They ask you to use the extra ball for a few holes. Tests against the best legal balls on the market prove you could add as much as 22 yards to your tee shots. If you don't, return the remaining dozen for a prompt refund. The free ball is yours to keep in any case—for fun or profit.

And if you ever cut one of these super balls in normal play, H & L will replace it free. You pay only the return postage, about 25¢.

A dozen hot balls cost $19.95 (plus $1.75 postage and handling). Two or more dozen cost just $18.00 each and H & L pays all shipping costs. The address is: H & L Labs (Dept. HG 54), 18 Lois Street, Norwalk, CT 06851. You can send a check or charge it, but be sure you give them your card's account number and expiration date.

INTERVIEW

CONTINUED FROM PAGE 69

Omni: Denis Hayes, head of the Solar Energy Research Institute, has offered two criticisms of the SPS idea [*Omni*, August 1980]. One, that we would have to spend eighty billion dollars before we got a return on our investment; two, that we can achieve the same cost goals here on Earth using solar technologies.

Glaser: And what if he's wrong? Major reliance on terrestrial solar energy may not be feasible, not in Europe or even Japan. Europeans are unlikely to put solar cells on their rooftops. We are very fortunate because we have the sunny Southwest.

Omni: There is still that big price tag. In the report you helped write for *Spectrum*, the Institute of Electrical and Electronic Engineers periodical, the number that jumps off the page is three quarters of a trillion dollars.

Glaser: Let me tell you how that number came about. The money to develop the first satellite is estimated to range from forty billion to sixty billion dollars. NASA came up with a scenario asking, How many satellites do you think we should consider from the year 2000 to 2030? I assure you it was like you and me sitting across this table saying, Well, we can build two a year. Over thirty years, that's sixty satellites. How about sixty? If the cost for each satellite were from ten billion to fifteen billion dollars and you add that to the forty billion to sixty billion, you come close to three quarters of a trillion dollars.

Now what people don't realize is that to supply three hundred gigawatts—whether we do it with SPS, coal, or nuclear power—the capital costs would be about the same. Besides, unlike the Apollo program, which cost about twenty-five billion dollars in 1965 dollars—and that's about seventy-five billion dollars today—I'm convinced the SPS shouldn't be a totally U.S. program.

Omni: Why?

Glaser: If you accept the premise that the SPS program would help global civilization utilize space, we would not be allowed to create a monopoly with SPS. The reasons are various, but the real reason is that if we go it alone, we would be the true global superpower. No way that's going to happen. That would be a cause for war. I am convinced that we will have to work with other nations. Our role would be as the catalyst, as we succeeded in doing with the Intelsat communications satellite organization.

Omni: How many satellites will it take to service the world?

Glaser: It's hard to tell. The difficulty is in knowing what percentage of baseload power is to be provided by solar power satellites. The NASA people are working with a sixty-satellite scenario for the United States. For Europe, forty satellites. That's over a thirty-year time span, starting in the year 2000. My guess is twenty or thirty for the rest of the world during that time.

Omni: What percentage of U.S. energy appetites could the SPS satisfy?

Glaser: I believe it could probably reach thirty percent over a thirty-year period. By 2050 the SPS could supply much more, perhaps fifty or sixty percent.

Omni: How would this massive undertaking be funded? By some multinational energy corporation?

Glaser: I don't believe one corporation will be able to do this. No one utility or corporation could obtain global acceptance. The closest thing to the idea of international organization, though the analogy is imperfect, is Intelsat. It's owned by one hundred two countries. I believe that InterSunsat [the SPS equivalent of Intelsat] will be owned by as many countries as will benefit from the SPS. This is one project from which everyone benefits and no one loses, as is already the case with the communications satellites.

Omni: More and more satellites are being put up in geosynchronous orbit. Should we be reserving space for the SPS now?

Glaser: If you look at the number of satellites placed in geosynchronous orbit in the last fifteen years, and you project that number to the future, it's clear we cannot go on like this forever. Therefore satellite functions will have to be agglomerated in satellite platforms. This proposal is already

being talked about by experts in the field

Omni: Some of the equatorial countries are suing for space rights over their land

Glaser: They just want to have a piece of the action. If they are in this with us and other countries and they see a benefit they shouldn't have any objections. We will have to work with developing countries. In a sense the SPS is more important for developing countries than for the United States because they don't have the alternative energy sources we do. They do not have the infrastructure to start nuclear-power plants but they have the know-how to construct receiving antennas.

Omni: It sounds as if there will have to be a new level of terrestrial diplomacy to prepare for the SPS.

Glaser: That's correct. I discussed the policy issues at some length with the State Department to get them sensitized to the international implications. There are projects on the SPS in Europe, Canada, and the Soviet Union. The Chinese are also interested. The United Nations Committee on the Peaceful Uses of Outer Space and the World Administration Radio Conference have also considered the SPS.

Omni: The Russians have been making almost monthly headlines by setting new records for living in space. They must be leading up to something. Do you know whether there is a strong interest in the SPS idea in the Soviet Union?

Glaser: I can only refer to an article that appeared in *New Scientist* on the subject of the Soviet space program. It quoted the designer of the *Salyut* spacecraft as saying that the kind of experience they were getting would enable them to build a space station, start industrial activities in space, and eventually build solar power satellites. Since some of the best articles on the solar-power satellite are published in Moscow, I feel they probably have a program. They very probably also have every one of the fifty reports that DOE has published and are carefully following our work.

Obviously they seem to have a much clearer vision of what they want to do in space and are methodically extending their capabilities. The Russians tend to be good chess players and plan ahead. Our chess game is limited by four-year presidential terms. This makes for difficulties in planning any long-range program.

Omni: Aside from objections to the cost of the SPS and the fact that it centralizes solar power, what about the claims that it can be blown out of orbit?

Glaser: There are many such vulnerability issues, and I think they're valid. They're valid if the satellite has a U.S. flag on it because then you're destroying U.S. property. If, for argument's sake, you have the U.N. flag on it, whose property are you destroying? I've always looked upon the satellite's vulnerability as being its best defense. It's not a military object. Also, it's not easily accessible to terrorists. It's a lot more difficult to damage the SPS in orbit than to attack a power plant here on Earth.

Omni Some of the larger satellites that have been launched have developed strange problems that smaller satellites have not, such as mass charging—where a kind of static electricity interferes with the satellite's operation. Are you monitoring the kinds of problems they are having?

Glaser Yes, work on spacecraft-charging phenomena is proceeding. In the technical area I'm very comfortable. Not a single real show stopper has been uncovered, and a lot of people have been looking for one. In the environmental area I believe we need more R&D. I don't believe that the biological effects of low-level microwaves are going to be a major factor, but we don't have the necessary data yet. As for accidentally burning up cities or frying ducks, I'm not worried. The low density of the microwave beam makes this impossible.

Omni Have you considered the possibility of eliminating microwaves if they are proved harmful?

Glaser Of course. We've just completed a report on alternative technologies for the SPS. We found about eighty of them. We started originally with microwaves because at the time I proposed the SPS concept it was the only credible way to transmit power over long distances. Had I said we were going to use lasers, it would have been unthinkable. People thought my idea was science-fictiony enough as it was.

Omni What about using lasers instead of microwaves?

Glaser That's much longer-term. I think. We don't have the technology quite in hand—for example, how to convert laser radiation directly into electricity. And beyond that, I'm concerned about the effects of exhaust products released in the upper atmosphere, particularly water vapor.

Omni You mean the effects of making a hole in the ionosphere?

Glaser Yes. We've identified these problems, but some data are still lacking. The space shuttle should help us get this information. Another environmental problem is the siting of the receiving antennas. But since most cities around the world are near the seashore, offshore antennas look very exciting, particularly since they can have secondary uses for mariculture, fishing, and a number of other processes.

Land sites could also be attractive if you put the antenna in an agriculturally hostile area, or even a desert. You could then justify greenhouse construction because the structure is already there. Work done at the University of Tucson under sponsorship of the Rockefeller Foundation has shown that in a closed environment you could raise vegetables and make the desert bloom. You could construct hydroponic farms underneath the antennas, which are actually quite transparent to sunlight. And they let the rain fall through.

Omni What most people seem to have trouble handling is the scale and complexity of the idea, plus the fact that we have to leave the planet to do it all in space, like the Apollo project.

Glaser The SPS concept is totally different from landing a few men on the moon. How many people really care now that we have made several trips to the moon and brought back some rocks? The SPS represents several things. In the long run it may be irrelevant that the SPS will produce power. That will be a by-product. The most important thing is that SPS technology will allow us to extend civilization beyond the earth, because we will develop our capacities to orbit payloads and assemble large structures. Without an SPS, I have grave doubts that significant industrial activity will take place in space.

Omni Is there no other catalyst that would draw people out to space?

Glaser That's right. The fact is, we'll have a large number of people living in orbit. Their objective will be first to construct the solar-power satellites. Once we do that, it will be just like the railroads that were built across this country. We couldn't have predicted all of the things that happened when railroads were built. I think the analogy between railroads and space transportation is very close.

"Who really cares that we made several trips to the moon and brought back some rocks? SPS technology, on the other hand, will permit us to extend civilization beyond Earth."

That leads me to the view that if solar satellites are as useful as I think they can be on a global basis, then we'll be constructing hundreds, but not only out of Earth material. We may have only ten or twenty built from terrestrial materials. I picture a scene where the InterSunsat equivalent of Intelsat has a board of directors' meeting. The chairman of the board and board members convene and announce they have plans to build another dozen satellites. The chief engineer makes a presentation where he may say something like this: "We think it will be more economical to use lunar materials to construct the SPS. I think it's going to be an economic decision to go back to the moon and use lunar materials."

Omni That meshes with Gerard O'Neill's vision of space habitats.

Glaser Absolutely. I think once we have the capacity to build an SPS, we can set up lunar bases. [*Omni* space expert] Brian O'Leary wants to capture asteroids; we could go and use the material there as well.

Omni O'Neill has said [*Omni*, July 1979] he believes his colonies are necessary but not urgent and that the solar-power satellite is urgent but not necessary.

Glaser The way I'm presenting the solar-power satellite is as an option with perhaps less present certainty than such other options as coal and nuclear fission, though these aren't really long-term options since we cannot expect to use them much beyond the twenty-first century. Therefore we will have to develop fast breeder reactors and then fusion. The uncertainties associated with these options are of a magnitude that I think far surpasses the uncertainties of the solar satellite.

Omni In the introductory part of your 1968 article you make an allusion to Freeman Dyson's three types of civilization. I suppose, according to his scenario, we are foundering through the dying phase of Type I—using up the energy available on our planet—and we're on the verge of Type II—using up the energy radiated by our sun. Do you think this solar jump is inevitable for us? Do you think others made it?

Glaser You know an interesting thing would have happened in Britain when James Watt started to work on the steam engine: if the British had not found coal easily accessible, we might now have a solar civilization. The central attraction of the Paris Exposition of 1889 was a solar-powered steam engine. So I feel the Industrial Revolution could have gone either way. But to answer your question, I think it's inconceivable that if there are other civilizations in the universe, they would rely on nonrenewable fuels or that they would rely totally on nuclear fuels because of the inherent dangers some of them may pose to any civilization.

Omni Right now much of our own hope of getting out into space is riding on the space shuttle. Do you feel frustrated at the halting progress they're making with it?

Glaser My chief concern about the space shuttle is the psychological damage a failure might have on the space program. I am absolutely convinced that we will build it and that it will fly, but what is happening now is that any opponent of the space program or the SPS can say, "You don't even know how to build this space shuttle, and you're telling me you're going to build this huge, expensive thing in synchronous orbit? What nonsense!"

Omni Do you hope to see an SPS put out there in your lifetime?

Glaser I am asked this often. Let me paraphrase a Talmudic saying: "You have the responsibility to start on a journey, but God does not expect you to finish it." I have the responsibility to share with people my view of solar power satellites and the potential of space industrialization that this implies. I can't say whether or not I will live to see this concept in its final form. ∞

Any individual or organization interested in joining the Sunsat Energy Council can obtain information by writing to: Sunsat Energy Council, P.O. Box 201, Cold Spring, NY 10516.

FOLK SOCIETY IN TORONTO

PEOPLE

By Dick Teresi

Kurt Vonnegut Jr once wrote that all of us "are full of chemicals which require us to belong to folk societies or failing that to feel lousy all the time" He was addressing the National Institute of Arts and Letters which he said didn't really give a damn about arts and letters but was instead held together by "chemically induced efforts to form a superstitious affectionate clan or village or tribe" Other attempts at folk societies the novelist claimed include the Lions Club the Loyal Order of Moose and the War Dads of America

The American Association for the Advancement of Science (AAAS) met this past January in Toronto and showed perhaps that a cold climate helps promote folk societies It was a week of record low temperatures for Toronto and most scientists wisely stayed home This left only the faithful to attend a total of about 3 000 or a little more than half the number who traveled to beautiful and warm San Francisco the previous year Perhaps because of that this year's AAAS meeting was rather warm and friendly on a personal level as everyone kept to the hotel lobbies and bars, rarely venturing into the Toronto cold Nor did they venture into differences of opinion or anything else that might smack of controversy

Porter Kier Hate mail and lots of it

An important symposium for example was held on evolution which is currently under serious attack by so-called *scientific* creationists Porter M Kier senior scientist at the Smithsonian Institution when asked to make a statement summing up his position said, "There are one hundred million fossils in museums throughout the world These are one hundred million facts that prove evolution without a doubt End of statement" This is not a stand designed to raise a lot of hackles at a convention of scientists And indeed everyone on the panel and in the audience agreed with Kier Or at least nobody challenged him

Joining the attack was William V Mayer of the Biological Sciences Curriculum Study in Boulder Colorado who claimed that coverage of evolution in biology textbooks has diminished considerably since the 1960s and has even been expunged from some books "Creationists tend to be conservatives," said Mayer "but in this area they use every governmental device available to put pressure on school boards" Mayer claimed creationist publishers make a great deal of money by getting their material mandated into school curricula

Kier emphasized that evolution had become a highly emotional issue When the Smithsonian announced plans to display a "Hall of Evolution," Kier said he received 600 hate letters

All well and good, but it's curious that the AAAS chose not to include any creationists in the symposium, which would certainly have livened things up a bit It also didn't help that the title of the symposium didn't include the word *evolution* Instead it was nebulously entitled "Views of the Universe Science versus Tradition"

Omni agrees wholeheartedly with the pro-evolution stance (see Ben Bova's article "The Creationists Equal Time" in the October 1980 Continuum) But scientists' refusal to come forward with their attack in a meaningful way is a bit maddening Some say they don't want to dignify creationists with a debate Boxer Roberto Duran displayed a similar attitude in his last fight with Sugar Ray Leonard —with similar results

Uri Geller The $100 000 challenge

Uri Geller the Israeli spoon bender and entertainer who claims to have paranormal abilities is offering a $100 000 challenge to magician James "the Amazing" Randi or anybody else who can duplicate his results at Stanford Research Institute In those experiments conducted by Russell Targ and Harold Puthoff in the 1970s, Geller supposedly accomplished several feats of telepathy Randi pooh-poohed the experiments in the April 1980 *Omni* Interview and in his book *Flim-Flam!*

Geller's challenge stipulates that any takers duplicate his results "under the same controlled conditions imposed on [me] with the same scientists at Stanford Research Institute" Randi has gleefully accepted the challenge on behalf of *Omni* We await Geller's response ∞

SCIENCE DOWN UNDER

EXPLORATIONS

By Robert Rivlin

From inside an airtight capsule, former astronaut Scott Carpenter gazes at a magnificent canyon of orange, white, and black coral. The reef resembles a forest of petrified cacti sloping gently on one side and plummeting to nearly 12,000 feet on the other. For an instant the eye is tricked into believing that our space program has reached an alien, watery planet and established a base for the brave aquanauts sent to colonize it.

Alas, the illusion ends. Carpenter is just 50 feet below the surface in terran tropical waters off St. Croix, in the U.S. Virgin Islands. The vessel that houses him is the NOAA (National Oceanic and Atmospheric Administration) Hydrolab—a cylinder 16 feet long by 8 feet in diameter with domed ends. And the ex-astronaut is merely a visitor among scientists who normally spend up to eight days underwater for the opportunity to study the marine ecosystem.

Carpenter minimizes the similarities between his experiences in outer space—he completed three orbits around Earth in a Mercury spacecraft on May 24, 1962—and those underwater, where he participated in the Navy's Sealab experiments. In a spacecraft, he explains, astronauts are weightless. In Hydrolab there is almost normal gravity. In space there is no nearby life, either to observe or to come to one's rescue. Venturing even a short distance from a spacecraft requires elaborate precautions. But aquanauts can come and go from the Hydrolab with the simplest of scuba gear.

Still, parallels spring to mind almost inevitably. In both instances technology is extending the physical frontiers of our knowledge. The world outside the life-sustaining capsule is one in which we are not at home. There is no immediate escape until the vessel returns to Earth's atmosphere.

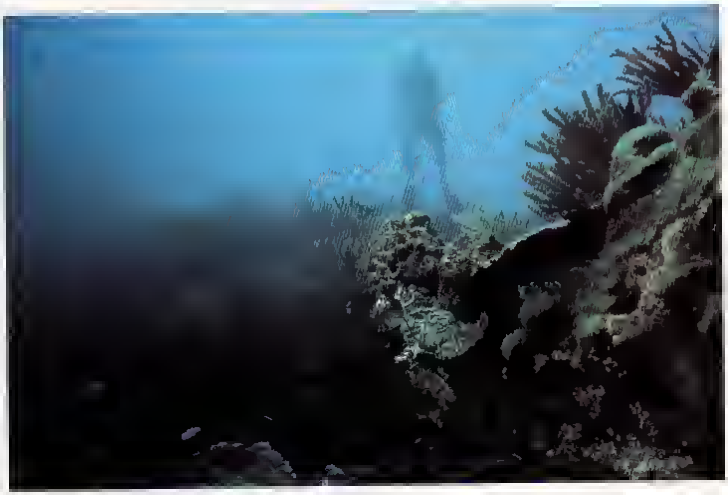
Carpenter's presence at the Hydrolab is unusual; he has never participated in any of the research missions the lab conducts each year. While Stuart Goodman Productions documents the space pioneer's visit for ABC television, operations manager John Fish takes time out to explain highlights of the laboratory's history.

The Hydrolab was built in 1966, during the heyday of interest in PVHOs (pressure vessels for human occupancy)—a field pioneered by George Bond and Jacques Cousteau. Bond, working for the U.S. Navy, used a pressurized chamber to simulate a prolonged dive to 200 feet. Encouraged by the success of the experiment, Cousteau submerged for several days in the Red Sea at nearly 30 feet. The Navy's *Sealab 1* took the process one step further, housing ten aquanauts at 200 feet for 11 days. (Carpenter missed the *Sealab 1* experiment because of a motorcycle injury but dived to the same depth for 45 days in *Sealab 2*.)

When these tests were conducted in the late Sixties and early Seventies, public interest in the marine world was enormous. Ocean scientists looked increasingly to the seas to supplement the strained resources of the planet's land areas. Could the oceans be made to yield up enough nutrients to feed the world's ever-growing population? What precious metals and other resources awaited in this vast, unexplored domain?

While the Sealab missions tested the limits of man's physical endurance underwater, the Hydrolab became the Volkswagen of the PVHO world. Operating in warm water at depths no greater than 60 feet, it was just large enough to hold four occupants. (There are only three bunks in the interior, because one diver must remain awake at all times.) Hydrolab was not intended to establish new frontiers. Its purpose was to let researchers spend extended periods below. The manufacturer, Perry Oceanographics, first leased it to a university in southern Florida, but then operated the lab itself from Freeport, in the Bahamas. When marine science began to lose popularity in the mid-Seventies, the large PVHOs became rusting hulks in shipyard junk piles. The compact, less luxurious Hydrolab kept chugging along—small enough to be run on even the most meager budget.

In 1976 Perry itself began to lose interest. NOAA purchased the facility and moved it to the Salt River Canyon, off St.



A Hydrolab-based scientist searches the Salt River Canyon for rare specimens of black coral

Croix—its present location. With an annual operating budget of less than $250,000, it has survived waning public interest, four or five big hurricanes, and several moves to become the world's only undersea habitat that runs year round. (A Soviet project in the Black Sea operates in slightly shallower water but only during the summer months.)

What makes the Hydrolab special and perhaps explains its survival is the continuing scientific emphasis of the projects at Salt River Canyon. Among other things, visiting researchers study the rate of coral formation, tidal drift through the canyon and the presence of various commercially harvested fish at varying ocean levels. Because of its unique location, Hydrolab also offers the chance to study the extremely rare black coral that is usually found only at much greater depths. Other scientists are exploring the nutrient-cycling ability of sponges by injecting them with brightly colored dye and measuring the rate at which it is ejected. This is marine science, not the human physiology and psychology of underwater habitation.

The week-long production schedule doesn't permit Carpenter to 'saturate' with nitrogen. The gas, which is contained in the compressed-air supply, gradually dissolves into the bloodstream under pressure. If the aquanaut spends a long enough period at a given depth, the blood absorbs as much nitrogen as it can hold at that pressure level; it becomes saturated with nitrogen. Once this equilibrium is reached, the diver can spend extended periods below without lengthening the time needed for decompression when he finally returns to the surface.

At 50 feet, Hydrolab's depth, the saturated diver must take several days to surface. If he attempts to make a rapid ascent, the nitrogen in his bloodstream will not have a chance to dissolve out slowly. Instead, it forms bubbles that become lodged in the blood vessels of the heart or the brain. This condition, known as the bends, can cause acute pain and even death.

Carpenter can spend only 25 minutes at 95 feet without extending his decompression time. Saturated aquanauts can stay there up to six hours before loss of body heat and exhaustion from the seemingly effortless act of swimming underwater force them back to the habitat. This is Hydrolab's real payoff. Scientists need to decompress only once, at the end of the week-long mission. Without the habitat, they would have to go through decompression after each dive.

Despite his visitor's status, Carpenter receives as thorough a briefing and medical checkout as a diver who might be staying down for weeks. Watched by the federal government, which funds Hydrolab through an NOAA grant to Fairleigh Dickinson University in New Jersey, the project has no room for error nor a moment's hesitation about what to do in an unlikely emergency.

Dr. William Schane, the program's medical officer, goes over the elaborate life-support systems with Carpenter. "Backups for the backups for the backups" is the general rule of thumb, both for the aquanaut's diving gear and for Hydrolab's equally vital support system.

Clearly the primary need is for air. Permanently anchored on the surface immediately above the Hydrolab is the Life Support Boat (LSB). This is a small engineless vessel that pumps a steady supply of oxygen down an umbilical cord to the Hydrolab. The same air supply feeds a number of "bubbles" located at strategic points around the study area. These are small, plastic domes in which two divers can remove their breathing apparatus and converse. The LSB also supplies Hydrolab with less essential conveniences—fresh water, electricity and radio-communications links.

The primary backup system is four 2,000-cubic-foot submarine flasks connected by a high-pressure air line to Hydrolab. At the base, two air compressors, one a backup for the other, keep the flasks topped off. If the LSB malfunctions, the aquanauts simply enter a small chamber immediately next to Hydrolab—the External Air Station—which constantly receives air from the submarine flasks or from the line that extends from shore.

If all else fails, Hydrolab itself stores enough air for 360 man-hours of breathing, though the air becomes stale very quickly without continual replacement and dehumidifying.

Safety is also designed into the aquanaut's personal diving gear. In an emergency the last thing any diver should do is head for the surface. Everything is engineered to keep the diver down, for without 16 hours of very carefully controlled decompression, death within a half hour is almost inevitable.

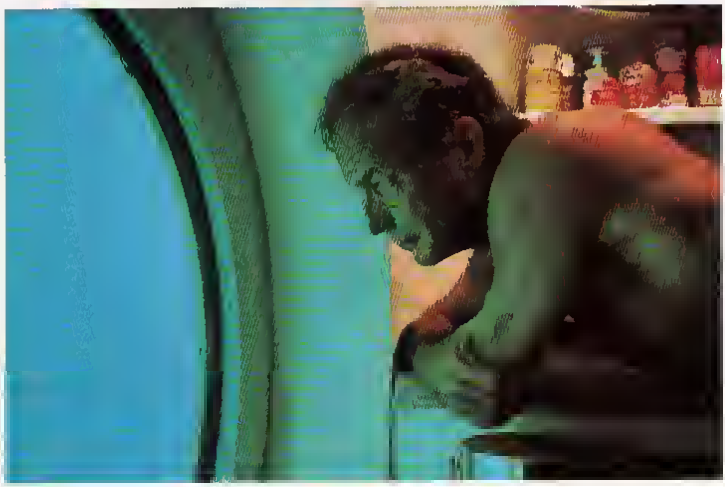
Weight belts that help keep the diver neutrally buoyant in the water are worn inside out to make sure they are not accidentally opened, sending the diver bobbing to the surface. Life vests are stripped of the CO_2 cartridges normally used to surface rapidly. Air tanks, generally made to float when empty, are weighted. The list of special precautions is almost endless. They all serve to make the aquanauts think of themselves more as fish, at home in the water than as surface-breathing mammals. When the divers are saturated, home is down below.

Where does it all lead? The question is uppermost in Carpenter's mind even while he watches the psychedelic rainbow of colored fish schooling outside the lab's viewing port. Hydrolab's scientific staff has no ready answers. As marine investigators, they have no problems with the most complex data—questions about sediment deposition rates, coral ecosystems, even the growth rate of black coral. But the future is a highly charged political question, dependent as much on congressional appropriations and public interest as on the validity of scientific research.

Hydrolab will continue as a research tool for ocean studies. And who knows? There may someday be a mobile Hydrolab, able to follow schools of commercial fish as they move from level to level. There may one day be a deepwater Hydrolab, permitting scientists to study species 300 feet or more down. But this is as far as anyone dreams. Bubble cities under the ocean are for the far future, at best.

Carpenter smiles knowingly, understanding how similar to the space program the Hydrolab really is. Schooling cod are not nearly as romantic as a city of mermaids and mermen, but much more realistically fundable.

Scott Carpenter's visit to the NOAA Hydrolab will be telecast in June on ABC's *American Sportsman*. Check local listings for the exact time. ∞



At home inside the Hydrolab, Carpenter ponders an alien world of black coral and exotic fish

MIND

CONTINUED FROM PAGE 26

displays on your TV showing you what's wrong by using programs from linked central storage libraries

If you work in a job where you stay in the same position all day feedback equipment may help relieve strain. You'll attach a joint angle monitor to your hip or knee, a pressure transducer on your chair, or a strain gauge on your back. When you're in the right position, they will remain silent. But you'll get a warning if you move too far from the healthiest, most efficient posture. The feedback will cut your risk of back pain and muscle aches and will bring you more energy on the job.

John Basmajian, M.D., a world-renowned rehabilitation expert, applies another BF technique to revive the muscles of paralyzed stroke patients. These people have to learn how to use their muscles all over again. Muscles are composed of groups of motor units, each controlled by a single cell in the spinal cord. Dr. Basmajian uses needle-thin microelectrodes to feed back the activity of a single motor group. Each nerve impulse causes a sound. That way, even the smallest amount of surviving muscle control can be measured through repetition.

After just a few days or weeks of practice, some of the patients were able to send Morse code BF signals by controlling their single-celled motor neurons. Basmajian says, "People have much better inherent ability to control internal behavior if they are given biofeedback. Training for improved muscle performance is one of biofeedback's most proven uses."

Other researchers have been training people to activate parts of the brain and turn on different brain-wave frequencies. Epileptics are being taught to abort seizures by producing a preventive brain-wave pattern. Psychiatric patients listen better when they produce brain waves that make them more receptive to suggestion. Bright, intuitively street-wise ghetto children are right-brain dominant, but they can improve their reading and mathematical abilities, which require analytical, logical thinking, by using biofeedback to increase the activity of their left brain hemisphere.

Already, computers have been connected with electroencephalographic (EEG) brain-wave monitors. They turn tape recordings or video terminals on and off depending on an individual's brain-wave state. This technology is still in its infancy, but eventually you'll be able to enhance your reading speed and information retention by working with a video screen connected to an EEG monitor. The rate the words are presented will be determined by your brain-wave activity. The color of the screen, the size of the letters, the audio background, all will be modulated to maximize your brain's receptivity.

With simpler technology, hyperactive children are already watching TV and slide shows this way. The program is turned on only when the kids relax their muscles enough.

After muscle biofeedback, thermal feedback training to increase blood flow is probably the most common BF technique used today. Blood heated at the body's core distributes warmth to the skin and limbs. Peripheral blood-flow regulation is one of the most easily mastered self-control techniques. It's used to relieve migraine headaches, chronic pain, arthritis, menstrual discomfort, high blood pressure, skin diseases, and stress disorders. Even Raynaud's syndrome, a disease in which hands, usually responding to cold weather or air conditioning, get painfully cold because of decreased blood circulation, has been alleviated with BF. It's even been shown to speed the healing of burns.

For all its benefits, we still don't understand how BF works. Ed Taub, president of the Biofeedback Society of America, doesn't see this as a problem. The actions of drugs, he argues, are also poorly understood. We test them to make sure they're safe and to see what they do, then we use them, even if the mechanism for their operation isn't fully understood. BF, he believes, is at the same stage and will remain so until much more is learned about the brain and its supporting network of nerves. ∞

EARTH

CONTINUED FROM PAGE 20

photovoltaic research Monika Lumsdaine of New Mexico addressed the conference on passive solar home design and Sarah Elston a "burned-out" teacher turned puppeteer told how she delivers the solar message to schoolchildren from a theater she carries on her back

Solar segregation was not the only issue that heated up the conference High-pitched voices filled the hall when the discussion turned to the issue of sexual preference and solar energy One panel for example was called "Lesbians and Grass-roots Solar Organizing"

"Eighty percent of the women in solar building are lesbians" Billi Luise Potts a forty-year-old self-proclaimed "lesbian feminist" declared "Considering their numbers she said lesbians are an untapped resource in the solar-energy movement "Lesbians have huge funding abilities and sophisticated skills" she said "We must recognize our witching powers"

Potts who has built a solar greenhouse on her 45 acres of abandoned quarry land stressed that it will take more to feminize the solar movement than simply including women The solar-energy field is entirely determined by male thinking she said complaining that the design of solar structures is sterile and cold Other solar builders agreed "Men come at greenhouses from an engineering or architectural point of view not from a growing point of view" one woman said "Women approach greenhouses as horticulturists"

The first person to acknowledge the existence of men at the conference was actress and solar activist Joan Hackett who had completed a CBS movie on solar energy called *Harnessing the Sun* She started to say "I'd like to see men included" but then stopped herself as it sensing that she was treading into controversial territory So she said only "I am pleased to see the men in the room and thank our brothers for coming here today"

By the end of the conference the future of solar sisterhood was uncertain Some women were disappointed with the parochial viewpoint of the speakers while one found the conference to be "a well balanced holistic approach for all women" By the closing ceremonies the women were divided into one group that wanted to affiliate with the International Solar Energy Society and another that wanted to remain an independent all-female organization

Special women's events are already being planned for the next Passive Solar Conference, to be held this year in Portland Oregon But if an organized body of solar feminists is present they won't be represented by Women in Solar Energy WISE officials have learned that there is already an international organization called World Information Services on Energy, which uses the same initials ⊠

COMMUNICATIONS

CONTINUED FROM PAGE 12

Half-life

"Brain Mending," by Kathleen McAuliffe [Life January 1981] states that embryos including human embryos might become an invaluable source of brain tissue for transplantations In order to get the embryonic tissue needed for transplantation You'll have to use a living human embryo An aborted fetus won't do

Twice I have witnessed spontaneously aborted human fetuses that cried moved and gasped for breath Neither fetus was large enough to survive One was allowed to gasp its last in a sterile stainless-steel basin watched over by several student nurses with tears streaming down their faces The other I held wrapped in a sterile towel until it died

Granted there are crucial minutes in which you could take the fetus to the hospital lab alive instead of dead But you couldn't get a nurse to deliver a living fetus to a doctor to dissect

June M McConnell R N
Port Richey Fla

How Observant Are You?

I want to quibble about the Games answer [February 1981] that says that hot dogs come in packages of ten Perhaps they do wherever Mr Morris lives but I checked a local supermarket and found brands that come in packages of 8 10, or 12 So the answer is not correct everywhere

Green is usually on the bottom of a traffic light but the city of Mount Pleasant, Iowa, used to have red on the bottom It's been switched since probably because of federal regulations

Robert D Smith
Swisher Iowa

Nigeria 2000

I want to commend Susan Mazur for her Explorations column on Nigeria [December 1980] However I disagree with the assumption that nuclear physicist Dr Felix Oragwu is probably the single most knowledgeable scientist in Nigeria *Omni*'s article should be an example to Western journalists who have focused their attentions primarily on the vices of African countries rather than on their virtues and progress

Buki O Dosunmu
Sault Ste Marie
Ont Canada

Capitalist Education

Malcolm Forbes's perspectives on education [Interview February 1981] were most enlightening As a senior engineering student at a university on the West Coast I relate to the struggle in our colleges as to what should receive the primary emphasis science and technology or the humanities

The problem stems partially from higher education's unwritten rule of developing a four-year undergraduate program for engineering majors as well as those who select other fields Ten years ago technology was such that a student could be provided with a solid engineering background and still enjoy the flavor of literature and philosophy Today with the overwhelming pace of electrical and computer engineering fields colleges have had to cut some essential fundamentals of study including the humanities

Colleges should reevaluate the time allotment needed for a well-rounded quality education Let's not skimp when it comes to educating America's youth for the future

Robert J Levi
San Luis Obispo Calif

Space Politics

There should be some consolidation of effort if the space program outlined in the articles by Brian O'Leary and Trudy Bell in the February *Omni* is to be effective

As I look at the list of organizations I wonder which one(s) I should throw my support to Overhead and administrative expense could be channeled into the programs they are touting if somehow they could be combined into one organization

Let government stick to defense and arbitrating disputes between states and if someone or some group(s) want(s) the United States in space then let them raise the money and get on with it If it's a noble and enterprising program there ought to be enough large corporations that will venture investments of their capital

We should involve ourselves in space exploration but let's do it by private initiative and capital investment not coercively through a government program

William G Byars
Lubbock Tex

I was much impressed with Brian O'Leary's editorial on the space program [First Word February 1981]

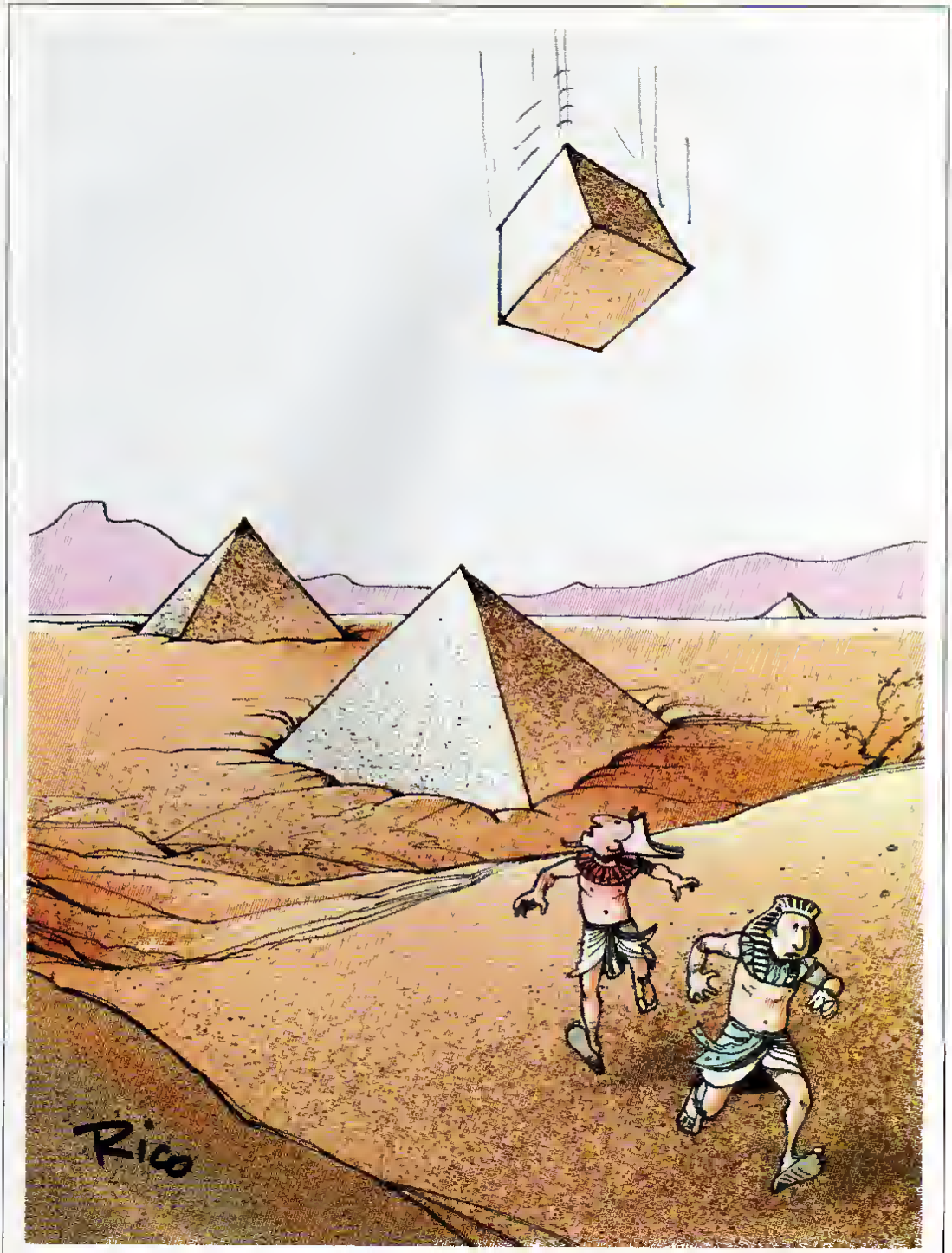
Now in control of Congress the Republicans will want to strengthen our economy by stimulating private industry This can be accomplished by funding a better space program There would be more opportunity for industry to design and manufacture space hardware, which would not only strengthen the economy but also offer the advantage of space exploration to the United States If it doesn't happen our space program will surely suffer

E Robert Steen
Fairfax Station Va

David Webb's Space column on the voting records of Congress [November 1980] and "Space Activism" by Trudy Bell [February 1981] are public services for which *Omni* should be highly praised

Join one of the pro space groups that Trudy Bell lists Look up the space voting record of your congresscritter in Webb's article then write your senators and the President too urging them to work for a larger more vital space program

Tim Kyger
Palo Alto, Calif ⊠



"Look out. Here comes another one!"

SPACE

CONTINUED FROM PAGE 24

for a problem we hadn't expected, something else was forced to wait.

And yet, according to Captain Bean, the delays are far less significant than they seem. "One of my favorite quotations," he says, "is 'History draws straight with crooked lines.' Even if the shuttle were delayed more in the long run it would have no effect, no more than it would have mattered in the long run if Magellan's ships had left port a year late or Columbus had gone back to rebuild a battered hull."

That leaves some nasty suspicions, at least at this writing. Whenever cost-cutting sets in on a complex project, corners are cut as well, details are neglected. Is the shuttle safe? The astronauts have little doubt. "I'd gladly take the place of the first crewman to 'go up,' says Brand, who is scheduled to command one of the orbital tests later this year.

"My concern is that we're testing a flight regime that hasn't been explored by a winged vehicle before," Bean comments. "We've tested the shuttle and done the best aerodynamic evaluations we possibly can with the best brains in the world. But what we've done is solve all the problems we know about. The question when you break new territory is what problems you aren't even attacking because you don't know they are there. All you can do is stick test pilots in it and give it a try. We're not going to learn any more about the shuttle by sitting around talking."

It sounds chancy at best. And it is not just the astronauts' lives that could be lost if the shuttle fails. NASA's eggs are all in one basket, and nearly everyone agrees that a shuttle disaster could effectively kill America's space program as well. Oddly enough, the astronauts are not among them. What would happen if the first flight failed or, far worse, proved fatal?

"Well," Bean answers, "nothing. We'll have a big investigation. Everybody will be sad, and there'll be a lot of hell raised about maybe we should cancel the whole thing and not go into space because God doesn't want it. The same routine has happened after every mishap with something new. But after it calms down, we'll figure out what went wrong, solve the problems, and launch the next one."

Bean is not alone in this belief. "A disaster could always happen," says Joe Kerwin, a physician who spent 28 days in space aboard *Skylab*. "Statistically speaking, someday it probably will. If it happens on the first flight, we'll be in deep trouble. But I hope our reaction would not be to wash our hands of the shuttle program. Instead, we should analyze what the problem is that caused the failure and fix it."

Kerwin is keen and animated, sometimes poetic. He rocks back and forth in his chair, talking with the pleasure of a man who knows he has made the sale, but is completing the pitch out of sheer enthusiasm. He doesn't look like an astronaut. In marked contrast to the taut athleticism of the others, he is large, gangly and academic-looking, more the eccentric professor than the seasoned space adventurer.

Like the other astronauts, Kerwin is eager to get on with the next step in space development. "I think of the shuttle as a new kind of railroad," he remarks. "Having built the railroad, we need a station at the other end. There's no use hauling everything up into orbit if you have to haul it all back down again afterward. So NASA really needs to get going on the Space Operations Center."

"It's not a very popular concept right now, even among the scientists. Most of them want their unmanned telescopes and planetary probes and things like that. They don't want ten million astronauts breathing on them. But it turns out that most of the long-term goals people talk about—a permanent lunar base, a manned Mars mission, an L-5 colony or a system of solar-power satellites—all have space stations along the track."

Beyond that, the exploration of space is no different in philosophical concept from the exploration of America. It usually justifies itself in the long run, but that isn't why we do it. If there are new lands to conquer, we must explore them, because that is the way humans are built. This is our next step."

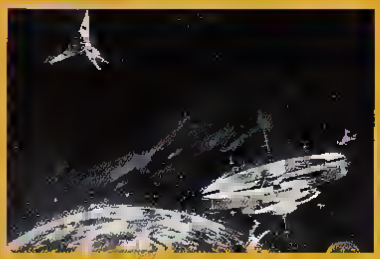
Kerwin looks toward the future in space optimistically, so do the other astronauts. But for Rusty Schweikart and some of the others who chose to leave NASA, the last few years have been a disappointment that makes optimism difficult. Somewhat typically for our American character, we lost the momentum we had back in the Sixties and early Seventies because we lacked will and leadership," Schweikart explains. "Not only was the space program spectacular, but it was also a substantial investment in the future. But we lost that sense, and it became just another case of climbing back down Everest, nothing more.

"The real problem with the space program is that the shuttle sucked the lifeblood out of everything else that NASA was doing, and should have been doing, but couldn't afford to. Everything else has dried up, if not in fact at least in spirit. But space is a mandate. We don't have an option of not going out. That's not reality. So we'll go out there."

Others share that opinion. Kerwin declares, "You know," he says, "the thing that drove us to the big budgets and effective space programs of the Sixties was fear of the Russians. We may have more reason to fear their space program now than we did then, but the public is no longer buying this argument.

"I think it's reasonably valid. I don't think the Russians are spending three times as much as we are (ten times as much if you figure if as a proportion of their national economy) for fun. I don't think the Russians do anything just for fun!"

NEXT OMNI



MARVELS

ILLUSION

FICTION

FUTURESCAPE—The popular view of space colonies hovering above the earth is largely the brainchild of physicist Gerard K. O'Neill. In his hugely successful *The High Frontier* (1977) O'Neill proposed a scenario for the wide open development of space which has since become part of the futurists' lexicon. Now O'Neill's new book, *2081*, expands his prophetic vision to encompass life on Earth in the next 100 years. Starting next month, an exclusive two-part excerpt charts the five forces of change that Professor O'Neill predicts will profoundly alter the fabric of everyday life. Sneak a preview of what lies ahead for the human species, in the May *Omni*.

MASTER OF ILLUSION—Why does a grown man build an impossible box that looks like something from the fourth dimension? "Because I'm interested in how the mind works," says Jerry Andrus. Described by Martin Gardner as "the one man most capable of fooling a professional magician" and by Dai Vernon as "the most original magician in the world," Andrus specializes in blowing minds. He designs optical illusions that have yet to be explained and creates his own magic of the future. Prepare to be amazed by our profile of the ultimate magician next month.

MECHANICAL MARVELS—"I have a Victorian belief in the mystical powers of the machine. To me, machines are still largely run by magic." Award winning science fiction illustrator Vincent DiFate produces some of the most vivid and realistic depictions of future technology in art today. Generously praised for his work in *Analog*, DiFate is best known for his science-fiction paperback book covers. His newest work, *DiFate's Catalog of Science Fiction Hardware*, is a visual survey of tomorrow's marvels of mechanics. Enjoy his imaginative art in the May issue of *Omni*.

ALIENS IN OUR SEAS—There exists on this planet a form of intelligence in a body so foreign, so completely lacking in any kind of mammalian attributes, that one would instantly identify it as arising from the demented dreams of bad science-fiction writers. But the octopus, whose heritage began with the humble clam, shed its protective shell and ventured out into an evolutionary gauntlet that whipped it into a fascinating, highly efficient shape. Read why Robert L. Forward thinks that one of nature's most intelligent creatures is one that isn't even a vertebrate after all.

SCIENCE FICTION—Next month a young boy and an old man join forces to wake up a sleepy American town in Ray Bradbury's "Colonel Stonesteel's Genuine Home Made Truly Egyptian Mummy." William Gibson's Johnny Mnemonic talks to a junkie dolphin in order to save his own life. Don't miss these arresting stories.

BOOKS

CONTINUED FROM PAGE 32

simulate extreme rage... model your behavior after the worst temper tantrums you have seen Khrushchev pull on television."

In a fact-minded period, Heinlein has been the supreme master of fact, offering his own special talents, attitudes, skills, and priorities as a model for all of us—the one road to survival. But perhaps put off by Heinlein's overbearing manner, we haven't always listened. This has been frustrating for Heinlein. Failure to heed him means failure to survive. How can we be so willfully immoral?

But all of the problems that Heinlein enumerates in *Expanded Universe*—from lack of defense against the ultimate weapon to loss of cultural nerve—remain as unresolved for Heinlein at the end of his book as at the beginning. And his refusal to be dominated, his superior competence, his 40 years of effort, his shouts, and his turning purple have not changed this.

Frustrating. To Heinlein, we ordinary folk have seemed morons, stinkers, boobs, marks, parasites, grinning apes, fat dumb and happy yahoos, fools, poltroons, peasants, animals, and zombies. At his most egotistical and despairing, Heinlein has been willing to turn his back on us altogether: "the probability (by a formula I just now derived) that either I or this *soi-disant* civilization will be extinct by A.D. 2000 approaches 99.92-plus percent. But do not assume that *I* will be the one extinct."

Heinlein underestimates the effect he has had on us. He does not seem to understand that the modern world, which he abhors, is in any part the natural result of the methods and values he has propounded. He does not recognize his intimate involvement with all that he both dislikes and rejects. But for both good and bad, and whether he likes it or not, he is an active participant in the present moment of change and transition.

The world moves on, and there *is* a moral path to be followed. The moral choice is not between extinction and survival. The moral choice is evolution.

Heinlein is mistaken when he says that the most basic thing about *Tyrannosaurus rex* is that he is "dead, gone, extinct." The most important fact about the dinosaurs is that they sprouted feathers and grew wings and became birds.

But if we are to evolve, we must shed our self-protectiveness, our bullying behavior, our egoism—and our solipsistic belief that we alone are real, that we alone count. If we are to surmount the problems that so haunt Heinlein, we must surrender mere survival behavior, all join hands, and leap together.

That goes for Robert A. Heinlein, too, the man who first inspired so many of us to learn and to alter ourselves. That is, it goes if he wants to come along with the rest of us grinning apes, us monkey folk, in our next step toward true humanity.

FILM

CONTINUED FROM PAGE 28

all this is the option, an intermediary contract covered by a sum of money delivered to the author that purchases the right to his work. Not necessarily to make a movie of it, but to think about making a movie. Usually there is a time limit on an option. In 1969 Martin Scorsese and Jay Cocks showed initial interest in filming *Sheep*, but the book was never optioned. Then in 1974 Dick was approached by the man who, six years later, would be responsible for the *Blade Runner* script—Hampton Fancher.

Forty-three-year-old Fancher had been writing scripts since he was a teen-ager and made a series of 8mm and 16mm short films culminating in a prize-winning 35mm movie called *Beach Parking*. But he was still a neophyte, a Sixties idealist lost in the Hollywood jungles, when a friend insisted that he read *Do Androids Dream of Electric Sheep?* by an author he'd never heard of. "I've only read two science-fiction books in my life," Fancher admits. "Bester's *The Stars My Destination* was the other one."

"So I read Dick's novel. This was way before *Star Wars*, but at the same time there was a smell of science fiction in the air. After reading *Sheep*, I realized that if there was going to be a serious movie in this trend, I'd just read it. I had a few dollars left. So I thought I'd take a stab at optioning it. First I tried to get a hold of Dick himself, but couldn't. It was impossible to find out anything about him. Then I flew to New York to talk to his agents, and though they were sympathetic, they weren't much help.

"I came back to Los Angeles. I was ready to give it up when I accidentally bumped into Ray Bradbury, whom I'd met once before. I told him I was looking for Philip K. Dick. Ray took out his little telephone book and gave me Dick's number."

Fancher's major hurdle still lay ahead. Though he and Dick then met a number of times, Fancher's idea of optioning *Sheep* with Dick doing his own screenplay met with little encouragement. "Although we got along very well, I had the feeling that Phil thought I was some sort of Hollywood hustler," Fancher recalls.

Dick's recollections reveal a different point of view. "I don't think Fancher realized I was as naive about Hollywood as he was. I got to know Hampton and to like him very much. But when it comes to Hollywood, I cringe, have a flinch reaction. Let's put it on an anthropological basis. I represent the tribe of the novelists and the short-story writers; they represent the tribe that makes movies. I look at their tribe, and their customs completely baffle me. I'm sure they look at me with the same confusion."

Discouraged, Fancher let matters drop. In 1975 *Sheep* was optioned by Herb Jaffe Associates, which kept the "property" through 1977. Jaffe wrote a screenplay but, as Dick remembers, "it was so terrible I couldn't believe it was a shooting script."

There were many other convolutions to the *Sheep* filmscript saga, but just as the novel seemed doomed to celluloid limbo, Fancher suddenly found himself back in the picture.

"I was about to go on a long trip," he recalls, "when I ran into an actor friend, Brian Kelly. I said, 'Why don't you try to option a book called *Do Androids Dream of Electric Sheep*?' Kelly, who'd had ambitions along those lines, promptly went out and closed the deal. He took the novel to Deeley with an eight-page outline. Deeley liked it, Kelly and Fancher went into partnership, and Fancher spent the better part of the next year writing the initial script. Deeley accepted it.

"Since then," Fancher says, "I've written so many scripts that they stopped binding them. I'm still writing. I'll be writing the damn thing until it's in the editing booth."

During the rewrites *Sheep/Blade Runner* drifted away from the original work. Gone are *Sheep*'s empathy boxes and its chicken heads (mental defectives produced by pollution). The android chase and protagonist Deckard have been kept, however, along with Dick's hovercraft. A crucial concept—that a real animal is worth more than a Rolls-Royce—has also been retained. "But nothing is permanent," Fancher adds. "The director and producer always have their own ideas. So does the star. When you're into the actual physical production, millions of things happen to alter your script."

Dick, however, was not even aware that *Blade Runner* was being made. "Herb Jaffe called to congratulate me," Dick explained. "And I said, 'On what?' 'On *Androids* being made into a film,' he said. I told him I didn't know a thing about it."

Dick's reaction to this second-hand notification? "I was having drinks with Bradbury a few months ago, and I mentioned that I'd heard the movie was being made by reading about it in the trades. He was scandalized. He thought it was totally unacceptable treatment. Bradbury started yelling and carrying on and telling me that I was a babe in the woods. I was amazed. I didn't feel that way at all. I just laughed it off and finished my drink."

"Which is the way it now stands," Dick smiles. "At this point I know nothing about what is going on. I haven't read Fancher's script. I haven't even been approached to be a script consultant. But I'm not bitter about it. I want to make it very clear that I haven't tried to contact the *Blade Runner* people, either. It's been entirely mutual. I do hope they don't turn *Sheep* into a simple fantasy about shooting androids, though. But if they go that route, there's nothing I can do to stop them."

After living through this experience, then, what are Dick's thoughts concerning the transition of a novel to film? "My observation on the conversion is that it's rarely successful. But I have seen cases where it has been successful. Those cases justify the effort." ☐

MUSIC

CONTINUED FROM PAGE 30

weapons, imposing their musical wills on the public airspace. Who are these noisemakers, and why do they feel compelled to blow us to kingdom come?

Several years ago, when my brother was teaching school in Port-au-Prince, Haiti, he encountered a young Haitian walking down the street, his radio/cassette perched on his shoulder like a pirate's parrot and merengue music blaring from twin speakers. My brother asked the youth why he was playing his music so loudly. The young man replied, "Distraksió," a Creole word meaning either "distraction" or "fun." Given the rife and oppressive poverty and the lack of opportunity in Haiti, either translation makes sense.

According to Dr. Sidney Lecker, a New York psychiatrist, boom-box fanaticism can be summed up in one four-letter word: *turf*. "In crowded places like New York City, you find people having to establish turf. Almost everywhere there's a need, but more so when people are packed closely together," he explains.

"Usually we're talking about people who are poor, who may share a bedroom with three or four other kids, who really don't have a turf. For them, the radio becomes a sound turf. When you're blasting that radio, the radius of sound defines your turf. Naturally, an adolescent finds it easier to establish turf by buying a radio than by purchasing three acres of land and building a house.

"A lot of us who are on the receiving end of a blasting radio perceive it as aggression, invasion, but that's a typical reaction when anyone invades our turf."

Lionel Tiger, professor of anthropology at Rutgers University in New Jersey, agrees with Dr. Lecker. "Adolescents use sound to mark their territory. Kids on a beach use a radio both to drive people away and to identify their own taste pattern, so it's rather like a dog going along the street peeing on poles. It's actually a territorial marking pattern."

Professor Tiger also speaks of the aggression inherent in the blasting of the boxes. "It's very much a young male phenomenon. They're getting back at the nice, quiet, grown-up world in which other people have more money and more access to power than they do."

Dr. Charles Hesselbach, a New York psychoanalyst, views the boom-box blasters in a different light. "In Freudian analysis, all impulses, motives, or needs are essentially either sexual or aggressive. They are sexual in the sense of giving pleasure: oral, anal, genital, or aural. Listening to music is associated with sexuality.

"Whenever I've come across aggressive behavior, I have found that it usually results from the frustration of sexual needs. Here I think you find the sexual and the aggressive equally in evidence. The loudness is

sexually stimulating on a primitive level The antisocial behavior exhibited by the youths who go around with these loud music boxes is a kind of very aggressive hostile demanding of attention "

When angry adults do pay attention to the individual playing the radio which is inevitable given the volume Dr Hesselbach perceives a completely gratified antisocial neurotic " He suggests that in order to discourage this antisocial behavior one should encourage the player to turn the volume up even louder

Whether boom-box blasting is indicative of young men's establishing their turf, or satisfying primitive sexual desires, or simply gaining a measure of revenge on the oppressive adult world it can still be extremely annoying sometimes

Shortly after the city's buses and subways were invaded by ghetto blasters the Metropolitan Transportation Authority counterattacked Subway riders can read a sign in every car that says NO LITTERING NO SPITTING NO SMOKING NO RADIO PLAYING Under the new law transit police are empowered to confiscate offending units The New York Environmental Control Board sponsored similar legislation to protect the sonic sanctity of the streets A person must complain to a police officer before an arrest can be made however Sound like a violation of civil rights? Depends on who's violating the rights of whom

But what if there are no cops around to enforce these laws? Most people try to ignore their hi-fi tormentors, but this stance Hesselbach asserts just eggs them on Last year several people including the actor Christopher Walken of *Deer Hunter* fame were severely beaten when they asked squawk boxers to lower their volumes This year too there have been several decibel deaths in a number of cities

A New York resident Susan Amsberg recalls the time a youth with a blasting radio/cassette player boarded a crowded city bus and ignored pleas by the passengers to turn down the radio

Finally a well-dressed, middle-aged man asked him how much he wanted for his box When the boy replied 'Fifty dollars the man removed the amount from his wallet and handed it to the startled teen-ager, who in turn handed over his unit. The man then turned and heaved it out the window Needless to say how one responds to such otic aggression is up to the individual Some approaches work, others do not

Will we ever see the end of portable radio/cassette players? Not likely The Walkman will more than satisfy the people who like to tote their tunes without disturbing others around them And if the consensus of our previously cited experts holds true adolescents and those who think young will continue to gratify their needs for distraction rebellion, attention, and territoriality by blasting their boom boxes Perhaps the best solution for those to whom this remains a painful problem is a set of earplugs and a smile button ∞

FORUM

CONTINUED FROM PAGE 18

The Institute for Defense Analysis the Rand Corporation and the Center for Naval Analyses should be in their glory now that Ronald Reagan with his defense-budget priority will help them obtain more plastic soldiers for their war games while the promised reduction in taxes which brought him victory will defeat the many constructive research programs that could assist in solving the ills of world society

I sincerely hope the early 1980s are not recorded in history as the Day the Innovative Revolution Died Who knows? Perhaps *Omni* will issue the last call that will awaken society to the positive alternatives for the future

Alan C Becker
Jackson Junction Iowa

I am a commissioned military officer who until recently worked inside a vault with a predominantly civilian think-tank group like that described by Paul Nahin in "For Your Eyes Only" The group conducted intelligence studies so crucial to national security that the code-word classifications of documents published were themselves highly classified

The group developed and employed its own arcane analysis techniques so that on the surface the think-tank process seemed to me a rigorous discipline I soon realized however that the group members were all out of touch with their respective academic disciplines their minds sapped of creativity by years of isolated study

Even worse in roughly 90 percent of the case studies we undertook for top military brass available data were unreliable or incomplete rendering any meaningful analysis impossible Of course the top brass who funded our research didn't want to hear this They expected hard answers When I was lacking data for my first case study one veteran analyst coached me "Pull some numbers out of your ass"

And so it was for the duration of my tour with the think tank Group members incessantly bickered and clowned among themselves over fabricated hypotheses and fudged data for the sake of giving something impressive to the top brass who tended to regard our results as theoretical hokum anyway

Be assured that in the event of nuclear war the thinkers will continue to argue pedantically in their vaults while the rest of us are blown to kingdom come

(Name and address withheld by request)

In writing about military capabilities and requirements Paul J Nahin falls into the propaganda pit the Pentagon digs to trap those trying to make some sense of the military debate' Nahin apparently buys the information his contact supplied him concerning Seafarer He says Seafarer is necessary because 'submerged submarines are on their own out of contact with their military command' when out to sea with scores of dead-accurate missiles armed with multiple nuclear warheads Having served several years on a Polaris (second-generation missile) submarine I can vouch for what common sense should have told Nahin If a "planetwide submarine communications system" similar to Seafarer didn't already exist these almost perfect weapons systems would never have put to sea These submarines have been making deterrent patrols since the early Sixties Does anyone seriously expect that one man (the captain) would be made solely responsible for making a launch decision? I've been there and I can assure you that command control of these weapons is continuous and absolute no matter where they are

R C Kelleher USN
Centreville Va

More from Love Canal

Omni's article on Love Canal [Mind December 1980] was excellent The sad fact is that the future Love Canals will be treated with the same apathy The failure of business leaders to take responsibility for their own actions is truly obscene The public is told to trust big business but time after time we see private enterprise cannot be trusted with securing our future It gives all of us young forklift drivers something to reckon with

J Blue
Phoenix Ariz

I wish to comment on the Love Canal article in *Omni's* December 1980 issue in which the Hooker Chemical Company is blamed for the seepage of wastes in the neighborhood of Love Canal Chemical wastes in dumps are sealed by clay which is impermeable Why did developers who must have known that something had been done remove the clay lid in the first place and then develop the area? If the clay had been left in place the seepage of chemical wastes would not have occurred

Carol Loveland
Stevenson Conn

The incidents at Love Canal stand as a monument to the corporate view of culpability Back when the chemicals were first dumped the Hooker Chemical Company acted as responsibly as anyone could ask by carefully sealing the dangerous chemicals under a lid of clay and warning the city of Niagara Falls not to build there Hooker would never have given up that land if the city had not threatened to condemn the land and take it anyway

Hooker's real ethical problems came only after the trouble with residents in the area Instead of bringing out all the facts to show that it had acted responsibly under the circumstances it publicized a report that states that "no one was poisoned" at Love Canal Poison is not the issue Ge-

netic mutation and cancer are the issues. Hooker did its best to protect the people from these dangers. If Hooker had let it go at that, people could blame the city but not Hooker. It was only by clouding the issues with claims about poison that Hooker became responsible for any wrongdoing.

Ralph Hicks
Woodside, Ill.

Games Goof?

I beg to differ with Scot Morris's logic on paradox 3 [Games, January 1981]. A man says he has two children, at least one of whom is a boy. What is the probability that the other child is a boy? Morris answered "⅓" and said that knowing one child is a boy leaves three possibilities. Actually, there are four (italicizing the "boy" referred to): (1) *boy*-boy, (2) boy-*boy*, (3) *boy*-girl, and (4) girl-*boy*. The second child is a boy in cases 1 and 2. So the correct answer should be ½. I would appreciate a response.

J. Bear Baker
Englewood, Colo.

Scot Morris replies: *Mr. Baker, like many other correspondents, makes the error of assuming that these four events are equally likely. They are not. In fact, his first two cases combined will occur as often as either of the other cases alone.*

Put it this way. If we looked at a large number of two-child families, we would find four equally likely arrangements, each of which would occur in about 25 percent of the cases (listing the older child first, for convenience): (1) boy-boy, (2) boy-girl, (3) girl-boy, (4) girl-girl. Note that case 4 is eliminated here since we know that "at least one child is a boy." Of the three other families in which "at least one child is a boy," there is only one in which there is a second boy. Thus, the probability is ⅓.

There was an ambiguity in the statement of the problem, which could lead to an answer of ½, but no readers caught it. If it is assumed that when both sexes are represented, the man will pick one child at random and say, "At least one is a ___," giving the sex of the child picked, then the probability that both children are of the same sex is, of course, ½. However, if one assumes, as I did, that whenever both sexes are represented, the man will say, "At least one is a boy," then the answer ⅓ is correct.

PHOTO CREDITS

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GAMMA-RAY BURSTS

STARS

By William Herbst

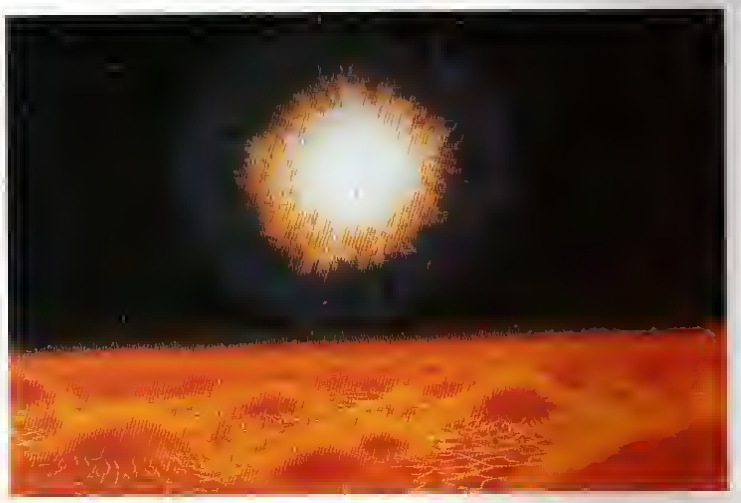
As Earthlings, we live a sheltered life, safe within our atmosphere. Only in the Space Age have we begun to learn just how turbulent the universe outside can be. On Earth, gamma rays are produced in nuclear reactors or explosions. In the violence of space, they are part of business as usual.

Until recently we were blissfully unaware that gamma rays permeate the universe at large. They are very effectively absorbed by the upper reaches of Earth's atmosphere. It came as something of a shock when a team of Los Alamos physicists announced in 1973 that gamma rays penetrate the solar system all the time; we are occasionally bombarded by enormous bursts of them.

Like waves at the ocean shore, whispering of violent storms at sea, the gamma-ray bursts were telling us that explosions of enormous magnitude were occurring somewhere in space. But where were these cosmic hurricanes? This question frustrated astronomers throughout the Seventies. Our satellite detectors, unfortunately, were omnidirectional. Acting like Geiger counters instead of telescopes, they recorded whatever radiation flowed into them but told nothing of its origin.

On March 5, 1979, however, there came a major break in this mystery. A "superburst" arrived. Lasting only 0.2 second, it reached a peak intensity greater than any gamma pulse seen before or since. Fortunately, we were ready for it. At that time the United States and the Soviet Union had no fewer than nine satellites and space probes equipped with gamma-ray detectors. Some were in Earth orbit. The USSR's *Venera 11* and *12* probes were circling the sun, having completed Venus flyby missions. NASA's *Pioneer* orbiter was traveling around another planet.

As the gamma-ray superburst pulsed through the solar system at the speed of light, it set off the detectors one by one. By carefully timing the progress of the pulse as it arrived at each point in the interplanetary network, physicists could determine quite precisely the point in the sky from which the gamma rays emanated.



Will another superburst from Nebula N49 explain the origin of gamma rays that bombard Earth?

The result was a surprise. The superburst came not from our own galaxy but from somewhere inside a nebulous patch of light known as N49, located in our nearest neighboring galaxy, the Large Magellanic Cloud. The gamma rays had traveled about 170,000 light-years to reach us. In order to appear as bright as it did, the object in N49 must have liberated as much energy in a few minutes as the sun will in 10 billion years!

What could produce such energy and, moreover, release most of it within 0.1 second? An important clue comes from the N49 nebula itself. It is a supernova remnant, the cosmic debris of a stellar explosion—a massive, incredibly dense neutron star. These bizarre end products of stellar evolution pack the equivalent of a million Earth masses into a sphere only ten miles in diameter. Their tiny size and surface gravity up to 300 times that of Earth make them uniquely suited to releasing gargantuan quantities of energy in moments.

Exactly what provoked the neutron star in N49 to launch its burst of gamma rays toward us some 170,000 years ago, we do not know. One possibility is a "starquake." Something—again, we can't say what—may have caused the neutron star to readjust its structure suddenly, like an earthquake, but on a vastly larger scale.

Whether this idea truly accounts for the superburst of March 5, 1979, only further observations can tell. And even then we will not be certain that the superburst was produced by the same mechanism that creates the lesser gamma-ray bombardments we ordinarily see.

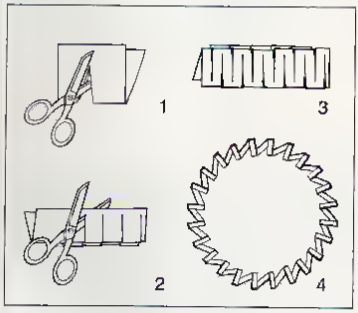
The space probes that detected the gamma pulse from N49 are still listening for radiation that may answer these questions. In 1985, if Congress passes the required funding this year, they will be joined by a shuttle-launched Gamma Ray Observatory (GRO).

Gamma-ray astronomy was born little more than ten years ago. It has already provided significant surprises. Ten years from now GRO and the satellites that have preceded it may revise our understanding of this violent universe. ☐☐

GAMES

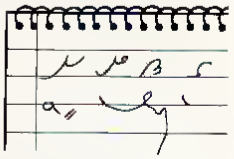
ANSWERS TO GAMES (PAGE 144)

1 *Fire* Dunk the bill briefly in 86-proof liquor and light it Flames will engulf it briefly but will quickly extinguish themselves without burning the bill
2 *"Bill Fold* The eight-fold way is still impossible even if you start with a huge piece of paper Every fold doubles the thickness After seven folds it is 128 sheets thick virtually impossible to fold again
3 *Neither Heads nor Tails* Moisten both the dime and the outside of a drinking glass Press the dime to the glass near the top and release it It will slide down to the table and rest on its edge
4 *Match Off* You ll need clean hair and a rubber or nylon comb Comb the hair slowly then hold the comb next to the glass Static electricity will make the match drop off
5 *Hair Raising* Rest one end of the hair on the ice cube and sprinkle salt over it The ice will melt and refreeze around the hair Lift the free end of the hair and the cube will come with it
6 *Knot Easy* Fold your arms across your chest then pick up the two ends of the rope one in each hand Unfold your arms The knot will be transferred to the rope
7 *Step Through* Fold card and cut alternately from two sides as shown Cut down the fold except for the end creases (Figure 3) With narrow enough cuts you can spread the paper into a lace ring that is large enough to step through



8 *Pick Up*

9 *One or Six* On 36 rolls of two dice a 1 a 6 or both will turn up an average of 20 times You ll win five times out of nine
10 *Corker* Your sucker has a hard time keeping the cork in the center it keeps drifting to the side and attaching itself to the edge of the glass Pour a bit more water into the glass not only until it is full but until the surface of the water is slightly above the rim of the glass The cork will float to the highest point of the water dome in the center of the glass
11 *Dead Eye Dick* When it comes your turn make sure the bill is reversed so that the top edge resembles a letter *S* rather than a *Z* Put the clips in the same spots as before but this time when you pull the ends of the bill the clips will shoot off and land not only touching but linked
12 *To Too Two* The sentence can be written in shorthand



13 *Drawing* The probabilities are with you by three to two
14 *Big Finish* This works Stover says even if your suit is blue serge

QUICK QUIZ

1 There are no penguins in the Arctic where Eskimos live
2 Yes freeze the water in the cans first
3 In
4 Horse racing
5 Drop the egg from a height of four feet
6 The two fathers and two sons were only three persons a son his father and his father s father
7 An hour and a half
8 *Misspelled*
9 A cone
10 The hat was hung over the end of his gun
11

12 5/12 There s a 1/6 probability that both will throw the same number so the chance of one throwing higher than the other is 5/6 or 10/12 Half of this is the probability that Sally will get a higher number than Sue
13 $2+1^{x}$
14 Walk around the table and view the equation from the other side

READER ORIGINAL

The letters are arranged alphabetically according to their word names The complete alphabetical list with the mystery letters in place is *ae aitch ar bee cee cue dee double-you ee eff ell em en es ex* **eye** *gee jay kay* **oe** *pee tee u vee wye zee* Franklin based his list of word names on those found in the *Standard College Dictionary* published by Harcourt Brace and World Inc

PHENOMENA

Dawn glows through the envelope of a half-inflated balloon as aeronaut Rudy Thorau checks seams for leaks and adjusts control cables. Later, in the stillness of morning skies, 2,180 cubic meters of hot air will be used to lift the three-passenger craft. Named *Condor*, the red-and-white balloon rises and floats because it displaces a volume of air equal to, or greater than, the balloon's total weight. This displacement is achieved by raising the interior temperature of the bag to approximately 38°C above local atmospheric temperature. The concept of lighter-than-air flight was formulated once scientists realized the atmosphere is a fluid that obeys physical laws. Free-lance photographer Vince Streano used a Nikon F2 with a 28mm Nikkor lens to record this image. Streano set the exposure at f/8 for one hundred twenty-fifth of a second and underexposed Kodachrome 64 film a half-stop to depict the preflight inspection **DO**

Wagers for April
and a new optical illusion

GAMES

By Scot Morris

Son, no matter how far you travel or how smart you get, always remember this. Someday somewhere a guy is going to come to you and show you a nice brand new deck of cards on which the seal is not yet broken, and this guy is going to offer to bet you that the Jack of Spades will jump out of this deck and squirt cider in your ear. But son, do not bet this man, for as sure as you do, you are going to get an ear full of cider.

Mr. Masterson's advice to his son
Sky in Damon Runyon's
The Idyll of Miss Sarah Brown

There is a class of wager called the bar bet or sucker bet that is especially appropriate this month. Success in pulling it off depends on the fact that you know something your sucker doesn't. Practice the stunts first or you may be the one who gets cider or worse in the ear. The bets below are phrased as you should state them. For the supersecret methods, see the answers on page 140. Step right up!

1. FIRE. I can set fire to a $10 bill so that it is surrounded by flames and still use it to pay for the drinks.

2. BILL FOLD. Place a dollar bill on the bar and fold it in half. Then fold it again so it is now one fourth its former size. Demonstrate to yourself, and your sucker, that it is virtually impossible to fold the bill this way *eight times*. After five or six folds the paper is too small to fold further. Bet the sucker that he can't fold any piece of paper eight times, halving its size with each fold, even if he starts with a huge, double-page newspaper sheet.

3. NEITHER HEADS NOR TAILS. Bet I can drop a dime three inches and have it stand on its edge.

4. MATCH OFF. First balance a nickel on edge on the table, then balance a bent match over the nickel. Finally invert a shot glass over them so that it is touching neither. The challenge: to knock the match off the coin without touching or moving either the glass or the table.

5. HAIR RAISING. Can you pick up a cube of ice with a single human hair?

6. KNOT EASY. First get a short length of rope (or a shoelace). Challenge: Can you hold the two ends of the rope in your two hands and tie a knot in the rope without letting go of the ends?

7. STEP THROUGH. Can you cut a hole in a 3 × 5 note card that is big enough for your whole body to squeeze through without tearing the card? This is an ancient trick, but still impressive to those who haven't seen it before.

8. PICK UP. You have a quarter and four common paper soda straws. How can you pick up all the straws and the coin at one time with another straw of the same kind so that nothing falls after being lifted off the table? (Puzzle sent in by Joe Eddy Brown of Glen Ellyn, Illinois.)

9. ONE OR SIX. Roll a pair of dice and bet even money that either a 1 or a 6 will come up.

10. CORKER. Take a glass that is almost full of water and drop a cork into it. The challenge: to hold the glass in one hand and, without swirling the water, make the cork float in the center.

11. DEAD-EYE DICK. Mel Stover of Winnipeg, Manitoba, collects bar bets and sent us this new twist on an old stunt. You need two paper clips and a dollar bill. Fold the bill in thirds so that if you look at the top

Who are these men? Other than being upside down, what is wrong with their pictures? *Here is a new optical illusion discovered by psychologist Peter Thompson of the University of York in England. Thompson first published it in the journal* Perception *(Vol. 9 [1980], pp. 483–484) using a photo of Margaret Thatcher. Carrying on the irreverent tradition, we repeat the trick here with two American leaders. Turn the page upside down to see the unexpectedly gruesome reality. The mouths have been inverted, the eyes inverted and reversed. Viewing the upside-down faces, we see the eyes and mouths oriented as they really are, which leaves the impression that the faces are "normal." Thus, an inverted face in which the eyes and mouth remain right side up may preserve the facial expression and identity better than a truly inverted face. The illusion works best, we find, on faces staring straight at the camera, smiling, and equally illuminated on both sides.*

edge It looks like the letter *Z* For the demonstration you will place one clip just to the right of center clipping together the two upper layers Now turn the bill 180 degrees horizontally and place the second clip in the corresponding position on this side again clipping the two upper layers together It should now look like this

Explain that the objective is to pull the ends of the bill quickly so that the clips are tossed into the air If they land touching each other that constitutes a win If they land separately that is a loss

Your sucker will find it almost impossible to get the clips to land anywhere near each other much less touch When it comes your turn say you have given this stunt a lot of practice and you are pretty sure of your accuracy If the clips fail to land touching you'll buy the drinks provided someone will buy you one if you succeed How can you turn this feat of marksmanship into a sure thing?

12 TO TOO TWO A linguistics professor you explain was giving a lecture on phonetics and during his speech he said "There are three to's in the English language" Challenge your sucker to write down this sentence unedited in any way and still keep it a valid sentence There isn't any way to write the fourth word Our example is obviously wrong it specifies only one word *to* If a phonetic *tu* is invented then that's a fourth word with the same pronunciation, and the sentence is invalid After your sucker agrees that the sentence can be spoken but not written down bet him that there is a way In fact a simple method was discovered by a secretary who transcribed the professor's lecture What was it?

13 DRAWING TO A TWO-CARD FLUSH Shuffle a deck of cards divide it into three piles and take the top card from each pile Before turning them over bet that among the three cards there are at least two in the same suit

14 BIG FINISH Canada's bar betting Mel Stover adds this follow up to the above bet From the same facedown deck pocket seven cards and bet that all of them are in the same suit

QUICK QUIZ

1 An Eskimo even if he or she is on the brink of starvation will not attempt to eat a penguin's egg Why?

2 You have two cans filled with water and a large empty barrel Is there a way to put all the water into the large barrel without the cans so that you can tell which water came from which can?

3 What is the exact opposite of not in ?

4 If sneakers are used in tennis cleats in football and spikes in baseball in what sport are all metal shoes used?

5 Standing on a cement floor can you drop an egg three feet without breaking its shell?

6 Two fathers and two sons went hunting and shot three rabbits Yet each took home one rabbit How was this possible?

7 A doctor gives you four pills and tells you to take one every half hour How long will the pills last?

8 One of the words on this page is misspelled What word is it?

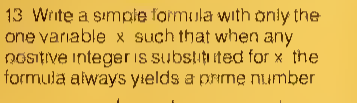
9 When a cone is bisected by a horizontal plane the remaining base segment is called a frustum What is the remaining uppermost segment called?

10 After a man had been blindfolded someone hung up his hat The man walked 100 yards turned around and shot a bullet through his hat How was this possible?

11 Form a row of seven matches as shown Remove one match and shift two so as to leave nothing

12 Sally throws an ordinary die Then Sue throws the same die What is the probability that Sally will throw a higher number than Sue will?

13 Write a simple formula with only the one variable x such that when any positive integer is substituted for x the formula always yields a prime number



14 Arrange ten toothpicks on a table as shown above Can you change it to a correct formula without moving adding or taking away any matches?

READER ORIGINAL $25

A, H, R, B, C, Q, D, W, E, F, L, S, X, G, J, K, P, T, U, V, Y, Z.

Four letters are missing from this rearranged alphabet What is the proper place for **O, M, N,** and **I?** (Problem suggested by Michael J Franklin of Eureka California)

Answers on page 140 **DO**

LAST WORD

By David E. H. Jones

"Hustlers who stubbed out their cigars on the eight ball were liable to go up in flames. It wasn't very good for the baize, either."

Scene: somewhere in Switzerland, 1846. Cows with tin bells around their necks, lurching sidewards. Bods in lederhosen, yodeling, etc. Pan to homestead in foreground right, where Professor Christian Schönbein, pride of the local university, is mixing nitric and sulfuric acids in his wife's kitchen. Wife is out of the way, so already-alert historian suspects domestic rift, guilty late-night Frankenstein work with the sinister acids, tension-fraught showdown when the truth leaks out, real kitchen sink drama. And then the worst happens. Flask breaks. Nitric and sulfuric acids all over the floor. Disaster! Prof looks round desperately for anything to stem the corrosive tide, quick before the whole floor dissolves. Grabs nearest cloth, which is wife's cotton apron.

Mop up the mess, floods of water, wash out apron in sink, finally domestic scene neat and tidy again, if a little damp. Close shave, there! Final touch: Put apron on stove to dry, then she'll never know.

Be sure your sin will find you out. Shortly afterward cotton apron explodes. Yes, indeed. Mixed together nitric and sulfuric acids convert cellulose to cellulose nitrate, guncotton, now a cliché in every chemical textbook in every schoolchild's mind, etc. Somehow Prof survives to confess all.

Domestic rift heals in smiles and tears as world's chemists applaud brilliant new discovery. New and awesome power put in man's hands for good or ill, price of progress and all that.

However, next act in the drama rather unexpected. Elephant Shortage Hits U.S. Sportsmen! Seems that in the 1860s billiards saloons the length and breadth of the United States were crying out for billiard balls to replace those lost in the rough, fired at grizzly bears from shotguns, and so on. But back in the Congo the tuskers were keeping their heads well down, and ivory shipments just were not getting through. Famed New York billiard ball manufacturers Phelan & Callendar run staring them in the tonsils, offer $10,000 for substitute material for billiard balls. Who else should answer the clarion call but down-at-the-heels jobbing printer John Wesley Hyatt? And what else should he choose for his new billiard balls but cellulose nitrate? The stuff dissolves in alcohol and ether, pretty potent mixture itself if you don't watch out, and Hyatt starts coating the goo on papier mâché balls and potting them around his test table. No luck with the $10,000 prize, but in no time he was peddling guncotton billiard balls with the best of them. Certain amount of customer resistance, alas! The hustler who stubbed out his cigar nonchalantly on the eight ball was liable to go up in a sheet of flame. It wasn't very good for the baize, either. There's this letter from a Colorado billiards-saloon proprietor complaining that when it happened every man in the room pulled a gun. Life hazardous enough in the Wild West without billiard balls backfiring. So back to the drawing board for John Wesley Hyatt. Soon the answer: Add a little bit of camphor to the stuff!

Camphorated guncotton was not only ideal for rubbing on your chest but also relatively safe, not even very explosive, easily molded into billiard balls, buckles, buttons, brushes... bingo! Celluloid had arrived. And thus began the Albany Dental Plate Company, later named the Celluloid Corporation, which remained for many years a proud purveyor of combustible false teeth and celluloid ducks.

Meanwhile, back at the Alfred Nobel Dynamite and Prize Company, our founder was seeking to harness cellulose nitrate for bigger and better bangs. Ingenious mixture with nitroglycerine, etc., gave us blasting gelatine, useful for shifting inconvenient Alps, vast works of engineering, and Dresden china. And of course variations for smokeless powder, cordite, and suchlike fillings for mines, torpedoes, and related military appurtenances. Herein lies a sad and sorry tale of shameful American realpolitik. Cast your mind back to February 15, 1898, when the USS *Maine* exploded at anchor in Havana harbor. She must have been mined! Who else but the treacherous Spanish authorities in Cuba could have done such a foul deed? The United States declared war on April 21. The despicable Europeans were defeated, and a new chapter of freedom and dignity opened for the oppressed, etc. Snag was, when the *Maine* was raised in 1911, it turned out she hadn't been mined at all. The explosion started in the ship's magazine. Dodgy stuff, cellulose nitrate. Dry rot sets in. Sinister, unstable decomposition products accumulate and react. When you least expect it, wham! up she goes.

However, the relentless sideways march of progress and all that. The nasty exploding celluloid of yesteryear has been swept away in a rubbery torrent of newer, less flammable, more plastic plastics. But celluloid still hangs on to a share of the Ping-Pong market. Ping-Pong balls, eh? A fantasy of power and drama materializes before my glazed eyes. "Driver!" I bark, my voice heavy with menace and command. "This is a hijack! At the first sign of opposition or disobedience, I will drop this lighted match into this suitcase full of Ping-Pong balls!"

The dream fades. Cold doubt returns. Will it work? Down to the kitchen, pausing only to grab a Ping-Pong ball and skewer it on a screwdriver. Light the gas. Gingerly edge the ball into the flame. No explosion. Ball ignites and burns fitfully. Black smoke ascends to deepen the telltale brown patch on the ceiling (legacy of decades of ferocious frying and overheated omelets). Now ball begins to melt, spraying cooker surface with sooty, molten blobs, which run over the white enamel, spoiling what remains of the finish. Final collapse of fantasy. What a mess! Where's that blasted cotton apron? OMNI