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THE SECRET SOVIET SPACE SHUTTLE

CASPAR WEINBERGER ON WAR IN SPACE

OMNI®

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Michel Tcherevkoff, one of New York's leading advertising photographers, is a technical wizard in his field. He designs and photographs all his sets within the confines of his Manhattan studio. In this picture a sphere is bisected by the transcendental number π

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FIRST WORD

By Cyril Ponnamperuma

"The chemical synthesis of food is a tantalizing area of exploration. If we can make the material for our shirts, can't we make the substance of our lunches?"

Food is the single most important requirement for life. The need for food is universal in the entire biosphere, and the success with which each individual obtains the elements and compounds essential for an adequate diet determines ultimate survival. With the explosive growth of world population, food has become global priority number one.

Although American dietary patterns might suggest otherwise, the moment of decision is upon us. A sense of urgency pervades scientific talk. At a recent address to the American Chemical Society, Nobel laureate Norman Borlaug, father of the Green Revolution, commented that "expanding food production fast enough to meet the increasing needs of a large and growing population over the next four decades will be vital to the survival of civilization."

In the sphere of foreign policy, the need to confront world-hunger problems has also come to the fore. The Presidential Commission on World Hunger, which concluded its studies under the Carter Administration, recommended that beginning in the Eighties, the United States should make the elimination of hunger the primary focus of its relationship with the developing countries. The prospect of disaster is at hand. It is closer than most people realize or are prepared to admit.

By 2015 our planet will be the home of almost 8 billion people, double today's population. It will not suffice, however, to double our food production; we must at least *triple* it. Two thirds of humanity are already suffering from inadequate nutritional balance, as the experts would say. In street parlance, they are starving. The gap between the billions of hungry people and the amount of food needed to feed them is constantly widening.

Population reduction is the obvious answer. But the numerical stabilization of the human race will not be achieved in a decade, nor in two, but perhaps in half a century it will. For at least another generation we must turn to science and technology to provide food for humanity. This is a formidable project. In the next 40 years alone, world food production must be upped by at least as much as it was increased during the entire 12,000-year period from the beginning of agriculture to the present day.

The choices are bewildering. On one hand, there is dire pessimism, on the other, a certain scientific optimism. After the World Food Conference, sponsored by the United Nations, there were even some scientists who advocated the totally unthinkable and absolutely abhorrent solution of triage. Let the hungry die of starvation, they said, while the strong conserve available supplies of food for themselves and their families.

Then there are those who profess a certain exuberant hope that science can solve all problems. Francis Bacon gave us his idea of utopia. The modern proponents of this utopian ideology quote the significant developments in science—from the conquest of space to the harnessing of the atom, to the decoding of DNA. The Apollo program was without question a supreme triumph of science and technology. The casting off of the shackles that bound us to Earth and gave us the exhilarating freedom to explore the universe will be recorded as one of man's greatest achievements. But perhaps there is a fallacy in the line of sanguine reasoning that suggests science can be a global elixir. The truth may lie somewhere between the poles of dismal pessimism and undue optimism.

How can the world food supply be increased? Is it possible for man to produce some food independent of climate? The chemical synthesis of food is a tantalizing area of exploration. If we can make material for our shirts, can we not make the substance of our lunches? Carbohydrates arise from the fixing of carbon, hydrogen and oxygen. Proteins result from the same three elements, with nitrogen thrown into the bargain. The laboratory of nature achieves this result through the complex process of plant photosynthesis and animal metabolism. In the laboratory of modern chemistry, the shortcut from molecules to meals is within scientific reach. There is an intriguing science-fiction story about a gourmet restaurant, where the only raw material that enters the building is coal. Such a concept may not be a mere technological fantasy.

It is commonly believed that nature knows best. Molecular biology has given us ample evidence that in many instances the ways of nature may be wanton and wasteful. In the breeding of plants, the reduction of respiration and the improved efficiency of photosynthesis might double the yield of our crops. Enhanced biological nitrogen fixation, accomplished by exploiting the symbiotic relationship of certain algae with the roots of cereals—the Azolla with rice, for example, a circumstance understood by the ancient Thai and Vietnamese and rediscovered today—is a potential area for active research. Epoch-making discoveries of recombinant DNA have opened horizons of wondrous proportions. We are on the threshold of major new advances. The Green Revolution will yield to the Gene Revolution.

Since 1971 Cyril Ponnamperuma has been professor of chemistry and director of the Laboratory of Chemical Evolution at the University of Maryland.

CONTRIBUTORS

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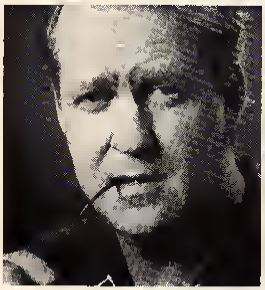

HAISTY

WALDROP

SIMMONS

RESTON

Engineers who plan and execute massive superhuman-scale projects are a breed unto themselves. Macroengineers, as they are called, are big dreamers with rich planetary fantasies. Consider a transoceanic tunnel linking Europe and North America, a single-building metropolis rising one mile high, a transcontinental bullet train linking Tokyo and Paris, with a connection under the English Channel to London and Edinburgh and a subsea tube to Dublin. Our article "Megaworks" (page 80), adapted from *Macro*—a book to be published by William Morrow and Company and coauthored by *Frank P. Davidson* and *John Stuart Cox*—reveals plans for fantastic engineering feats that are technologically feasible today. Davidson, a scientist at MIT and one of the founding fathers of modern macroengineering, has an eye for what history can teach us about the future. He says, "We have neglected achievements in the past that might solve current puzzles. No modern government has been able to equal or even come near the achievement of the ancient Romans in thrusting back the Sahara. I really believe that the United States now needs a Roman approach to such vital matters as water supply and transportation."

In this month's exclusive Interview, Caspar Weinberger, America's secretary of defense, candidly discusses the future of America's military presence in space with *Richard Halloran*, military correspondent for *The New York Times*. Weinberger is Reagan's most influential adviser and Cabinet official and has complete responsibility for the actions of the Pentagon. Weinberger elaborates on Reagan's now famous "star wars" speech and on the President's policies as they refer to the military development of space: the deployment of weapons that use laser beams, particle beams, and other directed-energy weapons that can track and destroy Soviet missiles. He proposes to utilize artificial intelligence for defense, and he predicts high-tech, millisecond-long battles fought with new weapons, all of them computer-aided in design. For a top-level prediction of the American way of war, see page 108.

Herman Kahn was our country's most distinguished futurologist, known for his controversial books on thermonuclear war and his development of a "trickle-down" theory of economics. Twenty-two years ago he founded the Hudson Institute, America's most renowned and prestigious think tank. He was chairman and director of research until his recent death. One of Kahn's great concerns was the "cloud of pessimism" hanging over this nation, especially over high-school students. To counter the malaise he perceived, he designed an ambitious program known as "Visions of the Future," a crash course in thinking optimistically about environmental, population, and resource concerns. Kahn foretold a fabulously green future. Too green, according to his critics, as journalist *James Reston, Jr.*, reports in "The Wrath of Kahn" (page 68).

Reston was shocked and saddened by Kahn's death. "For all our disagreements, it was clear that he was an extraordinary and vital human being. He loved intellectual engagement, and I think he was looking forward to the product of our many hours of sometimes-heated discussion. He was an important man who thought about important things."

It has been a productive year for Reston. His first film, *88 Seconds in Greensboro*, was offered in the new PBS *Frontline* series, and his second play, *Kaituma Sunset*, will open in October.

This month we present four new science-fiction stories. *Dan Simmons*'s "Carrion Comfort" (page 132) is a powerful horror tale set in contemporary Charleston, South Carolina. On page 62, award-winning novelist *Howard Waldrop* goes Eastern in "Man-Mountain Gentian," which combines two Oriental traditions, Zen and sumo wrestling. In *John M. Ford*'s "Boundary Echoes" (page 86), a famous musician meets a neurologist and is forced to face her own irrational fears. Ford's latest novel, *The Dragon Waiting*, will be published in November by Timescape. Our fourth selection is by *Robert Haisty*, a semiconductor-research scientist whose first love is science fiction. Two travelers meet unexpectedly, and one foils the other's plans in "Seventh Sense" on page 100.

LETTERS

COMMUNICATIONS

Comsat

Richard Wolkomir and *Omni* are to be applauded for the excellent article on the Communications Satellite Corporation (Comsat) and its advances in satellite-communications technology ["Satellinks," June 1983]. Wolkomir succeeded in taking a highly technical subject and writing it in such an interesting and informative manner that thousands of your readers now have a better understanding of the intricacies—and benefits—of satellite communications.

Recognition should be given also to Malcolm Kirk for the striking photos that accompanied the story.

Fine writing should not come as a surprise to your readers, excellence is what they have come to expect from *Omni*, an outstanding publication that gets better with every issue.

Allan Galfund
Manager, External Affairs
Comsat
Clarksburg, MD

Controlling Man's Aggression

Douglas Starr's discussion of the theories expressed by philosopher Paul Shepard was extremely interesting [Earth, May 1983]. I feel, however, that Shepard's concept of secondary bonding is a romanticized and ornate attempt to explain a much simpler psychological reality.

Man's ascent from the lower primates was governed by evolutionary processes favoring traits of aggression, cunning, and a high degree of intelligence. Over the ages these traits were reinforced in primitive man, enabling him to survive in a hostile environment.

As man progressed, he gradually developed the tools and knowledge of a hunter to secure his dominion over other animals. He controlled his environment by building shelter and providing himself with food and warmth. As his development continued, man extended his control by domesticating plants and animals. Through his intelligence, he established a stable supply of food, and this enabled him to further improve his condition. This led to the formation of social groups and the beginning of civilization.

Throughout this process, man aggressively sought to extend his control over the environment. The process has continued unabated; man now attempts to exercise dominion over other men geographically, economically, socially, and ideologically.

I would not attempt to describe man's contempt for his environment as a backlash against the land that bound him. Man has always shown contempt toward that which he has conquered.

I believe the time has come for man to develop the intellectual maturity necessary to restrain his aggressive and hostile nature. We have the wonderful gift of intelligence and the ability to understand the universe that gave us life. Our advances in science have been profound, but they have given us the awesome power to destroy ourselves. We have the necessary intellectual resources to control the darker side of our nature, and we must do so in our generation. The alternative is unthinkable.

R. Scott Ireland
North Miami, FL

Glorious Flight

Joseph P. Allen's article "Joe's Odyssey," in the June 1983 issue, was one of the most awe inspiring, poetic descriptions of orbital spaceflight I have yet encountered. My only regret is that, at forty one, I may never be able to experience the phenomenon of spaceflight or actively participate in the exploration of the new frontier.

The goal of the world's nations should be a cooperative effort to fund space research, not arms races that will lead only to a dead end. Age-old, culture oriented vendettas and bigotries must be minimized, if not eliminated, so that the human family can be free to work toward achieving its greatest potential, instead of engaging in dangerous bickering.

We are entering an era of great promise for our young in the realm of space exploration. Let these new opportunities be our gift to the future generations.

I would like to congratulate you for

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DIALOGUE

FORUM

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

Give Nukes a Chance

As an occasional newsstand purchaser of *Omni*, I am perplexed by the antinuclear themes that I seem to encounter regularly in your magazine. Certainly a healthy respect for the dangers, as well as the potential benefits, of nuclear power is appropriate. However, the irrational and patently antinuclear tone of Hans Fantel's review of *The Cult of the Atom* [Books, April 1983] is clearly out of place in a magazine that purports to have some association with science.

Particularly offensive to me were statements made by Fantel that seemed to portray the entire nuclear industry as "villains," and his citation of a few well-known and well-reported accidents as an indictment of the industry as a whole. The worst sin of all was using an illustration of a nuclear-bomb explosion to accompany the article.

Such crude sensationalism may impress those who had problems with their high-school physics, but it certainly betrays your lack of sensitivity for those who have taken the trouble to assess nuclear power from a reasoned and scientific perspective.

Gregory Schuler
Seattle

Everyone, it seems, loves a mystery—even Hans Fantel, whose review of *The Cult of the Atom* indicates that he revels in the prospect of an upper-level conspiracy of silence.

Sadly for Fantel and his readers, such cloak-and-dagger potboilers as Daniel Ford's egregious tome are the product of the hyperactive imaginations and lust for hyperbole of antinuclear authors.

I am amazed that Ford needed the Freedom of Information Act to obtain all those items he treats as great revelations. All he needed to do was to look through any newspaper's morgue or read one or more pro-nuclear books and pamphlets.

The Brown's Ferry incident did not discredit the nuclear industry. Rather, it demonstrated a principle unique to nuclear power known as "defense in depth." In this incident, two operating reactors shared a common control-cable duct with a third plant under construction. A tyro with a candle set some control and instrumentation wiring on fire, incapacitating 2 of the 11 separate cooling systems in one of the reactors. Of the remaining nine cooling systems, four required special procedures and five remained in operation. The reactors were shut down and cooled with no danger whatever to personnel or environment, and the end result was plant-equipment damage. The outcome of this incident was that plants now have their cabling in more secure areas, away from such dangers.

Also, what justification is there to condemn plant design because of the stupidity of an individual who used a candle to inspect the ductwork? Are cars unsafe because drunks drive them?

Fantel seems to expect nuclear power to be categorically safe before it is used. He'll never see this happen, because such an achievement is impossible. No reputable nuclear expert would make a statement to the contrary. Nukes are not 100 percent safe, but then neither is any other energy source. Given equivalent and properly operating coal and nuclear plants, the coal plant can emit up to 75 times as much radiation as the nuke. Most coal plants, if put under Nuclear Regulatory Commission control, would be shut down for exceeding radiation limits.

It can be easily proved through statistical analysis that more people have died in traffic accidents while driving to antinuclear rallies than have ever died because of nuclear energy.

Do not raise the issue of Hiroshima and Nagasaki as examples of death by nuclear energy, as the rabid antinuke activists eager to associate N-war with N-power do. This comparison is as asinine as someone demanding that we abolish lawnmowers because petroleum is used for both gasoline and napalm.

Far from being a faded dream, nuclear power is a gigantic resource awaiting America's decision to stop taking scientific direction from assorted Hollywood idols, rock stars, organic farmers, and self-styled environmentalists.

Bob Renaud
Massachusetts Voice of Energy
Pittsfield, MA

The Day We Bombed Utah

John G. Fuller's article "The Day We Bombed Utah" [May 1983] was excellent. I found it very interesting to read that there was a rain out in Troy, New York, in April 1953. While I was attending medical school in the Sixties there was an outbreak of Hodgkin's disease in the Albany area, which is near Troy. I recall that the Albany Medical School was involved in extensive epidemiologic studies to try to ascertain why there was a sudden and abnormally high statistical level of this malignancy cropping up in that one corner of the state.

These facts would certainly make one wonder whether Fuller hadn't stumbled onto the answer. Keep up the fine work.

Sherry Rogers
Syracuse, NY

I want to thank *Omni* for publishing the article "The Day We Bombed Utah." Although these nuclear tests were not news to me, reading the article left me quite upset, to put it mildly. Articles such as this one are needed so that the public can see what lengths some people and some governments will go to in order to cover up their horrible mistakes.

We sometimes forget that we are all on the earth together and that we share the same atmosphere. I hope articles like the one you printed will make people consider the consequences of their actions. I pray that I will live to see the day when nuclear testing, weapons, and power plants are relics of the past.

Susan Meeker-Lowry
Worcester, VT

WILD ORPHANS

EARTH

By Dian Fossey

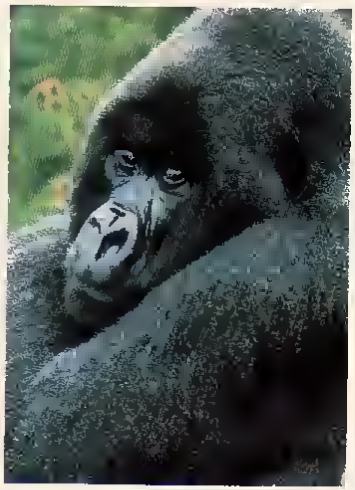
Editors' note. It was in 1967 that primatologist Dian Fossey traveled to the Congo (now Zaire) to launch the first long-term field study of mountain gorillas. After her work was interrupted by a rebel uprising, she founded the Karisoke Research Center, in Rwanda: there, in the rain forest of the Parc des Volcans, her research continues today. The following story comes from Fossey's new book Gorillas in the Mist. *The section below describes the plight of Coco and Pucker, baby gorillas destined for Germany's Cologne Zoo. The narrative picks up in March of 1969, right after Fossey has learned of Coco's violent capture, ordered by the Conservator in charge of the region at the time.*

Immediately I went down the mountain and drove to the rambling old barrack buildings that served as offices for officials connected with the park in those days. In the small open square behind the ramshackle buildings were a series of sheds, the largest of which now served as a garage for the Conservator's new Land Rover. Nestled between the Land Rover and a stack of wood was a coffinlike box surrounded by swarms of laughing people, mainly children. A discarded wire cage lay nearby. Pushing away jeering children, I slowly released the door bolt of the wooden box in an attempt to see the captive, who had retreated as far in the back of the dark interior as it could get. Instantly the little black furry form hurled toward me, shrieking in fear and rage. I slammed the door as people crowded around, laughing loudly at an injustice they did not understand.

I had the box carried into the Conservator's room, where relative quiet prevailed. Against his wishes I opened the coffin door, this time to let the baby out. Once more the small ball of fluff came hurtling forward. Before the Conservator could move she sank her teeth into his leg. She next ran to the windows, where the people had gathered to cheer the action noisily. The frightened gorilla baby beat on the panes with such force that I was convinced the glass was going to shatter. She shed pools of diarrheic dung as she ran back and forth between windows, and, because of her state of dehydration, stopped to lick it up. With an ashtray filled with water I was able to lure her back into the box.

I only briefly questioned the Conservator about the manner in which he had acquired the young gorilla, being desperately anxious to get the baby to camp as soon as possible. Every minute spent talking seemed to be a minute less of her life if the captive could survive at all. Without any abashment, the Conservator admitted to having asked the leading poacher of the park, Munyarukiko, to organize a group of poachers to make the capture. The men climbed Mount Kansimbi and selected a group containing a young gorilla. Later I learned that ten members of the gorilla group were killed in the capture.

The young animal was wired onto bamboo poles by her arms and legs and carried to a small village near the park boundary. Kept for two weeks in the specially made wire cage the park guards had ready for her, allowed neither standing nor turning space: she was fed corn, bananas, and bread until brought to Ruhengeri. There she was transferred to the coffinlike wooden box.



Fossey's charge, bound for captivity

I shall never understand how the orphaned infant managed to survive the confines of the cage, her meager diet or the infected wounds caused by the wire bindings. Somehow she had found the will to live an additional two weeks in Ruhengeri before I heard about her. Not wanting to waste more time in the Conservator's office, I informed him that I would be taking the baby back to camp with me. He showed no remorse in letting her go. He seemed more than happy to let me bear the responsibility of the captive's fate—probable death.

That night I firmly made up my mind that, provided she lived, I would release her to the wild rather than allow her to be put into another wire cage at the Cologne Zoo. I estimated her age as three-and-a-half to four years—old enough to be able to survive in the wilderness under the protection and care of adult gorillas, and I named her Coco.

The Karisoke staff had prepared the second room of my cabin for the captive's arrival, transforming it into a miniature facsimile of a gorilla habitat. With many screams and orders in Kinyarwanda, the porters had managed to squeeze her pen through the doors of the cabin and deposit it amid the trees that now sprouted between the floorboards. Suddenly the baby and I were left alone together in blissful quiet.

Cautiously I pried off the cover of the pen, unsure of the reaction to expect. Would the infant be timid, aggressive, or lethargic? I was thrilled when Coco straightaway left the pen and dazedly walked over the vegetation, patting the leaves and stalks as if to reassure herself they were real. Because of her weakened condition she made only one feeble attempt to strut by my side to indicate that she intended to be in charge of this new situation. She then stood and stared at me intently for nearly a minute before very hesitantly crawling onto my lap. I

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UNCORKING ARIANE

SPACE

By James Kitfield

Searing a high, fine arc over the steamy jungles of Kourou French Guiana, last September the Ariane rocket carried far more than just a two-satellite payload On the ascent of this first fully operational mission of the European Space Agency's (ESA) new launcher rode Western Europe s official bid for a share of outer space Perhaps even more important to the 11 nations of ESA, fhe flighf was to act as confirmation that they could cooperate setting aside parochial interesfs Thaf confirmation proved to be the only part of her mission that Ariane would complete

At 12 minutes into the flight Ariane burned well into the second of her three booster stages and champagne corks were popping at the ESA s Space Operations Center (ESOC) in Darmstadt, West Germany As soon as the launcher released her $100 million worth of satellites into geostationary orbit fhe ESOC team would take over full operational control

But somewhere between the Aleutian Island and Kenyan tracking stations Ariane disappeared from the screens

The lasf words a control operafor wants to hear at zero plus fifteen minutes were those that came over the audio loop ' The launch has failed to achieve required orbit. Repeat " Gravity being what it is everyone at ESOC knew the verdict was final. Within a matfer of minutes the mission which was to have catapulted Western Europe into full space capability, had aborted and frustrations were as hard to cork as fhe premature champagne

"Officially the Ariane is not a French launcher but a European launcher But of course nationalistic rumblings could be heard " says K G Lenhart research head at ESOC "The British newspapers said that it was a 'French' launcher that failed On the other hand, when the early tests were successful the French newspapers claimed it as a French launcher But in the ESA, we tend to say just that it's European "

The official show of unity that followed the ESAs greatest setback no doubt helped fo reduce potential strains in the young alliance When members of special-project teams and research groups devote up to four years to a mission only to watch it disappear from a computer screen, stress reaches a crifical stage

"Officially there was never any pointing of fingers, but internally you can bef there was some grumbling," admits a Brifish sysfems-control operator at ESOC "When a launch goes sour we're all concerned, because that s our job If we can t launch satellites, we re ouf of work And some of us felt there was a quesfion of poor quality control on the part of the French " Yef at the rank-and-file level the grumbling has the appearance of a family fight not an inferna tional conflict

"If I tell one of the French guys I work with, 'Hey Froggie not much of a launcher,' he'll just come back with 'Well Roastbeef at least we have one '" says the Britisher at ESOC

Under the charter fhat officially founded fhe ESA in 1975 each member nation contributes to optional projects according to its interest The French pushed for rocket development from the beginning, assuming nearly two fhirds of the budget for Ariane s development. The British preferred fo focus on the projected boom in communications satellites, and the West Germans turned their attention to NASAs development of Spacelab, due fo be launched soon with the shuttle

In the face of these diverse interests the ESA experiment depends on inferfacing highly fechnical hardware from different countries ESA's quesf for a piece of space also requires unifying groups of people who are, initially, foreign to one another The laboratories are ESA installafions in France, Germany, Holland, and Italy, where bad English is the official language, and participants go by such internal names as 'Frog, Clog, Krauf Wop, Beefeater, and Scandimaniac "

"At the worker level the international cooperation works very well " says a computer operator at ESOC "We work with one another we drink with one another we dafe one another we have the same lovers We spend more time with our colleagues than we do with our wives or girlfriends. So once in a

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ESA's Space Operations Center No one checks passports when it s zero minus ten

BASEBALL SHRINKS

MIND

By Mark Teich

When California psychologist Bruce Ogilvie was invited to the San Diego Padres' spring-training camp in the early Seventies, he was asked to keep a low profile. Around baseball clubhouses, he explains, psychologists were people asked to sneak up the back stairs in the dead of night. Nonetheless, the Padres thought he might be able to help improve the performance of their rookies, so they asked him to talk to the players.

After administering a series of psychological tests to a twenty-year-old rookie—a spectacularly talented catcher named Mike Ivey—Ogilvie gave Padres' management some advice. Ivey, he told them, had a fierce competitive drive, but he was also extremely sensitive and could easily be upset by harsh criticism. "Be careful," Ogilvie warned, "or you might mishandle this kid."

Ogilvie's warning was ignored. The very next day, however, Ivey made an errant throw to the pitcher and missed hitting a coach by inches. The coach turned on Ivey. "You goddamned stupid busher!" he yelled. "You stink! You'll never make it in the Big Leagues!" The abuse continued in that vein, with the entire veteran team listening. For the rest of the workout, the humiliated Ivey *rolled* the ball back to the mound. That evening he called the team office from a bus station to announce he was going home. He was through with baseball.

At that point, only Ogilvie's intervention saved matters. He persuaded Ivey to return and spend some time with him, if only for his own peace of mind. He then isolated himself with Ivey for two days, finally coaxing him back onto the team. Ivey switched from being a catcher to an outfielder. His powerful hitting ensured him a successful career in baseball.

Thanks to the Ivey episode and others like it, professional baseball teams have begun to realize that psychologists can be as valuable as trainers and physicians. After years of struggling for acceptance, psychologists are now working with players on most Major League teams. They give private psychotherapy to certain troubled players and use techniques ranging from relaxation exercises to hypnosis to enhance the performance of well-adjusted players.

All of these techniques, of course, would have been anathema in the grand old game's early days. When your nickname was Big Train, Iron Man, or the Duke, you were supposed to be a hero, and you didn't rave on about emotional pain. You were paid for flawless instinct and performance, not complaints.

But during the Sixties, this veneer of baseball machismo began to erode. First, the leagues added more teams, and younger, immature players were brought up from the minor leagues to fill the extra slots. Second, a rule known as the reserve clause was struck down. The rule had given teams the right to hold or trade players at will. When the clause was abolished by federal statute, baseball's peons—the players—were freed and began signing with teams offering the highest bids. Virtually overnight, pitchers and hitters just beyond their teens became millionaires. Coaches and managers, who now earned less than the players, grew stingier with their praise, and their high-salaried young charges felt an ever-increasing obligation to perform like supermen. Their worries damaged their concentration, whittling away their batting averages and slowing down their fastballs. Eventually, fearing that the money they'd spent was about to be thrown out the window, the teams tried a tack that was being explored by many corporations. They recruited a few psychologists.

Ogilvie was one of the earliest of these consultants. He recalls that at first managers feared the intruders would undermine their leadership, whereas the players viewed the "shrinks" as spies of the management. And because few had ever worked with athletes, the psychologists themselves seemed hopelessly amateurish. In the years that followed, though, they worked with a larger sampling of players, gradually developing a solid block of psychological theory.

By and large, Ogilvie insists, he and his contemporaries have found that

CONTINUED ON PAGE 144

A new type of psychologist is helping baseball players open doors to a level of metafitness

ARTIFICIAL INTELLIGENCE

By Phoebe Hoban

Instead of using artificial languages to communicate with their computers, some programmers are now teaching their machines to understand an old and complex language: everyday English.

Researchers in artificial intelligence are developing systems that may eventually make man-machine communication as natural a process as human conversation. "If computers are ever really going to become household appliances like the TV or radio, there is no question they will have to use natural language," says Kenneth Lim, of Dataquest, a California market-research firm. "The average Joe Public is never going to want to learn BASIC. You have to program the computer to be people-literate."

BASIC is a programming language used in applications that range from calculating a return on an investment to playing games. Writing computer instructions in BASIC or other common artificial languages requires strict adherence to rules. Misplacing a quotation mark, for example, can cause a program to quit, blocking the flow of data. By contrast, people continue conversations in ordinary English even when a previous phrase is ungrammatical or ambiguous.

Cracking the human communication code and teaching it to computers, however, is a challenge. Which comes first—form or content? Is it possible to comprehend the meaning of a group of words without first defining that group's structure? These and other fundamental questions have kept researchers busy since the Sixties. Now their work is beginning to pay off. And within the next 6 to 18 months, several companies plan to introduce the first natural-language programs for personal computers.

Like people, these programs will differ in how they use language. For example, one program, marketed by Artificial Intelligence Corporation, approaches English armed with a rich knowledge of grammar. The *Intellect* program understands such normal English questions as "What is the average salary of unmarried managers in the Rochester division?" and searches databases for answers. *Intellect* reacts to such questions by diagraming the user's command or query to outline its basic structure. Then it uses a built-in dictionary to interpret individual words, then phrases, until it has built up an understanding of the entire statement's meaning.

The $69,500 system deals equally well with incomplete or ungrammatical requests, and it adapts easily to different databases—features that have won acceptance for *Intellect* in some 150 locations, from Aetna Life Insurance to Du Pont. And its designers have just signed an agreement designating the system as the off-the-shelf natural-language program for IBM mainframes. Coming up: a personal-computer version of the program, which could be available within the next 18 months for under $500.

Another set of programs, marketed by Cognitive Systems, Inc., favors semantics—meaning—over syntax or grammar. Cognitive's founder, Roger Schank, believes that the key to all language is knowledge itself. "You simply can't talk about what you don't know about," Schank says. Based on the artificial-intelligence research Schank pioneered at Yale, each knowledge-based program avoids syntactic analysis and goes straight for the underlying meaning that each word represents. This model breaks down language into fundamental concepts rather than parts of speech. Any action, for instance, is categorized as 1 of 11 basic concepts. One of these, for example, is the idea of possessing something. These concepts are understood within a specific context supplied by a "script" that's based on knowledge of such real-life scenarios as reading a newspaper, having an argument, or analyzing stock-market prices. Because the system is not bogged down by grammar, it operates with equal facility in any language.

Since the vocabulary used cannot be separated from the information it conveys, Schank's programs are not just translators. They are virtual experts, or "advis-

CONTINUED ON PAGE 168

Some new machines are learning the foibles of an old, ambiguous language: everyday English

MOCK MACHINERY

BREAKTHROUGHS

By Michael Edelhart

The space tourists file a bit uncertainly into the briefing room. Five dozen seats line the circular walls of the room, where the travelers will receive instructions for their tour of the cosmos.

A robot in the center of the room, Logos the space guide, gives them orders. They are to throw a ball at him, but when they do, it curves away crazily. Then they try to move their hands, movement is difficult. Logos takes them through a preview of gravitational and motion effects they should expect on the trip.

Next, the tourists receive space physicals, balance, pivot, stress, and memory tests to ensure their fitness for space. And then they enter the space capsule. A huge port displays the launch tower. To the right, a video screen shows the crew preparing for launch. To the left, a digital display flashes the countdown. The sound of preparation is all about. Finally, the descending numbers reach 3, 2, 1, LIFTOFF, and the travelers are pushed into their seats as the capsule vibrates.

It's quite a trip, and it's even more impressive because it takes place entirely in a Manhattan office building in late 1983. The 2010 space vacation is actually The Space Works, a multimedia simulation scheduled to open in New York this December. Developed by Trans-Lux Corporation, The Space Works is a pioneering step in the new art of computer-simulation amusements. Combining the flight simulators used to train astronauts and airplane pilots with the technology of video disc and microcomputer, these realistic displays can place us in any corner of the universe of the human imagination. Unlike past amusement scenarios, they provide the physical sensations of the genuine event.

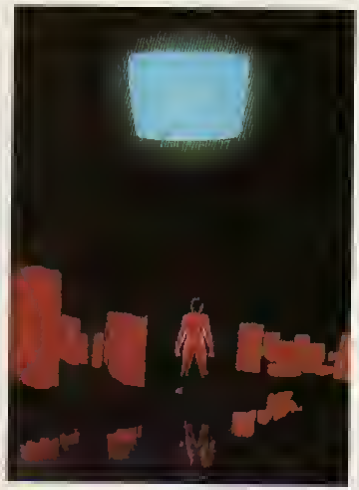
The Space Works uses computer controls and a huge centrifuge-room to create the effects of the spaceport briefing chamber. In the spacecraft itself, computers knit sound tapes, video disc images of the crew, and 35mm movies of the port views into a seamless whole. Hydraulic lifts are tied in as well, to sweep the "capsule" around and move the seats in ways that back up the images with authentic physical sensations.

Another similar simulation ride is the SR2, made by Doron Precision Systems, a small New York firm whose earliest products were driver-education trainers. From outside, the SR2 looks something like a van without wheels. Inside, a dozen seats face a rear projection screen.

The SR2 can become a spaceship, a super-roller coaster, a barnstorming biplane, a race car, or a white-water raft. The images flashed on the screen are coordinated by microprocessor with a complex hydraulic system that moves the unit about in convincing twists.

Already, Doron has placed more than a dozen SR2s in Japan and sees an unlimited future for simulation amusements in the United States.

"The future probably holds additional kinds of sensory stimulation," says David Treichler, of Doron. "Wind, strobe lights, more sophisticated motion. The future of the amusement industry is in simulation—creating sensations in the mind rather than on real rides."



Future fun: computer-generated illusion

And not only sensations of space or adventure. In the movie *Outland*, the evil mine owner played simulated golf with a computer-controlled screen that showed him the fairway and traced his ball's path toward the hole. That device already exists. It is called the Golfomat, and its developer, Arthur Angelos, has sold hundreds of them. Sensors behind the screen measure the angle and velocity of a ball hit by the player. The computer then calculates where the ball would land and selects the proper view of the course.

Ultimately the technology will lead to fully interactive scenarios in which the user has vast freedom of choice to interact with his environment, which will respond to whatever he does. Real-life Dungeons and Dragons? Tennis against Jimmy Connors? A mock auto race? All are possible through computer video simulation.

NEW PRODUCTS

The Spy Beam is a miniaturized system to mark and keep track of valuable cargo, vehicles, or people without attracting attention. A battery-powered transmitter attached to the moving cargo or person transmits a beam, invisible to the naked eye, to an infrared receiver. The beam penetrates smoke, fog, or fabric. It blinks every two to three seconds. But the unit can be set to transmit distinctive signal patterns. The system, costing about $400, could be used to locate a shore point from sea, or to find a specific person in a crowd. (CCS, 633 Third Avenue, New York, NY 10017.)

Microwave ovens are safe when they leave the factory, but according to Controlled Energy Systems, of Texas, some become dangerous at home when spilled food breaks the tight seal of gaskets designed to trap radiation. To find such leaks, the company sells the Micro Snooper ($19.95), a hand-held detector. Microwave owners move a wand around the seam of the oven door while heating water inside. A color-coded gauge warns of radiation. (14200 Midway Road, Dallas, TX 75234.)

MAKING GIRL BABIES

THE BODY

By Judith Hooper

When the phone rings at Gametrics Ltd. in Sausalito, California, biologist-entrepreneur Ronald J. Ericsson often finds himself fielding some odd requests. "Is this where you order boys?" a recent caller asked the czar of scientific sex selection. She wasn't joking, either.

Catalog-order babies, whether swaddled in blue or pink, aren't available, naturally, from Gametrics or anywhere else. But Ericsson's operation comes close. Now that his pioneer "sperm separation" technique—the first and only documented means of choosing your future baby's gender—has been put to the test by some 200 couples desiring sons, its success rate of 76 percent has held steady.

Left to her own devices, Mother Nature deals an even 50-50, of course—and those are the odds to which would-be parents of *girls* have had to resign themselves. Until now, that is. For the first time, there is a way to make the Ericsson method favor female offspring. The only problem is that no one, including the inventor himself, can figure out why it works.

Ericsson hit upon his male-producing method by accident some years ago in the course of fertility research. It just happened to favor the speedier Y-bearing sperm that produce baby boys. The technique works by filtering sperm through several layers of human serum albumin. Because the Y sperm outswim their X-bearing counterparts, what ends up at the bottom of the vertical glass column is a sample composed of about 80 percent Y sperm. Conception is then accomplished by artificial insemination at one of 17 licensed centers around the globe from Rome to Philadelphia.

Recently Ericsson started wondering about the fertility drug Clomid—designed to stimulate ovulation in women who don't ovulate—and found journal reports that it shifted the sex ratio slightly (about 56 percent) in favor of female offspring. Since some of the women using his method might be taking the drug, he asked his sex-selection centers for statistics.

The numbers made no sense. The combination of Clomid and the Ericsson technique seemed to beget a startling, and mysterious, preponderance of females. 15 out of 19 babies born. "Remember," notes Ericsson, "that the control group in this case isn't fifty-fifty, but is skewed heavily toward males, and that Clomid was the only variable." But how on earth could sperm samples consisting of 80 percent Y sperm be making 80 percent female babies?

Frankly, Ericsson doesn't know. Either the statistics are a fluke, or Clomid exerts a weird chemical influence on the filtered sperm. Despite the theory gap, at least three women are pregnant with what they hope are daughters following a Clomid/sperm-separation regimen. "I'm not giving anyone false hopes," says Ericsson. "We'll see what happens. I *am* telling the centers not to use Clomid for boys."

New methods are sure to follow. In Japan, for example, researchers report a promising technique that uses electricity to separate the Xs from the Ys. But it hasn't yet produced a baby.

What impels people to try to tamper with the gender game, anyway? The very idea seems to stir dark presentiments of a bioengineered society full of made-to-order firstborn sons. From the mail Gametrics receives, though, Ericsson predicts that kind of scenario won't happen. "A sociologist, Nan Chico, is analyzing our letters—several thousand by now—as part of her Ph.D. thesis," he says. "Only about one percent of the people want to preselect the sex of a first child. Most people in this country want a girl and a boy." At the East Bay Fertility Ob/Gyn Clinic, in Berkeley, where the Ericsson technique has produced 44 children so far, Dr. Ferdinand Beernink concurs. "Almost all of our couples already have several daughters, often from former marriages, and want a son."

"In Taiwan, where we have several centers, people do want sons," Ericsson notes. "Sons are their Social Security, they're supposed to take care of the parents in their old age. But twenty years from now—when I'm sure there will be better, logistically easier sex-preselection methods—I think the world will be a less sexist place." OMNI

Some parents prefer daughters to sons. Now there may be a method for begetting them

TOKYO'S HIGH-TECH MECCA

EXPLORATIONS

By Doug Garr

It is a miasma of neon and a veritable electronic emporium *extraordinaire*. It is a dazzling array of calculators, stereos, and televisions, as well as a supermarket of semiconductors and assorted electrical gadgets. Welcome to the proud center of the Japanese retail market for high technology, the inimitable Akihabara district of Tokyo. It is sometimes said that you haven't been to the Far East if you haven't spent at least a couple of hours perambulating the half-dozen square blocks along the Chuo Dori (central street) just off the Akihabara subway and train station.

In Akihabara there are some 500 stores and shops, ranging from the posh computer showroom of the Nippon Electric Company on the seventh floor of Tokyo's Radio Building, to the tiny stands in the cramped arcades featuring the raw innards of radios and computers. Last year the district sold $2 billion worth of goods, or 9 percent of Japan's total high-tech gross national product. And most of those goods went for 15 to 40 percent below the manufacturer's listed price. Nobody pays the suggested retail price in Akihabara. In fact, it would be considered impolite by Japanese standards if a buyer didn't haggle over even the "discount" price.

There are basically two kinds of products available in Akihabara. First such typical consumer appliances as refrigerators, electric heaters, and every imaginable variation of TV, tape deck, videotape recorder, amplifier, receiver, and camera. Strange hybrids also abound, from FM-radio digital watches to stereo tuners operated by remote control. Computerized tuning is very popular, as is computerized everything else. Almost every storefront has a flashy display with something whirring in the window.

The second category of Akihabara merchandise features kits, electronic parts, and gizmos that have marginal practical use but are nonetheless infatuations of the Japanese engineering mentality. Shoppers snatch up such exotic items as electric sesame-seed grinders, radish graters, ear picks, pencil erasers, miniature desk-top vacuum cleaners (for the really messy and busy executive, one imagines), battery-operated corkscrews, diaper alarms that beep when baby is wet, and an overflow-sensing device that automatically turns off the faucet when the bathtub is full.

Akihabara also attracts hobbyists of all kinds. You can buy electric trains, a scale-model remote controlled Bell Jet Ranger helicopter (about $510 list), a life-size robotic arm ($37), and kits to build everything from TV sets to home computers. Many of the customers frequenting the hobby shops are adults. Japanese men continue their hobbies far longer than American men do. School kids in their dark-blue uniforms can usually be found tinkering with music synthesizers or playing with computer keyboards. Sunday is the big sales day here, with Chuo Dori cordoned off from traffic to allow the 100,000 shoppers a little more elbowroom. Among them are high-tech marketing executives scouting the competition's products, as Akihabara sales are often the bellwether of an item's performance. The activity on Sunday is fiercely aggressive. Quite possibly this is the only place on earth where computers are sold on the sidewalk.

Tokyo's high-tech district actually has something of a varied history. Before World War II, Akihabara was the place where the Japanese bought bicycles (much more common as a mode of transportation here than in the United States). After the war, black marketeers who were driven out of the nearby Sudacho district congregated in Akihabara. Since the district had been ravaged by bombing, most of the peddlers sold their wares in open-air markets. Radio parts became the predominant staple. Remarkably, there are still one or two shops in Akihabara that sell antiquated vacuum tubes. The most amusing anachronism, however, is the sight of an elderly shopkeeper adding up the price of a purchase of electronic goods with his abacus. If you shake your head in bewilderment, he will probably reach into his coat pocket and produce a calculator.

One shop owner, Shuichi Take, sixty,

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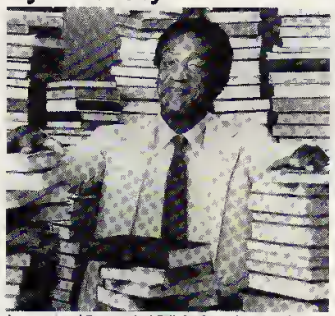
Cramped arcades of Tokyo's Akihabara district offer the world's best buys on electronic goods

How to read faster

By Bill Cosby



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

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

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

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

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

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

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

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

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

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

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

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

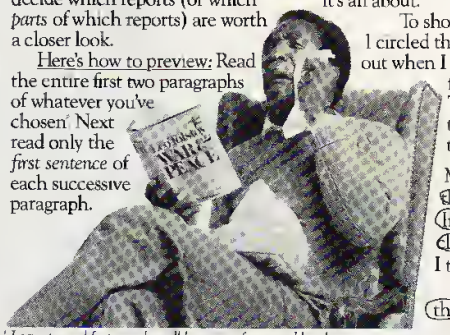
They'll give you the *overall meaning* of what you're reading. And let you cut out an awful lot of *unnecessary* reading.

1. Preview—if it's long and hard

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

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

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



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

Then read the entire last two paragraphs.

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

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

2. Skim—if it's short and simple

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

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

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

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

Everybody skims differently.

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

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

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

"Go and check then," he said.

I didn't want to, Russell said. I was chicken.

"Am not," I said.

"Are so," he said.

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

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

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

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

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

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

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

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

3. Cluster—to increase speed and comprehension

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

Like this:

My—brother—Russell—thinks—monsters...

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

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

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

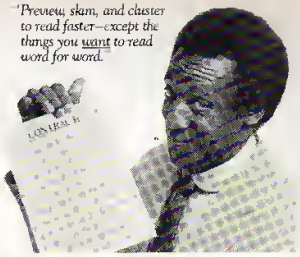
Here's how to cluster. Train your eyes to see *all* the words in clusters of up to 3 or 4 words at a glance.

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

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

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

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



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

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

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

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

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

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

Bill Cosby

CANCER MASQUERADE

LIFE

By Rick Boling

Ominous dark patches threatened to engulf the last vestiges of healthy skin on his legs. Under a microscope, the diseased tissue was seen to comprise hideously deformed cells—huge, lumpy blobs that clumped together in haphazard groups. To the pathologist on the case, all the signs clearly pointed to the vicious killer, melanoma. But the clinical picture seen by Dr. Mark Dahl, at the University of Minnesota's dermatology clinic, told a different story.

The patient, a retired schoolteacher, reported feeling fine at a stage in the disease's progression that should have left him at death's door. A battery of tests failed to uncover any evidence that the disease had spread. And when asked about some white blotches on his legs, the patient revealed that these were spots where other tumors had "gone away."

Regressing atypical histiocytosis, or RAH, is a newly identified disease that may be subjecting hundreds of people throughout the world to unnecessary cancer therapies. Because its mimicry of such insidious cancers as melanoma, Hodgkin's disease, or lymphoma is uncanny, Dr. Kevin J. Flynn, an assistant professor of pathology and dermatology at the University of Wisconsin at Madison, has been conducting studies to determine the course of RAH, how it looks to clinicians, its biopsy characteristics, and how it progresses and regresses. He hopes that his efforts will provide physicians with techniques designed to diagnose the imposter.

At a microscopic level, however, RAH's many faces share common features. These similarities appear to distinguish the disorder from lethal varieties of cancer. "Once you know what to look for," says Flynn, "RAH can be diagnosed with great assurance *most of the time*."

The distinction is crucial, for if doctors are fooled by the appearance of RAH, the treatment can prove worse than the disease. A Florida man, for instance, lost his leg to amputation before the deception was exposed. Because RAH disguises itself as a voracious killer, Flynn explains, doctors may feel compelled to adopt drastic measures when, in fact, the application of a hot compress to the body is probably the best course of action.

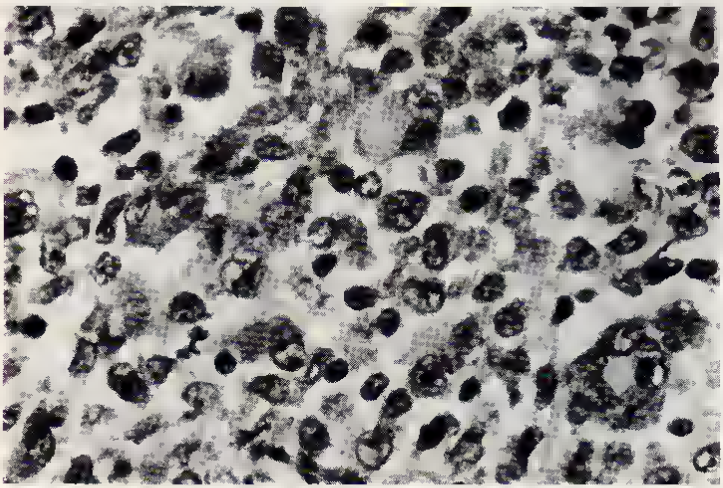
It is impossible to calculate just how many cases of RAH have been mislabeled in the past, but the number is probably in the hundreds. Flynn's search of the medical literature has uncovered many likely episodes of the disease. These reports typically mention numerous lesions that come and go while the general health of the patients remains good. Though not all RAH tumors regress completely, regression *is* one of the disease's indicators.

In the cases now documented, RAH is most commonly mistaken for malignant melanoma, which accounts for two thirds of all deaths from skin cancer. In diagnosing melanoma, the size of the tumor is a prime indicator of the patient's chances of survival. Because many an RAH tumor is as large as a melanoma tumor that would be fatal 50 percent of the time, doctors are faced with very difficult therapeutic choices.

"RAH looks as if it should be lethal," says Flynn, "but it's not. At worst, it may be a form of low-grade malignancy, and it should be treated accordingly."

Dr. Dahl, an associate professor of dermatology at the University of Minnesota medical school, views the disorder as a mild type of cancer. "If my hunch is borne out," he says, "the key question becomes, How does the body ward off the assault?" The answer could have far-reaching implications for treating cancer.

Dahl speculates that a specific reaction of the body's immune system could explain why RAH appears to regress spontaneously. He also believes it's possible that people get the disease only if they have a particular biological makeup that renders them susceptible. "Once we have an idea of who's likely to contract RAH, what it looks like at different stages, and what role the body's defenses play in controlling the disease, we may discover better ways to attack truly aggressive cancers in the bargain," Dahl says. "As things stand now, though, we have a long row to hoe."



RAH afflicted cells mimic lethal cancer so well that only careful diagnosis can tell them apart

THE ARTS

By Jonathan Rosenbaum

For a conceptual artist who's more often concerned with representation than with straight entertainment, Canadian filmmaker Michael Snow can be a pretty jokey fellow. In fact, of all the avant-garde artists I know, he may well be the one who laughs the most and the hardest. His longest and craziest movie—the 260-minute, encyclopedic "*Rameau's Nephew' by Diderot (Thanx to Dennis Young) by Wilma Schoen*—contains a grab bag of assorted puns, puzzles, and adages from lines like 'eating is believing' and "hearing is deceiving" to a mad tea party where words and sentences recited backward are then reversed to sound vaguely intelligible. Even *Wilma Schoen* in the title is an anagram for Snow's name. One of his shortest works, the eight-minute *Two Sides to Every Story*, is projected on two back-to-back screens simultaneously showing the same events in the same room from opposite angles.

Just as typical, in the living room of Snow's house in Toronto, where I recently interviewed him, is a front door that isn't in use—or rather, *is* in use, but not as a front door. Over the side facing inside the room is a life-size color photograph of a painting of the same door. A concept of a front door in place of a real one? A statement about representation instead of a portal to walk through? Perhaps a bit of both. But there's another detail in the photograph that makes the whole thing funnier and stranger: a gigantic hand in the foreground holding a lit match. This image is many times larger than life, totally contradicting the supposed equivalence between real door and represented door.

Perceptual and conceptual gags of this kind abound in Snow's work. Sometimes they're amazingly literal. After making an epic-film trilogy in the late Sixties and early Seventies about possible ways of moving the camera—zooming, panning back and forth, and rotating every which way—he built a set on rollers for a section of another film (*Presents*, 1981). Then he used a couple of forklifts to jerk the whole flimsy construction to and fro so that the camera wouldn't have to budge an inch. In the ensuing slapstick mayhem (a needle on a Bach record skips wildly, walls and furniture shake, objects crash to the floor, actors are buffeted about), something about the perception of movement—as well as the intimate relationship between creation and destruction—is being explored.

Just a few short subway stops away from Snow's house is the best known and most popular of all his works, *Flight Stop*. It isn't a movie, but it makes many people think of one. Located in the largest enclosed shopping mall on the continent, Eaton Center, which reportedly attracts more visitors annually than Niagara Falls, this photographic sculpture consists of 60 fiberglass geese, each suspended from three wires and glued to a contoured photograph of a real goose. Extended over about six stories, the geese seem to be landing in formation, and there's something eerily cinematic about the overall spread, as if each bird were a separate stop-frame in a dispersed simulation of animated flight.

Snow: perceptual and conceptual gags

For epic visual breadth, perhaps the only Snow creation to rival *Flight Stop* is the three-hour film *La Region Centrale (The Central Region*, 1971), in which a computer-operated camera spins in endlessly changing configurations around an uninhabited mountain landscape in northern Quebec. It probably wouldn't be an exaggeration to call this film one of Snow's *least* popular works—it certainly has the fewest laughs. But that's largely because it's so scary. There's a direct assault on the senses, including one's center of gravity, as the flip-flopping camera makes circular patterns at variable speeds that no human being could possibly duplicate, producing an experience roughly akin to riding a demonic ferris wheel. "I wanted to make the film a condensed day," Snow explained. "It isn't, really, but it does start in daylight, and then there's sunset and sunrise, and it's over at something like eleven."

In order to make the film, Snow enlisted the help of Montreal technician Pierre Abeloos, who designed a machine that used audio tapes to program the camera's 360° movements without any direct human contact. Then Snow went out looking for a wild location where nothing man-made was visible, finally settling on an area near Sept-Îles, on the Gulf of St. Lawrence. Renting a helicopter, he flew there with three crew members, installed Abeloos's machine on a remote mountain plateau, and hid from camera range with the others for five cold days in September while the film was being shot.

Why was it so vital to have nothing human either in front of the camera or behind it? "On the one hand, I wanted to have the machine make the film," Snow told me. "But on the other hand, I wanted to make what you see more yours than the cameraman's or the director's, in a way. Even though the height of the camera is the usual human standing height, five feet or so, it makes for a kind of experience that's not anthropomorphic; it's an experience that comes explicitly from the machinery."

"Ultimately," Snow went on, "the director or the artist is removed just one step in

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THE ARTS

By Robert S. Ryan

If you want to look into the real soul of a new machine, look into the eyes of Laurie Anderson. Look through her silver eyeglasses that are wired for sound. Sit around her electronic campfire. Laurie Anderson wants to tell you a story. *"Good evening. This is your captain./ We are about to attempt a crash landing . . ./Put your hands on your head /Put your hands on your hips. Heh. Heh . . . / And we are all going down together"*—'From the Air" ©1982 Difficult Music, BMI.

Echoes like this one—of our collective fear of flying—are scattered throughout Anderson's performance of *United States, Parts I–IV*. After nearly five years in development, this 78-part ode to America in the Eighties received its full-length premiere early in 1983, at New York City's Brooklyn Academy of Music. It took six hours divided into two evenings to experience the entire work. The premiere capped a previous year that saw Anderson move from the position of a relatively unknown avant garde artist fo that of a pop star and media celebrity. 'O Superman,' her single released on the independent One Ten Records label, reached the top of the British pop charts and the top of many American music critics' ten-best lists. Warner Brothers records then signed Anderson to a major recording contract, and her first album for them, *Big Science*, sold 800,000 copies worldwide.

When you meet her, Laurie Anderson is soft-spoken and personable. A state-of-the-art recording studio in her lower Manhattan quarters offers fhe only clue that she is proficient technologically as well as aesthetically. An accomplished violinist and sculptor, she casts electronic spells within a discipline that's really no discipline at all. Termed performance art, it can be part music, part film, part monologue, part anything. And it is Anderson's ability to engineer hundreds of bits of musical, narrative, and visual information into one seamless work thaf makes her important. "When I began to write *United States*," she tells us, "I . . . thought of it as a portrait of a country. Gradually I realized it was a portrait of any technological society, and people's attempt to live in a technological world." The dramatic big picture she develops in *United States* touches on everything from the space program to romantic love and captures the humor, confusion, and wonder that seem to coexist throughout contemporary life. Outer space satellites and extraterrestrial travel, in particular, fascinate her, but she is critical of the direction of the space program foday. "It seems everything we send up now is just for the purpose of looking back down," she comments. "It's such a huge change from the Apollo days. We just go up for a few miles now, and it's basically for surveillance." That's not to say she adds, that she would not jump on the first shuttle flight available.

As instrumentation in this new American Gothic, Anderson uses a Synclavier, which looks like an organ but is actually a "sample-to-disk" digital keyboard in which voices and sounds are assigned to various keys on the board—a bizarre, high-tech variant on the traditional keyboard arrangement. In the section of *United States* entitled "Example #22," the Synclavier allows her to recall programmed voices of so-called paranormals—those self-proclaimed conduits to the spiritual world—and to mix them with her own voice speaking in both English and German. Radio waves, satellite beams, and other precise electronic transmissions are juxtaposed with the "spiritualist" communiqués throughout fhe performance. The summoning of these voices resonates with eerie associations, reverberating between ancient concepts of mystical realities and new extraterrestrial visions. In another segment, on the other hand, Anderson indulges in a rather pedagogical ten-minute monologue on the importance of Nikola Tesla.

Anderson: technology's digital diva

Another of Anderson's tools, the Vocoder, a voice-activated synthesizer, alters the voice's character and tone. Through it Anderson speaks in rapid succession as a child, as herself, and as a middle-aged man. The capability of machines to affecf speech is a major theme of her work. "I think this issue will predominate as machines take over more of our modes of speech," she observes. "The question of what is human and what is facsimile arises with these disembodied voices that come to us over a PA system or through a phone line. I have a friend with a child," she continues, "and one of the hardest jobs she has is to teach this kid what's alive and what's nof. For insfance, fhe phone will ring and she'll say, 'It's Grandma,' and the kid says, 'But that's a piece of plastic. Is it alive? Is the TV alive? And these things are confusing not only to the child, they're confusing to me."

Anderson turns the kind of instinctive confusion we all feel toward supermarket checkout terminals that talk back, or friends who are present in spirit if not in fact through their phone-answering machines, into incisive gestures and images. At one point in the performance she turns her own body into a musical instrument by wiring her head for sound with those elecfronic eyeglasses. Knocking on her head and jaw,

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CONTINUUM

POLITICS AT THE POLE

Antarctica comprises one tenth of the terrestrial world, yet there is no consensus as to who owns it Does it belong to the seven nations that have asserted territorial claims to it or to the nations, now 14 in number, that have conducted most of the research there? Is it as some lawyers maintain *res nullius*—belonging to no one—because sovereignty is impossible to establish in such a hostile environment? Or does Antarctica belong to everyone?

As long as this ice-encased continent was the preserve of explorers and scientists, such questions were academic But now the prospect of finding valuable resources endows the matter with urgency Though exploration for Antarctic oil and gas has not even begun their existence is almost a certainty Coal and iron are known to be present in large quantities Trace amounts of copper chromium, nickel cobalt manganese, molybdenum, gold, silver, platinum, and other minerals have been found, and evidence indicates that significant concentrations exist Perhaps most important, the Southern Ocean surrounding Antarctica represents the world's last major undeveloped fishery, its prime food source—tiny shrimplike krill—could provide protein for millions of people throughout the Third World

Just 25 years ago the 12 countries most active in Antarctica agreed that the continent and its wealth should be used for peaceful purposes only Antarctica would be preserved as a domain where freedom of science was ensured and all military activity forbidden To this end, the 12 nations negotiated the Antarctic Treaty which came into effect in 1961 At the time it attracted a great deal of attention less perhaps for its specific provisions than for the fact that at the height of the Cold War, the United States and the Soviet Union were among those able to agree on nonmilitarization, unlimited right of inspection, and full exchange of information—at least in one corner of the world

But an important matter was omitted from the treaty the problem of claims to territory and the resources within The seven nations claiming territory in Antarctica were and still are, Argentina, Australia, Chile, France, New Zealand Norway, and the United Kingdom (the claims of the U K Argentina, and Chile overlap) Five remaining countries—Belgium, Japan, South Africa, the Soviet Union, and the United States—asserted no claims and recognized none but retained the right to stake claims at some future time Poland and West Germany have recently joined the treaty nations like the United States and the USSR these countries claim no territory at the present time

In an effort to establish ground rules for exploitation of Antarctic resources despite the confusion this "Gang of 14 ' is now trying to negotiate what they call a ' minerals regime ' As expected the parties are having difficulty The claimant nations assert that minerals found in their sovereign territory belong to them alone, while the nonclaimant states want some system of sharing resources wherever they may be found Although the nations involved have a strong interest in reaching agreement it is possible that avarice and virulent nationalism will destroy the consensus system developed during the last 20 years

If agreement can be reached, however, it isn t likely that the Gang of 14 will be able to ignore the rest of the world and divide the spoils among themselves, the treaty powers already seem prepared to make some token payment to the poorest countries if and when mining becomes profitable Nor will the developing countries allow the Gang of 14 to treat Antarctica as a private fiefdom where they alone make all the decisions Some compromise will be needed between the common-heritage principle and the notion that Antarctica can be run as a private club

My own hope is that the Antarctic Treaty system will be preserved and that the 14 consultative powers will administer the area as a commons in trust The treaty nations have so far acted responsibly and have acknowledged the interest of all mankind" in Antarctica They have already adopted agreements for the protection of the environment and the preservation of Antarctica as a unique scientific laboratory They are the nations with direct knowledge of Antarctica and with an understanding of the probable impact of their actions Provided the treaty powers can now reach agreement among themselves keeping decision making in the hands of the most experienced and concerned nations will best ensure in the words of the treaty ' that Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord ' —*PHILIP W QUIGG*

Philip W Quigg is the former managing editor of Foreign Affairs *and the author of* A Pole Apart The Emerging Issue of Antarctica

CONTINUUM

...lated research
... tha newborns

BABY SEE, BABY DO

When your two-month old baby smiles, the textbooks say it's only "gas," not a real social smile. And no less a child-development expert than Jean Piaget pronounced babies under six months old incapable of imitating another's behavior.

Now some of the pundits can eat their words. Testing 74 newborns at Miami's Jackson Memorial Hospital child psychologist Tiffany M. Field discovered that day-old infants can recognize and imitate facial expressions—in this case the smiles, frowns or surprised looks of researchers. While doing neonatal assessments, Field recalls, "I kept seeing this kind of behavior, so I decided to test it out formally." Fare well to the dogma that infants under three months lack the visual acuity to recognize facial features.

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Brand-new infants run the gamut from "poker-faced" to "extremely responsive." Field plans to follow her subjects up to the ripe old age of five to see what these traits portend.

—Madeleine Lebwohl

Even when pursued the butterfly is never in a hurry
—Japanese saying

BIONIC BEAKS

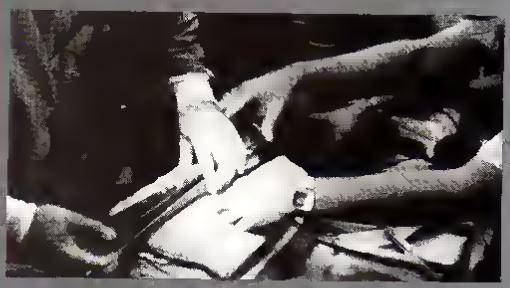
Beach goers strolling the southern California coast last fall were stunned to see 19 mutilated pelicans floating offshore. The brown birds had their upper beaks hacked off, probably by fishermen defending their anchovy patches. Four of the animals succumbed to the injuries almost immediately. The rest, no longer capable of catching fish, would have starved to death soon after.

This horror story, however, may have a happy ending. ...ary surgeons and an ...oe engineer have ... forces to save the 15 ...ng animals by fitting ... with artificial beaks. ...late October, after ...rds were found, Dr. ... Rooks and a team at ...rown Valley Animal ...al, in nearby Laguna ...el, south of Los Ange..., successfully attached an artificial beak to a pelican named Pinocchio. The new beak, made of epoxy resin, fiberglass threads and carbon fibers, was connected to the remains of the old beak with glue, pins and screws.

Shortly afterward James Crose, director of advanced technology at PDA Engineering in Santa Ana, joined the team to develop a new and safer method of attaching the artificial beak. Instead of using pins, which may cause injury to the birds when they strike their beaks on hard surfaces, he secured the prosthesis with epoxy and ultrapowerful bone cement. Though Crose tried to make the attachment just as strong as it was in nature, two of these beaks have recently broken, and the scientists must go back to the drawing board.

Nevertheless, hopes remain high that a working beak will soon be perfected. The surgical team hopes to operate on pelicans throughout the year.—Joel Schwarz

If you can look into the seeds of time
And say which grain will grow and which will not
Speak then to me
—William Shakespeare



Surgeons attach an artificial beak made of epoxy resin, fiberglass and carbon fibers to Pinocchio, a wounded ...ican

THE TELESCOPE VS. THE GOLF COURSE

The observatory that created some of the most detailed maps of the sky and that listened attentively over the past decade for radio signals from intelligent life in space was nearly destroyed by developers who wanted to build a golf course on the site

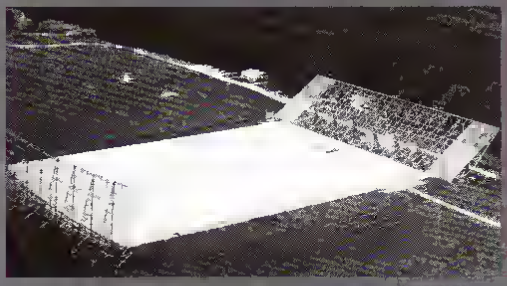
You may think that a radio telescope weighing nearly 500 tons and covering about 4 acres of ground is too large an item to fall between the cracks But that is what almost happened to the Ohio State Ohio Wesleyan Radio Observatory Through a series of misunderstandings and miscommunications Ohio Wesleyan sold the land out from under the telescope apparently to the great surprise of Ohio State even though the two universities have jointly operated the observatory since 1956 The site went along with the sale of some 250 acres to Green Highlands Ohio General Partnership a private group hoping to build housing tracts and putting greens

Early reports quoted the developers as saying that the telescope was right in the middle of the proposed golf course In later newsletter bulletins the partners referred to the telescope constituting an eyesore

But anguished cries from the telescope's defenders have recently been heard According to George Gamow who founded the Committee to Save the Telescope the developers just needed a little consciousness raising to put their priorities in order

Not only were the members of the partnership grateful for the astronomy lessons Foster said but they saw how influential friends of the telescope could help them win zoning variances on the land—provided they left the observatory alone

'Instead of a lot of static they'll get a lot of cooperation Foster explained They're beginning to look at the telescope as an attraction instead of an abomination —Dava Sobel



The Ohio State-Ohio Wesleyan Radio Observatory Developers wanted to replace the famous telescope with a golf course

A surprising manatee Scientists have found that the sea creatures have a rich vocabulary of more than 1 000 sounds

MANATEE TALK

The gentle, giant mammals known as manatees are fast becoming extinct But if they could be warned against such man-made hazards as boat collisions perhaps their lives could be saved

So thought Florida Institute of Technology biologist John Morris and his student Cathy Steel But when the two began studying ways to communicate with these creatures they hit upon a surprising discovery Manatees have a rich vocabulary of over 1 000 sounds including a series of interplay and distress calls

Using underwater hydrophones Steel and Morris used computers to identify the patterns of various tones frequencies and amplitudes They sorted the findings into 13 categories according to age and sex Adult females for example mimicked the noise of a low-pitched 'rusty pump while manatee infants sounded like chirping birds

All tones intensified with imminent danger Clearly, the manatees had developed their own warning signals claim the Florida researchers, and all of this *without* human help

Their sounds relate to their moods or convey information says Steel 'But how specifically we don't yet know

—MaryJane T Murphy

'Innovators and creative geniuses cannot be reared in schools They are precisely the men who defy what the school has taught them"

—Ludwig von Mises

'Do not free a camel of the burden of his hump you may be freeing him from being a camel"

—G K Chesterton

CONTINUUM

H Grady Young performs acupuncture on a patient. The American Veterinary Medical Association has attacked the procedure

PET ACUPUNCTURE

Does a visit to the vet send your pet into fits of jitters, mewing, barking, or clawing? If so, acupuncture may take the edge off its anxiety, suggests H Grady Young, a septuagenarian veterinarian from Thomasville, Georgia.

Taking his cues from ancient Chinese cavalrymen, Young first used veterinary acupuncture 38 years ago to calm an unruly horse. And he's been practicing it ever since to ease vet-phobia—as well as to anesthetize four-footed surgical patients and relieve emphysema symptoms. He claims the needles have also improved the performance of racehorses and restored a prizefighting rooster's bum leg.

The American Veterinary Medical Association views acupuncture as an experimental treatment from which the public must be protected. Young, however, retorts that the AVMA, with its financial ties to drug companies, won't endorse a procedure that lessens the need for drugs.

—Eric Mishara

An age is called Dark not because the light fails to shine, but because people refuse to see it.

—James A. Michener

BLUE PEOPLE

Kentucky is best known as the Bluegrass State, but it also has another, less publicized distinction: an inbred group of people with pale blue skin.

The first known blue person was born in France around 1800. An orphan, he came to the United States and settled in Perry County, Kentucky, along the banks of Troublesome Creek. By sheer coincidence, he married a woman with similar traits, and the two of them set the pattern that has lasted to the present.

Before 1900, blood specialist Madison Cawein explains, Troublesome Creek could be reached only by foot. Thus, the isolated inhabitants—all related—married one another and today have produced more than 200 blue offspring.

Cawein became aware of their plight in the mid-1960s and he set out to help. Working from his lab at the University of Kentucky, he traced their odd pigmentation to an enzyme deficiency. They were missing the enzyme that breaks down the blue-brown blood chemical known as metahemoglobin. With an excess of this substance flowing through their veins, the folks at Troublesome Creek had turned as blue as Oxford shirts.

Finally Cawein came up with a cure: daily administration of an inexpensive antiseptic called methylene blue, which activates an enzyme that replaces the missing one, turning blue skin to pink.

Because there are few doctors in the vicinity of Troublesome Creek, a daily treatment isn't feasible, says Cawein, who now directs Merrell National Laboratories in Cincinnati. On the other hand, "Although these people are embarrassed by their condition, most of them stay healthy and bright to a ripe old age."

—Tom Kovach

My means are sane, my motive and my object mad.

—Captain Ahab, from Herman Melville's Moby Dick

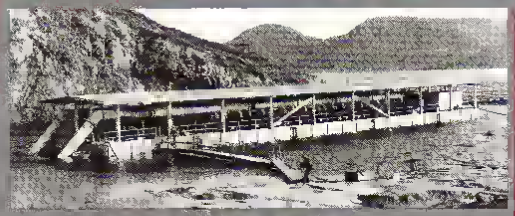
SWEDISH SATELLITE

In the fall of 1984, Sweden will launch its space program with a Boeing-designed satellite, aptly named Viking. Its mission: to study the northern lights, or aurora borealis, which Swedish scientists have long pondered from the ground.

The magnificent lights are created when solar wind interferes with the earth's magnetic field, unfortunately hinder radio communications. Perhaps Viking's eight-month voyage will tell scientists why.

Down the road, Viking project scientist Kerstin Fredga envisions a row of Swedish telecommunications satellites and even a Nordic cooperative satellite for direct broadcasting. Swedes are likely to greet their Space Age enthusiastically, she says, "especially when they can look at their own summer cottages via remote sensing." Viking is the Boeing Aerospace Company's first international satellite. —Frank Catalano

Viking. At last, a close look at the northern lights.



Mud-slide destruction after Mount St Helens Some residents now fear mud more than lava they re keeping the vans packed

VOLCANIC MUD

Three years after the cataclysmic eruption ot Mount St Helens, residents ot southwest Washington are still looking over their shoulders But nowadays people aren t as scared of lava as much as they are ot the mud

When the mountain blasted away its northern face in 1980, explains Ed Daugherty of the U S Army Corps ot Engineers, it plugged the upper watershed of the Cowlitz and Toutle rivers A natural dam of volcanic debris now holds back some 3 billion cubic yards of eruptive leftovers—and huge amounts ot water and mud Should the dam break 70 000 downstream residents could be engulfed

But for now according to Daugherty the situation is under control For two winters the corps has been operating a pumping station to relieve pressure on the dam And corps engineers are studying potential tunnels and pipe systems that would drain the area should eruption occur

Still even Daugherty admits that internal weaknesses, an exceptionally rapid snow melt or another violent eruption could result in a flood during the spring or fall For that reason many area residents want the government to buy out all the endangered property letting the mud flow where it may

"Everybody worries no matter what says Jerry Comstock of Castle Rock 'It s a constant fear We keep our van packed We don't know what to do, so we stay prepared "

—Tom Gauntt

"Of all liars the smoothest and most convincing is memory

—Olin Miller

PRESCHOOL SUICIDE

One August morning in 1982 three-year old Jenny Brandon climbed up to a kitchen cabinet and gulped down half a bottle ot window cleaner Fortunately her mother who found her doubled up on the floor rushed her to the emergency room in time But nine months later Jenny munched a handful of allergy pills she found on her mother's dresser, this time she died

Until recently most experts would have blamed these incidents on a mere twist ot fate But now, according to Dr Perihan Rosenthal, director of child ambulatory services at University of Massachusetts Hospital, many doctors don t take such "accidents at face value Children as young as two Rosenthal has found, attempt suicide

In nearly all cases, says Rosenthal preschoolers in repeated accidents have been abused or have lost a parent One two-and-a-half-year-old patient for instance, starved himself for two weeks, then tried to jump in front of onrushing traffic He also bit himself violently When asked why he was hurting himself he answered because nobody loves me—Mommy and Daddy went away '

Why did they go away?" Rosenthal prodded

Because I m bad Now I have to get punished the child explained

The child felt rejected and guilty, Rosenthal explains, and tried to punish himself just as he believed his parents had

The idea that a preadolescent could attempt suicide runs counter to the traditional Freudian view which holds that a youngster's superego, or conscience, is not yet developed enough to conceptualize such a self-destructive act But today says Rosenthal most psychiatrists look beyond Freudian theory "taking such factors as family situation and interpersonal relationships into account as well '

Rosenthal emphasizes that "children under the age of seven or eight really don't understand what they re doing They don t think that death is irreversible ' It's crucial, she adds, for these youngsters to receive some sort of therapy By helping the child achieve self-love and self respect the psychologist or psychiatrist may prevent self-destructive patterns from flaring up later in life

—Kathrine Jason

Scientists a re-assessing Freud's v w that young children s superegos are not developed enough to conceptualize suicide

CONTINUUM

SHRINKING TUMORS

A benign tumor on the face and neck isn't really so benign. Left alone, it can crowd delicate anatomical structures, causing serious damage. Yet surgery can also be dangerous and disfiguring.

Many such tumors, primarily those known as angiomas, are basically proliferating masses of blood vessels. If the tumor's blood supply can be cut off, the growth will shrink. But when physicians try to starve these blood-hungry tumors by clogging capillaries, the tumor attracts new blood vessels and keeps on growing.

Now the problem has been solved by New York University neuroradiologist Alex Berenstein, who has found a way to form a shield around the entire surface of the tumor. Instead of using gel or clotted blood to clog capillaries leading to the tumor, Berenstein injects the body with microscopic particles of polyvinyl alcohol foam. The particles are so small—250 to 600 microns in diameter—that they pass through the smallest capillaries to literally *coat* the body of the growth.

'In effect, you get to the heart of the matter,' says neuroradiologist Ira Braun, now using the procedure successfully at Emory University Hospital in Atlanta. The tumor is no longer able to receive blood because the particles are blocking it off completely.

'For some people this is the only hope, and it offers them a complete nonsurgical cure,' Braun says. He adds that the technique can also be used to shrink operable tumors—including such cancerous growths as tumors of the breast, thyroid, and kidney—prior to surgery.—David Dreier

"We live in a Newtonian world of Einsteinian physics ruled by Frankensteinian logic."

—David Russell

Before (left) and after (right) pictures of a patient whose benign face tumors were starved to death with polyvinyl alcohol foam.

A potato may not be what it appears to be. One scientist has built a spy spud whose mission is to squeal on rough handling.

POTATO ESPIONAGE

Shuttled through processing equipment, potatoes often develop bruises and rot in storage. To help solve this problem, two agricultural engineers created a spy spud.

Designed by Terry Morrow, of Pennsylvania State University, and tested by Neil Hallee, of the University of Maine, the spy spud looks like a potato, but on live television it has a voice.

Apart from a real potato, the silicone-rubber imposter contains electronic sensors designed to detect rough handling. When the spy spud is jostled and bumped, it yelps, relaying an FM signal. The greater the force of the bump, the higher the frequency of the signal.

Although it proved a success in testing, the first prototype has been dismantled for improvements. "Mostly we want greater range," the scientists said. Morrow.

Eventually, he said, the device may be adapted to snoop on apple and egg processing lines as well. Computerized data from the devices would allow produce handlers to redesign equipment to avoid rough handling.—Allan Maurer

We must not wait for favors from nature; our task is to wrest them from her.

—Ivan Vladimirovich Michurin

The dead live only with the exactitude and quality imparted to them by the living.

—Joseph Conrad

Is smoking good for expectant mothers? Not exactly, but smoking may protect infants against Respiratory Distress Syndrome.

PRENATAL SMOKING

Although no responsible physician would prescribe cigarette smoking, it may have one curious health benefit A pregnant smoker apparently doubles her baby s resistance to a fatal lung disease

Some infants are born with immature lungs that don t expand and contract normally a condition called Respiratory Distress Syndrome (RDS) Among 600 women studied at the Uni versity of Wisconsin, *non smokers* proved twice as likely to have RDS afflicted babies One in every five nonsmoking' newborns was stricken accord ing to researcher Luis B Curet but only one in ten of the smokers' babies was so afflicted And unborn children of mothers who smoked more than a pack a day had even better odds

Nicotine restricts the blood flow to the fetus Curet explains, and the long-term stress may actually prompt the unborn s lungs to mature Or perhaps the smoking mother s faster metabolism somehow ac counts for her baby s difference If researchers could isolate the crucial factor more than 5 000 RDS deaths could be prevented every year

But smoke in the womb is still unhealthy Curet cautions Smokers often give birth to underweight babies that don t survive as well as their heftier peers

—Sy Montgomery

I don t care anything about reasons but I know what I like

—Henry James

RUNNING AND ANOREXIA

Compulsive runners and women with anorexia nervosa suffer from different versions of the same defective psychology ac cording to researchers at the University of Arizona Both versions of the disorder they state, should be regarded as pathological

Psychiatrists Alayne Yates and Kevin Leehey and psychologist Catherine M Shisslak reached this conclusion after finding striking similarities between 60 marathon runners and a group of female anorexics who starved themselves to be thin Runners so consumed they ran even when sick or hurt reports Yates often set irrational goals for themselves 'They kept upping the ante add ing more and more miles to get in better and better shape but no goal was ever good enough for them In fact the compulsive runner felt out of shape even when he was overtrained Anorexics by comparison, were compulsively driven to lose more and more weight Even at dangerously low weights anorexics continued to see themselves as too fat

Yates notes that both compulsive runners and anorexics tend lo be introverted self effacing and unable to express anger They are often high achievers from affluent families The extreme examples of discipline seen in both groups she adds are actually efforts to forge a more stable identity

Not all disciplined runners have pathological problems Yates emphasizes Moreover the disorder may be found in a wide range of athletes including weight lifters javelin throwers high jumpers or anyone else who becomes obsessed with a sport

—Marc McCutcheon

Unborn tomorrow and dead yesterday /Why fret about them if today be sweet?"

—Omar Khayyám

'History is unpainful, memory does not cloud it 'You join the emphatic lives of the long dead '

—Elizabeth Bowen

Compulsive running may be similar to anorexia nervosa.

CONTINUUM

CARNIVOROUS BEES

David Roubik recently placed a nest of stingless bees in his yard. They seemed to behave like any of their stingless bee cousins—until the day after Thanksgiving, when he put out a turkey carcass for his cats. Thousands of bees soon swarmed, giving the felines some very stiff competition and convincing zoologist Roubik that he had discovered the only carnivorous bee species in the world.

The vulture bees, part of the species *Trigona hypogea*, look like slender black flies and have a preference for soft-skinned lizards and amphibians. But reports Roubik of the Smithsonian Tropical Research Institute in Panama, "they can strip a dead monkey, bird, or anteater down to the bare bones in days. A group stands in a circle and tears on the flesh until they've made a little hole," he adds. "Then they go down into the hole and tunnel right through, excavating viscera, internal organs, everything."

Like other bees, *T. hypogea* suck nectar to make the honey that provides them with carbohydrates, but they've lost the leg structure used for carrying pollen, the source of protein for all their cousins; instead they suck flesh. Most bees have only two teeth. Roubik adds, but *T. hypogea* belongs to a small subgroup endowed with 16.

"I've been studying the ecology of the so-called killer bees for seven years," Roubik says, "and now I find a bee that will clean up after the killers. It's a little bizarre, but it's a logical progression."

—Leah Wallach

"It's interesting to live when you are angry."
—Yevgeny Yevtushenko

A member of Trigona hypogea makes short work of a small frog. Unlike most bees, T. hypogea sports a mouth of 16 teeth.

Woody Allen, sloucher supreme, demonstrates his fame-winning form. Slouching, according to a new study, can fight failure.

SLOUCH FOR SUCCESS

Are you a failure? Has life dealt you the proverbial kick in the behind? As your old high-school coach might say after a crushing defeat, Keep your chin up and your shoulders pinned back, because things aren't all that bad.

Except Coach has it all wrong, according to a recent series of studies at Texas A&M University. More than 100 volunteers in those studies were given written tests consisting of purposely ambiguous, impossible-to-answer problems of analysis. Each volunteer was told he'd failed the test, then psychologist John Riskind instructed half the subjects to sit in a slouched posture and the other half to sit erect. Finally, he measured their moods through observation and questionnaires. The result: Those who had slumped were less depressed about their failure. Moreover, they were more self-confident and actually tried harder on a test taken shortly afterward.

"On a practical level," says Riskind, "the goal is to expand the domain in which we can control our own mood. Slouching promotes a kind of detachment, so if depression starts to set in, it might not be a bad idea to take on a slumped position and withdraw for a while."

—Eric Mishara

"Get place and wealth, if possible with grace, if not, by any means get wealth and place."
—Alexander Pope

QUEST FOR FLAME

BY KATHLEEN STEIN

There's not a whole lot written about flames. Although one will find a few musty volumes on flame retardants and the like, the seeker will find almost no sizable texts on the nature of fire. Instead he will find passion and temptation (*Flames of Desire*, *Flaming Hearts*, *Flames of Diablo*, *Flames and the Fury*), war and combat (*Flaming Feuds*, *Flames and the Dagger/Gun/Sword/Arrow*, *Flame of Doom*, *Flaming Apocalypse*), and any number of couplings suggesting something unusually hot (*Flaming Tongue*); something bizarre (*Flaming Terrapin*), or perhaps something redundant (*Flame Touches Flame*)

But if you're interested in

"Chigier offers us visions of engines that need no cooling devices, and fuels of water and coal"

something about flames as in "Flaming Fuel," or more specifically, "Flame Stabilization in Recirculation Zones of Jets with Swirl" or "The Structure of Eddies in Turbulent Flames" or "Dynamics of Droplets in Burning and Isothermal Kerosene Sprays" (recent papers) you have to look up Norman Chigier. Norman Chigier wants to know everything there is to know about flames. And he's got books, papers, and his own journal to, as he puts it, "propagate my flames." Flames of the mind—from a wiry, high-energy fifty-year-old whose professorial formality dissolves into boyish glee when he gets hot on the subject. As William J. Brown Professor of Mechanical Engineering at Carnegie-Mellon University (CMU), in Pittsburgh, he's in charge of a whole new laboratory devoted to flames and combustion. And he's a veritable Fellini of flame filmmaking. (See Chigier's photo, above, of a flame jet hitting a hard surface. His photos on the previous pages show a ring of fire and a propane flame.)

Fire is where it's at, declares this number-one champion of the Combustion Age. A la *Quest for Fire*, hominids have been playing with flames for at least a million years. Fire has been at the center of the human sense of mystery and power, it's been the universal principle of explanation for cosmology and philosophy (Heraclitean fire), and the nexus of science and industry. And yet, as Chigier says, nobody knows much about fire at all. It exists as one of nature's greatest and most enduring paradoxes: chaos in order, ignorance in knowledge.

"The world was created by an act of combustion in one form or another," Chigier begins. "From the time humans acquired heat for cooking, fire has been the requirement for survival, and the threat of destruction. Since the beginning of civilization men have been throwing fireballs at one another. The modern military machine—aircraft, missiles—is entirely dependent on burning fuels. Spaceships." The whole world sees huge quantities of fuel burning in seconds. Yet, in a peculiar way," he goes on, "people seem to think all that's needed to be known about flames must be known. In fact, it's just the opposite."

Whether fire can be considered a human trait or a natural force, it has been the foremost medium that humankind has used to shape the environment, says Stephen Pyne in one of the rare books about conflagration, *Fire in America*. "When early peoples grasped fire, they irreversibly altered the course of evolution." Fire is power; fire is the great transformer; and its work is irrevocable. Bright-faced fire is the mediator between the raw and the cooked, between nature and culture.

Fire may be one of the oldest words in any language. Studies of flame have been eclipsed, however, by sophisticated work in molecular chemistry and the physics of quantum mechanics.

"We will not, I believe, discover anything about fire as dramatic as a black hole," Chigier says, "but this uncovering of what's inside a candle flame, inside a combustion engine—the complexity of the interaction of chemicals, fluid dynamics, the mathematical concepts—requires ingenuity and creativity, the basic elements of scientific discovery."

Why is this so important? The volatile engineer offers us visions of engines that need no cooling devices, fuels made of water and coal, sprays of fuel so well controlled they burst into clouds of fire, each droplet a tiny explosion of energy. He promises us a laboratory where high-energy pulsed- and continuous-wave lasers will be used to measure with impressive accuracy the velocity, temperature, particle size, and concentration within the flame.

He fires off his view of the flame *Zeitgeist* like the staccato of machine-gun rounds. The burning of fossil fuels is the main source of energy now—90 percent of our energy, to be exact. "And in my opinion it might have the same proportion well into the next century. This statement is extraordinary, and against many scenarios prepared by energy and political departments and by economists who twenty years ago predicted that by now we would barely be burning fossil fuels at all!"

There's been a great deal of talk about alternative energy systems." He warms to the subject. "A lot of money has been spent on them. Nuclear power has been waylaid by grass-roots politics. Hydroelectric has already reached its potential. Solar is most suitable for heating the home and the swimming pool." The main problem for combustion science, Mr. Flames insists, is how to get the maximum conservation of fuel with the minimum pollution. And to avoid the fire next time. "Future wars will be fought on the basis of energy resources," he warns, "The political factors are already enormous."

To achieve maximum conservation of energy with minimum pollution, Chigier calls for a radical reexamination of the combustion engine and its design. Although there are many varieties of engines that work, the combustion mechanisms are not fully understood. In the early years of the auto industry, for example, Detroit paid little attention to the physics of combustion. They put fuel in an engine and it turned over and the car rolled down the road. They had a problem with knock, they put lead in the gas and the knock stopped. They didn't know why. "Ultimately it was the air-pollution crisis of the Seventies that aroused Detroit from its stupor," Chigier says. To achieve the contradictory goals

ot pollution reduction and fuel economy the automotive engineers reluctantly began peering into the engine again. That was a red-letter day for scientists pursuing knowledge of the flame.

Most engines today are quite efficient from a combustion point of view. That is the fuel put into them burns up. "But in terms of thermodynamic efficiency," he continues, "that's another matter." Thermal efficiency is the ratio of the heat gained by the system to the heat supplied by the fuel. "A well-insulated boiler could achieve combustion efficiency close to one hundred percent and an ideal thermal efficiency of ninety percent. But heat loss by flue gases reduces thermal efficiency. The auto is only ten to fifteen percent efficient thermally. For boilers used in electricity generation, today's heat exchangers transfer only forty to fifty percent of the available amount of heat.

"We know there's enormous scope for increasing total energy supply not only in the combustion process itself but in determining how the properties of the flame influence heat transfer and heat loss. The focus has turned from the single consideration of combustion efficiency to the recognition of the role flame structure can have on thermal and total energy efficiencies. In flames there's enough research to occupy me for the rest of my life and the lives of my children!"

Is there a physics of fire, we wonder, different from all the other physics? "Let us distinguish between the words *combustion* and *fire*," he says. "I am involved mainly with combustion, essentially a controlled reaction. The word *fire* is usually used for uncontrolled combustion. The two are obviously related, but much less is known about fire. There are many kinds of fires—forest fires, towering infernos—and they are more difficult to study.

"Most people get out of the way when there's a fire. There are scientists who study fires and probe and try to take measurements. But the study of fire is in a much more primitive state of development."

And what is a flame? "It's a rapid gas-phase exothermic [heat-producing] combustion process characterized by self-propagation." Flame's definition is proving to be as elusive as the thing itself. So what, then, is combustion? "An exothermic chemical reaction with the characteristic ability to propagate through a combustible medium, usually a fuel and an oxidizer." Both flames and combustion in general involve rapid oxidation (sometimes called burning) easily recognized by chemiluminescence and chemionization.

Is a flame a fluid? "Yes! It's not a solid or a liquid. A flame is essentially composed of gases. The luminous flame of a candle, the yellow section, has the presence of small carbon particles. The smoke is solid carbon particles.

"But the largest part of the flame is composed of hot gases. And there are a variety of them, they emit light at different wavelengths. The colors represent different compositions and temperatures."

The hottest flame Chigier announces is about 3000° Kelvin (about 2700° Celsius), and at that point it's a question of definition whether to call it a flame or a plasma. Plasmas go up to 10000°K. A typical flame is around 1500° to 1800°K. The maximum temperature in a flame is achieved only in certain locations. Although the basic laws of thermodynamics apply to combustion, he tells us, "there are many aspects of thermodynamics that do not deal with the complexity of high temperature and the simultaneity of chemical reactions."

We want to enter the flame itself. Chigier plays Virgil, guiding us through the mini-inferno of a small flame jet's conflagration. He has made a movie of flames and he is justifiably proud of it, having filmed it with a photographic system he adapted. Flames are fast, incessantly moving. His camera can film up to 10 000 frames per second to show the structures of eddies and flow patterns, to analyze the high-frequency changes, and to catch the flame in the act.

On the way to pick up the film, the internal-combustion machine we're driving misbehaves. So we get out and walk up the steep hills of Schenley Park. At the crest Chigier looks back over the three rivers of Pittsburgh, at the cold, lifeless steel mills that line the banks like burned-out cinders.

Later the flame flickers on the screen, a seething, pulsating abstract zone of force. What is going on? Filmed at 3 000 frames per second and projected in slow motion, the gas pours from its nozzle in a smooth and continuous, or laminar, flow. But as it reacts with the surrounding air, it begins to become unstable. Turbulent pulses of flame surge out like a breathing, unpredictable living thing. The pulses are the vortices Chigier knows them well; has written about them at length. In his book *Energy, Combustion and Environment*, he reports: "Neighboring pairs of vortices rotate around each other and amalgamate into a larger one. In flows with large density differences, individual vortices can be followed for their lifetimes."

The jet vortices wrap around the air taking it into the flame's core. This is entrainment, and combustion depends on this "roll-up" process in which air and fuel are surrounded by the flame's eddies and drawn inward. Chigier says that before his examination of eddies, vortices, and turbulence through photography and lasers, the flame experts thought entrainment was a "nibbling" process. But Chigier has shown that it is a much more dramatic "engulfing or gulping."

"My work concentrates on fluid dynamics within the flame." He moves gracefully, flamelike, in front of the screen. "I have seen the flame, initially laminar, become unstable, transformed into a ring vortex, a toroidal ring vortex! On the planet Jupiter there are concentric ring vortices. You can see them from the Voyager pictures. Those eddies, they are the same kind of rings.

Similar fluid dynamic processes occur in the jet flame, a flow such as the Sacramento River and the bathtub vortex when you pull the plug. They are everywhere.

In another part of the movie, a propane jet emerges from a nozzle, hits a steel plate—it could be a cooking pot's bottom—and spreads out like instant concentric tidal waves. Impingement that's called. These particular rings of fire move outward and break up into eddies, the air is trapped between the rings, and the only area where the mixture can become flammable is on the ring surface.

Within the flame room, Chigier lectures in time with the oscillating colors behind him: particles being formed, destroyed, regenerated. The flame begins with solid wax, becomes fluid. Molecules are blown into atomic fragments having electrical properties. That's your run-of-the-mill candle flame. Even the combination of simple methane, CH_4, with oxygen involves 100 intermediate chemical reactions. Chemical kineticists, chemists who deal with the rates at which things change, are discovering still more chemical reactions.

In the combustion of more complex hydrocarbons there are hundreds of chemical reactions taking place within fractions of a second. Milton's "whirlwinds of tempestuous fire" at an atomic level.

Millennia ago humans knew that flames were complex and powerful. In Greek myth, Zeus, the king of the gods, hid fire from mankind. But Prometheus stole it from heaven and brought it back to earth. The punishment for this crime was severe. In one version of the story, Prometheus was chained to a rock where an eagle feasted on his liver. In another variation, Zeus sent Pandora and her jar of evils as retribution. But in Greek poetry, Prometheus—whose quest for flames brought disaster upon himself—is revered as the father of the arts and sciences, the Titan whose name means "forethinker."

A paradox. This creator of chaos, this consumer and swift destroyer, is order. Logos. Fire has been involved in virtually every scientific revolution. Since before the Greeks, people have been burning things and measuring what's left. The proper explanation of combustion, perhaps the oldest chemical reaction, is usually said to have been the first great step in the development of modern science. And we will, no doubt, burn our way into the future.

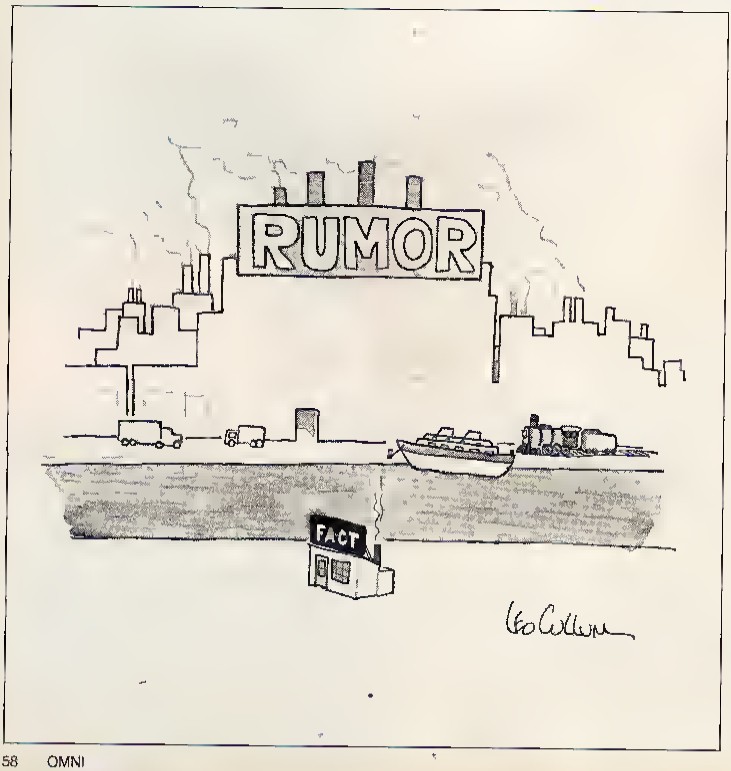
That first hint of the true nature of combustion was set forth in 1772 by Antoine Laurent Lavoisier when he concluded that the "fixed" air that had combined with sulfur in burning was identical to a gas obtained by Joseph Priestley, the English chemist, when he heated the metallic ash of mercury. Lavoisier decided to call the gas oxygen. More studies of gases were made with fire, and soon the first table of atomic weights was compiled, generating a whole new system of chemistry based on reliable measurement. In 1798 Sir Benjamin Thompson's experiments with burning revealed evidence of the theory of heat as movement of particles—energy. This heralded the kinetic theory of gases, the motion of atoms, and the laws of thermodynamics themselves, the theoretical underpinnings of the Industrial Revolution and its machines.

If the flame has brought order to the human condition, the flame itself is still considered a force of chaos, uncharted, immeasurable. Chigier has done much to find the order *within* the flame. "I was among the first fluid dynamicists to examine the close interactions between a flame's turbulence and its chemistry," he claims of his years of research at Sheffield, England, with its renowned steel mills and long history of combustion research. But it was at NASA's Ames Research Center in Mountain View, California, in 1970 that Chigier encountered the laser. And in one of those scientific epiphanies, he realized the capability of lasers for penetrating the flame to see and chart the patterns in flow fields and turbulence. He imported the technology Marco Polo-like back to Sheffield and began to find the symmetries within the flame front. "Now we can penetrate into the very high temperature regions to measure the flame's velocities and gaseous concentrations," he says. "We have seen the enormous changes that occur when air and fuel enter a combustion chamber—from around three hundred degrees Kelvin, about room temperature—to burn at two thousand degrees Kelvin. In this case there are enormous changes in turbulence."

Turbulence is fire's personality, as it is the essence of weather and even, perhaps, of the cardiovascular system of the body. "There has been a change of attitude toward turbulence," Chigier announces. "Conceptually, turbulence was always associated with chaos. But chaos may be an illusion. As the study of the subject matures, one sees the flow becoming less random. What we're finding in our measurements will serve as a basis for a new theory. Today, in one section of the 'turbulence community' there is a school of thought believing that there is order in turbulence and flames."

With lasers and high-speed photography, Chigier documented the turbulence's orderly progression as the eddies danced their way through the flame's body. To a certain extent these eddy structures can be modeled mathematically, using complex calculations and supercomputers. Chigier shows us a computer-graphic-generated "flame" created in a government research lab from a mathematical model. Even though it is the product of an immensely sophisticated program executed on the fastest computers around, it still looks like a high-quality cartoon after the fire-dragon drama of the real thing. Flame has not been captured yet.

On another part of the flame frontier, Chigier is exploring the combustion of va-



porized fuels. All fuels in diesel engines, furnaces, gas turbines, and rockets are forced through nozzles that break up the bulk into smaller particles with more surface area in order to burn faster. Chigier shows us pictures of clouds of droplets that burst from the nozzle in a liquid sheet. This sheet, he tells us, develops a "hydrodynamic instability," like a ragged wave that is torn by shear and dragged into ligaments that are further torn into large drops and then into smaller droplets. Chigier can determine the size of these droplets and to a certain extent he can predict their ballistics and trajectories as they interact with the hot air and vaporize. He can penetrate the cloud combustion noninvasively, without disturbing its life style, using dual-beam laser anemometers. And there he can measure particle size. Based on this research he discovered a weakness in previous explanations of the way clouds burn. When there are too many droplets in the cloud, there is oxygen starvation and the flame is forced toward the cloud's periphery. This is very inefficient. "I came to this finding much to the consternation of the combustion establishment," he recalls. "It has radically changed the concept, attitude, and approach to spray combustion."

"It is a concept for which I had to fight bitterly. When I presented our first results at international conferences, there was great reluctance to accept our findings, particularly by people who have a vested interest in the status quo. All that has radically changed. But in a way I enjoyed it, the controversy was stimulating."

The one episode that says more about Norman Chigier than his many macho fire stories has nothing to do with the flame. He hasn't climbed bodily into a fire yet, but he has physically entered into the vortex of a fluid. In 1977 Chigier was conducting research at NASA Ames on aerodynamic properties of turbulence in aircraft wakes. Aboard a Learjet he flew into the raging centers of two trailing vortices. These crystallized-water contrails persist as far as 20 miles behind jet liners. "If you are in a small, light aircraft," he explains, "trying to gain altitude, and you run into one of these invisible vortices, the plane can be shoved down violently toward the ground."

In the tests Chigier devised, he and a crack pilot flew in a Learjet following a Boeing 707. At 20 miles behind, they positioned themselves to move straight down into the vortex. "When we entered it we were twisted about forty-five degrees. I thought the wings would rip off." At 10,000 feet they were ejected from one vortex and hurled into the other, which was streaming off the other wing tip. "It was terrible when we hit it," he shudders. They reentered the vortices at ten miles, then five, three, and finally one mile behind. Chigier admits that he was sick.

"The pilot turned to me," he remembers, "and laughed. 'Yah, like vortices, Norm?' And at that point he flew under the belly of the jet and came up in front of it and executed a complete roll."

If fire put order into the human condition, it also gave structure to the life and times of Norman Chigier. He claims he was "thrown into combustion at the deep end." No, he was not a childhood pyromaniac, did not chase fire engines to the blaze. Born in Frankfort, South Africa, the son of a Zionist rabbi, he intended to spend his adult life on a kibbutz. He entered the university at fifteen, and as a compromise to his parents took a practical degree in mechanical engineering. "But I was more interested in enjoying myself." He was also involved in drama, music, and as much antiapartheid politics as an exceptionally young, bright Jewish college boy dared to be involved in. He graduated at nineteen and went off on a quest to seek adventure in Europe.

His twenties were rough-and-tumble, sweating on giant construction sites with ex-jailbirds and dockworkers. His desire was to become a construction site foreman and then a writer. It was by chance that he ended up at Cambridge instead, taking a Ph.D. in fluid dynamics under Sir William Hawthorne. Hawthorne fired his imagination for this most difficult branch of physical engineering, and without telling him, nominated Chigier as a representative to the International Flame Research Laboratory in Holland. The Flame Lab was located in the giant steel works of the Netherlands, and there Chigier conducted experiments in hellishly hot furnaces. Teams of scientists from many countries opened up the furnace doors and thrust probes into the roaring internos. Chigier spent three years in that Vulcan's pit. "It was the rough end of combustion." And he was tempered to a fine edge.

"I bring combustion with me," he says today as he guides us through the embryonic combustion lab at CMU. The students are building a glass chamber in which to observe the flame. To measure its temperature they will use microthermocouples made of platinum/rhodium alloys—thin wires, strung across the jet, with diameters of 0.001 inch or less. The slender sensors will be hooked to microprocessors to feed information about temperature flux and variation of the flame front.

In the engine room are two formerly abandoned internal-combustion machines now outfitted for experimentation. There is a diesel and a spark-ignition engine, which, Chigier says, they found in a box. "It was like discovering Pompeii. During the past two decades teaching and research in internal-combustion engines were abandoned in many leading universities," he adds. "They thought the engines were not elite enough. And they continued the trend to graduate engineers who had no contact with engines. We're reversing that trend. We face sophisticated problems. We use exhaust analyzers and computers. We will be able to conduct tests

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'Will that be all, sir?'

FICTION

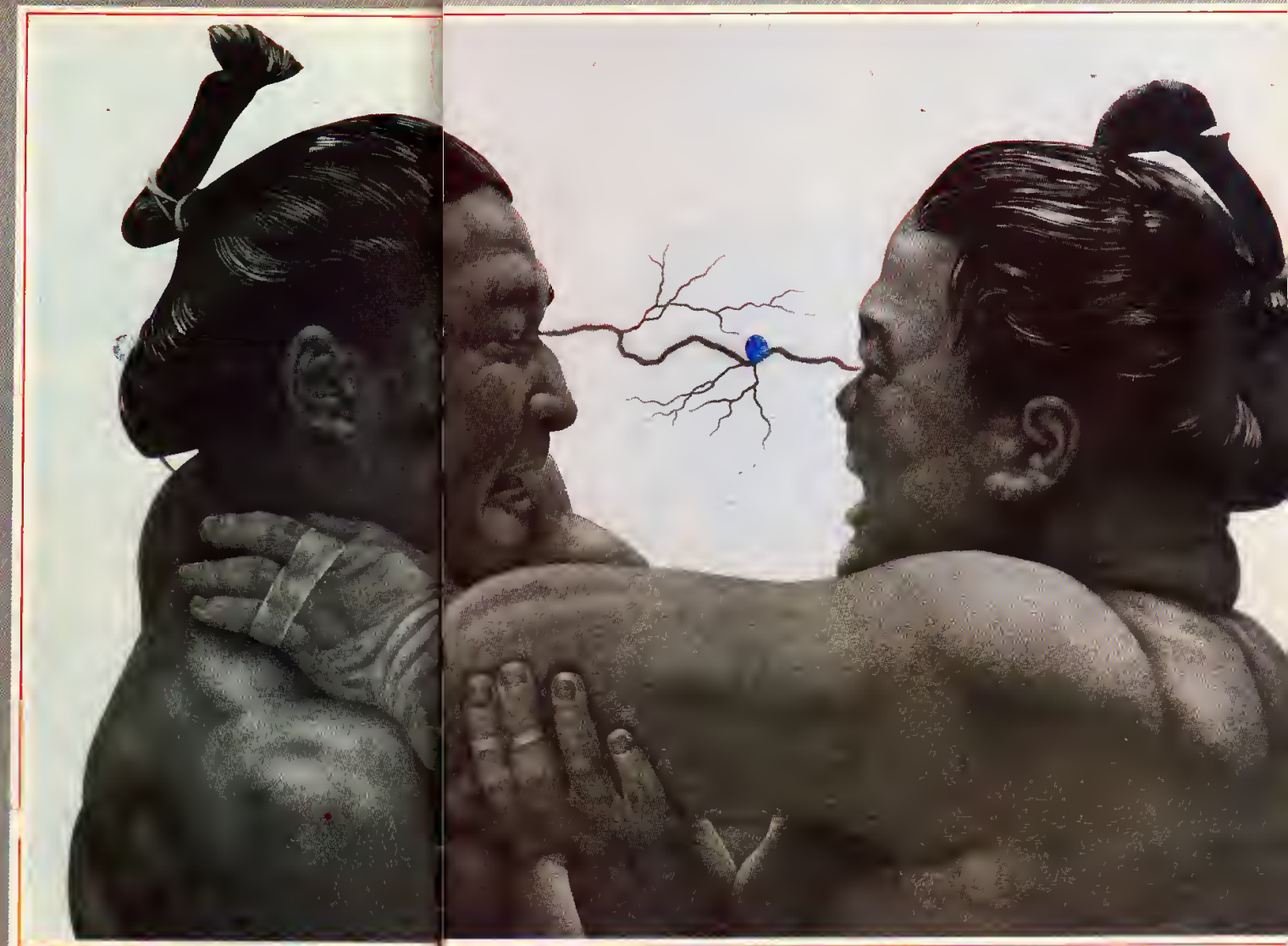
MAN-MOUNTAIN GENTIAN

BY HOWARD WALDROP

Just after the beginning of the present century, it was realized that some of the wrestlers were throwing their opponents from the ring without touching them."
—Ichinaga Naya, Zen-Sumo: Sport and Ritual, Kyoto, All-Japan Zen-Sumo Association Books, 2014.

it was the fourteenth day
of the January Tokyo tournament. Seated
with the other wrestlers
Man-Mountain Gentian watched as the next
match began
Ground Sloth Ikimoto was taking on Killer
Kudzu. They entered the
tamped-earth ring and began their *shikiris*
Ground Sloth, a *sumotori*
of the old school, had changed over from
traditional to Zen-sumo
four years before. He weighed one hundred
eighty kilos in his
mawashi. He entered at the white-tassle salt
corner. He clapped
his huge hands, rinsed his mouth, threw salt,
rubbed his body with
tissue paper, then began his high leg lifts,
stamping his feet, his
hands gripping far down his calves. The ring
shook with each stamp.
All the muscles rippled on his big
frame. His stomach,
a flesh-colored boulder, shook and vibrated

DRAWING BY TAKAHIKO II



Killer Kudzu was small and thin weighing barely over ninety kilos. On his forehead was the tattoo of his homeland, the People's Republic of China: one large star and four smaller stars blazing in a constellation. He also went into his ritual *shikiri* but as he clapped he held in one hand a small box, ten centimeters on a side, showing his intention to bring it into the match. Sometimes these were objects for meditation, sometimes favors from male or female lovers, sometimes no one knew what. The only rule was that they could not be used as weapons.

The wrestlers were separated from the onlookers by four clear walls and a roof of plastic. Over this hung the traditional canopy and tassles symbolizing heaven and the four winds.

Through the plastic walls ran a mesh of fine wiring, connected to a six-volt battery next to the north-side judge. This small charge was used to contain the pushes of the wrestlers and to frustrate help from outside.

A large number of 600× slow-motion video cameras were strategically placed around the auditorium to be used by the judges to replay the action if necessary.

Killer Kudzu had placed the box on his side of the line. He returned to his corner and threw more salt onto the ground, part of the ritual purification ceremony.

Ground Sloth Ikimoto stamped once, more twice, went to his line, and settled into position like a football lineman, legs apart, knuckles to the ground. His nearly bare buttocks looked like giant rocks. Killer Kudzu finished his *shikiri* and squatted at his line, where he settled his hand near his votive box and glared at his opponent.

The referee in his ceremonial robes had been standing to one side during the preliminaries. Now he came to a position halfway between the wrestlers, his war fan down. He leaned away from the two men, left leg back to one side as if ready to run. He stared at the midpoint between the two and flipped his fan downward.

Instantly sweat sprang to their foreheads and shoulders, their bodies rippled as if pushing against great unmoving weights, their toes curled into the clay of the ring. The two of them stayed tensely immobile on their respective marks.

Killer Kudzu's neck muscles strained. With his left hand he reached and quickly opened the votive box.

Man-Mountain Gentian and the other wrestlers on the east side of the arena drew in their breath.

Ground Sloth Ikimoto was a vegetarian and always had been. In training for traditional sumo he had shunned the *chanko nabe*, the communal stew of fish, chicken, meat, eggs, onions, cabbage, carrots, turnips, sugar, and soy sauce.

Traditional *sumotori* ate as much as they could, hold twice a day, and their weight gain was tremendous.

Ikimoto had instead trained twice as hard, eating only vegetables, starches, and sugars. Meat and eggs had never once touched his lips.

What Killer Kudzu brought out of the box was a cheeseburger. With one swift movement he bit into it only half a meter from Ground Sloth's face.

Ikimoto blanched and started to scream. As he did, he lifted into the air as if chopped in the chest with an ax, arms and legs flailing, a wail of revulsion coming from his emptied lungs.

He passed the bales marking the edge of the ring—one foot dragging the ground, upending a boundary bale—and smashed to the ground between the ring and the bales at the plastic walls.

The referee signaled Killer Kudzu the winner. As he squatted, the *gyoji* offered him a small envelope signifying a cash prize from his sponsors. Kudzu, left hand on his knee, with his right hand made three chopping gestures from the left, right, and above—thanking man, earth, and heaven. Kudzu took the envelope, then stepped through the doorway of the plastic enclosure and left the arena to rejoin the other west-side wrestlers.

The audience of eleven thousand was on its feet as one, cheering. Across Japan and around the world, two hundred million viewers watched television.

Ground Sloth Ikimoto had risen to his feet, bowed, and left by the other door. Attendants rushed in to repair the damaged ring. Man-Mountain Gentian looked up at the scoring clock. The entire match had taken a mere 4 1324 seconds.

It was three-twenty in the afternoon on the fourteenth day of the Tokyo invitational tournament.

The next match would pit Cast Iron Pekowski of Poland against the heavily favored Hokkaidan Typhoon Takanaka.

After that would be Gentian's bout with the South African Knockdown Krugerrand. Man-Mountain Gentian stood at 13–0 in the tournament, having defeated an opponent each day so far. He wanted to retire as the first Grand Champion to win six tournaments in a row undefeated. He was not very worried about his contest with Knockdown Krugerrand slated for later this afternoon.

Tomorrow, though, the last day of the January tournament, his opponent would be Killer Kudzu, who after this match also stood undefeated at 14–0.

Man-Mountain Gentian was 1 976 meters tall and weighed exactly two hundred kilos. He had been a *sumotori* for six years, had been *yokozuna* for the last two of those. He was twice holder of the Emperor's Cup. He was the highest paid, most famous *Zensumotori* in the world.

He was twenty-three years old.

He and Knockdown Krugerrand finished their *shikiris*. They got on their marks. The *gyoji* flipped his fan.

The match was over in 3 1916 seconds.

He helped Krugerrand to his feet accepted the envelope and the thunderous applause of the crowd and left the reverberating plastic enclosure

"You are the wife of Man-Mountain Gentian?" asked a voice next to her

Melissa put on her public smile and turned to the voice Her nephew, on the other side leaned around to look

The man talking to her had five stars tattooed to his forehead She knew he was a famous *sumotori* though he was very slim and his *chon-mage* had been combed out and washed, and his hair was now a fluffy explosion above his head

"I am Killer Kudzu" he said "I'm surprised you weren't at the tournament

"I am here with my nephew Hari Hari, this is Mr Killer Kudzu" The nephew, dressed in his winter Little League outfit shook hands firmly "His team the Mitsubishi Zeroes will play the Kawasaki Claudes next game"

They paused while a foul ball caused great excitement a few rows down the bleachers Hari made a stab for it but some construction foreman of a father came up grinning triumphantly with the ball

"And what position do you play?" asked Killer Kudzu

"Utility outfield When I get to play," said Hari sheepishly averting his eyes and sitting back down

"Oh How's your batting average?"

"Pretty bad One twenty-three for the year," said Hari

"Well, maybe this will be the night you shine," Killer Kudzu said with a smile

"I hope so" said Hari "Half our team has the American flu"

"Just the reason I'm here" said Kudzu "I was to meet a businessman whose son was to play this game I find him not to be here, as his son has the influenza also"

It was hot in the domed stadium and Kudzu insisted they let him buy them Sno Kones Just as the vendor got to them Hari's coach signaled, and the nephew ran down the bleachers and followed the rest of his teammates into the warm-up area under the stadium

Soon the other lackluster game was over and Hari's team took the field

The first batter for the Kawasaki Claudes, a twelve-year-old built like an orangutan got up and smashed a line drive off the Mitsubishi Zeroes' third baseman's chest The third baseman had been waving to his mother They carried him into the dugout Melissa soon saw him up yelling again

So it went through three innings The Claudes had the Zeroes down by three runs, 6–3

In the fourth inning Hari took right field, injuries having whittled the flu-ridden team down to the third-stringers

One of the Kawasaki Claudes hit a high looping fly straight to right field Hari started in after it but something happened with his feet, he fell and the ball dropped a meter from his outstretched glove The center fielder chased it down and made the relay and by a miracle they got the runner sliding into home plate He took out the Zeroes' catcher doing it

"It doesn't look good for the Zeroes" said Melissa

"Oh things might get better," said Killer Kudzu "Didn't you know? The opera's not over till the fat lady sings"

"A diva couldn't do much worse out there" said Melissa

"They still don't like baseball in my country" he said "Decadent Bourgeois they say As if anything could be more decadent and middle-class than China"

"Yet, you wear the flag?" She pointed toward the tatoo on his head

"Let's just call it a gesture to former greatness" he said

Bottom of the seventh, last inning in Little League The Zeroes had the bases loaded, but they incurred two outs in the process Hari came up to bat

Things were tense The infield was back ready for the force-out The outfielders were nearly falling down from tension

The pitcher threw a blistering curve that got the outside Hari was caught looking

From the dugout the manager's voice saying unkind things carried to the crowd Eight thousand people were on their feet

The pitcher wound up and threw

Hari started a swing that should have ended in a grounder or a pop-up Halfway through it looked as if someone had speeded up a projector The leisurely swing blurred

Hari literally threw himself to the ground The bat cracked and broke neatly in two at his feet

The ball, a frozen white streak, whizzed through the air and hit the scoreboard one hundred ten meters away with a terrific crash, putting the inning indicator out of commission

Everyone was stock-still Hari was staring Every player was turned toward the scoreboard

"It's a home run kid" the umpire reminded Hari

Slowly, unbelieving Hari began to trot toward first base

The place exploded fans jumping to their feet Hari's teammates on the bases headed for home The dugout emptied waiting for him to round third

The Claudes stood dejected The Zeroes climbed all over Hari

"I didn't know you could do that more than once a day" said Melissa, her eyes narrowed

"Who me?" asked Kudzu

"You're perverting your talent" she said "We're *not* supposed to be able to do that more than once every twenty-four hours" said Kudzu flashing a smile

"I know that's not true, at least really," said Melissa

"Oh yes You are *married* to a *sumotori*, aren't you?

Melissa blushed

"The kid seemed to feel bad enough about that fly ball he dropped in the fourth

inning. Besides, it's just a game."

At home plate, Hari's teammates congratulated him, slapping him on the back.

The game was over, the scoreboard said 7–6, and the technicians were already climbing over the inning indicator.

Melissa rose. "I have to go pick up Hari. I suppose I will see you at the tournament tomorrow."

"How are you getting home?" asked Killer Kudzu.

"We walk. Hari lives near."

"It's snowing."

"Oh."

"Let me give you a ride. My electric vehicle is outside."

"That would be nice. I live several kilometers away from—"

"I know where you live, of course."

"Fine, then."

Hari ran up. "Aunt Melissa! Did you see? I don't know what happened! I just felt. I don't know. I just hit it!"

"That was wonderful." She smiled at him. Killer Kudzu was looking up, very interested in the stadium support structure.

The stable in which Man-Mountain Gentian trained was being entertained that night. That meant that the wrestlers would have to do all the entertaining.

Even at the top of his sport, Man-Mountain had never gotten used to the fans. Their kingly prizes, their raucous behavior at matches, their donations of gifts, clothing, vehicles, and in some cases houses and land to their favorite wrestlers. It was all appalling to him.

It was a carry over from traditional sumo he knew. But Zen-sumo had become a worldwide not just a national sport. Many saved for years to come to Japan to watch the January or May tournaments. People here in Japan sometimes sacrificed at home to be able to contribute toward new *kesho-mawashis*, elaborate, heavy brocade and silk aprons used in the wrestlers' ring-entering ceremonies.

Money in this business flowed like water, appearing in small envelopes in the mail, in the locker room, after feasts such as the one tonight.

Once a month Man-Mountain Gentian gathered them all up and took them to his accountant, who had instructions to give it all above a certain princely level away to charity. Other wrestlers had more, or less, or none of the same arrangements. The tax men never seemed surprised by whatever amount wrestlers reported.

He entered the club. Things were already rocking. One of the hostesses took his shoes and coat. She had to put the overcoat over her shoulders to carry it into the cloakroom.

The party was a haze of blue smoke, dishes, bottles, businessmen, wrestlers, and funny paper hats. Waitresses came in and out with more food. Three musicians played unheard on a raised dais at one side of the room.

Someone was telling a snappy story. The room exploded with laughter.

"Ah!" said someone. *Yokozuna* Gentian has arrived.

Man-Mountain bowed deeply. They made two or three places for him at the low table. He saw that several of the hosts party were Americans. Probably one or more were from the CIA.

They and the Russians were still trying to perfect Zen-sumo as an assassination weapon. They offered active and retired *sumotori* large amounts of money in an effort to get them to develop their powers in some nominally destructive form. So far, no one he knew of had. There were rumors about the Brazilians, however.

He could see it now, a future with premiers, millionaires, presidents, and paranoids in all walks of life wearing wire-mesh clothing and checking their Eveready batteries before going out each morning.

He had been approached twice by each side. He was sometimes followed. They all were. People in governments simply did not understand.

He began to talk, while sake flowed, with Cast Iron Pekowski. Pekowski, now 12–2 for the tournament, had graciously lost his match with Typhoon Takanaka. (There was an old saying. In a tournament, no one who

CONTINUED ON PAGE 152

"I'll have my coffee black, like the somber state of the world's economy. eggs scrambled, like our disoriented social values. toast dry, like the arid wastelands of compassion and common sense. bacon crisp, like

Until his death, Ban-the-Bombers and the whole gloom-and-doom set had felt

THE WRATH OF KAHN

BY JAMES RESTON, JR

Yesterday March 3, 2036 I turned seventy years old" wrote one student at South Mountain High School in Phoenix. "Only a year before, on the same day, I retired from the Supreme Court. I had two reasons for retiring. I wanted to avoid the senility that all eight of my colleagues had fallen into — and I thought it was about time to settle down and have a family."

The passage, from a creative-writing exercise, reflected the ambivalence of South Mountain students' attitudes toward their future. A survey at the school—with its equal blend of Chicano, black, and white students—revealed the same mix of hopefulness and apprehension. In general, the Arizona teen-agers were relatively sanguine about their prospects for professional and personal happiness. But they were bleak about the future of society and the world. They imagined themselves doctors and scientists and pilots and Supreme Court justices—in a society of collapsed cities populated by the survivors of World War III.

It was just this kind of thinking that bothered the late Herman Kahn. From his headquarters at the Hudson Institute, in Croton-on-Hudson, New York, Kahn kept watch like a frettul weatherman on clouds of pessimism across the country. He plotted ways to replace doubt with hope, fear with optimism. Best known for work on national-security issues, the Hudson Institute has for 20 years developed the art of projecting scenarios for the future on such problems as how nuclear war might evolve. Kahn himself had wrestled with nuclear nightmares in his books *On Thermonuclear War* (1960) and *Thinking About the Unthinkable* (1962).

Now, Kahn and his colleagues had drawn up an entire campaign, a storehouse of scenarios, to attack negative thinking in America's youth. To press the attack, Kahn himself

PHOTOGRAPH BY PETER ANGELO SIMON

decided to go to South Mountain High

It was to be one of his last forays on behalf of optimism. Kahn died of a heart attack in July, at the age of sixty-one. In some ways his trip to Arizona was a model of his lifelong quest against dour thinking—against what he called "the whole cliche at the moment."

Watching him in action on the Arizona circuit, I found traces of the wit that won him many friends and the dogmatism that infuriated his many detractors.

On November 19, 1982, a class of gifted eleventh-graders at the school prepared themselves for the big day. The Hudson Institute had previously sent printed materials to establish a beachhead for hopefulness. The words identified Kahn as "the famous futurologist" and "expert in future studies." The Hudson texts, titled Visions of the Future, omitted the label often attached to Kahn after he published his prediction of a forthcoming economic surge: the Prophet of Boom.

But when Kahn arrived, flanked by TV minicams to catch students' reactions, his deportment suggested a man not so much of the future as of the past. Martin Van Buren, perhaps, or Edwin Stanton. Others might see in him the look of an Amish elder: round face, receding hairline, thick bottle-bottom glasses, crescent beard, and a body whose bulk is generally estimated at 350 to 400 pounds. On that day at South Mountain High, this awesome frame was clothed in a blue pastel suit, which clashed somewhat with the greenish tint of his beard. The beard color had been imparted by the chemicals in his motel Jacuzzi.

For three hours Kahn discoursed. His message was personal and engaging. Their generation was the product of a 20-year malaise in America, he proclaimed. He had all kinds of curves and charts in his office; they showed how the United States had gone to hell in the early Sixties, how productivity dropped, how youthful suicides were up, how drug use and crime rates were up. Every aspect of American life began to decline several years before the students were born, and while he avoided saying so, the categorical nature of this pronouncement logically included the civil-rights movement, the Green Revolution, and the women's liberation movement. There was reason for hope: he promised. Revitalization was coming, and great, exciting opportunities awaited them. For one thing, they were the post-baby-boom generation, and there were fewer of them than in the immediately preceding generation. "That makes you more valuable," he said. Despite temporary annoyances like the recession (which Kahn considered therapeutic), world history was riding on a surging Gulf Stream of progress called the Great Transition, and they were on the crest of a high-tech wave.

"Two hundred years ago, mankind was everywhere few, everywhere poor, everywhere powerless before the forces of nature," he announced.

"One hundred years from now," he went on, "mankind will be everywhere numerous, everywhere rich, everywhere largely in control of the forces of nature."

They were, therefore, living through the most exciting period of world history, and they should reject the gloomy predictions of the doomsayers. The country was not running out of resources. Nor was the world breeding too rapidly or falling short of food. Nor were the rich countries getting richer while the poor countries got poorer, nor were businesses sacrificing safety for profit. In short, they should not overconcern themselves with any of these fashionable preoccupations; for the mind of man and his technology were managing quite well, and history was being swept along on the warm current of advancement.

Kahn's visit to this working-class area of south Phoenix was considered a great success, both by Kahn's staff, which visualized his Visions of the Future program in every high school in America someday, and by the staff of South Mountain High School. A ten-minute segment of the videotape was prepared for use in a national promotional campaign for the Visions program. The institute hoped the tape would show that the program was not just for the homogeneous high-tech upper class but for ethnic audiences as well.

So it happened that South Mountain High School became the pilot program in Herman Kahn's three-week course in optimism. In the spring of 1983, more than 2,000 Phoenix high-schoolers took the class. This fall, four more cities will begin, and within five years the hope is that it will be offered in every high school in America.

In 1974, while the country prepared to celebrate the Bicentennial, Kahn decided that it was a good time not only to look back 200 years but to look forward 200 years. Apart from Vietnam and Watergate, there were long lines at gasoline stations. And an international organization of distinguished scientists, educators, economists, and politicians—called the Club of Rome—sounded a shrill, worldwide alarm. Looking at the world's economy as a single system of interdependent parts, the Club of Rome announced that, unless growth patterns were changed and controlled, the world economy would collapse in 75 years. In this view, the world was hurtling along from one crisis to the next with no master plan for development. Wealthy nations were using up irreplaceable resources at a preposterous rate. Poor nations were getting poorer. The Club of Rome called for recognition of the world community as a fragile lattice, and for a system of cooperative management that would transcend national boundaries.

The romantic concept of "spaceship Earth" was born. But to some, Earth was not so much a spaceship as a lifeboat, rich nations not only rocked the boat with their sheer economic bulk but also gobbled up

"I must be getting old. I look at her and see 65 percent oxygen, 10 percent hydrogen, 18 percent carbon, 3 percent nitrogen, 1½ percent calcium, 1 percent phosphorous."

the scarce precious provisions with selfish greed It was only a matter of time before the underfed weaklings got thrown overboard one by one

Already in 1974, Kahn was storming against this view of the world He became an energetic spokesman for the trickle-down theory of world development well before Ronald Reagan turned the theory into practice Kahn argued that the rising tide of economic profits lifts all boats the patched-up dugout as well as the luxurious ocean liner (The rising-tide image is taught to the Phoenix schoolchildren in Kahn's Visions of the Future)

In a somewhat *ad hominem* fashion former Secretary of the Interior Stewart Udall of Arizona, took on the Kahn position in his book *The Energy Balloon* Among the misconceptions about energy Udall included "the fat man fallacy," the proposition that the faster the rich countries consume the globe's resources, the sooner the fruits of general prosperity will be available to the poor nations "Such reasoning has many advantages to a nation or to an individual Udall wrote "It transmutes gluttony into an altruistic activity, it makes profligate behavior appear virtuous it deftly sweeps offensive accusations under the rug of benevolence " Udall referred to Kahn as a very clever man who was at his best when he was reassuring growth-oriented businessmen that their activities make them great benefactors of mankind (Kahn got his turn in a 1979 study on the future of Arizona dismissing Udall as a relic of the "old Arizona political elite ")

With such bickering as a backdrop Kahn proposed that as a celebration of the Bicentennial, the White House should initiate a massive national debate on the grim Club of Rome warnings kicked off with a conference In the Nixon Administration not only Kahn's confrontational proclivities but also his message would get a favorable reception In November 1973, as Richard Nixon was assuring a Florida audience of editors that he was not a crook he was also expressing his pleasure that the United States made up approximately 6 percent of the world s population and consumed 30 percent of its energy

That isn t bad that's good Nixon said That means we are the richest strongest people in the world and that we have the highest standard of living in the world That is why we need so much energy, and may it always be that way "

But while Kahn's proposal for a White House conference was according to him received favorably at the top levels of the administration the National Science Foundation and the National Endowment for the Humanities the staffs of these bodies considered the Kahn plan to be straight Republican propaganda They scuttled the project Furious because he and the Hudson Institute had put two years into the proposal Kahn contented himself for the time being with publishing his research in a book entitled *The Next 200 Years*

One morning in early March 1983 I drove to McClintock High School, in Tempe, outside Phoenix, to visit Ken Reid's social studies class To Arizonans accustomed to 350 days of sunshine a year the world was out of whack The storm that had devastated the California coast and washed away many lavish homes was pelting their desert leaving the gutterless streets of Phoenix covered with massive ponds In the past few years, these deluges had come with a certain regularity, raising fears that the bridges along the usually bone-dry Salt River would float away again as they had in 1979 and 1980

It is the logic of this desert that when the rains come not only must the riverbeds bear the runoff from the valley, but the gates of the Stewart Mountain Dam must be opened to release great quantities of water, lest the reservoir overflow its banks This results in a wall of water coursing down the rivers Occasionally squatters underneath the bridges are washed away before the bridges are But when the rains end, the desert blooms with fabulous garish color Under the extravagant sunshine and rain the sand and rocks turn to a painter s dream The scene is a kind of natural metaphor for Kahn s program for the future

On March 3 the news of scandal in the Environmental Protection Agency (EPA) dominated the front pages of the *Arizona Republic* If one had passed Kahn s Visions of the Future course, there was a skill at the ready for interpreting the EPA scandals They were the result of bad luck and bad management, only a trivial footnote in the upward press of the Great Transition Of course as Kahn himself would later concede a nuclear war could also result from bad luck and bad management

McClintock High serves a well-to-do district in Tempe where many students are the children of professors at nearby Arizona State University (ASU) the state s urban campus serving 40 000 students Kahn was the Barry Goldwater Professor of American Institutions at ASU At the high school I was greeted by Reid a craggy bearded Arizona original whose family dates back to the desert frontier of the 1870s 40 years before statehood, and whose sleepy miner's eyes and rapport with his students made me think that I was in the presence of a fine teacher For ten years a businessman before he became a teacher Reid had taught at McClintock for 15 years His off-beat oddball delivery makes him popular and a good catch for the Hudson Institute as someone to test its matenals

His classroom was decked out with the accoutrements of future study perhaps largely for my benefit since everyone seemed primed for this visit from *Omni* Propped against the blackboard were the books Malthus on population, Paul Ehrlich s *The Population Bomb*, Alvin Toffler's *Future Shock* Hal Lindsey's *The Late Great Planet Earth*, and a book called *Nuclear War What s in It for You?*, which Reid confessed he had chosen solely for its catchy title There were copies of *Omni* and the *Oracles of Nostradamus* and filmstrips of a somewhat pessimistic persuasion like "Doomsday 21st Century " An immense chart displaying scenes from Kahn's Great Transition spanned the room The pictures ranged from sketches of primitive labor and dwellings from the Preindustrial Age in the 1850s to illustrations of people happily engaged in science, technology and medicine during the twenty-first century, when man will be "everywhere numerous, everywhere rich, everywhere in control of the forces of nature '

Individualist that he is Reid had taken the Hudson Institute materials and tailored them to his own methods, often with an amused irreverence (In a document of his own he cast aspersions on the whole process of future prediction by stating that only 4 predictions out of 364 by professional futurologists had been correct between 1976 and 1979) But he accepted the basic premise of the Visions program that to instill in his students an attitude of hopefulness about the future was a worthy service The world had a future that young people could help to shape, if only their perceptions were positive enough But it remained unclear whether this was a class in social studies citizenship or religion (faith rather than fact seemed at the center), or simply in Republican politics

I would attend two of Reid s classes that morning The first comprised graduates of the three week Visions course and Reid confirmed that their attitudes toward their world had dramatically shifted to the optimistic side How did he know? Before and after the three-week experience the students had been tested Nine propositions were put to them and they were asked their reaction on a five-point scale between "strongly agree and "strongly disagree ' The propositions included

- Limiting growth is the best way to improve the world s future
- People like me can help solve the world's problems
- Almost everyone in the world will double his purchasing power in 50 years
- I believe there will be environmental catastrophes in the future

Lest the course appear to have no academic grit the students were also tested on their comprehension of Kahn's concepts In the test as in the Visions materials, the theory of the Great Transition had become the fact of the Great Transition Past and future came together like dance

partners. There were the Middle Ages, the Preindustrial Age, the Industrial Age, the Superindustrial Age, and the Postindustrial Age of Plenty.

True or false? In the period of the Great Transition we will have global cooperation among nations instead of competing national interests.

True or false? In the future the gap between the rich and the poor will decrease and wealth will be distributed more equally.

Thus, to pass the Visions of the Future course, your attitude should shift from pessimistic to optimistic, and you should understand how the Great Transition *will* work. If both desired results are achieved, you are certified a "realist" and you possess a "skill" of how to think about the future.

The managers of the Visions program were quite pleased with the results in Ken Reid's class of teen agers. Their attitudes had changed measurably. They were less scared of the future, more convinced that poor people would double their income dramatically, persuaded that the world would be healthier and richer in 50 years. But students are rough critics, and their test scores notwithstanding, Reid's first-period students did not seem to undergo much of a life change.

"The materials were lousy," one student said. "They were poorly put together and written for first-graders."

"It did give me a terminology," another student said, "but it did not tell me how these changes are going to affect me."

"His program said I shouldn't be a pessimist, but I wasn't to begin with," said a third member of Reid's class.

Between periods, Reid and I talked in the teachers' lounge. He too had observed with some wryness the cult of personality that Kahn enjoyed in Phoenix.

"Everyone is at his beck and call when he comes out. It is as if people say, 'The prophet is here. Let us go listen to him.' Sure, he's bright and has good things to say, but then there are a lot of people like that. It's more than admiration, and I'm not sure where it comes from."

Nevertheless, Reid acknowledged that the Visions program has had an impact on him personally and professionally. For example, in the past he had bridled at having to teach conflicting theories. Some texts told students that the world was in danger of a new Ice Age. Others presented simultaneously, reported that the polar ice cap was about to melt as a result of the greenhouse effect. In times past, he had projected some frightening doomsday notions onto his students.

A standard exercise for him was to drop a hypothetical nuclear bomb on Phoenix and calculate the concentric circles of devastation outward. He no longer performs the frightening demonstration.

"Generally the students concluded that it would be better not to survive the bomb. I think teaching the consequences of nuclear war is counterproductive right now," Reid said. "It swamps all else, and it's emotionally charged. I just don't think I ought to be teaching that."

Neither do the creators of the Visions of the Future program. Despite Kahn's reputation for facing the facts about thermonuclear war, the program's most glaring omission is its failure to deal with the international arms race and the possibility of a major conflagration. But the omission was deliberate, even though Kahn insisted that it would be rectified later.

"We don't have the case in the nuclear area that we have in other areas," he said. "I can't say [the talk of a holocaust] is nonsense. None of the experts think there's a very high probability of war, as most alarmists think. On the other hand, you shouldn't worry about it? I can't say that."

Even though nuclear war is not yet one of Kahn's Visions, students themselves have made it part of the curriculum. "Now this may be blatant propaganda," Reid began teaching the second-period class, "but America in the future is going to be a land of milk and honey, right?"

"No way," came the mumbles from the class. Reid pressed on.

"Are you going to live better or worse than your parents?"

"Different."

"You think we're making a mess of things?" Reid asked.

"It can't get any worse," one of the students suggested.

"Is war certain?"

"Overdue," someone in the class said, to general laughs.

"How many of you think there will be nuclear war?" Ninety percent of the class raised their hands. "Will it be limited or full scale?" the teacher asked.

"What do you mean by *limited*?" someone asked.

"*Limited* means I survived, doesn't it?" Reid observed. "How many of you think it will come in your lifetime?" More than half the class raised their hands.

"We can't do anything about it," said one of the teen-agers.

"I'm going to have fun and take one day at a time," observed another.

"I hate to equate Jesus Christ with nuclear war," Reid went on, "but Ancient Rome thought the world was going to end with the Second Coming. What would you have done then?"

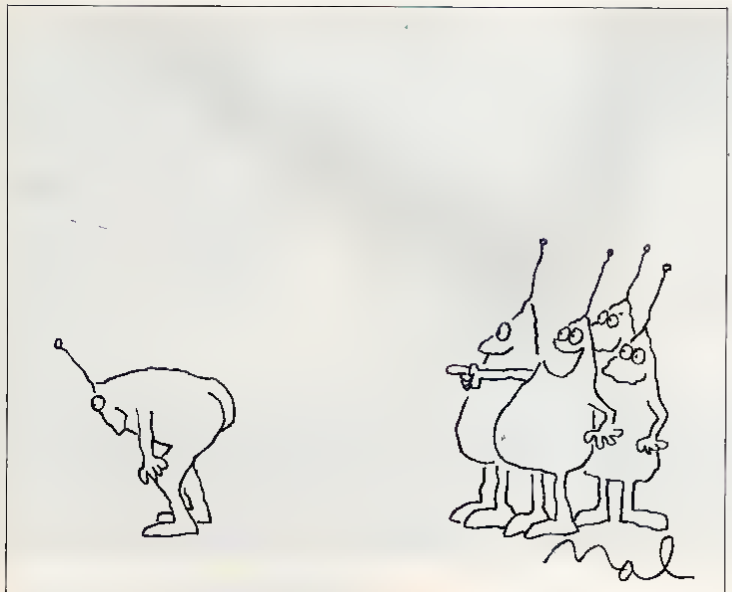
"Been real good," a student said.

"Are you totally pessimistic?" Reid asked.

"Hey, we're still here, aren't we?" a student responded.

I was beginning to think that future study was a rather soft discipline.

If students were pessimistic, Kahn and his colleagues tended to place the blame on certain books. At Hudson, a survey of social studies textbooks in American high schools determined that the alarm of the Club of Rome had "captured the intellectual class" of this country. Future studies a Hudson Institute study concluded, had



"Look. Xphap is earthing us!"

become "an exercise in moralistic judgments," a "package of New Testament virtues and preindustrial simplicity," "a glorification of the counterculture," and a blast of "hellfire and original sin." The standard method of instruction, the study suggested, was to "scare and shame children into being 'virtuous' and narrowly doctrinaire about the future."

The promoters of Visions of the Future cite other examples in this conspiracy to depress American youth. One is a two-minute filmstrip produced by the Canadian Film Board, wherein a beautiful, rich and wild valley is invaded by a menacing jet plane. Without narration, the film shows the plane spewing a cloud of slow-descending pollution over the plants and the birds, which die.

To Kahn, such gloom and doom was downright dangerous. In one article he aligned himself with an unnamed conservative "thinker" who attributed a high incidence of youthful suicides to depressing textbooks. The bad news in the textbooks leads to a negative self-image, he wrote, which in turn breeds troublemakers and encourages youth to drop out of school and society. In the Visions materials those who question uninhibited growth are patronized. "The people who resisted new ideas were not terrible people, but they were afraid that change would be dangerous to their society. And the growth of science and technology in industrializing societies has shown that a change in technology often means a change in society."

As the Visions materials began to take shape, Kahn added Jimmy Carter to his list of villains, along with the Club of Rome. In July 1980, after a three-year study involving 13 government agencies, the White House issued a massive three-volume report entitled *The Global 2000 Report to the President: Entering the 21st Century*. For the first time a government report treated population, resources, and the environment as related areas. The study used a global model inspired by the approach of the Club of Rome and made projections about world trends:

- In 2000 the world's population will jump to 6.35 billion, from 4 billion in 1975. By 2030 world population will reach 10 billion, which is considered by the National Academy of Sciences to be the maximum carrying capacity of the earth.
- Though coal, oil, gas, and uranium are theoretically sufficient for centuries, they are unevenly distributed and subject to profligate exploitation and hoarding.
- By 2050 the concentration of carbon dioxide in the atmosphere is expected to alter characteristics of the world's climate and upper atmosphere.

In short, *Global 2000* predicted a planet that will be more crowded, more polluted, less stable economically, and more susceptible to disruption.

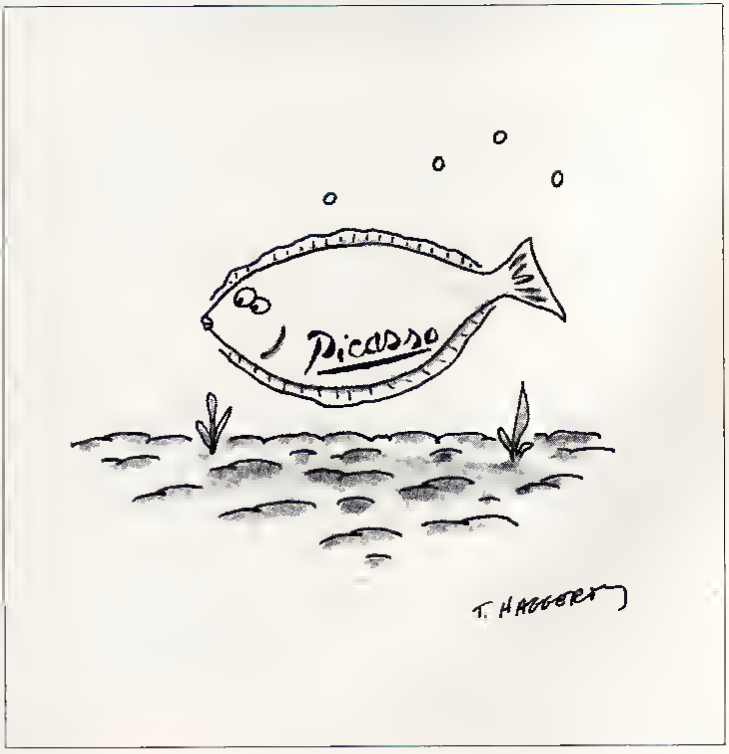
In its waning days, the Carter Administration followed *Global 2000* with another report called *Global Future: Time to Act*. *Global Future* purported to be a series of immediate and long-range actions that the U.S. government could take to address the global predicament. But unlike *Global 2000*, which had been prepared by professionals in the Council on Environmental Quality and the Department of State, *Global Future* was a political document, recommending a series of measures that had previously been proposed by congressional liberals and rejected by Congress. *Global Future* leaned far enough toward the left that the Reagan Administration found it easy to dismiss.

But when Reagan took over, despite agreement on a hard-line position against pessimism, the Republicans weren't sure how to mount the actual attack. Reagan's Global Issues Working Group, successor to the Carter *Global Future* effort, proposed three options for Reagan Cabinet consideration. The first was disbanding itself. The second was issuing a minimal, understated report disputing the notion that the world was going to hell. The third was launching a major counterattack on *Global 2000*. In the midst of this strategic waffling, Kahn was a hawk.

In an article entitled "Globaloney 2000," Kahn had treated the Carter document with acerbic contempt. The three-year government study was disgraceful. It reinforced prevailing pessimism. It encouraged an "apocalypse 2000" mind-set. It stimulated guilt feelings. It was advised and written by certified opponents of the kind of economic growth most Americans want, and it was crying wolf by the do-good establishment. All in all, Kahn could not understand why Jimmy Carter, whom he patronized as a "reasonably cheerful and responsible man," would choose such doomsdayism for his swan song.

Kahn's personal crusade against *Global 2000* continued until his death. He remained active in trying to get the administration to adopt his position officially and grandiosely. He was pushing again his old idea about a White House conference on the global future. He was studiously ignoring counterviews to his Visions of the Future material, laying himself open to charges that he was a propagandist but insisting that his program was an antidote to the propaganda of the other side (although neither the Democrats nor the Club of Rome ever targeted teen-agers in quite the way the Hudson Institute has). In the end, it didn't really matter if his school materials were right or wrong, liberal or conservative, Kahn said. It mattered only that they were pessimistic or optimistic.

"We geared up for an ideological objection to the materials," he told me, "but it just didn't happen, and that came as a shock to us. Out of four hundred school districts we have contacted, only two were ideologically opposed. The teachers couldn't care less whether we're right or



wrong. They are just tired of teaching pessimism. They want to teach upbeat stuff."

In the six hours I spent with Kahn, I kept coming back to what his intent was with the Visions program. But it was not until the end of our talks, in his motel room in Tempe, that he declared himself. He rose from his chair, his voice rising in anger.

"Yes, you're right! We are trying to desensitize these kids to the environment! We are trying to desensitize them to energy concerns! We *are* trying to kill the lifeboat mentality! The earth is not a lifeboat, and it is not a spaceship.

"This is not a fragile little planet that may disintegrate with the least tug."

When a 400-pound man, especially one who revels in his reputation as the Prophet of Boom, looms over you in a rage, you listen. I did listen closely to Kahn. But I heard in his passion more the tone of an ideologue than an educator.

On March 5 Kahn discharged his duty as Arizona State's Goldwater Professor of American Institutions by holding a day-long public seminar on his prediction of a coming economic boom. (Herman's predictions are always optimistic and always right—the chairman of the ASU economics department declared to the audience, "if you wait long enough.") In his opening two-hour presentation, Kahn ranged far and wide with an entertaining delivery. He was probably the only man around who joked, who was interested in designing a financial system that would survive a nuclear holocaust. His listeners should enjoy their ride on the high-tech wave that was carrying everyone into the twenty-first century, he said. He amused them by relating the evolution of his religious feelings.

"At twelve I was an atheist. At twenty I was an agnostic. At thirty, a theist, and I expect to die a rabbi," he said. Yet, in the same speech, he announced that he did not trust anyone, except himself. And sometimes he didn't even trust himself.

Ironically, his Visions course at its core teaches trust—trust of current and future leadership, trust in the great stream of human advancement. Visions students learn to dismiss environmental concerns and to disregard the possibility of nuclear war. And Kahn's students are taught to read all the other bad news in the papers as a mere swirl in the Great Transition.

Kahn conceded that there were some problems with the program. He said he was ashamed of the simplicity of the writing, blaming it on the professional curriculum experts who helped puf the materials together. (The Visions texts had been put through a computer before they were printed, to make sure they were written at the ninth-grade reading level. Twelfth-graders in Arizona—and many other parts of the country—read on the ninth-grade level. Part of the definition of *ninth-grade level* is "no three-syllable words.")

But Kahn held fast to the central tenets of his Visions. More than that, he had come to believe his position went beyond hypothesis into the realm of prophecy.

"I may be wrong," Kahn said. "I may be arrogant. I may be a megalomaniac. The Great Transition is not Einstein's theory of relativity. But it's the way the world works!"

The future world of Herman Kahn is already working in Arizona. The state's growth "is not manic, but structured, structured the way people like it, the way they want to live. This is Archie Bunker land, and this [Visions] program has got to be judged by their values." He went further. Arizona, he said, "is the culminating achievement of Western culture. Do you know that people come from all over the world to study the shopping malls here?"

To find Kahn's Tomorrowland, you have only to look at Metro Center, not so much a shopping mall as a minicity or urban village, of more than 160 acres in northwest Phoenix. And within the center, ancient human yearnings and the bright promise of the future intersect at the immense Goldwater's Department Store.

"It's the Greek agora," Kahn said. "The people bring the kids. They love the shopping center. That's a great way to live! It's very exciting. They've found it, and they're going to expand it, and they're going to like it even more in twenty years!" ∞

"I'm in touch with the virus herpes 107. It says it has a right to life, too."

QUEST FOR FLAME

CONTINUED FROM PAGE 60

that simulate conditions in Alaska in winter or Death Valley in summer."

Chigier points out the beautiful snake-like laser anemometer for measuring velocity, and the high-energy ruby laser an exotic bird that will measure the burning sprays using a ten-nanosecond pulse. "We are developing a combustion lab for the Nineties," he claims. "I encourage my students to look at flames, to play with them in a responsible way. We have much potential for danger, with the possibility of explosions, detonations, and damage from high-powered lasers—any one of them is enough to blow this lab sky-high. It is my business to control fire. We want to use the most sophisticated technology in the world to unravel the complex physics and chemistry of flames."

In the CMU student cafeteria where Chigier goes "gaining strength from its vitality," he has his habitual lunch: an apple and a cup of soup (to keep his athletic frame in top shape for tennis and skiing). We talk about pollution.

"Every burnable component should be burned, all the smoke, soot, carbon. It can be burned, provided one understands combustion engineering. It's really a crime that fuel is being emitted; it is an unnecessary pollutant."

We ask him about exotic new fuels. Will there be any, say, pseudofossil fuels made from compressed fast-food containers or trapped hydrogen? No, good old coal seems to be what we have to look forward to. Chigier's attention is focused on coal-water slurries. Thick rivers of coal and water muds oozing across continents of pipelines and transported by tankers to fuel thirsty factories and utility plants. The mixture of coal to water in a slurry can range from 60 to 40 percent coal. It can be sprayed and ignited. Huge corporations such as the nuclear-plant builders Babcock and Wilcox and Combustion Engineering are investing millions in coal-water slurry research. "Industry is being persuaded to replace crude oil for electricity generation," Chigier says, "for heavy industry and for retrofitting boilers. There is a bill in Congress for laying massive slurry pipelines. But the railways have a vested interest in preventing this. Maybe," he adds, "if they owned the pipelines it would make a difference." Chigier's spray-combustion research will probably have an immense impact on improving coal-slurry combustion efficiency.

And what about the old combustion engine itself? Combustion engineering has always been the Cinderella, he tells us. "The auto industry spends millions to redesign the outsides of cars and very little to develop the combustion in engines. With aircraft, it's only recently that active research has begun on engine development. There's room for radical change."

One of the few new engines, he reveals, is the Army's adiabatic chamber built for its tanks and trucks—a chamber that needs no coolant. Today's tanks are powered by diesel engines, and like any other diesel they have radiators with rubber hoses connecting them to the engines. "Can you imagine a tank, costing ten to fifteen million dollars, out in the field in a tank-style war? Cannons are firing, missiles are flying—everything in the modern arsenal—and a bit of shrapnel pierces the hose. All the water runs out and the tank is immobilized. The absurdity! Here you have this tank captain sitting there with water draining out of his radiator. Oh yes, the Army feels very vulnerable.

"So they're building this engine without a coolant. It has a ceramic coating that prevents the engine from burning up. More heat is contained inside the engine, but the ceramic material conducts the heat, transfers it to the outside of the chamber walls. It works. These tanks exist experimentally. But they're still too expensive for any other purpose now. Perhaps in the twenty-first century...."

At lunch Chigier reveals that he's eager to make a TV series, a sort of *Ascent of Flames*, rather like Bronowski's take on man. He's not deterred by Pyne's comment that fire's primacy has been usurped by nuclear energy that since Einstein the focus of science and the popular imagination has been on the atom rather than the flame. For Chigier fire was and still is pivotal. "My father counted the number of times fire is mentioned in the Bible. About forty. You know: the burning bush, the pillar of fire, Daniel. And then there's the Greeks. Heraclitus, the fires of the *Iliad*, Zeus's thunderbolts."

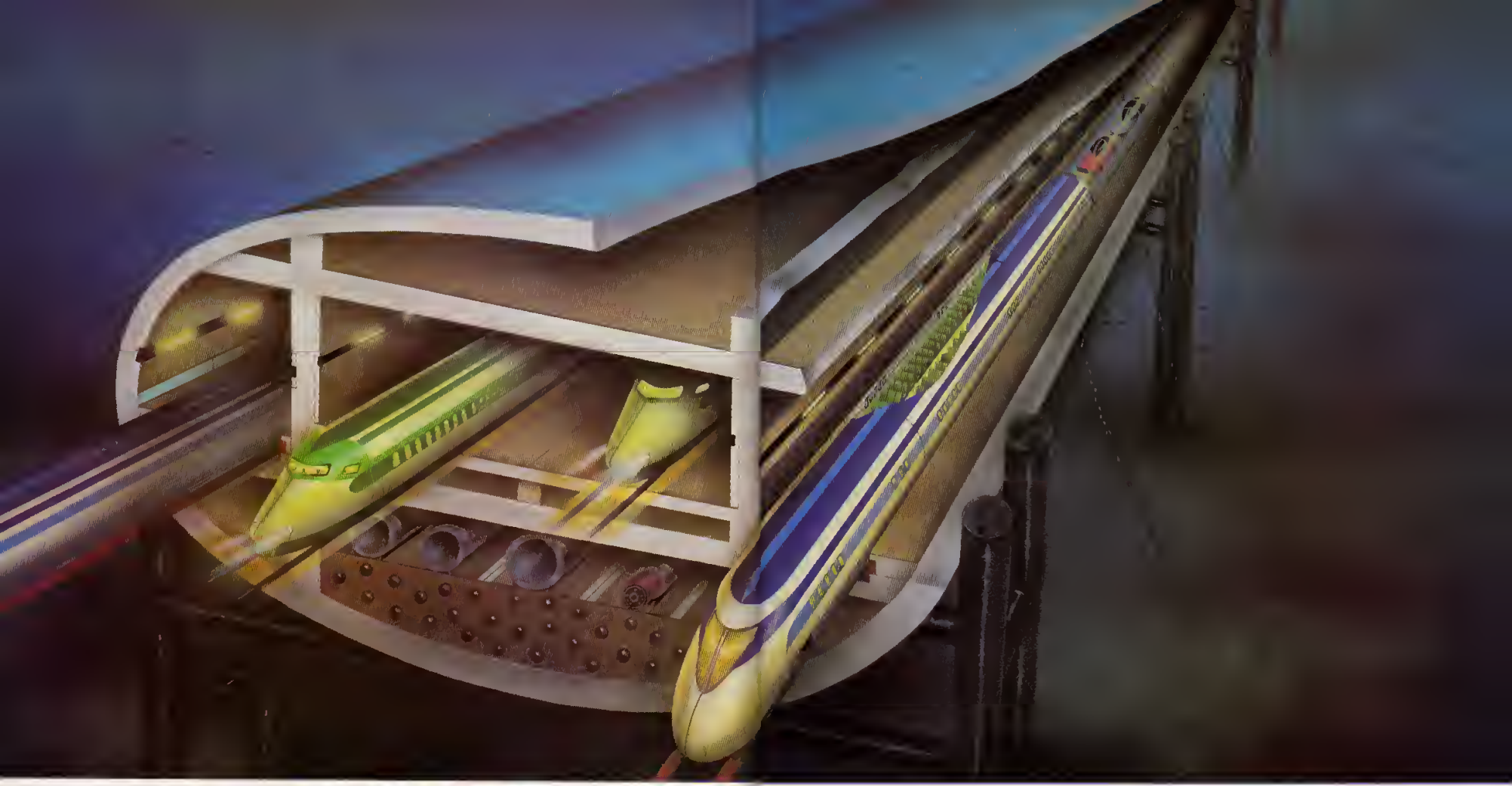
What about fire and brimstone?" asks a student at the table. "Sodom and Gomorrah." The young engineer is reminded of a radio disc jockey in San Francisco who played an hour of rock and roll songs inspired by fire or flame: "Light My Fire," "Great Balls of Fire," "Fire," "White Light/White Heat," and other hot selections. "There are not many paintings of fire, though," Chigier observes. "It's almost impossible to capture the reds, yellows, blues of a flame and its dynamism. I've had two or three painters try it."

Fire is the most tolerable third party (old saying). Chigier himself is out to capture the essence of fire, even in off-hours. He has a cabin up in the mountains, warmed by a wood fire. His wife, he says, is puzzled by the way he gazes into it hour after hour at night, drawn to it like a moth.

"There's a sense of awe. Always. Flames are so very beautiful and enigmatic. And because I know so much about them, I'm even more fascinated."

Postscript: "Fire is purifying,' she said, and gave him a great big smile." (Last line from *Fire Sermon*, by Wright Morris.) ◻◻

"They're indigenous to this area."



MEGAWORKS

BY FRANK P. DAVIDSON, WITH JOHN STUART COX

Consider a tunnel, a *long* tunnel crossing the Atlantic, from North America to Europe. Bullet trains whisking ores, goods, and passengers between the continents would speed back and forth.

When you think that big, the possibilities are endless. What about a subway flashing at rocket velocities between New York and Los Angeles? How about routing water from Canada to the arid southwest United States through canals that would rival the vast conduits

astronomer Percival Lowell once imagined he saw on Mars? What about self-contained metropolises floating on the oceans? Or single building cities each a mile tall?

We are entering a new era of planetary engineering where massive construction projects like these are feasible Well before the year 2000, we could witness the beginning of such projects as a tunnel between Britain and France a linkup of causeways and tubes between Japan and South Korea, or a Gibraltar funnel

We macroengineers have many dreams of which these are a sampling We dream huge, but we also dream realistically These vast projects and scores more like them are not just engineering fantasies They make sense—fechnologically economically environmentally, and humanly

For example a continent-to continent train running under the Atlantic would cost billions, but it would be worth every cent For one thing if would cut down on trans-atlantic ship and plane traffic a major polluter of our skies and seas By using more fuel-efficient train transport we would squander less raw material, because we wouldn't have fo replace ships and planes when they wear out every 25 years We would save millions of barrels of oil we now expend on turning ship propellers and powering jet engines And once completed the tunnel would be relatively immune to economic fluctuations The result would be lower shipping costs

But realistically could we do it? Do we have the technology to build a 2,000-mile-long tunnel over a norfhern global route fwo miles down on the ocean floor?

As it happens engineers are already working on what could be considered the trial run for such a project An international construction firm the Bechtel Corporation has been studying designs for a natural gas pipeline across the Mediterranean Sea, from Algeria to Spain It would stretch 155 miles and lie at a depth of up to 8 000 feet Cost would be about $33 million per mile a not unreasonable expenditure given the heavy use such a pipeline would get

Moreover, last January Japanese engineers linked the islands of Honshu and Hokkaido when they completed the underwater portion of a 33 7-mile underwater tunnel under the treacherous Tsugaru strait Built across a stretch of the Pacific considered too turbulent for safe ferry fravel the remarkable project is the longest of its kind in the world

Construction of the Tsugaru tunnel was accomplished by an ingenious procedure Experts blasted out a section of bedrock and then used an enormous machine to inject a special sealant into the walls of the finished tunnel section Beneath the main tunnel they dug a smaller channel to carry off water seepage Running parallel to the main shaft is a service tunnel for maintenance and for evacuating the passengers of trains that stall in the main tunnel

It was an immense project It required burrowing more than 400 feet beneath the seabed through some extraordinarily difficult geological formations Even more remarkable is the decision-making support Japanese officials gave to such a long-term project By the time the double-track railways are laid in 1986 the tunnel will have been over 15 years in the building

The Tsugaru strait project could be the inspiration for other large-scale subsea construction A tunnel from Italy to Sicily is one such possibility Another scheme calls for a Gibraltar tube that, instead of being burrowed beneath the surface would be suspended in the water to avoid tunneling costs In fact the art of designing such 'immersed tubes' (see large picture on the opening pages) is so advanced that a leading Japanese construction firm has contemplated a railroad tube stretching 100 miles across the Pusan straits from Japan to South Korea Now being evaluated by a team of scientists that includes one experienced macroengineer Professor Manabu Nakogawa chairman of the Japan Institute for Macroengineering It would open the way for bullet-train service that would go from Tokyo to Paris and pass on through an English Channel tunnel to London and Edinburgh, with a spur that would pass under the Irish Sea to Dublin

> *"A top Japanese construction firm has contemplated a railroad tube from Japan to South Korea. It would open the way for bullet-train service from Tokyo to Paris"*

Why not think even bigger? Within a decade we could see international teams analyzing various options for a transatlantic tunnel At depths of nearly a mile—5 000 feet—water pressure is sufficienfly low to allow engineers to borrow from pipeline technology Construcfion crews could lay prefabricated reinforced fubes in a prepared trench and then cover them over to keep them from shifting At greater depfhs, engineers mighf have to bore a tunnel through fhe seafloor's bedrock

Much preliminary research will be necessary for such a mammoth underfaking For sections of the pipeline where water pressure mighf present a problem engineers could draw upon techniques used in building the shells of submarines Also a full-scale prototype of a high-speed transport system that travels through the partly evacuated tunnel will have to be fested But if designers can keep the construction costs reasonable for such a project—about $100 million per mile—the project would be economically fruitful

Not all these grand tunnels will be underwater Robert Salter of The RAND Corporation has suggested building a subway from New York to Los Angeles Magnetically levitated above the tracks fhe trains would zip through the evacuated funnel at speeds faster than an SST crossing the country in less than one hour Building such a train presents no special technological problems buf the cost of tunneling from coast to coast would To be economically feasible engineers would have to develop a new way to dig The federal government's Los Alamos Scientific Laboratory in New Mexico however may have an answer to this challenge

Called the Subterrene the Los Alamos machine looks like a vicious giant mole (see inset photo on opening page) The beauty of the Subterrene is that as it burrows through the rock hundreds of feet below the surface it heats whatever stone it encounters into molten rock or magma which cools after the Subterrene has moved on The result is a tunnel with a smooth glazed lining For power the Subterrene can use a built in miniature nuclear engine or even a conventional power plant

Carnegie Mellon University's Robotics Institute is working on a related machine a robot tunnel builder It will be an unmanned boring and tunnel-lining machine that will also handle muck and debris as if bores and constructs a tunnel

Sophisficated new tunneling equipment like these will open up other possibilities One is a system of tubes for distributing goods between buildings and befween cities We already use oil and gas pipelines and researchers are working on pipelines for conveying solid products For roughly the cosf of a wafer-distribution nefwork, we could have underground pipes that move merchandise from stores to our homes as soon as we call in our orders

Such pipelines have vast potential, including transportation of coal phosphates and ores Eighty percent of all freight now moving on trucks, trains, and planes could be moved easily through a six-foot pipe Eventually these systems could move people too—and at high speeds New Yorkers might opt fo live in Vermont away from smog and congestion but close enough to pop in—via the tube—for an evening on Broadway

Macroengineers have many other

Editors' note Frank P Davidson is chairman of the Systems Dynamics Steering Committee at the Alfred P Sloan School of Management and program coordinator of the Macroengineering Research Group at the Massachusetts Institute of Technology School of Engineering He is considered one of the world's leading experts in the science of macroengineering

Adapted from MACRO *by Frank P Davidson with John Stuart Cox*

schemes in mind all of them grand but not all of them new One such idea is to move ships overland For example archaeologists in Greece have excavated the tracks the ancient Hellenes once used for specially constructed oxcarts that carried ships across the Isthmus of Corinth In 1881 American engineers proposed a mammoth railway designed to carry ships across Mexico s Isthmus of Tehuantepec between the Gulf of Mexico and the Pacific Ocean And in the Low Countries—Holland Belgium and Luxembourg—barges have been routinely moved for decades from one canal to another via railways

This option still makes sense Instead of digging expensive canals to float ocean-going ships from one sea to another, why not simply carry them across? Of course today's liners and supertankers are gargantuan, but so are our engineering capabilities We could still take a lesson from the ancient engineers and roll the giant ships on rails over miles of earth

We already have large Hovercraft that ferry cars between England and France across the English Channel Their design suggests that we could build Hovercraft large enough to levitate a freighter and float it overland on a cushion of air Special macrotractors the terrestrial equivalents of tugboats could do the pulling Other macroengineers have proposed building an enormous "bathtub" in which a great ship could regally float as it and the tub are hauled across short stretches of dry ground We already have made use of another option wheels NASA regularly transports the space shuttle and rockets to the launching pads with an ultraheavy-duty wheeled vehicle

And if a canal is preferred macroengineer E G Frankel has devised a clever canal-building system that under proper conditions would obviate the need for excavation altogether His scheme calls for installing precast walls aboveground to form the sides of the canal and then filling the newly formed channel to the desired depth of water to accommodate the ship traffic that will pass through

Before any country digs another canal it would be wise to compare the costs of the different methods for moving ships overland In fact Canada has the perfect spot to try out any one of the approaches the 11-mile-wide Chignecto Isthmus which separates the Bay of Fundy from the Northumberland Strait

But macroengineers can do more than devise systems for carrying heavyweights like the *Queen Elizabeth II* We can build big Many years ago architect Frank Lloyd Wright designed a huge skyscraper called the Illinois It was one mile tall In 1964 I was discussing that project with Gabriel Bouladon chief of the mechanical-engineering division of the Battelle Memorial Institute in Geneva Switzerland "My architect friends," I told him "say the building would not fall down but that it would consist almost entirely of elevators!"

Bouladon smiled enigmatically "Let me give this matter some thought," he said

Six months later a large package from Switzerland arrived at my New York offices Inside was a model for a unique elevator design Not only had Bouladon solved the elevator problem of the mile-high building but he had managed to patent the solution as well

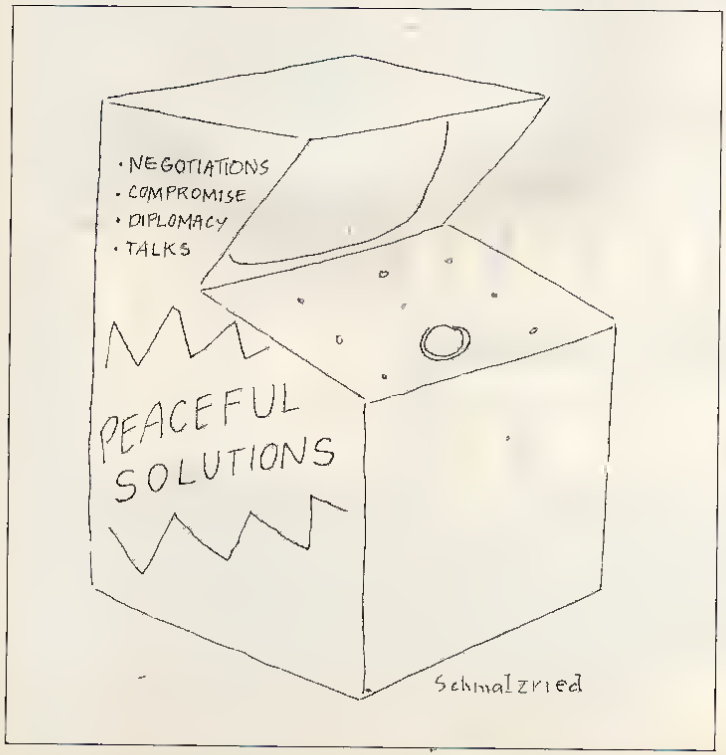
Instead of using standard, large elevators Bouladon s system updates an old elevator design the paternoster which resembled a vertical conveyor belt It was a continuous moving series of steps people could hop on or off as needed Bouladon s design was a more sophisticated version that had two-person-size boxes The boxes sit atop one another in a continuous chain of compartments that turns steadily keeping traffic flowing smoothly up and down

Thus the mile-high building unworkable when Wright first conceived of it, is now possible Land-poor Japan for example is considering such supersky scrapers to house its crowded population and in celebration of France s two-hundredth anniversary the republic is seriously contemplating the construction of similar giant structures called megatowers

Advances in technology are sure to challenge our traditional concept of what a city should be Beyond putting a city in a skyscraper why not erect one in the unspoiled reaches of the mid-Pacific? With the United Nations predicting a doubling of the present world population in 40 to 50 years we may *have* to move out onto the oceans New sovereign states may appear in what are now international waters, and the United Nations might well use these man-made sovereignties as living areas for dispossessed refugee populations

To provide easy access to offshore coal mines the Japanese have already built artificial islands in 40-meter-deep water at Kobe In the United Kingdom the Pilkington Glass Age Development Committee has proposed building a 30,000-person "Sea City" 15 miles off the Norfolk coast Especially fascinating is the notion of building new nations or port-city states for such landlocked countries as Bolivia and Nepal on the underwater mountains called seamounts that dot the Pacific

As awesome as such city islands and city skyscrapers may seem perhaps the most ambitious of all macroengineering schemes is the Great Recycling and Northern Development (GRAND) Canal It was conceived by Thomas W Kierans a professor of engineering at Memorial University, in Newfoundland and like any good macroengineering project, it is an attempt to solve a mammoth problem. The challenge is in alleviating the chronic shortage of water that plagues the entire North American continent—western Canada the central and western United States and northern Mexico Very simply Kierans's solution would redesign the drainage sys



tem of the entire continent.

He has proposed building a dam across the mouth of James Bay, a shallow saltwater inlet in the southern part of Hudson Bay. Cut off from the sea, James Bay would have the saltwater pumped out of it, and rivers flowing into it would refill it with fresh water, creating an enormous reservoir. To transfer this trapped water to arid parts of North America, Kierans next proposes digging canals connecting James Bay to existing rivers and lakes, ultimately feeding the water into the Great Lakes system. Thus interconnected, the Great Lakes could serve as a vast reservoir of water to be redistributed to the many areas of the continent where it is most needed.

Consider the benefits of such a project. For one, it would help stabilize the water levels of the Great Lakes and the St. Lawrence River system so that the present cycle of soil erosion during the wet years and shipping interruption during the dry years would stop.

Kierans's scheme would also reverse desertification in the United States and the Canadian middle west and far west, our continent's breadbasket. In parts of Kansas, for instance, groundwater levels have dropped more than 62 feet since 1950, mostly because of pumping for irrigation. If this trend continues, experts warn, the damage will be irreversible.

Kierans's premise is simple. Since the scope of the problem is continental, its solution must be continental as well. The estimated cost of the GRAND Canal would be $100 billion, but if its benefits match those of a similar but smaller plan, California's Central Valley water-diversion project, it could easily recoup that investment during its first year of operation. Can we afford *not* to consider this idea?

The GRAND Canal scheme also serves as a good example of why so few macroengineering projects are realized. Although we are technologically capable of doing work on such a vast scale, diplomatically the challenges become complex if a valuable natural resource like water is to be transferred across national boundaries. Still, this project offers the United States, Canada, and Mexico a chance to plan for better use of the continent's water.

By their nature, macroprojects tend to be conceived on an international scale. They are technologically and environmentally complicated and require careful analysis of the possible benefits and hazards. Something like a world policy is needed.

But humanity was made to dream big. Perhaps macroengineers should take as their motto the inscription on a statue in the town of Sapporo, Japan. There, on a promontory overlooking the site where much of the work on the Tsugaru strait tunnel was performed, stands a larger-than-life figure of a nineteenth-century teacher, an American revered by the Japanese. The words he used to encourage his students are now engraved on the figure's base:

BOYS, BE AMBITIOUS.

FICTION

BOUNDARY ECHOES

BY JOHN M. FORD

At sunset, with the red-gold light washing down the face of Shadow Mountain,

PAINTING BY NENAD JAKESEVIC

dazzling on the lake below, Dr Larkin told Mrs Weiss about the cancer

Helena Weiss stared at him for what might have been minutes They had gotten to the park before noon, hiked all over creation, and only now did he say anything as if he'd been saving it as a present

"Is it operable?" she managed to say

"What's operable, and what isn't? You would have to go through a couple of higher function centers to get to the body of the growth, but the damn thing's stellate—you know, starburst"

"I know"

"And you'd never get all the spikes So surgery plus irradiation, with plenty of chances for both to go wrong and no guarantee of a cure or anything like one"

Weiss looked straight out at the western horizon, at thin lenticular clouds trapped in the mixing layers of the atmosphere Her palms were damp She still hated heights Spacelab had been high foo, but you couldn't just slip and fall from orbit

You couldn't even jump

Still staring at the boundary clouds she asked, "How long?"

"Not long Probably not six months If it takes longer, there would be mental changes, convulsions It could get—"

"Messy?"

"Yeah"

"How *do* you get so cold?"

He did not answer, and she felt very bad sensing his hurt But she did not turn because there was nothing that way to look at but a rock and a tree and Boris Larkin, M D Finally she faced him

He was sitting on a rock, hands folded on a blue-jeaned knee, staring at the toe of his extended boot

Weiss said, "So now what?

He looked up Golden light bounced from his glasses, making his face indistinct "How long to do your symphony?"

"Quattrocycle, she said too quickly

"Quattrocycle, yeah," he said, and looked down the flare of light going out He looked very tired "How long?"

"Not long," she said, and as she saw him twitch she realized they had just turned each other's words around She looked back to the red sun, burning up the layers of cloud She said, "Just tell me

Helena Weiss first met Dr Boris Evgenovitch Larkin in a conference room at Penrose Hospital "Not Penrose *Community*" Dr Larkin had warned her over the phone Make sure the cabdriver knows

The driver recognized her— *The* Mrs Weiss?" and she was too honest to deny it—and all the way in from the airport hotel she was treated to *El tren subterraneo* and *Suite for Walking Beams* from a tape player on the taxi's dashboard Then they arrived at the wrong hospital and he played her all of *One Thousand Orbits* on the trip across town And out the windows were mountains, large mountains Pointing up High In the air *She* was high up in the air It wasn't worth a free cab ride

When she walked into the hospital lobby, hands white on the shoulder strap of her keyboard the staff tried to get her into a wheelchair and admitted on the spot Several repetitions of Larkin's name and her own finally got her pointed the right way into the little conference cubicle with a cup of something that had the color but no other characteristic of coffee

At least the room had no windows

She unzipped the case touched the keyboard within She clipped on the earphones turned power on and began to play—nothing of her own, of course The Pachelbel Canon in D, that perennial Muzak favorite because nobody was listening so what the hell! Even poststructuralist architectonic composers have to have secret vices

She looked up A man was standing across the table He was short, broad, dark and muscular in a white lab coat over a sweater and slacks He was in his early thirties like herself There were pencils and so forth in his pockets a photo-badge on his lapel He wore very large eyeglasses

"I'm Boris Larkin," he said

"Oh uh—hello"

She snapped off the keyboard power and took off the phones "I'm Helena Weiss Pleased to meet you, Doctor"

"Yeah Could I look at that? I like gadgets." He came around the table faster than she could push the keyboard toward him She said, "Do you play an instrument?

"No I have lousy taste in music too What's a timbre gate?"

"It shapes waveforms Under the panel—here—these slide pots alter the wave envelope at time increments set by these dials over here"

"Do you have to do that for every note?"

"That's just the programming panel This key moves the setting to a memory block I can hold eight reshapes at once and call them from this switch" She turned the power on again, gave him a phone, and played a few notes with different gatings

"I love it," he said "Where do you get one of these?"

"I built this one," she said

He laughed "Then I really love it Come on with me, then, and I'll show you what I do in the basement of this place

Mrs Weiss's head was held firmly inside a sort of Plexiglas helmet, crowned with a steel cylinder one meter across Dr Larkin was taking readings with a pocket Multimeter He said, "You feel okay?

"Fine" She sat comfortably in a padded metal chair

Good Some people get nervous when they're hooked up to this thing It reminds them of that one the state runs"

"What one is that?"

"The one over at the prison"

"Oh Yeah, right"

"And" he said theatrically, "I *will* know if you get nervous

"Really? She thought a moment "I'm scared to death of heights"

"Are you serious? Because I wasn't" She nodded He added, "I'll label the tape with that if you don't mind There are about eighty billion things we want to try correlations on and every piece of data helps

"Sure What's that?

Larkin was loading a glass cylinder into a bright metal device The tube came from a metal box marked PROPERTY U S AIR FORCE in blue and RADIOACTIVE in purple on yellow He snapped a lever on the gadget and it became a hypodermic syringe "This is the potion that makes the magic machine work Radioiodine 129 Scared of needles too?"

"I thought everybody was scared of needles" she said as he swabbed her neck She looked away The sting wasn't too bad

"Sorry" he said "I've only got two doctorates I'm not a nurse

"But that stuff belongs to the Air Force?

"In the same sense" he said quite seriously "that Johann Sebastian Bach's music belonged to the margrave of Brandenburg or Wagner's belonged to Ludwig of Bavaria We all have our patrons at court

Before she could think about that he said "Okay now what you want to do is watch that monitor Can you see it clearly?"

"I see it"

"We're all set then" Larkin closed the RADIOACTIVE box and went behind an instrument board With its knobs and little screens it reminded Weiss of a Hammond Polytronic or a Concert Moog VI There was no keyboard but an Arp-X synthesizer dispensed with that too She touched the keyboard in her lap rested her fingers lightly in home positions

Larkin worked his own console The monitor cube came to life with a pattern of colored bars, knotted around and through one another Larkin's hands moved below Weiss's line of sight and the interlinked pattern rotated, tumbled end for end

The cube went blank Above Weiss's head there was a faint noise of machinery Her eyes flicked up down In the arm of the chair out of sight but in easy reach was a switch that would immediately release her head from the scanner A chicken switch the European Space Agency ground crew called theirs, when they tested her for Spacelab She hadn't pulled it then

"Signal's coming through" Larkin said

In the cube monitor painted on the filament strands that filled it was something like a pink climbing vine

"That's your cranial artery" Larkin said The tracer's just getting there

The vine branched out became diffuse The cube flashed and a green-line overlay showed a rounded outline a humped, furrowed shape the shape of a human brain Helena Weiss's

The technique was called Solid Image Generation by Multi-Axial Positron Scanning SIGMAPS On the front of the control bank in burnished metal was the emblem $\Sigma\beta^+$ fhe Greek sigma and the symbol for a positron an antimatter electron The radioiodine tracer emitted positrons which crashed into the molecules of her brain to produce gamma rays In the cylinder around her skull scanners were triggered in sequence hundreds of times a second, reading the ray emissions and feeding data to the monitor She thought of a dollar in the-slot arcade machine *Brain Invaders*

The green sketch-plan was gone now unnecessary Weiss saw the outlines of her brain in blue a lacy cyan haze filling out the lobes of her cerebrum Within if were spots of colors from further down the spectrum—yellow fringes around hot or ange cores—and in her left frontal lobe was a blood-red star

"Comfortable Mrs Weiss?'

"Yes"

Okay Have a listen He put a little cassette player on top of the console and she tensed—there were flashes around the cerebellum—but it was not her music It was the Ninth Her brain lit up

Specifically two more red stars novaed left hemisphere and right The brain revolved in space, showing a fop view left side right

Larkin said This is something they found out with flat positron images what we called PET scans The activity zone on the right that's where all of us listen fo music But you're a professional musician and you're reacfing in the left cortex the analytical centers, too You're very analytical Mrs Weiss

Thank you

'Now here's something new" The left-side red zone began expanding the whole image was being enlarged The brain surface was soon lost beyond the limits of fhe cube until the whole monitor was filled with what must have been only a few cubic millimeters of her brain

The structure displayed was in layers of color with strands of contrasting colors interlaced It was she thought like fhe understructure of Manhattan or oil wells in deep rock strafa or—and each time fhe image changed in her mind, the image in the monitor shifted its form

This is the edge of a thought" Larkin said suddenly quite intense "For decades we argued about whether there were really activity centers Well there are the scan shows them working But what's the difference between working-center brain and noncenter brain? It's not a line you can see that not just a line any more than the skin was the simple mechanical structure we thought it was There's a whole boundary complex and if those intermittent flashes—see, there's one!—if those mean what I think, then the active brain is interacting with the— you can't call it inactive, call it otherwise-acfive majority And if fhe—what the *fuck*?"

The image on the monifor pitched over "*Alle Menschen werden Brüder*," sang the tape Weiss tried to furn her head which hurt just a little "What is if Doctor?'

He was silent for several seconds unseen behind his machinery Then he said 'Uh nothing Seeing things, I guess" His humor came back instanfly "Stare at brains all day and you'll start seeing pictures in them Queen Victoria The Yellow Brick Road" Larkin threw some switches and the monitor went dark the scanner silent

"Is that all? she said hands poised above the keyboard

'Enough for today Do you think you're going fo get a piece of music out of this?'

Weiss's hands moved across the keys but the power was off "I tell reporters I don't write pieces of music but I think so It's too soon to tell what it'll be like but—

'We'll do more scans You're not really a subject until I have an hour's tape on you But no more until Monday" He moved the catches and released her from the scanner stuck a label on a tape cassette and made unreadable scrawls across it

It's three days till Monday she said

"Uh-huh" he said distantly Then he looked at her scratching his temple with his pen 'You ever climb a rock?'

It had taken two hours Friday night at a shop that seemed to stock nothing but leather and blue denim and big hats to get Mrs Weiss fitted out with hiking rig By noon Saturday they were on a trail in Rocky Mountain National Park It was no strain for her, she was in excellent shape for thirty four she hiked regularly (over rather flatter ground), she had passed the ESA physical At least it was no physical strain *Keep looking at the trees* she kept telling herself *Keep looking at the ground Do not look over there There's nothing over there but a thousand meters of straight down*

They stopped for lunch in view of a peak Larkin said was named Hallett 'Over twelve thousand feet You look terrible Pace too quick?

No she said looking at a point about halfway up Hallett Peak Half the rest of the distance up anyway she realized they *were* halfway up and she chewed a supercarbohydrate bar in deep thought of meadows and living rooms Larkin handed her a cup from his vacuum tlask, and she took a long first swallow It wasn't water

Larkin said "Hey slow down that stuff's too good for guzzling"

White wine on a mountain?"

"A loaf of gorp a jug of Gewurztraminer, and thou beside me in the wilderness Hoo boy wilderness"

"I think you're crazy,' she said

"Of course I am Alcohol is illegal in na-

We're both devout churchgoers but Bernard is I think more God-fearing

tional parks. Try to look like you're drinking ginger ale."

Who's to know?" She looked toward the edge of their clearing, felt her feet getting damp, looked back. "In fact, who's to know it we fall off this vertical surface?"

"Sit down. It doesn't really tilt. Invisible hands aren't really thrusting you toward the edge." He reached into a pocket of his down vest and showed a flat, black object with a set of buttons on its face. "And if anything untoward happens, this FM phone can call that ranger station yonder"—he pointed, but she didn't look—"and they'll have the choppers out in nothing flat. Any time, any weather. I've seen 'em come in with more ice than blade overhead."

Well, at least I'll get a decent burial."

He took a bit of beef jerky, sipped his wine. "You know, it's probably not heights you're afraid of, it's falling. Everybody's scared of falling at birth, and we overcome it to varying degrees. I'm not really sure acrophobia is a separate fear at all."

"I didn't think you were a psychiatrist. Or is that your other doctorate?"

He shook his head. "Ph.D. electrical engineering."

"Yeah? Me too. Don't call me Doctor."

"Why?"

"I'm an artist. I want to keep my amateur standing."

He chuckled. "My first research work was on perception. One of the things we did was put subjects over a cliff—"

"What?"

"A visual cliff, sorry. A drop-off with checkerboard painting to make it very obvious. We could read a basic fear blip. Some showed it more strongly than others, but everyone showed it to some extent."

"All scientists are sadists," she said, watching him gesture explosively as he spoke.

"Yeah. I'll buy that. Ever put EEG wires on a baby? The parents smile and nod at you, helping science march on, and you feel like a pervert. But the really weird thing was, there was no cliff. The perspective of the drop was painted on a dead-flat board. You could touch it, pound on it, jump on it—and people did all that—and we still got the falling-fear blips." He turned to look at the mountaintop, the brim of his cap throwing his face into shadow. "It was like an archetype. A basic subconscious code for—" He held out his hands, palms outward, framing the view.

She said, "Faw down go boom?"

He laughed. "Exactly. Exactly! We have to learn that fire burns, too much candy makes tummyaches—but faw down go boom is hard-wired somehow." He turned back to her. "How did you come by the minor-chord triplets for the aquifer theme in *Walking Beam Suite*?"

"I thought you said you had terrible taste in music," she said, surprised.

"I don't know one note from another," he said, "unless I ask and somebody tells me."

"Well, I warn you, you won't get far asking artists where they steal things from."

He looked expectant. She said, "You're supposed to laugh at that, but let it pass. It happens that I do remember where those notes came from. I was listening to the geophone tapes I'd made in Oklahoma and had the coffee percolator on, and the triplets just... well, bubbled up. It that's not a terrible choice of words."

"It's... excellent."

"You sound disappointed."

"I'm not. No. Not at all. Have you thought about your new work?"

"There's hardly been time. You want to scan me again, don't you?"

"Mrs. Weiss, I could scan you for hours."

She waited for him to kiss her, but he didn't. He closed the thermos of wine and said, "That's enough for a first day in the mountains."

They drove back to Colorado Springs, arriving a little after dark. Larkin let Weiss off at the hotel doorstep. She said, "If you'd like to come in for coffee—"

"I've seen quite a few hotel rooms.

"The fourth cycle snapped into existence from silence, as if the ear refused to hear the chaos at its very beginning. Then above the rush a single line of melody rose."

thanks," he said politely, "and one's like another. Good night, Mrs. Weiss."

"My late husband made me promise..." she started to say, too late. She watched from the curb until the car's taillights had vanished.

Over the next weeks she did spend hours in the scanner, listening to music playing. It. He showed her tapes of other subjects, pointing out patterns in patients with fugue, dementia, cranial wounds, the great spreading darkness of stroke. He gave her a joystick wired to the main console so she could explore the corridors of her own brain, flying nap-of-cortex through convolutions, looping the corpus callosum.

On Thursdays the Air Force "got its money's worth," as Larkin put it, bored and unwilling cadets were sent in to be scanned as they did mental and manual exercises. The Air Force wanted a magic indicator of potential piloting skill.

He got Weiss a white coat and stethoscope and addressed her as Doctor ("It's not a lie, right?"). They gave one young man a paper and told him to read it aloud, and the bewildered cadet recited all of 'High Flight' while Weiss entered chords in the keyboard's memory and Larkin hid laughing helplessly behind his console.

She watched him lecture neurology students on SIGMAPS and more mundane subjects; she did a special series of talks for advanced music classes and gave a couple of recitals.

After the recitals she began to get headaches behind her left eye; he gave her aspirin and caffeine, and that was all. "If you need aspirin-codeine, I'll prescribe it," he said, "but I don't like tranquilizers for headache. Valium in particular. You give somebody Valium, and they tell you it works just great, and you don't know whether to be happy or scared."

They went to movies. They never ate twice at the same restaurant. She never saw where he lived. He never went further than the hotel lobby. After four weeks they went back to the mountains.

"I'm going to do a quattrocycle," she told him in the high, clear air.

"I have no idea what that is," he said, "unless you tell me."

"Four cycles—subpieces that interlock. A little like symphonic movements, but not as elaborate as a symphony, and the parts are more closely related. The themes of the cycles are—"

"The temporal lobe," he said, "occipital, parietal, and frontal lobes."

"You guessed."

"What else have you been staring at for a month? It had to be that, or else cerebrum, cerebellum, medulla, and pons."

"Hmm. I may have to write two." She looked out at the peaks surrounding them, ice-blue and chocolate and snowcapped and vivid red. "It's not too hard to look at them," she said. "Especially since they're outside the window every damn morning. Do you ever get tired of looking at mountains, Boris?"

"No. My melancholy Russian soul."

"You told me you weren't Russian. Just had some family with long memories."

"Yeah. Maybe melancholy souls are genetically determined."

"Or part of the collective unconscious?"

"Now there is something I would like to know. How long has it been, Helena, since you wrote the Spacelab piece?"

"*One Thousand Orbits* was... three years ago, Christmas."

"That would be nearer three and a half."

"Yes, I suppose so."

"You'd produced much faster before that, hadn't you?"

"I guess so. I did about one major work a year after Terry died, plus the other things—songs, radio commercials."

"But nothing now for three and a half years."

"Not nothing, Boris. Nothing major. Do you think composers live on composing? The first day we met, you talked to me about patrons at court. I'm a rich widow. If they melted all my records down for floor tile, I'd still be a rich widow."

"But not as happy."

"I'd have to think about it," she said, joking, and at once regretted it. Worry was marked in every part of him. She touched his shoulder, asked about several things it might have been, all of which he denied. Her head began to hurt, and he said, "It's tension," from somewhere very far away.

They went back to the city, and he left her at the hotel.

The following week he went to Denver, where he could not be reached and would not return calls.

On Saturday morning he phoned early from the lobby downstairs. They went to the park, they climbed the trails, and that afternoon he told her what the SIGMAPS scan had found: the Denver specialists confirmed.

"Just tell me," she said (recalling "—*what the fuck?*" "*What is it?*" "*Nothing—*") "Did you know then?"

"Not for certain. Not then. And I didn't want—I couldn't say anything until I was certain."

Well, she thought, *this is one I can't blame on Terry's ghost.*

Larkin said, "I really do want to hear your symphony."

"*Quat-tro-cycle!*" She turned away from him, looked down at the lake, too angry to realize what she was doing. She felt slightly dizzy, touched her eye where there was the promise of pain. He would give her pills for that, because she could not work in pain but nothing that might relax her, make her rest. He would not let her rest until the music was done. He wanted to hear it. All right. She would give it to him.

"Let's go," Larkin said to her, "before we lose all the light."

She left the Springs for home the following week, with a trunkful of notes, her suitcase, and her keyboard. A taxi took her to the airport, and no one saw her off. That was just how she wanted it.

She had not been back to the house for sixteen months. There were no deliveries there to stop or start; the mail accumulated at her post-office box until she or her New York agent called for it.

The house had no telephone either, and the electric power came from a generator that ran on gasoline, moonshine, or anything in between. In the basement was a bombproof shelter, gas/blowar protective suits in several sizes, including maternity, and enough dehydrated food to last for at least five years.

In a room on the main floor was Helena's master composition console, a percolator, and a framed photo of Terence Gallagher Weiss, deceased, who had refused to be called a survivalist, insisting that he just didn't believe in miracles. He had gotten a promise out of her, that if the time came, she'd go on living without him.

Now and again, she would rage at his picture, calling it anything she could think of. It was not that she had been made to keep her promise. She had just never imagined that it could be so hard to keep.

Writing the quattrocycle took almost four months. The lobes of the brain failed her as a framework, as did the gross structures she had to tear down and build up again, note by note, phrase by phrase.

The headaches became blinding more than once, and she would have to stop for a day, take aspirin, drink coffee, sleep, but only for a day at a time.

When she was satisfied with the last note, she made a shortwave call to the state police, telling them that the house would be empty again, loaded tapes and bag and keyboard into the Land Rover, and drove away through the yellow haze of autumn.

They found a sheltered spot on the lee slope of Shadow Mountain. Mrs. Weiss set up the keyboard and auxiliary tapes on a rock of a convenient height, and Dr. Larkin unspooled a strand of wire and hooked it to a pair of thin-panel speakers.

They had a tiny amphitheater in the shadow of the spine of the land. Larkin poured some white wine from his flask and settled down. Helena Weiss began to play.

The first cycle crashed against itself in waves of antiphony, a quick, bold, immediate theme for the right hand against a more deliberate and reverberating one for

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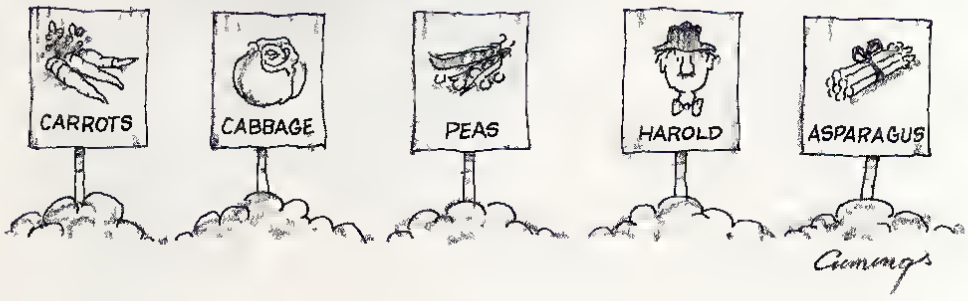

Its secrets have been swallowed by hissing wind and the raw, wild weather of the plain

MERLIN'S ROCK

PHOTOGRAPHS BY PETE TURNER

Dawn August 2484 B.C. A great procession of men and rock crosses Salisbury plain. Under the sting of summer sun, oxen haul sacred blue stones to the entranceway of a circular bank where men roll the stones into a ring. Some 500 years later the descendants of those first builders post huge boulders upright in the earth, like sentinels. The constellation of stone described above and caught in the camera lens of photographer Pete Turner is Stonehenge in Wiltshire, England. For 4,500 years its niches and archways have been molded by Britain's raw rains and hissing, wild winds. Legend has it that while turbulent heavens and dark, billowing clouds spiraled above, Druids huddled within, performing strange, hermetic rites. The Druid legend is just one of many Stonehenge myths created over the millennia. Some people relate the tale of Merlin the magician, who supposedly cast a spell to send the blue stone sailing from Ireland to the English plain. Others claim the megaliths were built by extraterrestrial "astronaut gods." But finally, after decades of research, a clearer picture is beginning to emerge. Scientists speculate that the great archways pictured here—called trilithons—were completed centuries after the first Stonehengers began their awesome task. The builders rolled huge boulders to the site and whittled tongues and grooves so that the stones would lock together. Then, by wedging blocks of wood under a platform, they raised beams atop 20-foot-high boulders.

TEXT BY KATHRINE JASON

Why did the Stonehengers labor so long? Searching for a clue in 1961, American astronomer Gerald Hawkins found that by walking around the stones while applying mathematical formulas, he could track celestial patterns and predict such cyclical phenomena as solstices equinoxes, and eclipses Thus, he concluded in his book *Stonehenge Decoded* that the ancient site was actually an "astronomical observatory."

But in recent years British prehistorian Christopher Chippindale has discredited the observatory theory "Even if the astronomy is theoretically valid," he says "England's murky weather makes accurate observation nearly impossible" Today even Hawkins admits that Stonehenge was probably *not* an observatory Instead, he says "it was a site of rituals connected in some way to agriculture to the sun and the moon"

FICTION

SEVENTH SENSE

BY ROBERT HAISTY

We unsnap our seat belts and lean back. I am hoping for two things: to get away from the gray Chicago rain and to finish my report for the Baltimore meeting. But by the time we reach cruising altitude I'm sure neither is going to happen. There's no break in the clouds, and already I know the old guy in the window seat is going to be a talker.

I halfway expected it—as soon as I saw him plop through the forward cabin door, hold out his boarding pass to the blond stewardess, and say something that made her dimple sweetly. It's that feeling you get when there are at least fifteen empty seats in front of you, but you know, sure as prunes, he's going to walk past every one of them and stop at your row with a little smile, and you were saving that seat in case Miss Galaxy came by.

He isn't really *doing* anything—just sitting there. Why do I find myself staring at him? On closer study, he doesn't even look so old; it's just that he seems archaic, somehow—and cautious. Imagine a thoroughly circumspect turtle eyeing over his shoulder the galloping approach of a half-grown Great Dane puppy.

He nods, grins. "You travel much?"

"Not a whole lot," I mumble halfheartedly. "Do you?"

"Oh, yes indeed. I'm on the move constantly."

He sits quietly then, and I optimistically begin sorting out my notes for the report. But as soon as the stewardess has dropped

PAINTING BY ROBERT GIUSTI

off a gin and tonic for him and a vodka martini for me—and a faint, wistful scent of orange blossoms for both of us—he lowers his seatback, turns foward me and starts. 'Yeah,' he says with an ironic chuckle that there could have been any question about it, 'I travel all right.'

He has a voice that sounds deceptively unobtrusive, quiet even, yet it carries handily above the roar of the engines—not an easy man to ignore. And immediately as if he were the Ancient Mariner and I, the Wedding Guest, I find myself putting my papers aside to listen to him.

'I'll tell you this. When you make as many towns a year as I do, you get so you can taste things in the wind. You pick up on all kinds of stuff.' I once read, 'The constant traveler grasps propositions too subtle to describe. Too fleeting to hold. He knows things others do not.'

'Like what?' I know I rolled my eyes disbelievingly toward the heavens before I could stop myself. But he doesn't pay any attention to that, or to my question.

'I've come to realize it gradually,' he says. 'Through God knows how many thousand lonely breakfasts, up too early for the body to respond, trying to come back to life on coffee too strong, pale eggs too runny, with too much black pepper and the morning paper. Then out of the red-clothed breakfast grill and into the city still sleeping in the morning haze, all cities seem to gather. Thirty years of it hasn't stopped that gnawing in the gut of a morning. That's the loneliest time there is. Not the nights. At night, people draw together. You get a feeling of order. We've conquered the night with soft electric lights and whiskey sours. Old travelers get together in quiet little bars and wear the night away. We don't say much. We don't really have to.'

The Constant Traveler stops talking and pulls an orange out of his pocket, digging a stubby thumb into the peel. The aroma makes me think of the stewardess, and I wish I had ordered two drinks. He offers me part of his orange, and involuntarily I start to reach for it, then draw back.

'Hey!' he says. 'Were you born like that?'

'Like—?'

With three fingers. He leans forward to look across at my left side. 'On each hand?'

'Yes, as a matter of fact I was. Sure.'

'Well I'll be. Cause you any problems?'

'No. No, of course not.'

'Well,' he says, laughing, 'long as you're not a piano player.'

'No problem there. I'm what you call tone deaf.' I shouldn't have said it, because instantly his eyes dart to my ears, and I know he is studying them now.

He starts to say something else but apparently thinks better of it. Instead he forces himself to gaze at his knees and says, 'Well I'll be double dipped damned.'

I try again to withdraw to my papers, but it isn't easy.

'Now then,' he says, 'you travel around some, don't you? Haven't you noticed the difference lately?'

'The difference in what?'

'The feeling. In the air.'

I shake my head. 'What does it feel like?' I shouldn't have asked.

'Listen,' he says. 'Not long ago I was in New Orleans. It was the end of summer, actually—one of those muggy nights you can't stir with a stick. And we were sitting out on a veranda bar, listening to the mournful honks of the riverboats, trying to drink ourselves out of a mood we didn't like, but getting worse info it instead. Anyway, here's the story.

'There were four of us at the table: Ralph Turner and Bill Ryan—they're copies of me, though we don't really look a lot alike. But we all have graying, thinning hair and what I guess you'd call travel-worn faces. The other guy was new to me. His name was Frank Burgeston, and there was kind of a keenness about him. As tall as Ralph, he was powerfully built and in excellent physical condition. He had a longish face, but it wasn't thin. His eyes, behind horn-rimmed glasses, seemed to burn with a restless energy. And my offhand remark that night triggered something in them.

'I get a funny feeling,' I had said.

'I've got those can't get with the Neo- because my head's still with the Paleolithic' blues.'

breaking a long silence that ensued after we finished ordering drinks 'that something s going to happen pretty soon

"So you feel it, too" Bill said dryly lighting a cigarette

Old Ralph drew long and hard on his pipe, then cupped it in his hands as he let the smoke slowly roll out For the first time in ten years I suddenly had the desire to smoke again Ralph poked at the pipe with a matchstick, sending a small aromatic cloud across the table He glanced up quickly when a slight breeze shook the strings of red and yellow paper lanterns hanging in shallow parabolas above the tables Ralph looked across at Bill then quickly back down to the checkered table cloth a little embarrassed at what he was saying 'Yeah Me too I can t seem to shake the damned thing

'But it was Frank s eyes and the way he said what he did that set my backbone crawling "I can tell you a little more about it ' he said flatly "You aren t the only ones you know I got the same thing in Cleveland St Louis—all over

' Earthquake? I said Brushfire war?

"Frank shook his head slowly No he said We were silent for a while Then I shoved my chair back and stretched my legs straight out in front of me, wiggling my toes inside my shoes to get some blood flowing Aaaaggghhh ! said Come on, you guys What the hell's the matter with us? So we think we all have some kind of premonition So what? You know we just talked ourselves into it—with the help of the goddamned humidity Or maybe because the market is so lousy '

The drinks arrived then, and there was another long silence When Frank finally spoke he gave me another bout of gooseflesh, though all he said was 'I'm afraid there's more to it than that '

"He turned away from us then to gaze for a moment through the open door as the bartender inside deftly capped a tray of drinks with cherries and lemon twists Our eyes shifted automatically to catch the play of nipples along a pair of long tinely turned thighs in black net as the cocktail waitress executed a little dip that turned into a smooth practiced lifting of the heavy tray when she straightened Then she moved out on her next sortie Was it really just my imagination that the mood of the whole place was quiet and heavy and waiting?

Frank seemed uncomfortable about what he had just said, as if he had revealed more than he intended Yet I had the distinct impression he wanted to tell us something else But he kept watching the rhythmic swings of the waitress, and to change the subject he said, There's some beautiful bilateral symmetry for you ' He turned back to the table 'Do you guys know one of the top textbooks in the world on crystallography uses a full-page color photo of the sexiest bikini model you ever saw to illustrate bilateral symmetry? That s what I call forward thinking '

"Jesus! You spend your time reading about crystallography?'

' 'It is one of the things' Frank said, 'that interest me Fascinating, in fact '

" 'I'll tell you what fascinates me ' Bill chuckled 'Ralph when she comes back let's ask her if she's bilateral '

"Everybody laughed, but our mood would not stay up It drifted like a curled leaf floating on a pond—blown first out in aimless patterns, then back, then out again We sat for a time, pensive

" 'I think we drink too much, and too late at night,' Ralph said 'Bad for the liver, you know Back in Milwaukee they say *Dir ist wohl eine Laus über die Leber gelaufen*

" 'A louse must have walked across your liver' Frank echoed smiling for the first time that night But then, falling back into his deep mood, he shook his head again 'Look around this place Now you can say it's their livers or too many positive ions in the air or the phase of the moon—but there s not a person in here that doesn f act like doomsday '

' Yeah sure Bill grunfed 'Let's say that it must be the ions

' 'Or' Frank replied, a little sharply, 'let s say it isn f' He hesitated a minute, then said 'Listen, let me tell you something that happened a few years back See, I used to play trumpet in a pretty good symphony orchestra Well, after the concerts there would always be a reception for the guest artist And one night—after a particularly good performance—a stranger at the party dropped a verbal bomb

' 'I remember he was a short, heavyset man with dark, bushy hair and quick brown eyes New in town, he had been invited by a neighbor, and he certainly had not intended to stir up a hornet s nest He simply remarked that, yes, the performance had been brilliant, and wasn t it unfortunate that the piano was a little out of tune

'Is that all? Bill asked, like the rest of us listening, more than a little puzzled by Frank s tale

All! You wouldn t believe how upset musicians can get over something like that He might as well have said the conductor couldn t keep time So the thing grew and grew, and there were two armed camps those who said the piano had been in perfect tune and those who said, come to think of it, they had noticed it was a little off Finally somebody remembered the tape recording of the concert, and the tapes were put through an elaborate analysis with oscilloscopes and tone generators

All that just to—

'It was important to us! Anyway, the results bore out the stranger s contention Several notes *had* been out of tune, but so slightly it was generally regarded as an incredible feat that human ears had detected them '

, "Frank paused then for a long sip of his drink By reflex, we all reached for our glasses, swirling the remaining bits of ice gently before we drank High to our left a tiny point of light came into view and moved steadily through the bright stars until, crossing in front and continuing westward away from us, it appeared for a while to be stationary, then it was lost in the background Probably a 707 It was so high we heard nothing of it only the faint sounds of trucks in the distance, then a boat I wondered again about the point of Frank s story Everything is moving in its proper course I mused Why do we look for witches among the milkmaids?

Then Frank replaced his glass on the table and sat with the tips of his fingers touching At the time the tapes were being analyzed, he said, we were also checking out the stranger What we discovered was that the man was an incredibly skillful lip-reader And that he had been totally deaf since early childhood '

'What! we all shouted at once

' Well I can tell you, we asked the same thing' Frank said 'Besides that, we were mad as hell because we thought he had been playing a stupid joke on us But you know, when we confronted him, he was completely shocked He said he hadn t realized we were not aware of the problem with the piano We asked him how then, in God s name, he had known the piano was out of tune "Why," he said surprised we should ask "I saw it in your faces

"Jesus! Bill gulped Who ever heard of anything like—

" I learned a lot from that man Frank said 'A lot He showed me how there are many inputs to our senses that don t register in our conscious minds but show up in other ways The main thing is to develop confidence in what you perceive It s more than intuition Intuition is like smelling This is more like *tasting* It's knowing—a sensation of being aware

"And you think we re sensing the integrated reading from thousands of faces with an awareness that something is not right? Ralph asked quietly, almost as if he d been afraid to voice it

' Why don t we go ahead and say it ' Frank replied flatly What we re talking about is the end of the world—at least the world as we know it You know there s been a group somewhere hollering about it ever since man learned to talk Now nobody anywhere is saying a thing Because this time it s for real

We nodded, shuttled around in our chairs Yeah' Frank agreed 'That s about it But you feel so damn foolish coming right out and trying to talk about it Do you see a giant fireball or what?

"No Nothing like that I think—I know—


IT MUST BE SWELTERING IN THE CITY RIGHT NOW
Gillee

they're on their way. An invasion. I don't even think there'll be much violence. Just such superior beings... it won't be our world any longer.

Well. I remember we didn't say much after that, but shortly finished our drinks and went up to what was—for me, at any rate—a restless night. I was glad to get back on the road. And I really don't know what made me want to talk about it today. After all, nothing's happened."

The Constant Traveler's story has filled most of the flight. We must be just minutes out of Baltimore. I glance at my watch. It's about ten minutes. "How long ago was all that?" I ask him as I collect my papers.

"Oh, let's see... New Orleans... it must have been three or four months."

"Well, that was quite a night you guys had, huh?" I grin at him.

"Yeah. Yeah. I guess it was." He looks a little sheepish.

I finish gathering my things and snap the case shut. Outside it looks completely black. We must be in some heavy clouds, but the flight has actually been very smooth. Better get my jacket down, they're just about ready to call the approach.

I hate landing in the rain, especially at night. It's like being thrown out of the womb at the wrong time. I hate the smell of wet coats, having to stand in a little pocket of people under a roof that's too small, the *schisching* sound the tires make on the water. All the lights are smeared.

And of course the baggage is taking longer. He waits with the ease of habit. The others are shifting their feet, turning at every new noise, checking their watches. Finally our bags come down.

"Say, do you want to share a cab?" he asks. "They'll be hard to come by tonight."

"No, thanks. I'm renting a car. Not staying in the city."

"Oh, okay." He seems disappointed.

"Can I drop you somewhere?" I ask a little more kindly.

He waves negative with a palm vertical. "Wouldn't want to take you out of your way."

"Come on." We lift our suitcases at the same time and turn down the long corridor to the transportation area. "I'd be glad to have the company."

The little hotel where he is staying is several blocks off the main route. It's an old section, pretty run down, but it feels comfortable. There are a few islands like this one left in every city, and these old salesmen know them all.

It is still raining—cold and steady. He turns his collar up, pulls the checkered travel hat down tighter, thanks me again, and dashes for the front door. There is a quick shaft of light, making silver wires of the raindrops, and he's gone. In a few minutes he'll be at Old Fashioneds, surrounded by the red-amber glow of antique polished mahogany, warm out of the rain.

I stop to light a cigarette, hold the smoke deep for a minute, then direct a slow, thin stream at the windshield wipers before I pull back out into the street. I have had an uncomfortable feeling about it for quite a while, and now I'm sure. They *do* sense it. They don't know we are here, of course, but they know something is. And they're definitely not ready for our migration. *If we come in now they will damage themselves trying to resist.*

It may be a struggle for me to convince the rest of the Encroach Team, but they've got to be convinced. We certainly have no wish to destroy this planet or any of the beings on it. But if Encroach debates too long, it'll all be over. At best, we'll barely be able to get word back to Leader Twelve in time to stop them. Miserable communications lag! Will we ever break the c-cubed velocity barrier? It's a good thing we decided to have a final meeting—and that group from Cappadocia finally agreed to come. With Encroach so scattered and not allowed to use normal communications channels, I'd never be able to get an agreement in time to stop the migration.

As it is, maybe I won't have too much trouble. After all, what is one cycle to us? But think what one hundred seventy-two of their years can do for them. They really do have a remarkable degree of perception already—even as he said, a rudimentary awareness sense, though they do not seem to understand the Schuman resonances at all. It's even possible we could wait for two cycles. In any case, it would be unthinkable to do it now.

.

The group from New Zealand does not agree. Neither does the one from Galapagos. Some of the others are undecided. It's definitely not going to be easy. And the time we're losing!

I never heard of such a thing. Are you questioning whether we can handle them? When have we ever had any trouble controlling the Originals? There is much nodding of agreement with New Zealand.

"After all, we had a full report from Exploration before anything was planned." One of the Central European groups is heard from. "This is no time to be calling it off. Too late anyway."

With all due credit to Exploration, I tell them, they have not encountered this degree of development in our other galaxies. It simply is not obvious on a casual encounter. There is real sensitivity here. They are beyond accommodation."

And in another cycle or two they may be beyond anything. Galápagos retorts. "I don't think we have a choice. There's no place else to go. You know how long it took us to find this planet. We certainly can't risk being burned out with no place to—"

"What risk?" I interrupt. "They are not progressing faster than we are, certainly. We'll be able to come in next cycle if we have to. And I'm convinced they will be able to accept us by then. It should be interesting, they are so much like us in many ways. Take away their extra finger, their peculiar ear structure, and they're even ahead of us in certain things. The sounds they call music, for example—"

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Spokesman for the President's "star wars" policy, the secretary of defense says lasers, particle beams, and superfast computers may deter nuclear holocaust

INTERVIEW

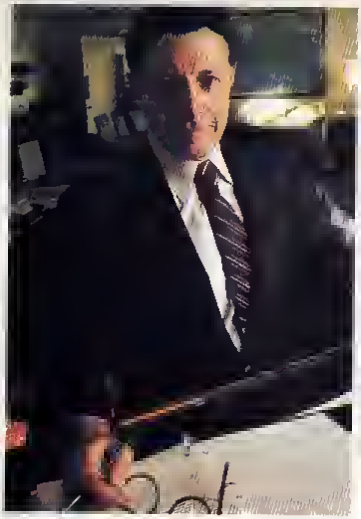
CASPAR W. WEINBERGER

WASHINGTON, D.C.—Over the last 36 years most of the nation's 15 secretaries of defense have left a distinctive imprint on that office. Robert S. McNamara, who served Presidents Kennedy and Johnson, made his mark as a manager. Melvin R. Laird, in President Nixon's Cabinet, was known for his ability to persuade Congress, whence he came to the Pentagon. James R. Schlesinger, who served during the Ford Administration, was a nuclear-warfare strategist. Harold Brown, President Carter's defense secretary, was regarded as a superb technician.

Today the incumbent, Caspar W. Weinberger, true to his calling as a lawyer, is President Reagan's advocate—a single-minded proponent of the President's policies on national security. Both the admirers and the critics of Weinberger agree that he has at least one distinctive attribute, unswerving loyalty to President Reagan. Weinberger has been the President's chief spokesman for vastly expanded military spending, for various basing plans for the wandering MX nuclear missile, and for the President's 'star wars' proposal that the United States seek to defend the nation against Soviet missiles and to ease away from the doctrine of retaliation and mutually assured destruction.

Weinberger, however, is not merely the mouthpiece of the President on national security. Most of the policies Weinberger advocates in public are those he helped to formulate. In Washington he is considered the Cabinet officer with the most influence on the President. Reagan and Weinberger go back a long way in California politics, and the loyalty up is said to be matched by the loyalty down. Since Weinberger took office in January 1981, he has been in political battles with former Secretary of State Alexander M. Haig, the director of the Office of Manage-

PHOTOGRAPHS BY ANTHONY WOLFF



"It's a matter of getting into a position from which we can track a rising missile, fix aim, and fire. The goal is to do it against thousands of missiles, including missiles that carry ten independent warheads."

ment and Budget, David A. Stockman and White House Chief of Staff James A. Baker III. He gets along well with current Secretary of State George P. Shultz although Weinberger often takes more hard-line positions in the inner councils of government. But generally speaking, those who thought they could see light between the President and the secretary of defense have found themselves sadly mistaken.

Beyond loyalty, however, the jury is still out on Weinberger's overall performance as secretary of defense. His admirers assert that the sixty-six-year-old Weinberger is a quick study, which is what might be expected from one who graduated magna cum laude from Harvard in 1938 and from Harvard Law School in 1941. Personally, his courtesy is unfailing, and his sense of humor, which is often self-deprecating, has defused more than one tense moment in this city that thrives on confrontation. Perhaps because of his good humor, Weinberger has an affinity for picking up nicknames. He was "Cap the Knife" during his days as budget director in the Nixon Administration, when he zealously cut other people's budgets. As secretary of defense he has been known as "Cap the Suitcase" for his frequent travels and "Cap the Shovel" for scooping money into the military budget. And his relentless support of Reagan's hard-line national-security policies has earned Weinberger the sobriquet "Defender of the Free World."

On the other hand, Weinberger's critics contend that his performance has been weakened by a variety of shortcomings. Those critics, many of them in Congress, argue that he is rigid and incapable of political compromise. More than a few senators and congressmen say they have been offended by Weinberger largely for ignoring what they consider to be political imperatives. He has come under fire from senior officials in the White House who contend that, for all his loyalty to the President, Weinberger has not done his homework and has failed to master the admittedly vast field of defense. Members of the press note that Weinberger has exerted himself vigorously in public relations but assert that he's been ineffective in nurturing a national consensus on defense.

In recent months Weinberger has been the leading advocate of the President's star-wars proposal. Although Reagan surprised the public by including that in a speech on defense in March, the idea of coupling sensors with computers and directed-energy weapons to attack Soviet missiles had been percolating in the military establishment for some time. The technology of infrared sensors and radar has moved ahead rapidly, according to technical experts in the Pentagon. They say that is being followed by swift strides in the development of computers capable of handling enormous amounts of information at extremely high speeds. But the third element, such weaponry as lasers and particle beams, which are based on directed energy, still has far to go, they say.

Even so, high-level interest in those weapons was expressed in late 1982 when the *Defense Guidance* for the fiscal years 1985–1989 was drafted. That document, written under the supervision of Under Secretary of Defense for Policy Fred C. Ikle and signed by Weinberger, outlines strategy and sets budget priorities for the Defense Department and the military services for the coming five years. *Defense Guidance*, which is slightly more than 100 typewritten pages in effect holds the marching orders for the armed forces.

The 1983 *Defense Guidance*, which is classified as secret, includes for the first time a section devoted to directed energy. Over the next five years the services are instructed "to verify predictions of lethality and effectiveness; to expand the technology base toward identifying new concepts and applications that could yield marked increases in the capabilities of directed-energy weapons, to provide a scalable technology base capable of supporting, with confidence, decisions to initiate development of prototype weapons." Each service is also assigned specific tasks.

In February the Joint Chiefs of Staff suggested in a meeting with the President that he take the initiative in supporting the use of directed-energy weapons. Reagan was intrigued and included the subject in his televised star-wars address, despite strenuous objections from some technical advisers who feared he would get too far out in front of the technology. Since then Weinberger has actively promoted the plan in testimony before Congress, speeches, television appearances, news conferences, and interviews.

In addition to the star-wars initiative, technical specialists in the Pentagon have been working on what some call revolutionary technology for conventional wars. It is similar to the star-wars idea, with sensors as eyes, computers as brains, and precision-guided munitions as fists to strike enemy tanks, ships, and aircraft. Those munitions, often called "smart bombs," are so accurate that one or two could do the job that would take 50 or 100 rounds today. The technicians contend that most of the technology is available now but that the military services must be persuaded to adopt the organization and tactics to take advantage of it.

Weinberger and Richard Halloran, the Washington-based military correspondent for *The New York Times*, discussed both of these new military applications of high technology during an interview for *Omni*.

Omni: Mr. Secretary, the newest military application of high technology is President Reagan's proposal for missile defense in space using lasers, particle beams, and other weapons of directed energy. How do you go about developing those weapons? What is available now, and how do you get from here to there?

Weinberger: We can do a fair amount now

But the goal is something better than existing ground-based conventional ballistic-missile defense which consists of missiles that destroy incoming missiles. Those missiles do it quite close to Earth and are pretty good over small target areas, but they are not totally effective. As a matter of fact, it was the capability of that existing ballistic missile to defend a small target that was one of the factors leading the President to choose closely spaced basing for the MX missile, a decision he was required to make within a very tough time schedule imposed by Congress.

But that system really isn't good enough for defending the country or defending large areas. What we would really like to do is to get Soviet missiles as they come up out of their silos and before they fall back into the atmosphere after their flight, or before they get close to the earth, and to destroy them. We hope to do that with nonnuclear weapons.

We can do some of this now. It is mainly a matter of getting into a position from which we can track very early and very, very quickly the path of a rising missile, fix an aim, and fire some kind of destructive power at that missile. We can do that now against a comparatively small number of missiles. But the test and the goal would be to try it against thousands of missiles, including missiles that carry ten independent warheads, and missiles whose warheads can change direction.

It is, I am told, essentially a problem in very, very large and extraordinarily rapid computer capability. We must develop that to the point where we can reliably identify, track, and destroy several thousand targets in a very, very short space of time. As I say, we can do it with a few targets now. So to some extent it is a matter of expanding the capability and the technologies we now have. But it is far more than that, because as you get up into these very large-scale attacks, we see that the existing problem more than multiplies.

It is capable of solution. It will take quite a while, but it is a great dream and a great hope that we could free the world from this type of nuclear intercontinental ballistic missile. To be sure, you would need other defenses to catch any missiles on the way down that you missed on the way up. The entire system would have layers so that it would be as reliable as possible.

The President wants to do this very much. It is completely consistent with his goal of protecting, not avenging, the American people, and it is something that would add enormously to the stability and hope of the world. So we are organizing ourselves to do it both internally and on a government-wide basis, that is, raising the priority of it very substantially.

Omni: What are the most likely technical avenues of approach here—lasers, particle beams, or something else?

Weinberger: Laser beams are promising because of their speed and potential power. Particle beams are considered to have somewhat similar properties. Platforms from which to operate are also necessary [in military parlance, a platform is a ship, tank, aircraft, or satellite from which a weapon can be fired], and most of the people who have talked to us indicate those platforms should be based in space. The Soviets are doing a great deal of work in space, developing space weapons and antisatellite capabilities. So from all points of view it is important that we expend considerable research-and-development resources in this area.

Omni: The President spoke of a program that would go on for decades. What sort of schedule do you have in mind, and what sort of phase lines could people expect for high-technology military applications?

Weinberger: I don't think there is any plan that says we will have this program implemented by 1991. It isn't subject to that kind of precision. It involves some new applications of what we are doing now. I have heard it compared to the Aegis system [a collection of radar and other warship-based sensors, computers, and long- and short-range weapons], which allows a cruiser to track several hundred targets while focusing, aiming, and controlling the fire of weapons against those targets, whether they are planes or rockets. Then there are layers of closer-in systems, the most specific being the Phalanx missile, in case your other missiles have missed the target earlier, the Phalanx hits it on the way in, very close to its destination.

We must have that kind of concept on an enormously expanded scale. The shortness of time we have to find, track, aim, and fire means that we have got to do computations on a scale that we are not yet able to do. I hope that we can get this capability in the Nineties, before the end of the century, but I don't have any certainty that we can. We are going to devote considerable effort to it.

Omni: The key then, is in computer technology. Are you saying that computers must be able to absorb vast amounts of information from satellites and radar, examine the data, and direct weapons in outer space to aim and then to fire?

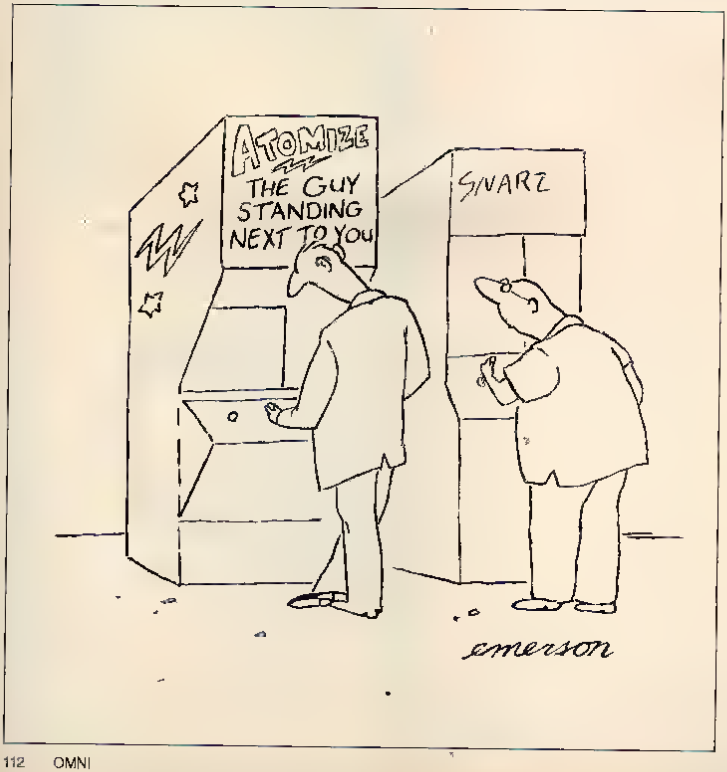
Weinberger: That seems to be it. Obviously there are a lot of parts to it. But ultimately—and indeed immediately—we need something that will lock on to missiles very early in their trajectory and, at the same time, control, by aiming and firing, weapons systems that can destroy those missiles. But we have little time, and we have to do it on a very large scale, because the Soviets will have literally tens of thousands of warheads.

Omni: The time here is measured in seconds, as I understand it?

Weinberger: Milliseconds.

Omni: You are talking about a total battle time of as little as possibly one hundred twenty or two hundred seconds?

Weinberger: It is very short. It is a very big



task—a task about which a lot of people say, "Well, we can't do it." But then, a lot of people said that we couldn't fly.

Omni: What is the first phase?

Weinberger: As I say, we can do some of it right now. But we have to improve our computer capabilities. We have got to get platforms. We have to improve the accuracy and reliability of the systems our computers can fire. And we have to do a lot with improving laser and particle-beam applications and techniques.

Omni: Will this be done by the Defense Department, the scientific community, or a combination of the two?

Weinberger: A combination. The Defense Department will obviously do a lot of it. We have established a departmental committee that will coordinate the very considerable resources we are already devoting to this. There will be a government-wide effort in which NASA, the Department of Energy, and various other groups will be involved. That will be managed through an intergovernmental group, and obviously we in Defense will have a great interest in the process. Both groups, I hope, will be able to recruit substantial amounts of scientific talent from throughout the country to help with this endeavor.

Omni: Generally speaking, would those scientists be invited to come into the government, or would they do their research on contract in private laboratories?

Weinberger: One way or another. The academic community, I hope, would get interested and perhaps do its own research in certain areas. I would hope this area would attract and keep a great deal of the country's best intellects. These various complex fields represent a type of work that looks toward protection of a people. Believe it or not, these are not offensive weapons; these are not weapons that go against people. These are weapons that protect people. I would hope that a lot of the moral problems that people quite understandably have with working on a nuclear weapon would not apply in this case because here we would be trying to destroy weapons of destruction.

Omni: What kind of research-and-development role will industrial companies and laboratories have?

Weinberger: Oh, there will undoubtedly be contracts, and there will undoubtedly be proposals, and there will undoubtedly be a number of people who will offer to help, so to speak, or people who will say, "We know what you are trying to do, and we have the best system." But one way or another we want to get the job done. We don't have any fixed idea that it all has to be done in a government laboratory or in the private sector, or whatever. There is assuredly a lot to be done.

Omni: Two questions about cost. What is all of this going to cost, and what are the trade-offs—what should we not have to buy in the twenty-first century?

Weinberger: Well, we don't know the cost. The cost is obviously going to be a function of how long we have to spend, how quickly we have breakthroughs, and what it costs to develop computer techniques of this kind. I just couldn't say.

We are going to devote substantial research-and-development resources to trying to find out what we have to do and how we can do it. It will be a long-time effort. I don't know how much it will have cost at the end of fifteen years or so. When we total the bill, we'll be able to tell you. But certainly substantial resources will and should be devoted to this, unless we are forbidden to work on it because of congressional veto. I don't see anything to suggest that such an event will happen.

Omni: The second part of the question, Mr. Secretary, was about trade-offs and what you would not have to buy later.

Weinberger: If it works, we will be able, I hope, to eliminate the need to keep maintain, and continue to modernize offensive weapons. That would be particularly true if the Soviets develop comparable technology, and I assume they will.

They are working on it and, from a military point of view, have been in space longer than we have. I hope that we can just eliminate the whole possibility that anyone might use missiles. That would spark not only very substantial economic savings but hopes for worldwide peace as well. Now, that doesn't mean we can afford to give up conventional weapons, but it does mean that we could remove this ominous nuclear shadow that has been hanging over the world for several decades.

Omni: Even in the best of all worlds, though, wouldn't you have to keep some sort of residual retaliatory force?

Weinberger: Well, you always have to worry about and plan against a scientific breakthrough that would give the Soviets a monopoly or a weapon of ultimate destruction that would override deterrence.

Omni: Let me turn the discussion in a different direction. How does all this relate to the subject of arms control? Are we likely to get into a situation where there would be a race between the Americans building defensive weapons and the Russians building offensive weapons? Or would you foresee a need for an arms-control agreement to make the thing work?

Weinberger: Regardless of anything else, I would like to get arms reduction—not arms control, but an arms-reduction agreement. I think that's vital, and I think that is vital whether we have any scientific development in the defensive arena or not.

If America manages to get the kind of defensive system that we want, I would suspect the Soviets would not be far behind. That would then have the effect of canceling out these nuclear missiles altogether. Both sides would know that its missiles wouldn't be able to get through and, recognizing that, they would turn their attention to other means of deterring war.

But at least we would have removed the

"It's okay, they're only burning cat books."

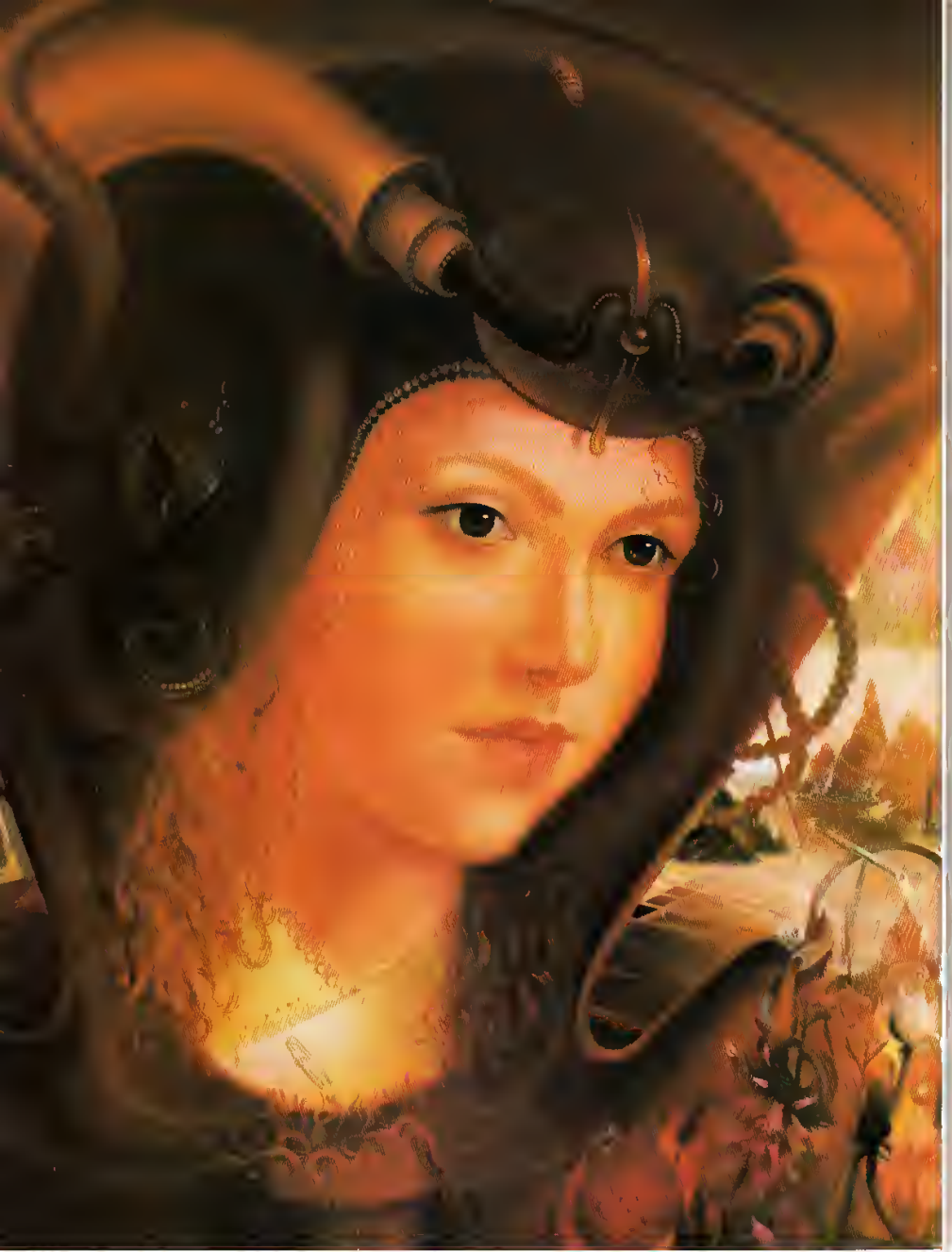
CONTINUED ON PAGE 122

OMINOUS ICONS

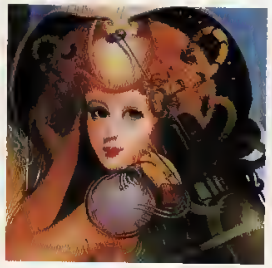
In the tradition of the Flemish masters, a Canadian surrealist makes bold statements about our age

BY KATHLEEN DILETTANTE

PAINTINGS BY RALLE



"I paint in symbols that are part of a universal language," says Rallé, a Yugoslavian-born artist who now makes Ontario his home. Fascinated by icons, Rallé is an admirer of the fifteenth-century Flemish painter Hieronymus Bosch, who he says was a "surrealist born five hundred years ahead of his time." Just as Bosch used rich symbolic imagery to depict religious allegory, Ralle is drawn to archetypes in his interpretation of the themes of twentieth-century life. The seashells and armor in



"By using symbols, I have tried to communicate a warning to people that technology is destroying the romanticism and the beauty of life."

his portraits represent a false sense of protection—' the feeling that one can escape technology' Ralfe chose the speared fish image to "communicate man's destruction of his environment." Says Rallé. "I juxtapose the symbols in my mind to create my own stories—the viewer should do the same."

INTERVIEW

CONTINUED FROM PAGE 114

threat of nuclear missiles. I wouldn't find it destabilizing to do that. I think it is vital that we work on this. We would not want to be in a position wherein the Soviets would learn how to do this and we would not. That would be dangerous. On the other hand, it wouldn't bother me at all if we had this and the Soviets had it, too. Then we could sit down and negotiate with the idea that these nuclear weapons are now obsolete, and we will have to concentrate on more conventional means.

Omni: So far we've been talking about the President's recent initiative and plans that go well into the future. What about the more immediate future, technical experts in the Pentagon say that there will be increased emphasis on military use of space, which has already been started. What do you foresee there?

Weinberger: There will be much more there. The armed services already rely on satellites for their long-haul communications, and that reliance will increase. I can't go into details about surveillance satellites, but we are looking for greater accuracy and what the technical people call specificity. The products will be more useful, I'm told.

The Global Positioning System, which will help in all sorts of navigation, will be entirely in place around 1987. I'm told that a ship, plane, or tank will be able to pinpoint its position to within about fifty feet of anywhere on earth. There also will be more reliance on satellites for weather reports, mapping and geodetic surveys, and environmental studies. We're also beginning to use the space shuttle to carry military payloads, and that practice will become more common in the future. It will cost less to put things up that way.

Omni: How about ASAT, the antisatellite weapons system?

Weinberger: Well, the Soviets already have an operational antisatellite system, even though it has limited capabilities. We have to catch up with them if we want to deter them. Our program is moving along with the F-15 fighter and a rocket with a nonnuclear warhead.

Omni: Turning to conventional forces, Mr. Secretary, the technical experts here in the Pentagon say another revolution in the use of high technology in warfare is going to come in the conventional field. They talk about sensors, the fusing of the information stream—that is, the translating of all forms of intelligence data into digital form—artificial intelligence, and dissemination so good that the user will have the information almost as soon as it happens, in what the military people call real time. All of this, they say, can be linked to precision-guided munitions. What do you foresee ten or fifteen years down the road?

Weinberger: I think we will see the battlefield application of many of these things, perhaps the use of laser weapons and certainly the use of some sensors for intelligence gathering. There will be better and different tactics whereby we can multiply our forces by using technology as opposed to just adding more and more divisions. We are looking for methods to ensure that even large masses of enemy manpower will not be the deciding factor in combat. We are also dealing with the logistical problems of assembling such effective forces of our own.

Omni: The experts say that many of the sensors can be built now, that the information-gathering and fusing technology exists, particularly if digital computers are used, and that the communications apparatus for dissemination is available. How much more needs to be done before you can really move into this arena?

Weinberger: We are doing a great deal in the field. There is electronic warfare, the use of computers, and a lot of very advanced technologies—things that bring intelligence and information gathering right down to the division level, where previously they had been active only at general headquarters.

We are seeking the ability to move very rapidly and to have very quick dispersion of forces, a high degree of mobility, and flexibility with small, light forces that can move very quickly. That means equipping all of those forces with very modern radar and other sophisticated intelligence-gathering equipment that can change the whole nature of the battlefield. But we are also working on tactics that can make it difficult for the other side to assemble reserves or to mass tanks at one particular point to take advantage of even temporary breakthroughs. We are working on improved radar and improved "smart" weapons, guided weapons, and all-weather, all-night observation devices.

Omni: One of the things these experts say is that "stealth" technology for evading radar can be applied to any vehicle. So far we have used it on bombers, fighter aircraft, and cruise missiles, but are we getting to the point where it could be applied to a ship, tank, or anything else?

Weinberger: I am not really going to be able to talk much about that. I think it's obvious that we want to utilize whatever technology we are able to develop in a way that would be most effective on the battlefield.

Omni: Could I turn to precision-guided munitions? The technicians say that in the artillery, for instance, munitions have a probability kill factor of five or ten percent, which means that you have to fire many rounds to destroy a target. Is it true that you will be able to build munitions with such great accuracy that the kill factor will be ninety percent? Do you think that this is in the immediate future?

Weinberger: The accuracy and smartness of conventional weapons and the ability to guide and utilize them at night and in all kinds of weather—all of these things are being worked on constantly. Certainly the greater the accuracy, the more you can

pinpoint vital targets and have a much higher degree of confidence that they can be destroyed

Omni: How long will it be before these advances come into the force?

Weinberger: Well, much of it is coming into the force all the time. We have a division at Fort Lewis, out in Washington, that employs some of the latest tactics and has some of the latest equipment: computers and battlefield adaptions of things that were previously way behind the lines. You might find it worthwhile to take a trip out there and let them show you all that stuff. Don't ride in the dune buggy, however.

Omni: Why not?

Weinberger: It doesn't have any springs.

Omni: If you can get conventional explosives to such a point of accuracy that you would need far fewer rounds to destroy a target, wouldn't there be a multiplier effect on logistics? Wouldn't you need less ammunition, fewer ships or planes or trucks to haul it, fewer people to handle it, and maybe even fewer guns to fire it?

Weinberger: Indeed. There is no question about that. And in combat scenarios thousands of miles from home, this becomes extremely important. It affects the air- and sea-lift; it affects the numbers of troops; and it enables us to make a far more effective use of our troops for actual combat.

It is obviously to our advantage as a defending force to multiply as much as possible and to deal with hitherto favorite Soviet tactics, such as massing a very large number—huge, overwhelming numbers—at narrow points.

Omni: What does this do to manpower requirements, both in terms of numbers and of training?

Weinberger: Well, at the moment we are having very fine success and luck with an all-volunteer system. We are getting all the people we can use and all the people we need now. We will have to make sure that that continues, since we have a somewhat shrinking demographic base [of young men and women of military age]. It is better to utilize the forces we have more effectively and thereby not require very large additional numbers. If we had to go to war, we would certainly have full-scale conscription, and we'd make sure that everybody was at work on the projects most vital for the winning of that war. But if we do our job right, we'll never have to do that.

Omni: If you can bring high technology to bear, conventional deterrence could work something like nuclear deterrence. Do you think that by using conventional deterrence there would be even less chance of us getting into a nuclear war?

Weinberger: Yes.

Omni: How could you achieve that?

Weinberger: There is no question that we want to reduce and someday, I hope, eliminate nuclear weapons from our deterrent. We can't do that, however, until we can persuade the Soviets to do it, too. The old idea that we could have a short, conventional exchange and that it would escalate immediately into nuclear war is no longer the plan or scenario toward which we would be working. A nuclear exchange is too terrible an action to resort to lightly.

The other side of the argument is that you have to increase conventional forces in two ways: the traditional way, by recruiting or drafting a larger standing military force, or through the use of very modern technologies that multiply your military power but reduce the numbers of people you need. All the things we have been discussing will do that. We have done quite a lot of it now. We have manned cruisers that are very much better and have higher firepower than those we used in World War II and, as opposed to sixteen hundred people, we do it with three hundred nineteen. So we have embarked on this program.

Omni: Are you going to be able to persuade the military services to accept the implications of the new high technology for the battlefield? We are talking about a revolutionary concept here, and the services tend to be rather conservative when it comes to change. Will you be able to persuade the services to adopt the tactics, the doctrine, and the procurement practices to make this come to pass?

Weinberger: Oh, I think they are going to be very eager to do it. I haven't encountered any of what used to be called the battleship syndrome, which is opposed to the aircraft carrier. We have both aircraft carriers and battleships around.

Shy Meyer [General Edward C. Meyer, the Chief of Staff of the Army until June 30] has been working on this from the Army point of view for quite a while. The Air Force is always interested in the very latest technologies. The Navy has already made reductions in its manpower, and although we could use more ships, they will be different kinds of platforms.

I don't think there is going to be a problem with that. At the levels where I've been privileged to deal with them, I haven't found the military to be either hidebound or wedded to ancient concepts or anything of that kind. They want to develop and are spending a lot of time developing ways to overcome the numerical differences.

There are always going to be those differences in numbers because free, open, democratic, liberal societies don't like standing armies. We don't like large expenditures for defense. The problem is that reliance on reserves implies a substantial amount of time available for mobilization, and I don't know that we will have that. So we have to try to get a quick response, which is the best kind of deterrent.

As for the strategic nuclear deterrent, if we can deter conventionally, we want to deter conventionally. We want to be in the situation in which we can say we have enough military power to deter an attack. Whether it will be too much or not, no one can say. If we have enough military power to deter an attack, we'll never know whether it was too much, because if it deters an attack, we will have succeeded. ∞

Some say the tiny craft is a shuttle prototype. Others fear that it may not be

The Russian fleet was far from home and near unfriendly shores. Seven ships, including a guided-missile cruiser and three heavily instrumented tracking vessels, steamed in formation at their assigned duty stations. Aircraft from other nations kept watch from above while their warships lurked all around the Soviet fleet—on the surface and beneath it. The risk was great, but the mission's importance was greater.

Then, out of the dawn sky, the reason for the unprecedented naval expedition materialized at supersonic speeds. A streamlined, delta-wing craft (artist's conception at right) soared into view. Instruments aboard the tracking ships testified to the vehicle's recent plunge back into the atmosphere from space at Mach 25. It had survived the fiery reentry under automatic guidance (nobody

THE ELUSIVE SOVIET SPACE PLANE

BY JAMES E. OBERG

PAINTING BY PAUL LEHR

was on board) and now was nearing its target in the southeastern Indian Ocean.

A sonic boom echoed over the waves just as the small space plane popped a parachute for the final descent. With a splash and the hiss of seawater enveloping a still-glowing heatshield, the mission ended. Frogmen jumped from a helicopter and approached the floating capsule. On the space plane's wing was written its point of origin: СССР. The Russian frogmen read this as the abbreviation for the Union of Soviet Socialist Republics.

High overhead, Australian P3C Orion patrol planes photographed the operations. Within hours, their film was rushed to military intelligence analysts in the United States. After years of myths and rumors, hard evidence was finally at hand. It was June 1982, and the homecoming of the Soviet Union's Kosmos 1374 had just been observed and recorded. Russia's "space shuttle" was real.

Or was it? For at least a decade, Western observers had been awaiting the advent of the Soviet space shuttle—Russia's technological riposte to the NASA space fleet of *Enterprise*, *Columbia*, *Challenger* and their sister ships. From Soviet spokesmen came conflicting and puzzling hints. Intelligence sources spoke of strange preparations at secret Soviet spaceports. There were rumors of a fully reusable space plane that would catapult Soviet cosmonautics a generation ahead of would-be competitors among the Western nations.

Surely here was a mystery to warm the heart (and try the patience) of any analyst. Curiously official Soviet statements of recent years indicated that the USSR was not really interested in such a project, at least not yet. Two of these public statements were particularly detailed and explicit. The first came in June 1980, when chief cosmonaut Lieutenant General Vladimir Shatalov, three-time space veteran, told a Hungarian journalist, "Soviet specialists have also investigated the possibility of producing spacecraft that can be used more than once. At this stage, however, they consider that the employment of these spacecraft is not justified for Soviet research because the present tasks can be resolved with the well-tested methods in an economic way."

Then, in April 1981, Cosmonaut Vitaliy Sevastyanov, who hosts a popular Soviet television program on scientific topics, declared: "We are also thinking—on a long-range basis—of a reusable space shuttle. At present, however, detailed calculations confirm that the use of our existing system of transport of persons and cargo, as well as orbital stations of the new generation, will be much cheaper than a space shuttle—in the next decade at least. We will build large, modular orbital stations suitable for a longer stay of dozens of specialists, and for this purpose our [existing] transport techniques are more suitable." A few months earlier, at a space conference in Paris, Sevastyanov had also expressed confidence that the *Soyuz-Salyut-Progress* system would remain in use for the next 15 years. (*Salyut* is a Russian space station serviced by *Soyuz*, a manned spacecraft, and *Progress*, a cargo-carrying vehicle slightly larger than *Soyuz*.)

These disclaimers contrasted sharply with the rumors circulating in American and European space circles in the late Seventies. Most sensational of the stories was the one about "Project *Albatros*" (the Soviet spelling of *albatross*), which supposedly consisted of a fully reusable, two-stage system of winged space vehicles. The craft was to be launched from a speeding hydrofoil on the Volga River or the Caspian Sea. The first stage, much bigger than a Boeing 747, would carry the orbiter to the edge of space and then glide back to a runway. The orbiter itself would continue into space for its cargo mission before returning to the same runway a few hours or days later. According to the stories, the Soviet terminology for such a vehicle reportedly was *raketa-plan* ("rocket plane") or *kosmo-lyot* ("space flier").

Most serious observers considered this project far too advanced for a first step into space-shuttling operations. The Soviets had demonstrated neither the materials, the computer capacity, nor the high-energy rocket engines necessary for such a system. And this skepticism was borne out later when the true origin of the *Albatros* project became known. It was merely a detailed design study by students at a Moscow aeronautical-engineering institute. The real Soviet manned space program evidently had no connection with it.

Meanwhile, U.S. Secretary of Defense Harold Brown told a congressional committee early in 1980 that he had seen indications the Soviets really were building a space shuttle. "There is evidence that they are working on something," he said. "It is probably more along the lines of the earlier U.S. program, the Dyna-Soar, than something of the capability of the shuttle." The Dyna-Soar, or X-20 space glider of the early Sixties, was canceled before its first flight. NASA administrator Robert Frosch confirmed Brown's suggestion. And in 1981 Robert S. Cooper, of the Defense Advanced Research Projects Agency (DARPA), announced that the Soviets were "working on a manned space plane."

Nevertheless, the June 1982 Indian Ocean splashdown came as quite a shock to most Western observers, who were expecting something a little more advanced and quite a bit bigger. So even though the June mission and a nearly identical follow-up flight last March were quickly identified as the rumored space plane, there were still several mysteries.

Both launches had been staged at the small Kapustin Yar rocket base on the lower Volga River. Both launches had occurred at about midnight. The boosters—modified medium-range missiles similar to the

"Before we answer any questions about our six-month orbit of the planet Mercury, Commander Ferlinghetti and I would like to announce our engagement."

American Thor—had carried the payloads southeastward, across the Aral Sea and the Himalayas and into very low orbits about 100 miles up—roughly 40 miles below the lowest altitude of orbiting American shuttles. Both times the one-ton payloads separated from their boosfer rockets (which stayed in orbit several days before burning up) and circled Earth once, crossing Malaya, Java, Australia, the South Pacific, Panama, the North Atlantic, England, central Europe, and then the Crimea. Over the Crimea, where the main Soviet space-tracking facilities are located, the vehicles turned tail forward, and each fired a small rocket engine to initiate its return to Earth. Both fell back across Iran, southern India, and Sri Lanka, where the June mission filled the skies with a fiery streak. Minutes later it landed, south of the Cocos Islands, in the eastern Indian Ocean, amid the waiting Soviet recovery fleet and the uninvited Australian snoopers.

The photographs from this first landing showed a streamlined craft with one stubby vertical sfabilizer and two outboard att stabilizers, both tilted outward. The front of the fuselage appeared to have a three-paned cockpit window. From a top hatch amidships, parachute lines extended to a long, conical, inflated balloon—presumably some sort of recovery aid. The whole craft could not have been more than 13 feef long and perhaps 10 feet across, from wingtip to wingtip. It would have just fit under the standard nose cone used atop the booster rocket. Could it have been a pint-size prptotype of what was to come?

The mini-space-shuttle explanation was so obvious and so neat that some skeptics resisted falling for it. A few private analysts even went so far as fo say these tests had nothing to do with the Soviet manned space program at all. Instead, these observers suggested, the objects fished out of the Indian Ocean were dummy thermonuclear warheads designed to drop out of orbit and attack Western naval forces.

These analysts built their argumenfs on what they knew of past Russian performance, beginning with the fact that the launch site, Kapustin Yar, had never before hosted any man-related missions. But it *had* been involved in weapons testing for 35 years. They also knew that only two earlier Soviet space vehicles had splashed down at sea, and then only because they were returning from the moon. A splashdown would never be a feature deliberately chosen for a manned vehicle, the heretics argued. And if these flights were merely aerodynamic tests, why would the Russians have gone all the way into orbit when they could easily have achieved the desired velocities at lower altitudes? The orbital mission required them to develop a special service module complete with power source and retrorocket—a waste if the spacecraft were merely a subscale model. The shape of the vehicle they went on was exactly what one would expect for a warhead designed for "cross-range maneuvers" to get from orbit to target.

Would the Soviets build such a weapons system to attack American aircraft carriers? The skeptics argued that the USSR would, since they had already developed a nuclear-powered ocean-surveillance radar satellite to look for such fleets. (This is the same kind of satellite that has fallen out of the sky at random three times, most recently last January.) Moreover, there are likely to be American fleets near enough to Soviet targets to be dangerous but out of reach of other Soviet antifleet weapons. And even though such an orbiting weapon is outlawed by international treaty, the Soviets have already demonstrated their lack of regard for the treaty by developing, between 1967 and 1971, the so-called Fractional Orbit Bombardment System (FOBS) for placing nuclear warheads into temporary low orbit for sneak attack.

The 2,000-pound winged orbiters fished from the Indian Ocean are large enough to carry a warhead of several hundred kilotons, continued the heretics, and the launch vehicle is small enough to be based in already-existing missile silos in the USSR. The "windows" on the vehicle's nose then are for the guidance sensors to peer through, not for cosmonauts' eyes. And no landing system is needed, since the vehicle would detonate high in the air.

Superficially, this terrifying interpretation seems to explain more elements of these missions than does the space-shuttle-test theory. But government analysts and others swear the vehicles "look like space shuttles." We can hope they have other classified data to support judgments that the weapons idea is "fantasy."

Two days after the second splashdown, DARPA director Cooper unequivocally identified the Soviet vehicles as development tests for a Soviet manned space plane. No one could say, however, how much the test model would be scaled up for the manned version. Various estimates ranged from a factor of two to a factor of four in all dimensions.

The second Soviet mini-space-plane flight last March coincided with the release of a Pentagon special report from the office of the secretary of defense. The document, called *Soviet Military Power*, contained a special space-vehicles section that gave uncharacteristically specific parameters on not one but *two* distinct Soviet space-shuttle projects.

The first project was the space plane, the little craft that had landed in the Indian Ocean. "Orbital development test flights of the smaller vehicle have already occurred," the report claimed. But the second project allegedly involved a spacecraft—nicknamed "Shuttleski" by CIA photo analysts—with much greater performance capabilities than those of the American space shuttles.

The Pentagon report described this second vehicle as disturbingly similar to

"Hi. Me, master. You, tool."

the U S. design, but with the double advantages of a lighter liftoff weight and a larger payload. Like the U.S. system, the Soviet Shuttleski includes a winged orbiter, a large disposable external tank (half again as long as the U S equivalent), and two strap-on booster units for liftoff assistance These are evidently liquid-fueled, unlike the solid-fueled ones used by NASA The Soviet shuttle "could be in regular use within a decade " the report said

The Pentagon's information supposedly came from actual observations of existing test hardware But in the week preceding the report's release the Washington newsletter *Aerospace Daily* obtained an even more precise description of the Soviet space-shuttle orbiter vehicle, based on spy satellite photographs of the craft at the Ramenskoye flighf test center near Moscow The Soviet spaceship was 109 feet long (NASA's is 122 feet) with a 76-foot wingspan (compared to NASAs 78) The Soviet fuselage diameter measured 18 feet and the wing leading-edge sweep was 46 degrees—little different from *Columbia* and *Challenger* Both the Soviet orbiter and the giant external tank were said to be transported in cradles atop modified Bison aircraft veteran long-range strategic bombers The giant new runway at Tyuratam just east of the Aral Sea was designed expressly to accommodate these planes according to *Aerospace Daily*

A few weeks later even better photographs were obtained These showed one of the Sovief Bison carrier aircraft—with an orbiter mounfed on top—that had strayed off the runway at Ramenskoye and gotten stuck in the mud for two days

Such observations allowed American analysts to assess the design differences between the U S and Soviet vehicles For example the Soviets evidently are still unable to build powerful and reusable rocket engines like the ones that propel NASAs shuttle They are sticking to expendable engines mounted on their large external tank (which should thus be counted as a rocket sfage and nof merely a tank)

Without engines at the aft end of the orbiter, however, the Soviets can streamline fhe craft to give it twice the aerodynamic handling capability of the U S system Additionally analysfs estimate that if the Soviets built payload doors at the aft end—to look like a pair of clamshells—they could save even more structural weight

Without reusable engines and boosters, the system is not economical But perhaps economy is not what the Soviets are after According to General James Abrahamson NASAs associate administrator for spaceflight and a former Air Force Manned Orbiting Laboratory asfronaut NASAs design never delivered the launch economy that had been anticipated although it did provide something almosf as good ' special services ' Speaking recently fo a convention of the Aviafion/Space Writers Association, Abrahamson explained that ' service—being able to provide a man or

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BOUNDARY

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the left that faded and crested. Jaynes's bicameral mind, the centers of direct response having access to the higher reasoning potential only in moments of stress, and then only as an oracular voice from beyond. The overvoice ceased oscillating, becoming coequal to the instant mind: the breakdown of bicamerality, the origin of conscious thought.

The second cycle began in thunder.

The second cycle was concrete thought. The sounds of the hunt, the battle: the crowd, dance music and work song; gongs of bamboo and brass and steel. Notes progressed evenly, bricks on bricks in square measures and even time, until as the thunder returned, the lightning cracking it across, the notes seemed to strain against the lines, as if trying to expand.

The third cycle: abstract thought.

Note sequences leaped the scale as it intuitively finding the upper registers: there were five-tone scales, twelve-tone, twenty-tone, in measures of seven notes or thirteen or any number. There was ragtime. There was atonality. There were 4'33" seconds of silence. There were blue notes. Doppler-shifted into the red, bending around the universe and back. Out again went the bridge, bending, stretching, galloping in a harmonic wind, until it shifted into the black.

The fourth cycle snapped into existence from silence, as if the ear had refused to hear the chaos at its very beginning. Then, above the incoherent rush of sound, a single line of melody rose like a vocalist in an unknown language, singing of those things that no language has ever found words for. A counterpoint split from the voice, the 'Starscape' theme from *One Thousand Orbits*, and the melody sang against a background of stars, of crystalline, inhuman precision, but in the melody the inhumanity dissolved, and the distance to the stars—the boundary between what was thought and what was not thought—was bridged.

She launched into the last line. Her left hand played an overpowering major-chord sequence, while her right fingers picked out delicate knotworks of sound in the keyboard's pipe voicings, a million impulses of thought submerged in the torrent of intellect in motion, going on forever.

And Amen!

She leaned on the rock that held the board. Her knees were weak, and the sweat was cold on her forehead and the back of her neck. She turned slowly to face him. "And no headache," she said. "Guess you were right. It was just tension. Just—"

Larkin was sitting with his back against a boulder. His left leg stuck out, twisted at a bizarre angle. His head was back against the stone, eyes open and staring at the sky, hard as ice. There was a dark trickle from his nostril.

Not very messy, she thought.

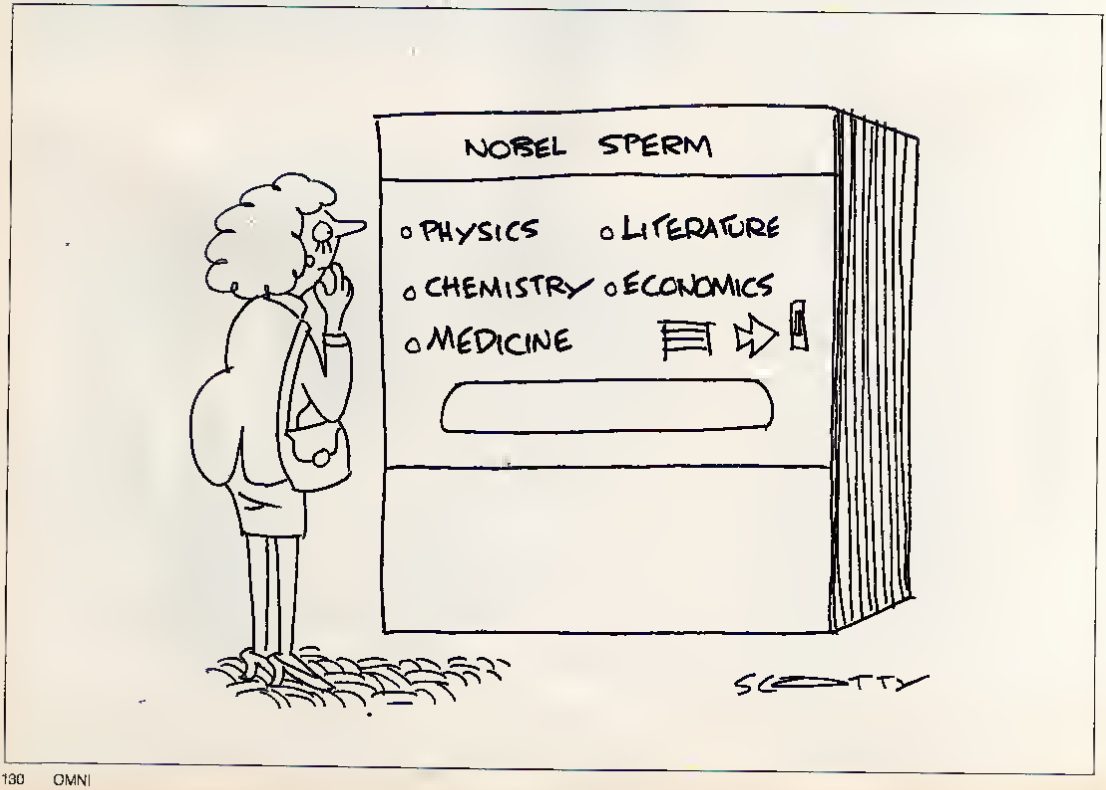
She touched him. He was stiff and quite cold. *Oh, Boris . . . how did you get so cold?* She wondered if he had first realized he was dying the day she arrived, when he had that small seizure behind his console. "*What is it?*" "*Nothing.*" But surely there had been earlier signs. The man who built SIGMAPS must have known his own brain. The goddam son of a bitch who had swindled her out of the only fear that she could admit to having.

She shouted. "You got it out of me, didn't you, you selfish son of a bitch? You wanted me to do it up here, so you could hear it just for yourself—all for yourself—and now what? How am I supposed to get us off this rock? Listen to me, you bastard!"

Two fingers of Larkin's right hand were thrust deep into his vest pocket.

Inside the pocket was his FM phone, with instructions typed because his handwriting was so bad.

The helicopter came very soon, just as he had said it would. And as it lifted them away, its lights like gemstones on the velvet cloth of the sky, Helena Weiss sat in its open door, playing the last cycle with her fingers bloody, the notes echoing from the peaks and in every layer of the air. ∞



FICTION

The contestants in a game of mind manipulation find they are caught in their own malicious trap

CARRION COMFORT

BY DAN SIMMONS

Nina was going to take credit for the death of that Beatle, John. I thought that was in very bad taste. She had her scrapbook laid out on my mahogany coffee table, newspaper clippings neatly arranged in chronological order, the bald statements of death recording all of her Feedings. Nina Drayton's smile was radiant, but her pale-blue eyes showed no hint of warmth.

"We should wait for Willi," I said.

"Of course, Melanie. You're right, as always. How silly of me. I know the rules." Nina stood and began walking around the room, idly touching the furnishings or exclaiming softly over a ceramic statuette or piece of needlepoint. This part of the house had once been the conservatory, but now I used it as my sewing room. Green plants still caught the morning light. The light made it a warm, cozy place in the daytime, but now that winter had come the

This piece is the first section of a two part novelette

PAINTING BY ROBIN MULLER

room was too chilly to use at night. Nor did I like the sense of darkness closing in against all those panes of glass.

"I love this house," said Nina.

She turned and smiled at me. "I can't tell you how much I look forward to coming back to Charleston. We should hold all of our reunions here."

I knew how much Nina loathed this city and this house.

"Willi would be hurt," I said. "You know how he likes to show off his place in Beverly Hills—and his new girlfriends."

"And boyfriends," Nina said, laughing. Of all the changes and darkenings in Nina, her laugh has been least affected. It was still the husky but childish laugh that I had first heard so long ago. It had drawn me to her then—one lonely, adolescent girl responding to the warmth of another as a moth to a flame. Now it served only to chill me and put me even more on guard. Enough moths had been drawn to Nina's flame over the many decades.

"I'll send for tea," I said.

Mr. Thorne brought the tea in my best Wedgwood china. Nina and I sat in the slowly moving squares of sunlight and spoke softly of nothing important, mutually ignorant comments on the economy, references to books that the other had not gotten around to reading, and sympathetic murmurs about the low class of persons one meets while flying these days. Someone peering in from the garden might have thought he was seeing an aging but attractive niece visiting her favorite aunt. (I draw the line at suggesting that anyone would mistake us for mother and daughter.) People usually consider me a well-dressed if not stylish person. Heaven knows I have paid enough to have the wool skirts and silk blouses mailed from Scotland and France. But next to Nina I've always felt dowdy.

This day she wore an elegant light-blue dress that must have cost several thousand dollars. The color made her complexion seem even more perfect than usual and brought out the blue of her eyes. Her hair had gone as gray as mine, but somehow she managed to get away with wearing it long and tied back with a single barrette. It looked youthful and chic on Nina and made me feel that my short, artificial curls were glowing with a blue rinse.

Few would suspect that I was four years younger than Nina. Time had been kind to her. And she had fed more often.

She set down her cup and saucer and moved aimlessly around the room again. It was not like Nina to show such signs of nervousness. She stopped in front of the glass display case. Her gaze passed over the Hummels and the pewter pieces and then stopped in surprise.

"Good heavens. Melanie. A pistol! What an odd place to put an old pistol."

"It's an heirloom," I said. "A Colt Peacemaker from right after the War. Between the States. Quite expensive. And you're right. It *is* a silly place to keep it. But it's the only case I have in the house with a lock on it, and Mrs. Hodges often brings her grandchildren when she visits—"

"You mean it's *loaded*?"

"No, of course not," I lied. "But children should not play with such things. . . ." I trailed off lamely. Nina nodded but did not bother to conceal the condescension in her smile. She went to look out the south window into the garden.

Damn her. It said volumes about Nina that she did not recognize that pistol.

On the day he was killed, Charles Edgar Larchmont had been my beau for precisely five months and two days. There had been no formal announcement, but we were to be married. Those five months had been a microcosm of the era itself—naive, flirtatious, formal to the point of preciosity and romantic. Most of all, romantic. Romantic in the worst sense of the word: dedicated to saccharine or insipid ideals that only an adolescent—or an adolescent society—would strive to maintain. We were children playing with loaded weapons.

Nina, she was Nina Hawkins then, had her own beau—a tall, awkward, but well-meaning Englishman named Roger Harrison. Mr. Harrison had met Nina in London a year earlier, during the first stages of the Hawkinses' Grand Tour. Declaring himself smitten—another absurdity of those times—the tall Englishman had followed her from one European capital to another until, after being firmly reprimanded by Nina's father (an unimaginative little milliner who was constantly on the defensive about his doubtful social status), Harrison returned to London to settle his affairs. Some months later he showed up in New York just as Nina was being packed off to her aunt's home in Charleston in order to terminate yet another flirtation. Still undaunted, the clumsy Englishman followed her south, ever mindful of the protocols and restrictions of the day.

We were a gay group. The day after I met Nina at Cousin Celia's June ball, the four of us were taking a hired boat up the Cooper River for a picnic on Daniel Island. Roger Harrison, serious and solemn on every topic, was a perfect foil for Charles's irreverent sense of humor. Nor did Roger seem to mind the good-natured jesting, since he was soon joining in the laughter with his peculiar *haw-haw-haw*.

Nina loved it all. Both gentlemen showered attention on her, and although Charles never failed to show the primacy of his affection for me, it was understood by all that Nina Hawkins was one of those young women who invariably becomes the center of male gallantry and attention in any gathering. Nor were the social strata of Charleston blind to the combined charm of our foursome. For two months of that now-distant summer, no party was complete, no excursion adequately planned, and no occasion considered a success

"Your mother and I thought that perhaps you might enjoy playing with your Captain Asteroid Death Ray Pistol outside."

unless we four were invited and had chosen to attend. Our happy dominance of the youthful social scene was so pronounced that Cousins Celia and Loraine wheedled their parents into leaving two weeks early for their annual August sojourn in Maine.

I am not sure when Nina and I came up with the idea of the duel. Perhaps it was during one of the long, hot nights when the other "slept over"—creeping into the other's bed, whispering and giggling, stifling our laughter when the rustling of starched uniforms betrayed the presence of our colored maids moving through the darkened halls. In any case, the idea was the natural outgrowth of the romantic pretensions of the time. The picture of Charles and Roger actually dueling over some abstract point of honor relating to *us* thrilled both of us in a physical way that I recognize now as a simple form of sexual titillation.

It would have been harmless except for the Ability. We had been so successful in our manipulation of male behavior—a manipulation that was both expected and encouraged in those days—that neither of us had yet suspected that there was anything beyond the ordinary in the way we could translate our whims into other people's actions. The field of parapsychology did not exist then, or rather, it existed only in the rappings and knockings of parlor-game séances. At any rate, we amused ourselves for several weeks with whispered fantasies, and then one of us—or perhaps both of us—used the Ability to translate the fantasy into reality.

In a sense, it was our first Feeding.

I do not remember the purported cause of the quarrel; perhaps some deliberate misinterpretation of one of Charles's jokes. I cannot recall who Charles and Roger arranged to have serve as seconds on that illegal outing. I do remember the hurt and confused expression on Roger Harrison's face during those few days. It was a caricature of ponderous dullness: the contusion of a man who finds himself in a situation not of his making and from which he cannot escape. I remember Charles and his mercurial swings of mood—the bouts of humor, periods of black anger, and the tears and kisses the night before the duel.

I remember with great clarity the beauty of that morning. Mists were floating up from the river and diffusing the rays of the rising sun as we rode out to the dueling field. I remember Nina reaching over and squeezing my hand with an impetuous excitement that was communicated through my body like an electric shock.

Much of the rest of that morning is missing. Perhaps in the intensity of that first subconscious Feeding, I literally lost consciousness as I was engulfed in the waves of fear, excitement, pride—of *maleness*—emanating from our two beaus as they faced death on that lovely morning. I remember experiencing the shock of realizing, *this is really happening*, as I shared the tread of high boots through the grass. Someone was calling off the paces. I dimly recall the weight of the pistol in my hand—Charles's hand, I think. I will never know for sure—and a second of cold clarity before an explosion broke the connection, and the acrid smell of gunpowder brought me back to myself.

It was Charles who died. I have never been able to forget the incredible quantities of blood that poured from the small, round hole in his breast. His white shirt was crimson by the time I reached him. There had been no blood in our fantasies. Nor had there been the sight of Charles with his head lolling, mouth dribbling saliva onto his bloodied chest while his eyes rolled back to show the whites like two eggs embedded in his skull.

Roger Harrison was sobbing as Charles breathed his final, shuddering gasps on that field of innocence.

I remember nothing at all about the confused hours that followed. The next morning I opened my cloth bag to find Charles's pistol lying with my things. Why would I have kept that revolver? If I had wished to take something from my fallen lover as a sign of remembrance, why that alien piece of metal? Why pry from his dead fingers the symbol of our thoughtless sin?

It said volumes about Nina that she did not recognize that pistol.

"Henderson does the most important work
He reads the fine print on our government contracts"

"Willi's here," announced Nina's amanuensis, the loathsome Miss Barrett Kramer. Kramer's appearance was as unisex as her name: short cropped black hair, powerful shoulders, and a blank, aggressive gaze that I associated with lesbians and criminals. She looked to be in her mid-thirties.

"Thank you, Barrett dear," said Nina.

Both of us went out to greet Willi, but Mr. Thorne had already let him in, and we met in the hallway.

"Melanie! You look marvelous! You grow younger each time I see you, Nina!" The change in Willi's voice was evident. Men continued to be overpowered by their first sight of Nina after an absence. There were hugs and kisses. Willi himself looked more dissolute than ever. His alpaca sport coat was exquisitely tailored; his turtleneck sweater successfully concealed the eroded lines of his wattled neck, but when he swept off his jaunty sports-car cap the long strands of white hair he had brushed forward to hide his encroaching baldness were knocked into disarray. Willi's face was flushed with excitement, but there was also the telltale capillary redness about the nose and cheeks that spoke of too much liquor, too many drugs.

"Ladies, I think you've met my associates, Tom Luhar and Jenson Reynolds?" The two men added to the crowd in my narrow hall. Mr. Luhar was thin and blond, smiling with perfectly capped teeth. Mr. Reynolds was a gigantic Negro, hulking forward with a sullen, bruised look on his coarse face. I was sure that neither Nina nor I had encountered these specific cat's-

"Oh well another day s digging shot to hell."

paws of Willi's before It did not matter

"Why don't we go into the parlor?" I suggested It was an awkward procession ending with the three of us seated on the heavily upholstered chairs surrounding the Georgian tea table that had been my grandmother's "More tea, please Mr Thorne" Miss Kramer took that as her cue to leave but Willi's two pawns stood uncertainly by the door shifting from foot to foot and glancing at the crystal on display as if their mere proximity could break something I would not have been surprised if that had proved to be the case

"Jense!" Willi snapped his fingers The Negro hesitated and then brought forward an expensive leather attache case Willi set it on the tea table and clicked the catches open with his short broad fingers "Why don't you two see Mrs Fuller's man about getting something to drink?"

When they were gone Willi shook his head and smiled apologetically at Nina "Sorry about that Love"

Nina put her hand on Willi's sleeve She leaned forward with an air of expectancy "Melanie wouldn't let me begin the Game without you Wasn't that *awful* of me to want to start without you Willi dear?"

Willi frowned After fifty years he still bridled at being called Willi In Los Angeles he was Big Bill Borden When he returned to his native Germany—which was not often because of the dangers involved—he was once again Wilhelm von Borchert lord of dark manor, forest and hunt But Nina had called him Willi when they had first met in 1931 in Vienna and Willi he had remained

"You begin Willi dear" said Nina "You go first"

I could remember the time when we would have spent the first few days of our reunion in conversation and catching up with one another's lives Now there was not even time for small talk

Willi showed his teeth and removed news clippings notebooks and a stack of cassettes from his briefcase No sooner had he covered the small table with his material than Mr Thorne arrived with the tea and Nina's scrapbook from the sewing room Willi brusquely cleared a small space

At first glance one might see certain similarities between Willi Borchert and Mr Thorne One would be mistaken Both men tended to the florid but Willi's complexion was the result of excess and emotion Mr Thorne had known neither of these for many years Willi's balding was a patchy self-consciously concealed thing—a weasel with mange Mr Thorne's bare head was smooth and unwrinkled One could not imagine Mr Thorne ever having *had* hair Both men had gray eyes—what a novelist would call cold gray eyes—but Mr Thorne's eyes were cold with indifference cold with a clarity coming from an absolute absence of troublesome emotion or thought—Willi's eyes were the cold of a blustery North Sea winter and were often clouded with shifting curtains of the emotions that controlled him—pride hatred love of pain the pleasures of destruction

Willi never referred to his use of the Ability as *Feedings*—I was evidently the only one who thought in those terms—but Willi sometimes talked of The Hunt Perhaps it was the dark forests of his homeland that he thought of as he stalked his human quarry through the sterile streets of Los Angeles Did Willi dream of the forest I wondered Did he look back to green wool hunting jackets the applause of retainers, the gouts of blood from the dying boar? Or did Willi remember the slam of jackboots on cobblestones and the pounding of his lieutenants' fists on doors? Perhaps Willi still associated his Hunt with the dark European night of the ovens that he had helped to oversee

I called it Feeding Willi called it The Hunt I had never heard Nina call it anything

"Where is your VCR?" Willi asked "I have put them all on tape"

"Oh Willi" said Nina in an exasperated tone "You know Melanie She's *so* old fashioned You know she wouldn't have a video player"

"I don't even have a television" I said Nina laughed

"Goddamn it" muttered Willi "It doesn't matter I have other records here" He snapped rubber bands from around the small black notebooks "It just would have been better on tape The Los Angeles stations gave much coverage to the Hollywood Strangler and I edited in the *Ach!* Never mind"

He tossed the videocassettes into his briefcase and slammed the lid shut

"Twenty-three" he said "Twenty-three since we met twelve months ago It doesn't seem that long does it?"

"Show us" said Nina She was leaning forward and her blue eyes seemed very bright "I've been wondering since I saw the Strangler interviewed on *Sixty Minutes* He *was* yours Willi? He seemed so—"

"*Ja ja* he was mine A nobody A timid little man He was the gardener of a neighbor of mine I left him alive so that the police could question him erase any doubts He will hang himself in his cell next month after the press loses interest But this is more interesting Look at this" Willi slid across several glossy black-and-white photographs The NBC executive had murdered the five members of his family and drowned a visiting soap-opera actress in his pool He had then stabbed himself repeatedly and written SO SHARE in blood on the wall of the bathhouse

"Reliving old glories Willi?" asked Nina "DEATH TO THE PIGS and all that?"

"No goddamn it I think it should receive points for irony The girl had been scheduled to drown on the program It was already in the script outline"

"Was he hard to Use? It was my question I was curious despite myself"

Willi lifted one eyebrow "Not really He was an alcoholic and heavily into cocaine There was not much left And he hated his family Most people do"

"Most people in California, perhaps," said Nina primly. It was an odd comment from Nina. Years ago her father had committed suicide by throwing himself in front of a trolley car.

"Where did you make contact?" I asked.

"A party. The usual place. He bought the coke from a director who had ruined one of my—"

"Did you have to repeat the contact?"

Willi frowned at me. He kept his anger under control, but his face grew redder. "Ja, ja. I saw him twice more. Once I just watched from my car as he played tennis."

"Points for irony," said Nina. "But you lose points for repeated contact. If he were as empty as you say you should have been able to use him after only one touch. What else do you have?"

He had his usual assortment. Pathetic skid-row murders. Two domestic slayings. A highway collision that turned into a fatal shooting. "I was in the crowd," said Willi. "I made contact. He had a gun in the glove compartment."

"Two points," said Nina.

Willi had saved a good one for last. A once-famous child star had suffered a bizarre accident. He had left his Bel Air apartment while it filled with gas and then returned to light a match. Two others had died in the ensuing fire.

"You get credit only for him," said Nina. "*Ja, ja.*"

"Are you absolutely sure about this one? It *could* have been an accident."

"Don't be ridiculous," snapped Willi. He turned toward me. "*This* one was very hard to use. Very strong. I blocked his memory of turning on the gas. Had to hold it away for two hours. Then forced him into the room. He struggled not to strike the match."

"You should have had him use his lighter," said Nina.

"He didn't smoke," growled Willi. "He gave it up last year."

"Yes," smiled Nina. "I seem to remember him saying that to Johnny Carson." I could not tell whether Nina was jesting.

The three of us went through the ritual of assigning points. Nina did most of the talking. Willi went from being sullen to expansive to sullen again. At one point he reached over and patted my knee as he laughingly asked for my support. I said nothing. Finally he gave up, crossed the parlor to the liquor cabinet, and poured himself a tall glass of bourbon from father's decanter. The evening light was sending its final horizontal rays through the stained glass panels of the bay windows, and it cast a red hue on Willi as he stood next to the oak cupboard. His eyes were small red embers in a bloody mask.

"Forty-one," said Nina at last.

She looked up brightly and showed the calculator as if it verified some objective fact. "I count forty-one points. What do you have, Melanie?"

"*Ja,*" interrupted Willi. "That is fine. Now let us see your claims, Nina." His voice was flat and empty. Even Willi had lost some interest in the Game.

Before Nina could begin, Mr. Thorne entered and motioned that dinner was served. We adjourned to the dining room—Willi pouring himself another glass of bourbon and Nina fluttering her hands in mock frustration at the interruption of the Game. Once seated at the long, mahogany table I worked at being a hostess. From decades of tradition, talk of the Game was banned from the dinner table. Over soup we discussed Willi's new movie and the purchase of another store for Nina's line of boutiques. It seemed that Nina's monthly column in *Vogue* was to be discontinued but that a newspaper syndicate was interested in picking it up.

Both of my guests exclaimed over the perfection of the baked ham, but I thought that Mr. Thorne had made the gravy a trifle too sweet. Darkness had filled the windows before we finished our chocolate mousse. The refracted light from the chandelier made Nina's hair dance with highlights while I feared that mine glowed more bluely than ever.

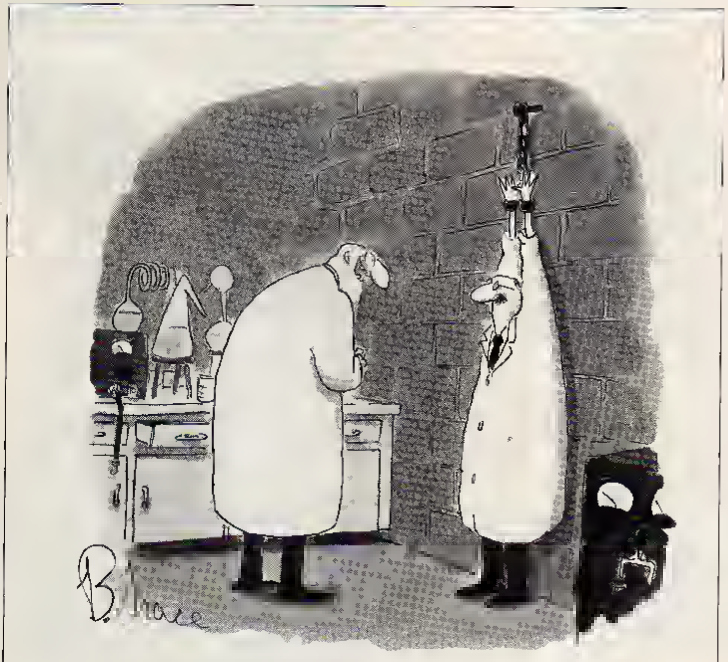
Suddenly there was a sound from the kitchen. The huge Negro's face appeared at the swinging door. His shoulder was hunched against white hands, and his expression was that of a querulous child.

"... the hell you think we are sittin' here like goddamned—" The white hands pulled him out of sight.

"Excuse me, ladies." Willi dabbed linen at his lips and stood up. He still moved gracefully for all of his years.

Nina poked at her chocolate. There was one sharp, barked command from the kitchen and the sound of a slap. It was the slap of a man's hand—hard and flat as a small-caliber rifle shot. I looked up and Mr. Thorne was at my elbow, clearing away the dessert dishes.

"Coffee, please, Mr. Thorne. For all of us." He nodded and his smile was gentle.



"Me? Mad? Yes! Yes! I'm mad! But I have tenure."

Franz Anton Mesmer had known of it even if he had not understood it. I suspect that Mesmer must have had some small touch of the Ability. Modern pseudosciences have studied it and renamed it, removed most of its power, confused its uses and origins, but it remains the shadow of what Mesmer discovered. They have no idea of what it is like to Feed.

I despair at the rise of modern violence. I truly give in to despair at times, that deep, futureless pit of despair that poet Gerard Manley Hopkins called carrion comfort. I watch the American slaughterhouse: the casual attacks on popes, presidents, and uncounted others, and I wonder whether there are many more out there with the Ability or whether butchery has simply become the modern way of life.

All humans feed on violence on the small exercises of power over another. But few have tasted—as we have—the ultimate power. And without the Ability, few know

the unequaled pleasure of taking a human life. Without the Ability even those who do feed on life cannot savor the flow of emotions in stalker and victim: the total exhilaration of the attacker who has moved beyond all rules and punishments; the strange, almost sexual submission of the victim in that final second of truth when all options are canceled, all futures denied, all possibilities erased in an exercise of absolute power over another.

I despair at modern violence. I despair at the impersonal nature of it and the casual quality that has made it accessible to so many. I had a television set until I sold it at the height of the Vietnam War. Those sanitized snippets of death—made distant by the camera's lens—meant nothing to me. But I believe it meant something to these cattle that surround me. When the war and the nightly televised body counts ended, they demanded more. *more* and the movie screens and streets of this sweet and dying nation have provided it in mediocre mob abundance. It is an addiction I know well.

They miss the point. Merely observed, violent death is a sad and sullied tapestry of confusion. But to those of us who have. Fed. death can be a *sacrament*.

"My turn! My turn!" Nina's voice still resembled that of the visiting belle who had just filled her dance card at Cousin Celia's June ball.

We had returned to the parlor. Willi had finished his coffee and requested a brandy from Mr. Thorne. I was embarrassed for Willi. To have one's closest associates show any hint of unplanned behavior was certainly a sign of weakening Ability. Nina did not appear to have noticed.

"I have them all in order," said Nina. She opened the scrapbook on the now-empty tea table. Willi went through them carefully, sometimes asking a question, more often grunting assent. I murmured occasional agreement although I had heard of none of them. Except for the Beatles, of course. Nina saved that for near the end.

"Good God, Nina, that was you?" Willi seemed near anger. Nina's Feedings had always run to Park Avenue suicides and matrimonial disagreements ending in shots fired from expensive, small-caliber ladies' guns. This type of thing was more in Willi's crude style. Perhaps he felt that his territory was being invaded. "I mean, you were risking a lot, weren't you? It's so damn *public*."

Nina laughed and set down the calculator. "Willi *dear*, that's what the Game is *about*, is it not?"

Willi strode to the liquor cabinet and refilled his brandy snifter. The wind tossed bare branches against the leaded glass of the bay window. I do not like winter. Even in the South it takes its toll on the spirit.

"Didn't this guy, what's his name, buy the gun in Hawaii or someplace?" asked Willi from across the room. "That sounds like his initiative to me. I mean, if he was *already* stalking the fellow—"

"Willi, dear." Nina's voice had gone as cold as the wind that raked the branches. "no one said he was *stable*. How many of yours are stable, Willi? But I made it *happen*, darling. I chose the place and the time. Don't you see the irony of the *place*, Willi? After that little prank on the director of that witchcraft movie a few years ago? It was straight from the script—"

"I don't know," said Willi. He sat heavily on the divan, spilling brandy on his expensive sport coat. He did not notice. The lamplight reflected from his balding skull. The mottles of age were more visible at night, and his neck, where it disappeared into his turtleneck, was all ropes and tendons. "I don't know." He looked up at me and smiled suddenly, as if we shared a conspiracy. "It could be like that, writer fellow, eh, Melanie? It could be like that."

Nina looked down at the hands on her lap. They were clenched, and the well-manicured fingers were white at the tips.

The Mind Vampires. That's what the writer was going to call his book.

I sometimes wonder if he really would have written anything. What was his name? Something Russian.

Willi and I received telegrams from Nina. COME QUICKLY. YOU ARE NEEDED. That was enough. I was on the next morning's flight to New York. The plane was a noisy propeller-driven Constellation, and I spent much of the flight assuring the overly solicitous stewardess that I needed nothing, that, indeed, I felt fine. She obviously had decided that I was someone's grandmother who was flying for the first time.

CONTINUED ON PAGE 156

SOVIET PLANE

CONTINUED FROM PAGE 129

a woman in orbit to tend equipment and to exploit what happens there—may be the most important service the shuttle provides for the future. He explicitly pointed to the development of the Soviet shuttle as proof that they, too, are convinced of the value of such services.

This flurry of new data on "Soviet space-shuttle programs" that became public early in 1983 did not really solve any of the mysteries, however. Even the first hard evidence for a Soviet shuttle from the Indian Ocean test reflected nothing more than a technology mastered in the mid-Sixties by American space engineers. It seems likely that the Russians will need several years to produce a full-scale manned version ready for testing.

At that rate, the vehicle could hardly become operational much before 1990. And it is difficult to imagine any manned orbital missions for a 1990 space plane that couldn't be conducted now by the already available *Soyuz-T*.

The *Soyuz-T* is a three-man spacecraft based on the structure of the classic *Soyuz* but outfitted with entirely new equipment. It began operations in 1981 after an expensive five-year test program. The expense will have to be amortized over years of use—another reason Western observers tend to doubt the imminence of a new Soviet manned space vehicle.

As for the giant shuttle described by the Pentagon and buttressed by "leaks" of spy-satellite imagery, its purpose is even more questionable than that of the Indian Ocean craft. Perhaps one disturbing answer can be found in Moscow's propaganda blitz against the American space-shuttle program. Soviet news broadcasts consistently portray the NASA spaceships as carriers of weapons (including H-bombs), weapons platforms, satellite interceptors, and "space pirates" out to kidnap peaceful Soviet scientific satellites.

Conceivably Soviet leaders believe this doctrine, or Soviet military planners fear it. In either case, they might decide to create their own system as a counterbalance, whatever the cost.

If the Soviets are indeed building such vehicles for this reason, they have allowed gross misperceptions of U.S. intentions and capabilities in space to foster a potentially wasteful technological detour. The project could actually damage any of the really valuable Soviet programs, such as their permanent space station. It could even help bring about in reality the scenario the Soviets just imagine at present: armed and highly maneuverable space shuttles on combat missions in orbit.

We can only hope that the code name *Albatros* will prove to be close to the mark, that the Soviet space shuttle, in whatever manifestation it finally takes, hovers peaceably aloft, threatening no harm. DC

CONTINUED FROM PAGE 22

ballplayers are a healthy population "full of strong, determined independent people." Nevertheless, because the players face incredible stress including constant public scrutiny and the possibility of a sudden, early end to their careers, they can often use professional help.

To find out just what strategies to use, Ogilvie and his contemporaries generally begin by giving a subject two or three psychometric profiles, tests that yield insights into a player's particular psychological needs. Once the tests are completed, the psychologist holds a one- to two-hour interview with the player. For those with serious problems, Ogilvie likes to conduct what he calls a "minimarathon"—an extended one-on-one encounter. During this 10- or 15-hour session Ogilvie probes relentlessly for the secret causes of the man's anxieties; often enough, he finds his answers in obvious, startling bursts of revelation. Toward the end of one marathon, an athlete who had plummeted seemingly on purpose from the top of his profession suddenly cried, "Daddy, why don't you love me!" In an instant Ogilvie knew the man's triumphs were meaningless because they brought no parental acceptance.

Athletes like that young man, Ogilvie notes, might need intensive counseling. But for most professional ballplayers, the basic techniques are used as "performance-enhancement strategies" designed to ease anxieties caused by the game itself.

The first step in reducing an athlete's anxiety is teaching him to relax, says Bill Little, who has counseled members of the St. Louis Cardinals for more than four years. Any relaxation technique, from yoga to transcendental meditation, can help, but the psychologist's handiest technique is usually hypnosis. Little usually tapes hypnosis sessions so that the athlete can listen to them on his own whenever he's feeling anxious. After enough run-throughs with the tape, says Little, the player can induce his own relaxation, even when he's on the field.

In the relaxed state, adds Ogilvie, the player enters a sort of "emotional isolation chamber," a state in which he can concentrate better, pinpointing the specific cues and causes of his tension. During one relaxation session, a pitcher recalled that whenever he walked a batter, he felt a searing pain behind his shoulder. This was the cue, says Ogilvie, that he was losing his confidence and tensing up.

To correct such tension triggers, a psychologist may take the player through a series of visualizations, using the player's memory of himself performing at his best. "If he's a pitcher," says Little, "you have him envision himself on the mound, and you lead him through every motion, from the time the catcher gives the signal, to the moment when the ball curves perfectly and settles in the strike zone. After he has rehearsed these visualizations enough times, the imagery of success will eventually overcome the imagery of failure."

In addition, Ogilvie says, the sports psychologist tries to cultivate a player's "language of success"—the way he speaks to himself when he is in command of a situation. When a pitcher who gives up a few hits keeps saying to himself, "I'm screwing up again, the manager's going to pull me any minute," it's liable to become a self-fulfilling prophecy. The psychologist gets the player to look at his hand and say such things as, "You beautiful son of a bitch, you're gonna make me a million dollars."

Though many of the teams in baseball have dabbled in psychological techniques of one kind or another, the Philadelphia Phillies may be the first to wholeheartedly embrace them. In addition to referring troubled players to New Jersey psychiatrist Tom McGinnis, the team also has access to a couple of very effective psychological weapons right in the clubhouse.

> *"The sports psychologist tries to cultivate a player's language of success, the way he speaks to himself when he is in command of a situation."*

First of all, team trainer Jeff Cooper keeps a 4' × 5' × 8' fiberglass float tank tucked away in his training room. An athlete can lie in it on his back in the solution of Epsom salts and float as easily as if he were lying on an inner tube. The tank is pitch black inside, and the athlete's ears are stuffed with plugs; he can neither hear nor see. In this relaxed, isolated state, freed of distractions, he can concentrate on marshaling his physical and emotional resources.

An even more important protector of the Phillies' mental hygiene is Gus Hoefling, the team's strength and flexibility trainer. The title understates Hoefling's function, since he actually uses everything from kung fu to hypnotherapy to toughen up his charges. Of all Hoefling's techniques, the most avant-garde is his "breakthrough environment" chamber, a computer-operated cubicle that combines many of the performance-enhancement strategies in one neat package. At the center of the blue-carpeted room sits a reclining massage chair that faces a painting of a shoreline. When a player sits back in the chair, Hoefling closes the door and hits a button. Within seconds the chair heats up and rollers massage the athlete's back muscles. The lights begin dimming, and a soothing voice fills the room. "Relax, you are going on a journey." For the next half-hour a hypnotherapeutic tape of Hoefling's voice leads the athlete through relaxation exercises, words of encouragement, and such subliminal instructions as "I will keep control."

Hoefling has a personalized tape for each player who uses the chamber, and he changes the messages according to the player's needs. If a player has been downing a few too many drinks lately, for example, Hoefling may sneak in a subliminal message such as "Alcohol is bad for my body" to help him break the habit. As the tape ends, the lights slowly brighten, simulating dawn on the picture of the ocean. The athlete usually emerges feeling relaxed, positive, alert and in the best possible mood for a day of long, hard work.

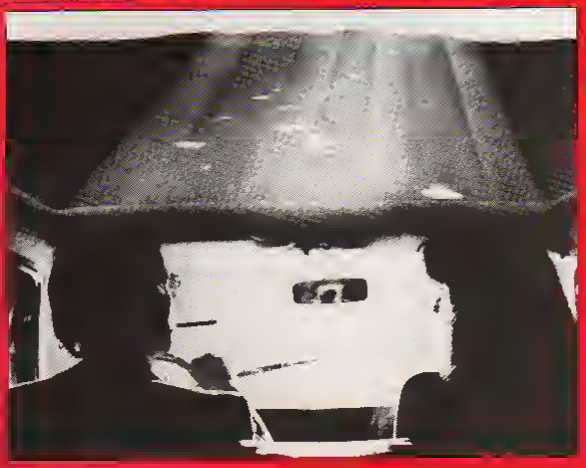
Several Phillies sing Hoefling's praises, but none sing louder than the usually taciturn Steve Carlton, whom many consider to be the greatest living pitcher. When Carlton came to the Phillies in the early Seventies, he had a respectable lifetime winning percentage of .556, but he had yet to realize his full potential. Since giving himself over to Hoefling's mind-body overhaul, he has had one 20-game-win season after the next, brought his percentage up to an incredible .658, and recently broken the all-time record for strikeouts. Like a religious zealot, Carlton comes early to the stadium before each game, spends his half-hour in the breakthrough-environment chamber, then two or more hours following Hoefling's regimen of weight training, stretching and meditation. As the *pièce de résistance* each afternoon, he and Hoefling head off to the lawns around the stadium for a session of kung fu.

Devices like Hoefling's chamber may be important experiments in sports psychology, but professionals like Tom McGinnis think that the most important goal for teams is to fake on full-time clinical psychologists. He predicts that will happen as such problems as drug and alcohol abuse worsen, and as more open-minded college-educated players come into the game.

Such an enlightened time may not be that far off. In the past few years alone, Ogilvie has helped inaugurate a Ph.D. program in sports psychology at the United States International University in San Diego, and an associated research center called the Institute for Athletic Motivation. Last year the St. Louis Cardinals became the first Major League club to openly take on a part-time *team* psychologist when they hired Little to provide counseling services throughout spring training and at all home games. And in the even harder-nosed sport of professional ice hockey, the Philadelphia Flyers took on Dr. Julie Anthony as the first *full-time* team psychologist in the history of professional athletics. Most important, more athletes are using psychological techniques to realize their full abilities—and to protect their careers.

Striking Metro-North trainmen saw the spectacular lights hover over their picket line in Brewster

ANTI MATTER



UFO UPDATE

Meteorologist Bill Hele was cruising the Taconic State Parkway in Westchester County New York when he saw a check-mark-shaped object with six prismatic lights The row of multicolored lights blinked off for a moment, Hele recalls then shifted to brilliant green The whirring form was almost 1 000 yards across, he adds and hovered 1 000 feet in the air Two or three minutes later it gradually drifted to the north and out of view

So began the most spectacular display of UFOs in the history of New York State and possibly the nation On three consecutive Thursday nights as well as a couple of Friday and Saturday nights, from March 17 through March 31 1983 hundreds of people around Westchester reported a boomerang-shaped object that hovered soundlessly and shot dazzling rays of light

Within days of the first sighting accounts were appearing in newspapers throughout the country And the mounting reports soon reached Phil Imbrogno, a Westchester science teacher and field investigator with the Center for UFO Studies, based in Evanston Illinois Imbrogno coinvestigator George Lesnick and J Allen Hynek director of the center quickly launched an in depth investigation interviewing witnesses and cross-matching data with an Apple II computer Doctors lawyers, nurses heads of corporations and housewives, the team found all gave descriptions that matched Hele's Even a group of striking Metro-North trainmen were startled to see the spectacular lights over their picket line in Brewster

The saucer-investigation squad also came up with some bizarre contradictions Simultaneous sightings in towns miles apart suggested the presence of more than one object And hundreds of sightings in five Connecticut towns a month after the Westchester incidents indicated a possible hoax Witnesses there described engine sounds and maneuvers that could have been performed by a formation of small planes trying to mimic the original open V Such reports, in fact convinced one local Federal Aviation Administration official that a group of top-notch pilots flying out of the tiny Stormville airport in Dutchess County New York had manufactured the glowing UFO

But Imbrogno disagrees "Single-engine planes he says, 'cannot hover soundlessly make ninety-degree turns or shoot down dazzling beams of lights

As for Hynek, he says the case is one of the most unusual he's ever seen "Most UFO sightings occur on lonely back roads in places like Oklahoma ' he notes But this UFO was seen in a relatively urban area over a number of days with a broad spectrum of witnesses '

Well-known UFO critic and aerospace journalist Philip Klass also ventured an opinion I've been investigating UFO reports for seventeen years he commented and have yet to find an indication of an unknown or extraterrestrial phenomenon It would take a lot to convince me, but it could be that for the first time in seventeen years this is an unexplainable case '—*TONIA SHOUMATOFF*

MAMMOTH BURGERS

Next time you visit Siberia, you might be offered some exotic culinary fare mammoth meat roasted or fried

The mammoth that hairy ancestor of today s elephant has been presumed extinct for thousands of years But people have reportedly eaten the animal s frozen remains for centuries During the Twenties tourists v sit ng Siberia claimed they feasted on mammoth flesh It s been rumored that Russian scientists occasionally gather for mammoth banquets And just recently a group of Soviet construction workers caused a stir among paleontologists by preparing mammoth meat for their dogs

The issue came to a head last year at a Helsinki symposium on mammoth tissue Some researchers suggested that mammoth may still be roaming the Siberian plains And zoologist Nikolai Vereschchagin of the Soviet Academy of Sciences even proposed cloning a new mammoth herd from a few frozen cells

American researchers who examined the frozen mammoth tissue however cast doubt on such plans Paleontologist David Webb of the Florida State Museum in Gainesville for instance found the flesh was poorly preserved 'By and large Webb said the specimens were about fifty percent sludge and fifty percent real cells and the chance of cloning them is pretty slim with today s technology

Eating the disintegrating flesh may not be too good an idea either Geologist Robert M Thorson of the University of Alaska in Fairbanks is presently excavating a local partially preserved mammoth Though he hasn t had the chance to taste mammoth meat he did sample the flesh of a bison found in permafrost sediments s 30,000 years old The piece I ate tasted pretty bad ' Thorson says Colleagues who afe mammo meat also found the qual left a lot to be desired he adds But at least no body s gotten sick

Rick Boll

'All history repeats itself "
—Erich von Danike

SPIRITUAL EMERGENCY NETWORK

While meditating, a young woman recalls being entombed alive dur ng a previous life This sudden jarring of her subconscious mind has triggered mood swings ranging from depression to hysteria

Most psychiatrists would label her psychotic recommending a hospital stay drugs or both Bu according to Stanislav Grof M D resident scholar at Califor nia s Esalen Institute such a diagnosis would be a grave mistake The young woman he says is actually in the midst of a "spiritual emergency a frequent consequence of death and rebirth past life recall and ESP

To provide the stricken with appropriate care, Grof and his wife Christina have recently founded the Spiritual Emergency Network (SEN) The network pathetic psychologists theologists and spiritualists to assist its patients And in just three years the group has grown from a phone line in Big Sur to a 24 hour referral service, with on call counselors in 32 countries Workers are currently organizing retreats for long-term care

If understood and treated as difficult confusing or dramatic stages in a natural developmental process says counselor Peggy Goodale 'these experiences can be regarded as transformative and evolutionary they don t have to be dark nights of the soul

SEN asks troubled ESPers and past-lifers as well as potential counselors to call the network at (408) 667-2151 Sandra Hansen

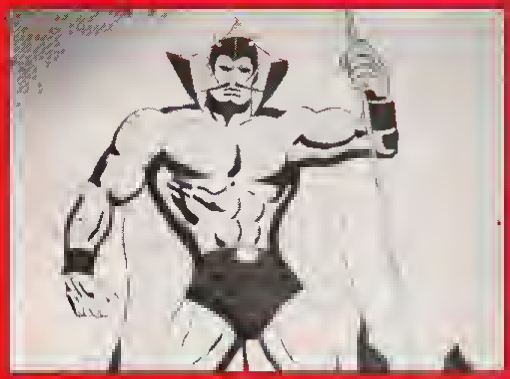
For whatever a man may do, he does it in order to annihilate time in order to revoke it and that revocation is called space
*Hermann Bro_*

BLUE DEMON

Most high schools have a mascot—usually a panther a tiger or a knight—displayed on football helmets athletic jackets and class rings But at Christiansburg High School in Christiansburg, Virginia the mascot is a bit more diabolical a blue demon complete with horns goatee flowing cape and pitchfork

The Christiansburg Blue Demon has been portrayed school principal Sam Lucas put the issue to a vote last spring The student body decided by a 98 percent margin to keep the demon much to the relief of school officials (It would have cost the school system some $30 000 to replace the demon logo on rings uniforms and more)

'Unfortunately the students thought we were criticizing them Kitts notes 'But I m not saying that there is anything satanical



on shirts and a foot high painting in the school gym for decades But now a group called Parents Against Demons is trying to get that changed "Demons are real explains mother and group founder Diane Kitts And they do evil things in the world I don t want my kids cheering the devil

Kitts who attended Christiansburg High School herself took petitions to area churches collecting 500 signatures against the symbol As a result, school officials are saying the demon is real We are supposed to be in a battle with him not a partner with him And I m still determined to do away with the mascot

Reporter Ray Cox, who first broke the story in the *Roanoke News* adds think people were upset because the devil was the symbol of a school named Christiansburg But the truth is the town was named for some man named Christian not the religion

—Sherry Baker

VULTURES OF GETTYSBURG

Each winter hundreds of vultures descend on the cannons and monuments of Gettysburg National Military Park The carrion eating birds—labeled by myth and history as sentinels of death—roost amid the grapevines and their droppings cover the ground like a heavy dusting of snow

Black vultures and turkey vultures, says park resource specialist Harold J Greenlee have been visiting the Pennsylvania site for at least a century But now Greenlee and colleagues have launched a study to find out why The group s prime theory The birds were attracted to the area on July 1, 1863 after the start of one of the bloodiest battles of the Civil War

After three days of fighting says Greenlee Plum Run a small stream that flows through the battlefield ran red with blood Nearly 50 000 men lay slaughtered or dying And thousands of dead horses covered the ground for months The birds roost on Little Round Top and Big Round Top hills where some of the heaviest battles took place he explains 'So it s not unreasonable that the vultures could have been attracted to the bodies they might have scavenged the horse carcasses stayed on for the winter and then gotten into the habit of coming here The vultures could also be drawn by the region's vegetation or by the prominent slope of its hills

Greenlee is currently working with students and professors from Virginia Polytechnic nstitute and Pennsylvania State University to study the vultures habitat as well as their migration and feeding patterns The group also plans to scour the extensive written history of the Civil War for mention of the grim Gettysburg scavengers

We want to explain to the public says Greenlee ' why nine hundred vultures continue to roost in a national park —Sherry Baker

"You can t blow dust away without making a lot of people cough "

—Prince Philip
Duke of Edinburgh

ANTI MATTER

ALTERNATIVE 003

Are the Unite[illegible] the Soviet Union [illegible] ing peop e then se[illegible] them off to Mars? Yes accordi[illegible] to the book *Alter native 00* The kidnapped zombies the book exp ains are building a Martian retreat for geniuses hand picked to create a master race and rule the universe Once the colonies are built the zombies will be destroyed

Alternative 003 s only a joke, of course was published on Apri Fools Day of 1977 b Avon But despite the book s obviously outlandish claims has convinced and terrified readers around the world

To make his book believable author Leslie Watkins admits he mixed fiction with a twisted version of the truth For instance he [illegible] and [illegible] or [illegible] Mars At one [illegible] erview In [illegible] that the s[illegible] tle was really desi[illegible] to transport human cattle

But never imagined people would take this stuff seriously,' says Watkins Sl[illegible] - ls release the book has been ranslated nto several languages in luding Iranian l v- gotl[illegible] un[illegible] eds of letters from people con- vii ced their miss ng friend or wife s on Mars One man even laims he talked [illegible] Bob G di[illegible] fatne

According to the Earl of Clancarty an official of the British House of Lords [illegible] he book has also been [illegible] esponsible or the first UFO [illegible] estigation Committee i British history Let s face it says the a l the com [illegible] tee s president 'every [illegible] g can be explained [illegible] this *Alternative 003* If [illegible] ot a hoax t probably [illegible] st horrible co[illegible] sp [illegible] ce the Third Reich

Peter Rond none

[illegible]time hat Her [illegible] G[illegible] ernment [illegible] ou people f what [illegible] w ab[illegible] F s [illegible] If e[illegible] people [illegible] the [illegible] th [illegible] ley Le Poer Trench Earl of Clancarty

AQUATIC [illegible]

[illegible] features t[illegible] nd apart [illegible] can be explain[illegible] a watery detou alo g the course of evolu[illegible] That, at least, is the opinion of British author E aine Morgan who says that somewhere between [illegible] 5 illion and 9 million ears ago our ancestors took to the oceans and there began a long series of aquatic adaptations When they reemerged to live on land their bodies were already naked ompared to other apes and their hind legs, grown long an strong from eons of swimming were ready to assume all the work of walking

Man did not lose his hair because of the need to un while hunting in he sweltering heat of the open savanna argues Morgan whose new book *The Aquati Ape* was recently published in the United States by Stein and Day If that were the case the lion and the hyena would surely have lost their hair as well Instead she contends man lost his hair for the same reason the whale and the dolphin lost theirs

Because if any fairly large aquatic mammal needs to keep warm in water t is better served by a layer of fat on the inside of its skin than by a layer of hair on the outside of it

Speech would not have emerged as an aid to the hunt either Morgan continues adding that primitive tribes surviving today hunt in silence despite heir ich her tage of language More likely speech became essential to protoman when the need to swim and dive cu down on eye to-eye contact making facial expressions difficult to read

Morgan also notes that while human tears distinguish our species as the weeping primate seals and other sea mammals cry as well "If we view man as a land animal she says he is unique and inexplicable I we view him as an ex aquatic he is conforming to the general pattern '

n the absence of fossil evidence for the missing link contends Morgan the aquatic theory makes as much sense as other arguments formulated to fill the gap — Dava Sobel

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"History is more or less bun

—Henry Ford

MAN-MOUNTAIN

CONTINUED FROM PAGE 66

won more than nine matches ever beat an opponent who has lost seven That had been the case with Takanaka Eight was the number of wins needed to maintain current ranking)

"I could feel him going," said Pekowski in Polish "I think we should talk to him about the May tournament "

"Have you mentioned this to his stablemaster?

"I thought of doing so after the tournament I was hoping you could come with me to see him "

"I'll be just another retired wrestler by then."

"Takanaka respects you above all the others Your *dampatsu-shiki* ceremony won t be for another two weeks They won t have cut off all your hair yet And while we re at it I still wish you would change your mind "

"Perhaps I could be Takanaka s dew sweeper and carry his ceremonial cloth for him when he enters his last tournament I would be honored "

"Good! You'll come with me then Friday morning?"

"Yes "

The hosts were much drunker than the wrestlers Nayakano the stablemaster was feeling no pain but still remained upright Mounds of food were being consumed A businessman tried to grab ass a waitress This was going to become every bit as nasty as all such parties

A song! A song!" yelled the head of the fan club a businessman in his sixties "Who will favor us with a song?"

Man-Mountain Gentian got to his feet went over to the musicians He talked with the samisen player Then he stood facing his drunk attentive audience

How many of these parties had he been to in his career? Two three hundred? Always the same drunkenness discord braggadocio on the part of the host clubs Some fans really loved the sport some lived vicariously through it He would not miss the parties But as the player began the tune he realized this might be the last party he would have to face

He began to sing.

"I met my lover by still Lake Biwa
just before Taira war banners flew "

And so on through all six verses in a clear pure voice belonging to a man half his size

They stood and applauded him some of the wrestlers in the stable looking away as only they not even the stablemaster knew of his retirement plans and what this party probably meant

He went to the stablemaster who took him to the club host made apologies concerning the tournament and a slight cold shook hands bowed and went out into the lobby where the hostess valiantly brought him his shoes and overcoat He wanted to help her but she reshouldered the coat grimly and brought it to him

He handed her a tip and signed the autograph she asked for

It had begun to snow outside The neon made the sky a swirling multicolored smudge Man-Mountain Gentian walked through the quickly emptying streets Even the ever-present taxis scurried from the snow like roaches from a light His home was only two kilometers away He liked the stillness of the falling snow, the quietness of the city in times such as these

Shelter for a stormy night?" asked a ragged old man on a corner Man-Mountain Gentian stopped

Change for shelter for an old man?" asked the beggar again looking very far up at Gentian s face

Man-Mountain Gentian reached in his pocket and took out three or four small ornate paper envelopes that had been thrust on him as he left the club

The old man took them opened one Then another and another

"There must be more than eight hundred thousand yen here he said very quietly and very slowly

I suggest either the Imperial or the Hilton," said Man-Mountain Gentian then the

"I'm sorry, but Mr Detrick is rehearsing his presentation to the stockholders "

wrestler turned and walked away

The old man laughed then straightened himself with dignity stepped to the curb and imperiously summoned an approaching pedicab

Melissa was not home

He turned on the entry light as he took off his shoes He passed through the sparsely furnished low living room turned off the light at the other switch

He went to the bathroom put depilatory gel on his face, wiped it off

He went to the kitchen picked up half a ham, and ate it, washing it down with three liters of milk He returned to the bathroom brushed his teeth, went to the bedroom unrolled his futon, and placed his cinder block at the head of it

He punched a button on the hidden tape deck, and an old recording of Kimio Eto playing "Rukodan" on the koto quietly filled the house

The only decoration in the sleeping room was Shuncho's print *The Strongest and the Most Fair* showing a theater-district beauty and a *sumotori* three times her size it was hanging on the far wall

He turned off the light Instantly the silhouettes of falling snowflakes showed through the paper walls of the house cast by the strong streetlight outside He watched the snowflakes fall as he listened to the music and he was filled with *mono no aware* for the transience of beauty in the world

Man-Mountain Gentian pulled up the puffed cotton covers put his head on the building block and drifted off to sleep

They had let Hari off at his house The interior of the runabout was warm They were drinking coffee in the near-empty parking lot of Tokyo Sonic #113

"I read somewhere you were an architect" said Killer Kudzu

"Barely" said Melissa

"Would you like to see Kudzu House?" he asked

For an architect it was like being asked to one of Frank Lloyd Wright's vacation homes or one of the birdlike buildings designed by Eero Saarinen in the later twentieth century Melissa considered

"I should call home first" she said after a moment

"I think your husband will still be at the Nue Vue Club whooping it up with the money men"

"You're probably right I'll call him later I'd love to see your house

The old man lay dying on his bed

"I see you finally heard" he said His voice was tired

Man-Mountain Gentian had not seen him in seven years He had always been old but he had never looked this old this weak

Dr. Wu had been his mentor He had started him on the path toward Zen-sumo (though he did not know it at the time) Dr Wu had not been one of those cryptic koan

spouting quiet men. He had been boisterous, laughing, playing with his pupils yelling at them, whatever was needed to get them to see.

There had been the occasional letter from him. Now for the first time there was a call in the middle of the night.

"I'm sorry," said Man-Mountain Gentian. "It's snowing outside."

"At your house too?" asked Dr. Wu.

Wu's attendant was dressed in Buddhist robes and seemingly paid no attention to either of them.

"Is there anything I can do for you?" asked Man-Mountain Gentian.

"Physically, no. This is nothing a pain shift can help. Emotionally, there is."

"What?"

"You can win tomorrow, though I won't be around to share it."

Man-Mountain Gentian was quiet a moment. "I'm not sure I can promise you that."

"I didn't think so. You are forgetting the kitten and the bowl of milk."

"No. Not at all. I think I've finally come up against something new and strong in the world. I will either win or lose. Either way, I will retire."

"If it did not mean anything to you, you could have lost by now," said Dr. Wu.

Man-Mountain Gentian was quiet again.

Wu shifted uneasily on his pillows. "Well, there is not much time. Lean close. Listen carefully to what I have to say.

"The novice Itsu went to the Master and asked him, 'Master, what is the key to all enlightenment?'

"'You must teach yourself never to think of the white horse,' said the Master.

"Itsu applied himself with all his being. One day while raking gravel, he achieved insight.

"'Master! Master!' yelled Itsu, running to the Master's quarters. 'Master, I have made myself not think about the white horse!'

"'Quick!' said the Master. 'When you were not thinking of the horse, where was Itsu?'

"The novice could make no answer.

"The Master dealt Itsu a smart blow with his staff.

"At this, Itsu was enlightened."

Then Dr. Wu let his head back down on his bed.

"Good-bye," he said.

In his bed in the lamasery in Tibet, Dr. Wu let out a ragged breath and died.

Man-Mountain Gentian, standing in his bedroom in Tokyo, began to cry.

Kudzu House took up a city block in the middle of Tokyo. The taxes alone must have been enormous.

Through the decreasing snow, Melissa saw the lights. Their beams stabbed up into the night. All that she could see from a block away was the tangled kudzu.

Kudzu was a vine, originally transplanted from China, raised in Japan for centuries. Its crushed root was used as a starch base in cooking; its leaves were used for teas and medicines; its fibers, to make cloth and paper.

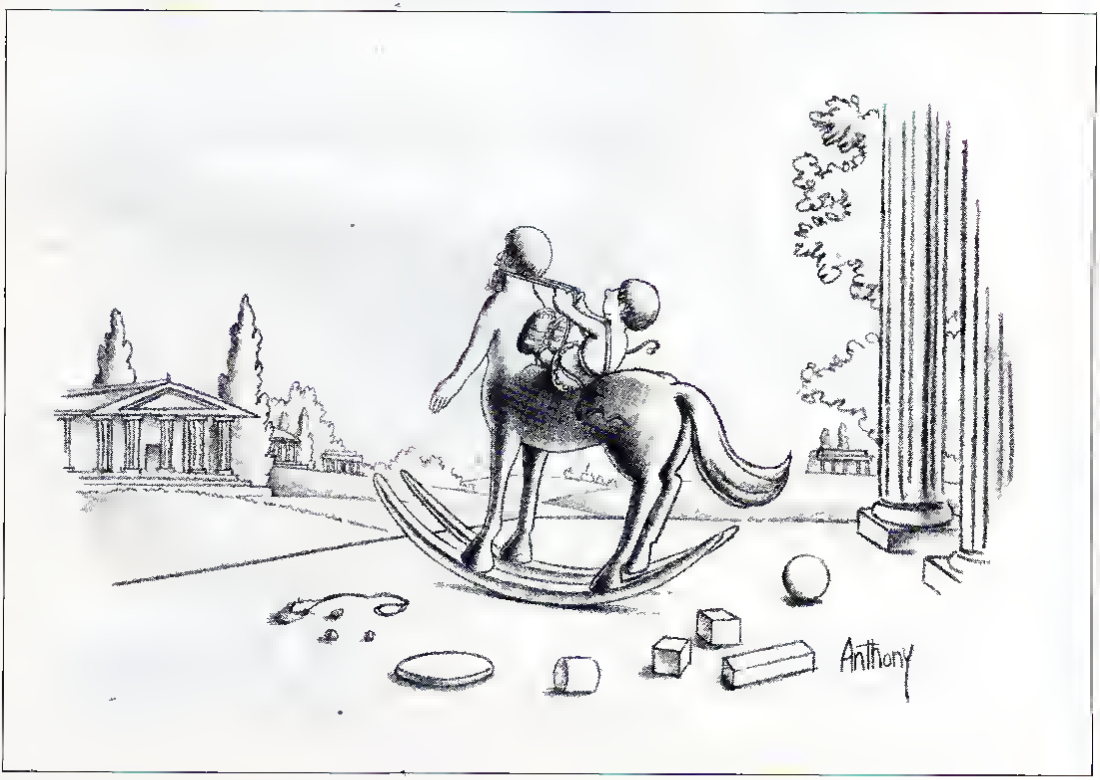
What kudzu was most famous for was its ability to grow over and cover anything that didn't move out of its way.

In the Depression Thirties of the last century, it had been planted on road cuts in the southeastern United States to stop erosion. Kudzu had almost stopped progress there. In those ideal conditions it grew runners more than twenty meters long in a single summer, several to a root. Its vines climbed utility poles, hills, trees. It completely covered other vegetation, cutting off its sunlight.

Many places in the American south were covered three kilometers wide to each side of the highways with kudzu vines. The Great Kudzu Forest of central Georgia was a U.S. national park.

In the bleaker conditions of Japan the weed could be kept under control. Except that this owner didn't want it to. The lights playing into the snowy sky were part of the heating and watering system that kept vines growing year-round. All this Melissa had read. Seeing it was something again. The entire block was a green tangle of vines and lights.

"Do you ever trim it?" she asked.



The traffic keeps it back ' said Killer Kudzu and he laughed 'I have gardeners who come in and fight it once a week They're losing

They went into the green tunnel of a driveway Melissa saw the edge of the house cast concrete as they dropped into the sunken vehicle area

There were three boats four road vehicles, a Hovercraft and a small sport flyer parked there

Lights shone up into a dense green roof from which hundreds of vines grew downward toward the light sources

'We have to move the spotlights every week he said

A butler met them at the door 'Just a tour, Mord ' said Killer Kudzu 'We'll have drinks in the sitting room in thirty minutes

'Very good sir

This way '

Melissa went to a railing The living area was the size of a bowling alley or the lobby of a terrible old hotel

The balcony on the second level jutted out from the east wall Killer Kudzu went to a console punched buttons

Moe and the Meanies boomed from dozens of speakers

Killer Kudzu stood snapping his fingers for a moment 'Oh send me! Honorable cats!' he said That's from Spike Jones an irreverent American musician of the last century He died of cancer ' he added

Melissa followed him noticing the things everyone noticed—the Chrome Room, the Supercharger Inhalorium the archery range (the object is *not* to hit the targets said Kudzu) the Mososaur Pool with the fossils embedded in the sides and bottom

She was more affected by the house and its overall tawdriness than she thought she would be

' You've done very well for yourself

'Some manage it some give it away some save it I *spend* it

They were drinking kudzu tea highballs in the sitting room which was one of the most comfortable rooms Melissa had ever been in

'Tasteless isn't it? asked Killer Kudzu

"Not quite,' said Melissa 'It was well worth the trip '

' You could stay you know said Kudzu

"I thought I could She sighed 'It would only give me one more excuse not to finish the dishes at home ' She gave him a long look ' No thank you Besides it wouldn't give you an advantage in the match

'That really never crossed my mind

'I'm quite sure

"You are a beautiful woman

'You have a nice house "

'Hmmm Time to get you home

' I'm sure

They sat outside her house in the cold The snow had stopped Stars peeped through the low scud

"I'm going to win tomorrow you know said Killer Kudzu

"You might said Melissa

' It is sometimes possible to do more than win he said

I'll tell my husband '

"My offer is always open he said He reached over and opened her door on the runabout 'Life won't be the same after he's lost. Or after he retires

She climbed out shaking from more than the cold He closed the door whipped the vehicle in a circle and was gone down the crunching street He blinked his lights once before he drove out of sight

She found her husband in the kitchen His eyes were red he was as pale as she had ever seen him

Dr Wu is dead he said and wrapped his huge arms around her covering her like an upright sofa

He began to cry again She talked to him quietly

'Come to bed Let's try to get some sleep ' she said

No I couldn't rest I wanted to see you first. I'm going down to the stable ' She helped him dress in his warmest clothing He kissed her and left, walking the few blocks through the snowy sidewalks to the training building

The junior wrestlers were awakened at four A M They were to begin the day's work of sweeping, cleaning cooking bathing feeding and catering to the senior wrestlers When they came in they found him stripped to his *mawashi* at the three-hundred-kilo push bag pushing, pushing straining crying all the while not saying a word The floor of the arena was torn and grooved

They cleaned up the area for the morning workouts one junior wrestler following him around with the sand trowel

At seven A M he slumped exhausted on a bench Two of the *juryo* covered him with quilts and set an alarm clock beside him for one in the afternoon

Your opponent was at the ball game last night ' said Nayakano the stablemaster Man-Mountain Gentian sat in the dressing room while the barber combed and greased his elaborate *chon mage* Your wife asked me to give you this

It was a note in a plain envelope addressed in her beautiful calligraphy He opened and read it

Her letter warned him of what Kudzu said about more than winning the night before and wished him luck

He turned to the stablemaster

Had Killer Kudzu injured any opponent before he became *yokozuna* last tournament? Man-Mountain asked

Nayakano's answer was immediate 'No That's unheard of Let me see that note He reached out

Man-Mountain Gentian put it back in the envelope tucked it in his *mawashi*

' Should I alert the judges?

'Sorry I shouldn't have mentioned it ' said Man-Mountain Gentian

' I don't like this said the stablemaster

Three hefty junior wrestlers ran in to the dressing room carrying Gentian's *kesho mawashi* between them.

The last day of the January tournament always packed them in. Even the *maegashira* and *komusubi* matches, in which young boys threw each other or tried to drew enough of an audience to make the novices feel good.

The call for the *ozeki* class wrestlers came and they went through the grandiose ring-entering ceremony, wearing their great *kesho-mawashi* aprons of brocade silk and gold, while their dew sweepers and sword-bearers squatted to the sides.

Then they retired to their benches, east or west, to await the call by the falsetto-voiced *yobidashi*.

Man-Mountain Gentian watched as the assistants helped Killer Kudzu out of his ceremonial apron, gold with silk kudzu leaves, purple flowers, yellow stars. His forehead blazed with the People's Republic of China flag.

He looked directly at Gentian's place and smiled a broad, crooked smile.

There was a great match between Gorilla Tsunami and Typhoon Takanaka, which went on for more than thirty seconds by the clock, both men straining, groaning, sweating, until the *gyoji* made them stop and rise, and then get on their marks again.

Those were the worst kinds of matches for the wrestlers, each opponent alternately straining, then bending with the other, neither getting advantage. There was a legendary match five years ago which took six thirty-second tries before one wrestler bested the other.

The referee flipped his fan. Gorilla Tsunami fell flat on his face in a heap, then wriggled backwards out of the ring.

The crowd screamed and applauded Takanaka.

Then the *yobidashi* said, "East—Man-Mountain Gentian. West—Killer Kudzu."

They hurried their *shikiris*. Each threw salt, twice, rinsing once. Then Man-Mountain Gentian, moving with the grace of a dancer, lifted his right leg and stamped it, then his left, and the sound was like the double echo of a cannon throughout the stadium.

He went immediately to his mark.

Killer Kudzu jumped down to his mark, glaring at his opponent across the meter that separated them.

The *gyoji*, off guard, took a few seconds to turn sideways to them and bring his fan into position.

In that time, Man-Mountain Gentian could hear the quiet hum of the electrical grid, hear muffled intake of breath from the other wrestlers, hear a whistle in the nostril of the north side judge.

"*Huuu!*" said the referee, and his fan jerked.

Man-Mountain Gentian felt as though two freight trains had collided in his head. There was a snap as his muscles went tense all over, and the momentum of the explosion in his brain began to push at him, lifting, threatening to make him give or tear through the back of his head.

His feet were on a slippery, sandy bottom; neck-high wave crests smashed into him; a rip tide was pushing at his shoulder at one side, pulling his legs up, twisting his muscles. He could feel his eyes pushed back in their sockets as it by iron thumbs, ready to pop them like ripe plums. His ligaments were iron wires stretched tight on the turnbuckles of his bones. His arms ended in strands of noodles; his face was soft cheese.

The sand under him was soft, so soft and he knew that all he had to do was to sink in it, let go, cease to resist.

And through all that haze and blindness he knew what it was that he was not supposed to think about.

Everything quit. He reached out one mental hand, as big as the sun, as fast as light, as long as time, and he pushed against his opponent's chest.

The lights were back, he was in the stadium, in the arena, and the dull pounding was applause, screams.

Killer Kudzu lay blinking among the ring bales.

"Hooves?" Man Mountain Gentian heard him ask in bewilderment before he picked himself up.

Man-Mountain Gentian took the envelope from the referee with three quick chopping motions, then made a fourth to the audience, and they knew then and only then that they would never see him in the ring again.

The official clock said 0.9981 second.

"How did you do it, Man-Mountain?" asked the Tokyo paparazzi as the wrestler showered out his *chon-mage* and put on his clothes. He said nothing.

He met his wife outside the stadium. A lone newsman was waiting with her. "Scoop" Hakimoto.

"For old times' sake," begged Hakimoto, "How did you do it?"

Man-Mountain Gentian turned to Melissa. "Tell him how I did it," he said.

"He didn't think about the white horse," she said. They left the newsman standing there, staring.

Killer Kudzu, tired and pale, was getting in his vehicle. Hakimoto came running up. "What's all this I hear about Gentian and a white horse?" he asked.

Kudzu's eyes widened, then narrowed. "No comment," he said.

That night, to celebrate, Man-Mountain Gentian took Melissa to the Beef Bowl.

He had seventeen orders and helped Melissa finish her second one.

They went back home, climbed onto their futons, and turned on the TV.

Gilligan was on his island. All was right with the world. ◻

CARRION

CONTINUED FROM PAGE 142

Willi managed to arrive twenty minutes before I. Nina was distraught and as close to hysteria as I had ever seen her. She had been at a party in lower Manhattan two days before—she was not so distraught that she forgot to tell us what important names had been there—when she found herself sharing a corner, a fondue pot and confidences with a young writer. Or rather, the writer was sharing confidences. Nina described him as a scruffy sort, with a wispy little beard, thick glasses, a corduroy sport coat worn over an old plaid shirt—one of the type invariably sprinkled around successful parties of that era, according to Nina. She knew enough not to call him a beatnik, for that term had just become passé, but no one had yet heard the term *hippie*, and it wouldn't have applied to him anyway. He was a writer of the sort that barely ekes out a living these days, at least by selling blood and doing novelizations of television series. Alexander something.

His idea for a book—he told Nina that he had been working on it for some time—was that many of the murders then being committed were actually the result of a small group of psychic killers he called them *mind vampires* who used others to carry out their grisly deeds.

He said that a paperback publisher had already shown interest in his outline and would offer him a contract tomorrow if he would change the title to *The Zombie Factor* and put in more sex.

"So what?" Willi had said to Nina in disgust. "You have me fly across the continent for this? I might buy the idea myself."

That turned out to be the excuse we used to interrogate this Alexander somebody during an impromptu party given by Nina the next evening. I did not attend. The party was not overly successful, according to Nina, but it gave Willi the chance to have a long chat with the young would-be novelist. In the writer's almost pitiable eagerness to do business with Blll Borden, producer of *Paris Memories*, *Three on a Swing* and at least two other completely forgettable Technicolor features touring the drive-ins that summer, he revealed that the book consisted of a well-worn outline and a dozen pages of notes.

He was sure, however, that he could do a treatment for Mr. Borden in five weeks, perhaps even as fast as three weeks if he were flown out to Hollywood to get the proper creative stimulation.

Later that evening we discussed the possibility of Willi simply buying an option on the treatment, but Willi was short on cash at the time, and Nina was insistent. In the end, the young writer opened his femoral artery with a Gillette blade and ran screaming into a narrow Greenwich Village side street to die. I don't believe that anyone ever bothered to sort through the clutter and debris of his remaining notes.

"It could be like that writer, *ja*, Melanie?" Willi patted my knee. I nodded. "He was mine," continued Willi, "and Nina tried to take credit. Remember?"

Again I nodded. Actually, he had been neither Nina's nor Willi's. I had avoided the party so that I could make contact later without the young man noticing he was being followed. I did so easily. I remember sitting in an overheated little delicatessen across the street from the apartment building. It was over so quickly that there was almost no sense of feeding. Then I was aware once again of the sputtering radiators and the smell of salami as people rushed to the door to see what the screaming was about. I remember finishing my tea slowly so that I did not have to leave before the ambulance was gone.

Nonsense, said Nina. She busied herself with her little calculator. "How many points?" She looked at me. I looked at Willi.

"Six," he said with a shrug. Nina made a small show of totaling the numbers.

"Thirty-eight," she said and sighed theatrically. "You win again, Willi. Or rather, you beat *me* again. We must hear from Melanie. You've been so quiet, dear. You must have some surprise for us."

"Yes," said Willi. "It is your turn to win. It has been several years."

"None." I said. I had expected an explosion of questions, but the silence was broken only by the ticking of the clock on the mantelpiece. Nina was looking away from me, at something hidden by the shadows in the corner.

"None?" echoed Willi.

"There was one," I said at last. "But it was by accident. I came across them robbing an old man behind , but it was completely by accident."

Willi was agitated. He stood up, walked to the window, turned an old straight-back chair around and straddled it, arms folded. "What does this mean?"

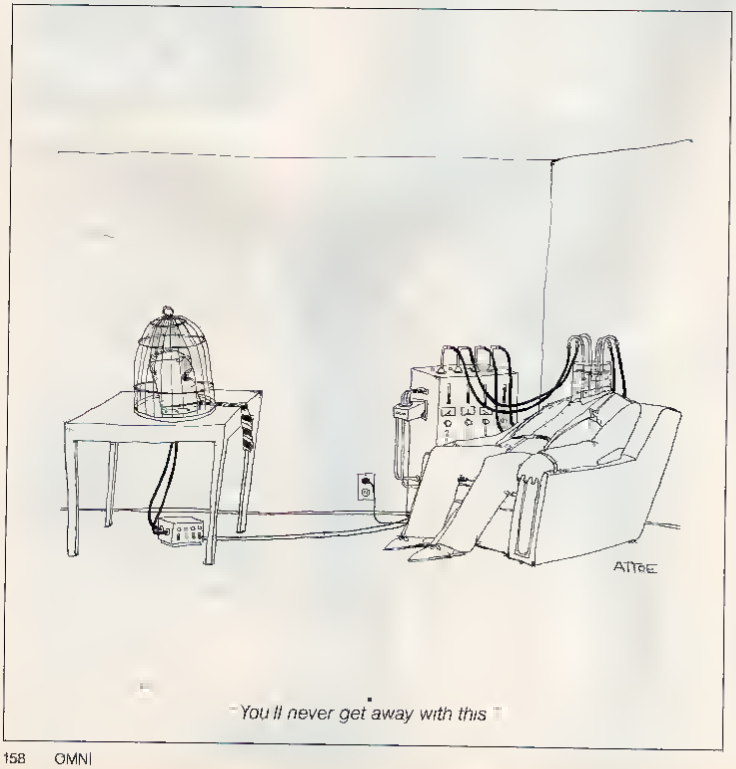
"You're quitting the Game?" Nina asked as she turned to look at me. I let the question serve as the answer.

"Why?" snapped Willi. In his excitement it came out with a hard *v*.

If I had been raised in an era when young ladies were allowed to shrug, I would have done so. As it was, I contented myself with running my fingers along an imaginary seam on my skirt. Willi had asked the question, but I stared straight into Nina's eyes when I finally answered. "I'm tired. It's been too long, I guess. I'm getting old."

"You'll get a lot *older* if you do not Hunt," said Willi. His body, his voice, the red mask of his face, everything signaled great anger just kept in check. "My God, Melanie, you *already* look older! You look terrible. This is *why* we hunt, woman. Look at yourself in the mirror! Do you want to die an old woman just because you're tired of using *them*?" Willi stood and turned his back.

"Nonsense!" Nina's voice was strong.



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confident, in command once more. 'Melanie's *tired*, Willi. Be nice. We all have times like that. I remember how *you* were after the war. Like a whipped puppy. You wouldn't even go outside your miserable little flat in Baden. Even after we helped you get to New Jersey you just sulked around feeling sorry for yourself. Melanie *made up* the Game to help you feel better. So quiet! *Never* tell a lady who feels tired and depressed that she looks terrible. Honestly, Willi, you're such a *Schwachsinniger* sometimes. And a crashing boor to boot.'

I had anticipated many reactions to my announcement, but this was the one I feared most. It meant that Nina had also tired of the Game. It meant that she was ready to move to another level of play.

It had to mean that.

'Thank you, Nina darling,' I said. 'I knew you would understand.'

She reached across and touched my knee reassuringly. Even through my wool skirt, I could feel the cold of her fingers.

My guests would not stay the night. I implored. I remonstrated. I pointed out that their rooms were ready, that Mr. Thorne had already turned down the quilts.

"Next time," said Willi. "Next time, Melanie, my little love. We'll make a weekend of it as we used to. A week!" Willi was in a much better mood since he had been paid his thousand-dollar prize by each of us. He had sulked, but I had insisted. It soothed his ego when Mr. Thorne brought in a check already made out to WILLIAM D. BORDEN.

Again I asked him to stay, but he protested that he had a midnight flight to Chicago. He had to see a prizewinning author about a screenplay. Then he was hugging me good-bye, his companions were in the hall behind me, and I had a brief moment of terror.

But they left. The blond young man showed his white smile, and the Negro bobbed his head in what I took as a farewell. Then we were alone.

Nina and I were alone.

Not quite alone. Miss Kramer was standing next to Nina at the end of the hall. Mr. Thorne was out of sight behind the swinging door to the kitchen. I left him there.

Miss Kramer took three steps forward. I felt my breath stop for an instant. Mr. Thorne put his hand on the swinging door. Then the husky little brunette opened the door to the hall closet, removed Nina's coat, and stepped back to help her into it.

'Are you sure you won't stay?'

'No, thank you, darling. I've promised Barrett that we would drive to Hilton Head tonight.'

'But it's late—'

'We have reservations. Thank you anyway, Melanie. I *will* be in touch.'

'Yes.'

"I mean it, dear. We must talk. I understand *exactly* how you feel, but you have to remember that the Game is still important to Willi. We'll have to find a way to end it without hurting his feelings. Perhaps we could visit him next spring in Karnhall or whatever he calls that gloomy old Bavarian place of his. A trip to the Continent would do wonders for you, dear."

'Yes.'

"I *will* be in touch." After this deal with the new store is settled. We need to spend some time together, Melanie . . . just the two of us . . . like old times." Her lips kissed the air next to my cheek. She held my forearms tightly. "Good-bye, darling."

'Good-bye, Nina.'

I carried the brandy glass to the kitchen. Mr. Thorne took it in silence.

'Make sure the house is secure.' I said. He nodded and went to check the locks and alarm system. It was only nine forty-five, but I was very tired. *Age*, I thought. I went up the wide staircase, perhaps the finest feature of the house, and dressed for bed. It had begun to storm, and the sound of the cold raindrops on the window carried a sad rhythm to it.

Mr. Thorne looked in as I was brushing my hair and wishing it were longer. I turned to him. He reached into the pocket of his dark vest. When his hand emerged a slim blade flicked out. I nodded. He palmed the blade shut and closed the door behind him. I listened to his footsteps recede down the stairs to the chair in the front hall, where he would spend the night.

I believe I dreamed of vampires that night. Or perhaps I was thinking about them just prior to falling asleep, and a fragment had stayed with me until morning. Of all mankind's self-inflicted terrors, of all its pathetic little monsters, only the myth of the vampire had any vestige of dignity. Like the humans it feeds on, the vampire must respond to its own dark compulsions. But unlike its petty human prey, the vampire carries out its sordid means to the only possible ends that could justify such actions—the goal of literal immorfality. There is a nobility there. And a sadness.

Before sleeping I thought of that summer long ago in Vienna. I saw Willi young again—blond, flushed with youth, and filled with pride at escorting two such independent American ladies.

I remembered Willi's high, stiff collars and the short dresses that Nina helped to bring into style that summer. I remembered the friendly sounds of crowded *Biergartens* and the shadowy dance of leaves in front of gas lamps.

I remembered the footsteps on wet cobblestones, the shouts, the distant whistles, and the silences.

Willi was right. I had aged. The past year had taken a greater toll than the preceding decade. But I had not fed. Despite the hunger, despite the aging reflection in the mirror, *I had not fed*.

I fell asleep trying to think of that writer's last name. I fell asleep hungry. ∞

To be concluded next month

"What a great idea, Martha! If you miss, I'll have something to write about!"

EARTH

CONTINUED FROM PAGE 18

badly wanted to hug her but did not do so for fear of jeopardizing the first trust she had been able to place in a human being.

Coco sat on my lap calmly for a few minutes before walking to a long bench below the windows that overlooked nearby slopes. With great difficulty she climbed onto the bench and gazed out at the mountain. Suddenly she began to sob and shed actual tears, something I have never seen a gorilla do before or since. When it finally grew dark she curled up in a nest of vegetation I had made for her and softly whimpered herself to sleep.

During the next two days Coco ate increasing amounts of natural vegetation—*Galium*, thistles, nettles, and—after a battle of wills—she accepted a milk mixture containing all the medications I considered essential for her health. Yet she continued to cry frequently, particularly when looking out of the window of her room. One day gorilla vocalizations were heard from the slopes behind camp, causing Coco to keen more than ever. Quickly I turned on the radio as loud as possible to drown out the sounds of the group, but Coco continued to gaze up at the slopes for most of the day, whimpering softly, with the knowledge that her own kind were near.

On the third day the youngster's partial satisfaction with her new environment diminished, and, as is the case with every captured gorilla I have ever known, she took a sudden turn for the worse. She completely stopped eating, her dung seeped out in liquid bloody pools, and she lay huddled in a pile of nest vegetation, shaking uncontrollably. Nothing I could do, including playing tape recordings of other gorillas, could shake her out of this semicomatose lethargy. I started her on antibiotics, but there was no sign of response, and she continued to fail at an alarming rate.

On the sixth night of Coco's stay at camp I carried her to bed with me for what I assumed would be her last night alive. Warmth and security were all that I could now provide. At five o'clock the following morning, instead of finding a corpse in my arms I found Coco still alive and both of us lying in a bed soaked with diarrhetic dung. She seemed somewhat more lively, and I hoped that her crisis might have passed during the night. After giving her the medicine, I carried her outside into a large wire enclosure adjoining her room, built so that she might have access to the sun. The door was closed between the room and the cage to allow men and myself to sanitize every inch of her room and put in fresh foliage and saplings.

While we were working I suddenly heard porters' voices approaching camp. I ran outside and saw about six men carrying what looked like an oversized beer barrel suspended between long poles supported on their shoulders. The head porter handed me a note from a friend. "They've captured another gorilla. They want you to take care of it but didn't know how to send it up to you, so I improvised this thing. Hope all is going well with the first. Doubt this one will survive either."

Incredulous, I paid the porters and had the barrel brought into Coco's room, leaving Coco outside in the sun-filled pen.

Because the captive showed no inclination of emerging, I laid the barrel on its side and gently spilled her onto the foliage-covered floor. I was horrified to see that the young female was far more emaciated than Coco had been. Pus was oozing from wounds on her head, wrists, and ankles from deep cuts where she obviously had been bound by wire. From the extent of her infections and deterioration I judged she had been caught about the same time as Coco but had had to spend nearly a week longer with her captors.

Three days passed before Pucker—named for her morose and dejected facial expression—would accept the same milk formula I was giving Coco. Estimated to be about a year older than Coco, Pucker was far more introverted and depressed by the changes brought about in her capture than the younger female. Much later I learned that Pucker had come from a group of about eight animals and, like those of Coco's group, all the family members had died trying to defend the youngster. Despite my constant reassurance that she wasn't going to be further harmed, Pucker remained extremely apprehensive, particularly when people were heard or seen near the infants' room or outdoor cage.

The day finally came when Coco was healthy enough to be allowed the freedom of the trees and meadows around camp. Pucker had not yet sufficiently recovered from her wounds, and I doubted my control over her. On our first venture outside the cabin I had to carry Coco on my back, since she seemed overawed by the vast amount of open space around her. Even when we perched on a huge *Hagenia* tree trunk laden with *Galium* and other gorilla foods, she wouldn't leave my lap.

The 30-minute reintroduction to the wild took us no farther than some 165 feet from the cabin. Pucker, who had gone into the outdoor cage to watch Coco and me leave, began whimpering softly. The cries soon built up into loud sobs terminated by screams and shrieks as Coco and I moved farther away. I was obliged to return much sooner than intended, although Pucker's cries seemed to be ignored by Coco. The howling subsided upon my obedient return, but in typical Pucker style our reentry was totally ignored as she feigned a sudden interest in feeding. Her behavior might have seemed comical, nevertheless I felt it indicated a deep sense of deprivation.

On the morning I was ready to take both babies out, the park guards came up to camp unexpectedly. The two youngsters

"I don't think you mean an astronaut. I think you mean a proctologist."

were in their outside run when the guards noisily arrived, carrying spears and guns. Terrified, the infants fled into the room, climbed onto the highest shelf, and clung there for the remainder of the day. The guards demanded that I immediately turn the gorillas over to them for the trip to the Cologne Zoo. After an hour I was able to get rid of the intruders by convincing them that the gorillas were not well enough to leave—the truth, at least in Pucker's case. Two days passed before the babies could be coaxed out of their room.

Some weeks later we again had an unexpected visitor, in the form of the Conservator. The behavior of the two youngsters upon his arrival epitomized my own feelings exactly. Coco hid and Pucker went to the door separating my room from theirs and slammed it shut.

The Conservator had made the long climb to camp to demand the infants' prompt release to the Cologne Zoo. For the second time I insisted that they were not well enough to travel. While I was desperately insisting for more time, the sounds of play—chuckles, chasing, and wrestling—unfortunately were heard from the next room. I silently cursed them both for choosing this inopportune time to play, even though I was pleased that they would play in spite of the Conservator's presence. The harder I pleaded to keep them, the more insistent he was about taking them. He claimed that the Cologne Zoo was exerting pressure on him for the animals' sick or not. What he did not tell me was that the zoo was giving him a trip to Germany, ostensibly to act as a "companion" for the gorillas. For a man who had never been out of his own country, this was indeed an exciting prospect.

After a circuitous and argumentative conversation, the Conservator stated flatly that if I did not immediately relinquish Coco and Pucker, he would send poachers to capture two more young gorillas. He had called my hand. That same day I sent a cable to the Cologne Zoo officials, telling them that they could have the captives once I felt the infants were well enough to make the long journey. Sending that cable in order to avoid further slaughter was one of the biggest compromises I had to make during the years of my gorilla research. At that time there were few regulations concerning exportation or importation of endangered species. The Conservator's intentions to capture more young gorillas left me no alternative but to relinquish Coco and Pucker. Once the man had left, I went into the infants' room and received enthusiastic welcomes from both. Hugging them to me, I felt like a traitor.

The days of feeding and playing went on as usual for Coco and Pucker. Their lively behavior resembled that of two rowdy little girls at summer camp. For myself, most of the joy of watching them flourish into near-normal, playful juvenile gorillas was gone. Knowing their time in the forest was so limited and their future so bleak was constantly depressing, particularly since there was nothing I could do to prevent their return to cages. I wrote to Cologne imploring the zoo director to allow me to reintroduce the gorillas to the wild in a foster group, but received a flat negative in reply.

Several weeks after the Conservator's visit, the park guards returned to camp to demand the gorillas, but this time in a very aggressive manner by waving rusty rifles at me, the youngsters, and the Rwandese camp staff. By now Coco and Pucker freely accepted the men on the staff but retained a deep fear and timidity around unknown Africans. For this reason I was quite surprised when the gorillas tried to "attack" the guards by screaming and beating violently at the wire between themselves and their would-be captors. Their actions were just the cue I needed to tell the guards they were more than welcome to enter the room to collect the gorillas, but that they couldn't expect my help. Nothing, including the wrath of the Conservator, could possibly have induced the men to enter the pen, and in a few minutes they left. Afterward I learned that they told the Conservator the juveniles were still much too sick to travel.

A few days later the Conservator arrived at camp, accompanied by guards carrying a small, newly built coffinlike box intended for the captives' flight to Cologne. The only opening to the box was a small, 12-inch door. Ventilation had not even been considered. The Conservator moreover had the effrontery to ask that I pay for the container. Eventually he left, content with the equivalent of $30 in his pocket. I was slightly pleased only because I had gained several more weeks until the terrible departure day by explaining that the box would have to be entirely rebuilt.

When the dreaded day came, numerous pages of instructions for Coco and Pucker's care were provided. Tins containing their milk formula were strapped on to the crate's sides, and a fresh selection of forest vegetation, the last they would ever eat, was packed up. I also placed two large bracket fungi inside the crate. The instant the youngsters ran in to grab them, the door was latched shut. The porters who would carry the box down arrived a few seconds later. That was all I could endure. I ran out of the cabin, ran through the meadows of our countless walks, and ran deep into the forest until I could run no more. There is no way to describe the pain of their loss, even now, more than a decade later.

For a number of years a member of the Cologne Zoo periodically informed me of Coco and Pucker's welfare through bulletins and photographs. The photographs revealed to me all too clearly that the captives were just barely tolerating their caged environment. While writing this book I learned that Coco and Pucker, within a month of each other, died in 1978 in the Cologne Zoo. DO

This article was condensed from Gorillas in the Mist, *which was published in August by Houghton Mifflin. © 1983, by Dian Fossey*

SEVENTH SENSE

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"We agree with Central USA." The African groups stand up. "We've seen it too. There is no question of their sensitivity. It must be allowed to develop before we approach them. They must be able to understand—to accept us."

"Agreed!" shouts Far North.

"If we are going to call it off," Encroach Leader says, "it has to be done immediately. Let's have the vote now."

"I think you're imagining things," Galápagos mutters. "And I'll tell you something else. Disengagement won't be trivial."

Galapagos was right about that. We carried the vote, though it was closer than I had expected. But it has taken until Friday to work out the details of the disengagement. I am thoroughly tired by the time I finally get to the airport.

He is there. The Constant Traveler. He lifts the arm resting on the bar a couple of inches in greeting. "Hello, Traveler," I tell him. "Is this a coincidence, or is somebody following somebody?"

He grins, showing the wide gap in his front teeth. "Pure plain coincidence. Happens all the time, believe me."

"Well"—I signal for a beer—"I don't know about that."

"Oh, yes," he assures me. "When you've traveled more you'll know what I mean. You keep running into the same people."

"How was your stay?" I reach for the beer.

"Great. Made a couple of good sales. Hey! How about that market? Up nearly sixty points this week."

"Yeah!" Suddenly I am not so tired anymore. "Interesting, isn't it."

"Interesting, hell! It means about three thousand bucks to me. Say, what flight are you on? Going back to Chicago?"

"No. Another direction."

"Too bad," he says, just before he drains the glass and pops it down on the bar with a loud, long sigh of pleasure. "Sorry I won't be having your company." He slides easily off the stool and picks up his case. "But I'll see you again somewhere. Better run. I got a plane to catch."

I watch him walk out into the main corridor, then angle off to the left and merge into the stream of shoulders, heads, and assorted luggage moving to the flight gates. I am sorry to see him go. He's like part of the furnishings. But just before he said good-bye there was an instant when he looked at me, wanting to say something—and in that instant he, a superbly trained professional, knew he had violated security. He is a machine-tool salesman like I am a Xeninian sheepherder!

That story of his—fantastic. It bought them one hundred seventy-two years, anyway. But there was no Frank. And no Bill. And no Ralph, or New Orleans bar. There was a light in the sky, all right. Was there really a deaf man? Perhaps. DO

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this particular case. Because it *is* directed. And it *is* controlled. But the control is not that control of directing your heartstrings. It makes the wilderness yours in one sense because there's such a distance between the means of recording it and the kind of thing that the wilderness is. And it also brings into question the whole process of the perception of nature."

Forever resourceful in reusing material, Snow later remounted Abeloos's machine in a video-installation piece with four monitors. "The camera goes in the center and you can set it for different patterns. It's really nice. the National Gallery of Canada bought it. It's called *De la*. Obviously it's a completely different thing from the film, because you get involved in watching the machine move and seeing the kind of drawing that it makes on the monitors, relating the movement to the kind of images that are produced."

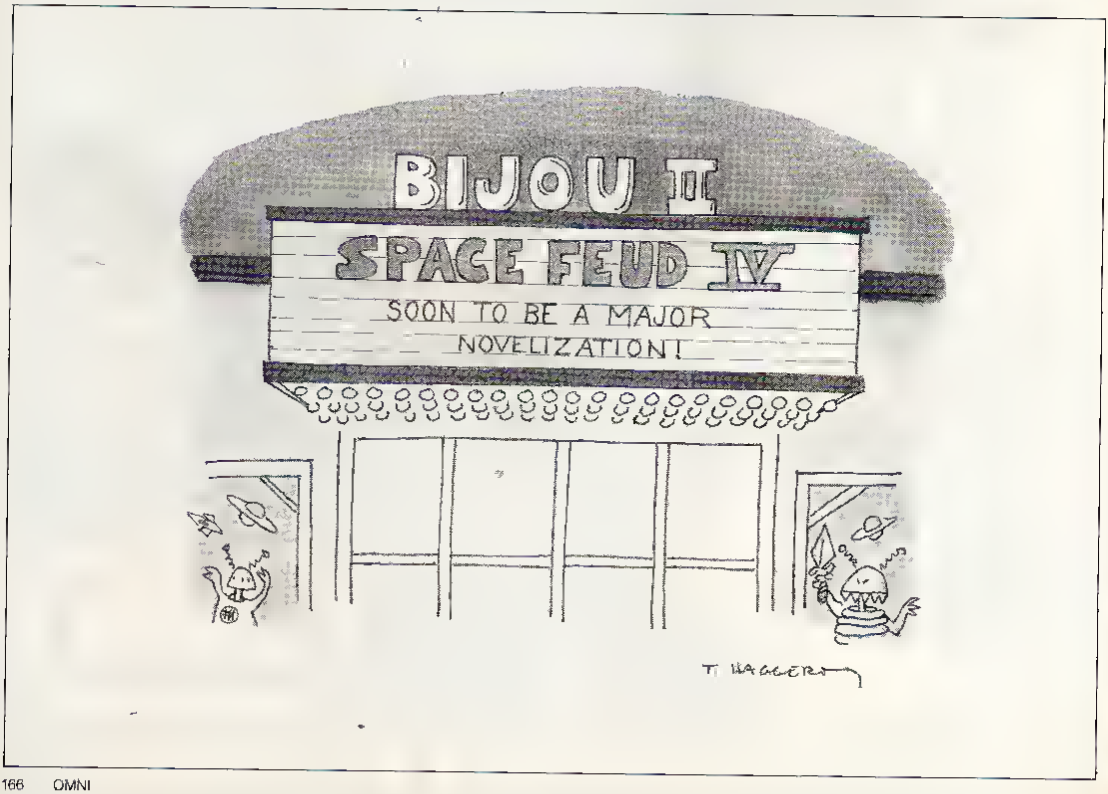
Something of a prankster and philosopher at the same time, Snow in his mid-fifties, has a flair for starting off with an unlikely or outrageous idea and somehow making it work. In his first major film (*Wavelength*, 1967), 40 odd minutes long, he begins with a sputtering camera zoom across an 80-foot Manhattan loft, not much action, as most movies go. But he uses this central concept like a clothesline on which to hang abstract notions about space, time, color, waves, death, storytelling, and representation. (Characteristically, the shooting took him a week, and the editing, a couple of weeks, "but I did spend a lot of time musing—a year.") In Snow's most recent film (*So Is This*, 1982), with roughly the same running time, he has the brass to fill his silent screen with nothing but one printed word after another; his imagination and resources keep audiences amused and involved all the way through.

How does he pack so much into so little? In *Wavelength*, the zoom's journey across the loft—joined on the sound track by a sine wave gradually moving from its lowest note to its highest—starts uneventfully. But as the camera approaches the four double windows and intervening wall space of the other side of the loft, a man is heard breaking into the building and walking upstairs. He staggers into the frame and drops dead on the floor—just before the zoom blithely lurches past him.

Still later, a woman enters, discovers the moribund body, and phones her boyfriend while the camera steadily approaches one of the photographs posted on the central wall space. The photo proves to be a picture of sea waves. The sound of an approaching police siren merges with the sine wave, which by now has risen from 50 to 12,000 cycles per second.

As prosaic as all this sounds, Snow has been passing his painterly image through many changes along the way. He uses a variety of color filters, film stocks, superimposed flashbacks of earlier stages in the zoom, and qualities and degrees of processing and light exposure to keep the film moving like a kaleidoscope; yet, it seems to be practically standing still. (Many of the same technical variations in *Wavelength* are used to comparably fluid effect on the single words in *So Is This*.) In Snow's elegant description of the movie's progress, "The space starts at the camera's—spectator's—eye; is in the air; then is on the screen; then is within the screen—the mind." He has also described the film as a "pun on the room-length zoom to the photo of sea waves, through the light waves and on the sound waves."

A simpler and wittier forward camera movement defines a 1976 Snow short called either *Breakfast* or *Table Top Dolly*. In this case, a camera fronted by a shield of see-through plastic slowly creeps across a table converting an artistic still life of groceries—eggs, orange juice, sugar, Dixie cup, plates, and fruit—into a sticky, gooey mass of garbage while the sounds of dishwashing are heard offscreen. A movie about consumption? If eating is believing and hearing is deceiving, you had better believe it. ∞



INTELLIGENCE

CONTINUED FROM PAGE 24

ers ' in their specific field or domain. One Cognitive program, *Explorer*, was developed for an oil company. In response to natural-language questions, it consults a database, retrieves information, and converts it into maps of oil wells. Another program, *Marketeer*, was developed as a natural-language interface for *Access*, a marketing-analysis database from Dialogue Inc. And *Broker* accesses information from Standard and Poor's stock-market database *Compustat*. The company is now developing advisory systems, costing between $250,000 and $350,000, to provide linguistic fluency and decision-making support in personal investment and tax preparation. "Our advisory systems are basically computer models of human experts," Schank explains.

For the future, the company is considering a way to offer such computer expertise to owners of personal computers. Using a modem—a device to connect home computers to distant mainframes via telephone—anyone could tap into the wisdom of Cognitive's advisory systems, paying only for the amount of time they were connected. Users could pick up advice on investments, for example, almost as easily as dialing a long-distance call.

Symantec, a spinoff of Machine Intelligence Corporation (which makes robot vision), has ambitious plans for its natural-language system. Based on work first done at Stanford Research Institute, the company is developing a $300 to $500 program that combines rules of syntax and semantics with a proprietary database management system (DBMS) designed for the IBM personal computer. A businessman could use the system to keep his own file of personnel and sales data that could be accessed easily using ordinary English. An earlier version of the technology, called *Straight Talk*, is currently available for $660 as a natural-language interface for the Dictaphone System 6000 word processor. Symantec hopes to market the new DBMS system by the end of this year.

Meanwhile, one company already markets a widely used English-language system for personal computers. Mention *Savvy* to anyone in the artificial-intelligence community, and you will immediately trigger a semantic debate. Developed by Excalibur Technologies Corporation, this $349 to $950 tool talks to computers but ignores such niceties as semantics and syntax completely. Instead, it concentrates on recognizing letters of the alphabet as they are punched into the keyboard. It uses a pattern-recognition system—matching up strings of characters—to identify key words and phrases typical of the user. The Savvy system may not be artificial intelligence, but it is already popular with Apple II users, and the company is introducing a model for the IBM personal computer.

What's next for *Savvy*? Natural-lan-

guage interfaces for personal robots. *Savvy* has developed a general-purpose interface that will be marketed for the RBX5 robot manufactured by RB Robots of Denver. And, says company spokesman Nelson Winkless, this interface could be adapted to other robots like Heath Company's Hero. In fact, predicts *Savvy* president Jim Dowe, the personal robot and the personal computer will eventually merge into one mobile, intelligent system capable of humanlike decision and behavior.

In research-and-development laboratories from Bell to Bolt Beranek and Newman, work is already under way on the next generation of natural-language technology—programs that can combine the in-depth knowledge of an advisory system like *Explorer* with the adaptability of a query system like *Intellect*. What's hitting the market now is just the tip of the camel's nose under the flap of the tent," says William Woods, of Bolt Beranek.

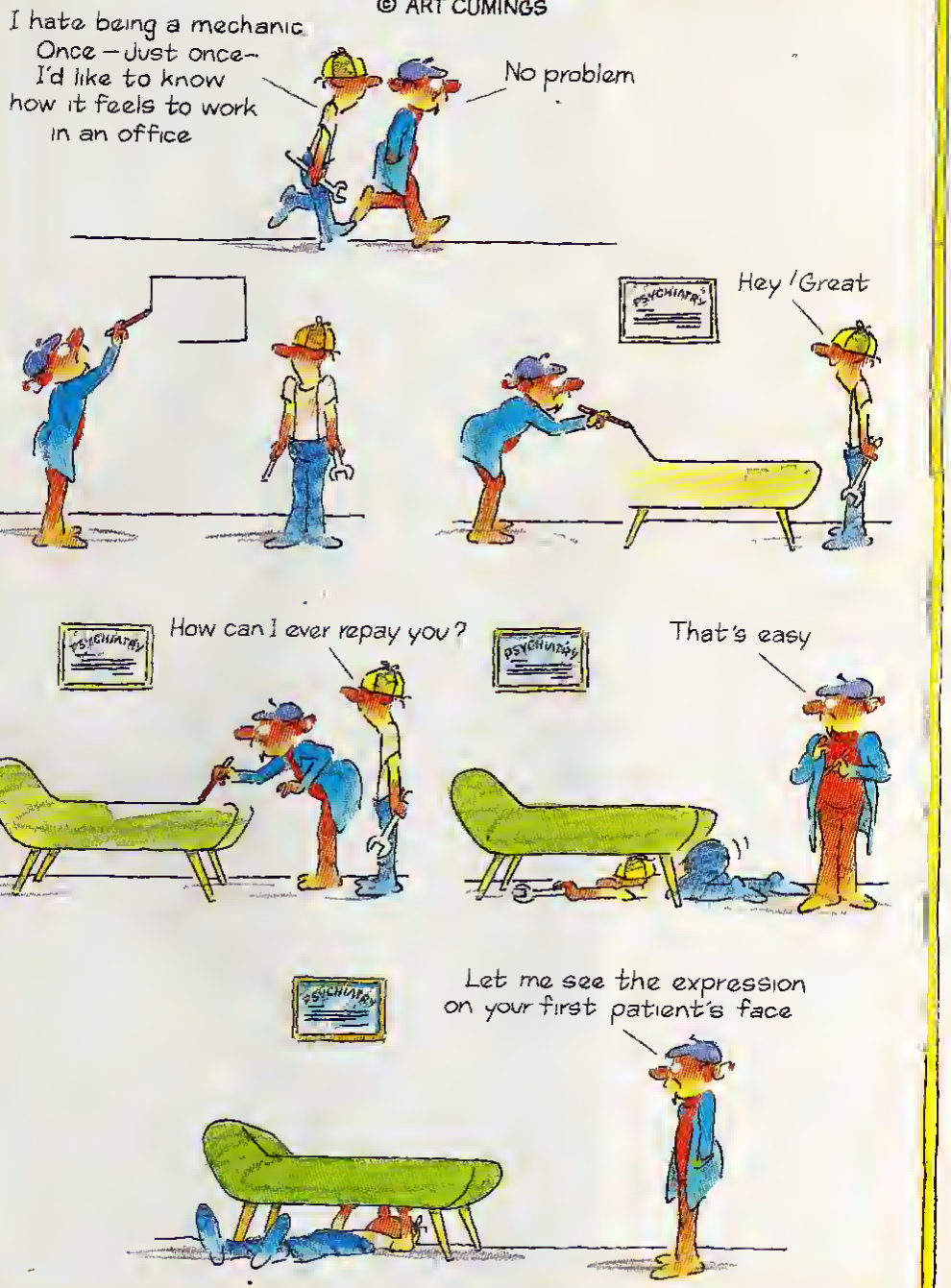
Widespread use of natural-language systems for computers is still a decade away, believes Ken Lim, of Dataquest. "But each piece of technology further closes the gap between man and machine. Someday," Lim predicts, "the human brain may actually be able to think commands directly into computers." Until then, we will have to be happy with machines that understand slang.

NEW WARES: HARD AND SOFT

Personal computers can create some pretty powerful color graphics—from simple pie charts and bar graphs to complex computer-aided designs. Now there is a simple way to instantly reproduce these cybernetic doodles and preserve them for posterity. The Palette system, developed by Polaroid, is a desk-top unit that plugs into the Apple II and the IBM PC and automatically converts even monochromatic displays into full color prints or slides. The Palette system includes a software diskette, a 35mm camera back and adapter plate, and the Polaroid 35mm Autoprocess slide developer introduced earlier this year. The instant-print attachment is offered as an option. ($1,300, from Polaroid Corporation, 575 Technology Square, Cambridge, MA 02139.)

Chinese, with as many as 40,000 ideograms, is certainly not the easiest language to master. But now any computer can be retrofitted with a circuit board to print perfect Chinese. The board, a Chinese-character generator developed by Eastern Computers Inc., works with an ordinary English keyboard. Letters of the English alphabet are combined to construct each ideogram. It takes multiple keystrokes to generate one character. But each ideogram represents a word rather than just a letter; the total time required is comparable to that needed to type in English. ($400 to $500, from Eastern Computers Inc., 120 South Lynnhaven Road, Virginia Beach, VA 23452.)

The Artist



SPACE

CONTINUED FROM PAGE 20

while you might tell the guy next to you to piss off but later you will go out and have a beer together.

Thrown together in a foreign country, often under difficult working conditions ESA workers undergo a crash course in multinational integration. They form sports clubs, hold barbecues and respectively await Italian, French, German or English film night at the company canteen. They suffer the inevitable affairs common to enclaves of foreigners and accustom themselves to one another's national characteristics.

At ESOC the Germans share a reputation of being thorough and methodical, practically to a fault. The Italians and French register as hotheaded and impulsive. Brits are stubborn, and the Scandinavians party a lot. Yet when it's zero minus ten and counting, with hundreds of millions of dollars worth of equipment on the multiple computer and data screens at operations center, no one is checking passports.

"All the pressures build at launch, and at that point we're in the same boat no matter where we come from," says a Scottish shift leader at ESOC. "That's when we tend to work best together. If the mission fails, we're all upset. You're part of a team."

"It's around the board-meeting table where it often falls apart," adds a colleague. "The British delegation can't be seen as giving in to the Germans, the Germans can't be seen as giving in to the French, and so on."

If the team spirit felt at launch is seemingly absent around the conference table at ESA headquarters in Paris, it's not because the pressures are any less intense. Both politically and economically, the member nations of ESA lie galaxies apart. With worldwide recession widening the void between inflation-riddled Italy and relatively stable Switzerland, for instance, seemingly minor debates over when to align currencies assume huge import.

Yet tempering these discussions is the underlying awareness that the countries of Europe can mount a meaningful space challenge only if they are unified. No European country acting alone could have achieved satellite launch and operations capability in such a short time. And along the way to positioning the agency as a solid third behind the U.S. and Soviet space efforts, ESA officials did pioneering work in multinational space cooperation.

"One of the first lessons we learned at ESA was that when you put different nations with very different ideas together, working for a common goal, you have to consider the individuality of those nations," says Lenhart. "Each decision has psychological and sociological implications, and each country expects a certain return for its investment."

That return comes most significantly in the form of contracts awarded to industries in a country that has proved particularly generous to a project. Indeed, the willingness to fund the ESA stems in large part from the realization among politicians that to compete in the coming technological era Western European industries need the research and technological benefits of a vital space program. As with most ESA decisions, however, the repercussions of the contracts-for-contributions policy are most clearly felt at the operations level.

A prime example, according to ESOC operators, was the awarding of a contract to a state-run British firm for the computer support system of the Meteosat satellite. That computer should never, ever have been there," admits a British head operator on the Meteosat operations team. "We know it was done so that Britain could share in the spoils, so to speak. But we're trying to support a spacecraft which is difficult enough. And we had to do it with this totally untried and unfamiliar computer system."

If the compromise inherent in its multinational character stands as an ESA weakness—often requiring lengthy political debate—it may also prove the agency's greatest strength. A successful launch in late June proved that Ariane is over some of its teething problems. From now on, the ESA rocket should be able to place a communications satellite into geosynchronous orbit for about the same price as the space shuttle can. Yet the cost cutting and basic design that resulted from compromise kept the development cost to about 10 percent that of her American competition.

Compromise also resulted in the strictly nondefense role of the ESA, adopted in the charter at the insistence of neutral members Switzerland and Sweden, and establishing the agency as the closest in spirit to the United Nations' declaration for a weapons-free space. In their resulting role as goodwill ambassadors among space agencies, ESA officials have established relations between the agency and space programs in every interested country in the world, including the United States, the Soviet Union and China. And on such cooperative projects as last year's launching of India's Apple satellite, ESA operators are quick to put a Hindi inflection in their English or to sneak guest operators on the audio loop for illegal calls to faraway friends.

Eventually the cooperative project that could prove the agency's most successful and innovative is ESA's very reliance on 11 separate member nations for support and direction. Says former director general Sir Hermann Bondi, now chairman of the National Environmental Research Council in England: "There are certainly advantages and disadvantages to ESA's multinational character. It's bound to make the agency a little slower and less efficient than strictly national space programs. Yet, it gives the ESA a measure of stability. Every country goes through periods of uncertainty.

"With eleven members, it's less likely that trouble in any one country will hurt the space program. You spread the risk." ∞

THE ARTS

By A. A. Attanasio

The first atomic bomb blasted into reality in 1945, horrifying and surprising the entire world, including the scientists who invented it. Amazingly, the weapon itself was accurately predicted 32 years before by one of the earliest science-fiction writers, H. G. Wells. Wells, in fact, coined the term *atomic bomb* in his "scientific romance" *The World Set Free*, published in 1913. The technical information for that boldly prophetic novel was taken, some of it word for word, from "The Energy of Uranium," a 1908 *Harper's* article by physicist Frederick Soddy.

Nowadays atomic bombs are more commonplace than mustard gas was in Wells's day, yet the extrapolative fiction that Wells invented is practically extinct. Most of the speculative fiction published these days ignores current scientific ideas and relies instead either on the supernatural or on futuristic technology so advanced that it has the power, mystery, and accoutrements of magic.

Part of the reason for this avoidance of realistic science is the widening gap between what science writer C. P. Snow called "the two cultures"—technology and the humanities. These two cultures not only speak different languages, but their world views are frequently antagonistic, as described in Isaac Asimov's novel *Foundation's Edge* (Doubleday). Asimov's two Foundations share responsibility for the survival of humanity. The First Foundation has mastered the physical sciences. The Second Foundation embodies the secrets of psychohistory and the mathematical description of human behavior, and its leaders can control the thoughts and emotions of individuals. Though the two Foundations are humanity's guardians, their mutual antipathy endangers the whole galaxy. Only the intervention of a third power prevents chaos. By blending philosophy and science, Asimov artistically addresses the gap between the hard sciences and the irrational dimensions of the human soul. Unfortunately, it is unlikely that any such third force will appear in our troubled century.

Closer to home, Arthur C. Clarke prefaces his latest work, *2010: Odyssey Two* (Ballantine), with the honest disclaimer that his book will "be out of date by 2001." The novel, a sequel to *2001: A Space Odyssey*, is engaging and imaginatively wrought, but as a work of extrapolative fiction, it deserves Clarke's qualification. *2010* is the story of the rendezvous of *Spacecraft Alexei Leonov* at Jupiter with the U.S. *Discovery*, the craft David Bowman abandoned to confront the alien monolith in *2001*. Bowman and the infamous computer HAL reappear in this novel, and the book is loaded with marvelous "factoids" about the Jovian system. But the science of the story blurs into mysticism instead of technological prediction.

Has science become so complex that it can only be extrapolated mystically? Gregory Benford's *Timescape* (Pocket Books) successfully projects a near-future society and its physics without resorting to the supernatural—and its realism is frightening. His novel connects the post-*Sputnik*/pre-moon walk decade of great scientific optimism with a bleak 1998, where science is blamed for the imminent collapse of civilization. The links between the two times are tachyons, faster-than-light particles. The scientists of 1998 use these time-reversed signals to send a message backward in time to the physicists of 1962 with the desperate hope of undoing the human causes of a future ecological disaster.

A successful blend of science and imagination

The disenchantment with science of Benford's future society mirrors a dissatisfaction that already exists. Fear of the unknown in science has led many to see William Blake's "dark Satanic mills" echoed in the skyline of Three Mile Island.

The optimistic expectations of progress prevalent in Wells's time have been tempered by grim disillusionment since then. In a world on the brink of self-destruction, it is no wonder that fantasy fiction predominates in the marketplace. Where does this leave science fiction?

Traditionally, science fiction's role has been to traverse the yawning gap between technology and the popular imagination. For the writer this has become a dangerous assignment. Unless an author is naturally endowed with the wide-ranging sapience of an Asimov, he must either be an expert, like physicist Benford, or have expert guides, like those Clarke acknowledges in his book.

Despite the difficulties of creating Wells's kind of fiction in these science-shy times, our future-committed society must use its imagination to test new technologies against the human principles we've inherited from our past. And it is not just the general public that needs to compare discoveries and values. Scientists must also look up from their research and consider the ways that their ideas will affect people. The guilt that physicists experienced after Hiroshima and Nagasaki is the price they paid for forgetting that our search for knowledge is also a quest for wisdom. Science urges us toward a hopeful future. If we use our souls along with our minds we will arrive, because through fiction and science—as dreamers and thinkers—we are already there. ∞

THE ARTS

By Patrick Tierney

The story is as old as art itself. Fingers of fire inscribe stone tablets, mysterious visitors leave a statue behind, an ethereal image precipitates on wood or cloth. All of these are familiar calling cards to both art historians and theologians. But the scientific investigation of religious objects "not made by human hands" is as new and disconcerting for scientists as it is for believers. After they take off their vestments and put on their private selves, churchmen doubt: "What if it's a forgery?" In their laboratories, scientists fret: "What if it's not?"

These questions are now being asked about a picture of the Virgin Mary that is the most revered religious icon in the Americas. Every year millions of pilgrims travel to the Basilica of Guadalupe in central Mexico, to see two strips of old sacking cloth, coarsely woven and weakly stitched together, bearing the image of an olive-skinned girl in a pink robe. This "Dark Virgin" has been the center of Latin American religious symbolism ever since December 12, 1531, when Catholics believe the Virgin Mary appeared to an Aztec convert named Juan Diego. She gave him roses, mysteriously blooming in winter, as proof of her visitation. According to tradition, Mary's likeness miraculously stamped itself upon Juan Diego's tilma, or apron, which he used in carrying the roses to an unbelieving bishop.

Scientific controversy over the tilma dates back to 1666, when the first of several panels began their investigations. By the eighteenth century, experts recognized peripheral decorations (an angel, a sunburst, and stars on the blue mantle) as obvious additions to the original. But the lifelike execution of the central figure confounded artists because it seemed to combine oil, watercolor, tempera, and fresco effects simultaneously—an achievement they considered even more remarkable given the crude, unconventional canvas of agave, a vegetable fabric. Doctors could deduce no natural cause for the survival of the fragile tilma, exposed to centuries of humidity and the smoke of numberless votive candles. Attempted replicas showed badly faded colors and signs of decomposition.

Modern scientists theorized that some preservative in the pigments themselves might account for the crisp, unsullied hues of the Virgin's portrait. A sample sent to Nobel Prize–winning Austrian chemist Richard Kuhn, however, was returned to church officials in 1936 with a cryptic appraisal: "On the two fibers analyzed, one red and the other yellow, there do not exist animal, vegetable, or mineral colorants." No one knows what this means, since explanations from chemistry drop off abruptly outside the animal, vegetable, and mineral kingdoms. Efforts to find Kuhn's complete study of the fibers have so far failed, and new analyses are still in the planning stage.

Others suspected Renaissance artists of sizing—glazing—the tilma, a procedure judged indispensable for making paint adhere to such a difficult surface. But infrared photography employed by Philip Callahan, a biophysicist and infrared expert with the U.S. Department of Agriculture, and Jody Smith, a philosophy-of-science professor from Pensacola College in Florida, detected neither underlayers of sizing nor overlayers of protective varnish. "It is remarkable," Callahan wrote following a three-hour examination of the painting, "that after more than four centuries there is no fading or cracking of the original figure on any portion of the agave tilma, which—unsized—should have deteriorated centuries ago."

"We also used infrared to search for an undersketch," Smith explains, "because paintings without underdrawings are almost nonexistent from that era. There was none. We were even more surprised by the absence of brush strokes—it looks as though someone applied the paint with a jet spray instead of a brush. We concluded that the image was created by an unknown technique."

The same conclusion is being reached by another line of inquiry that began in 1951, when an oculist examined the pupil of the Virgin's right eye with a high-

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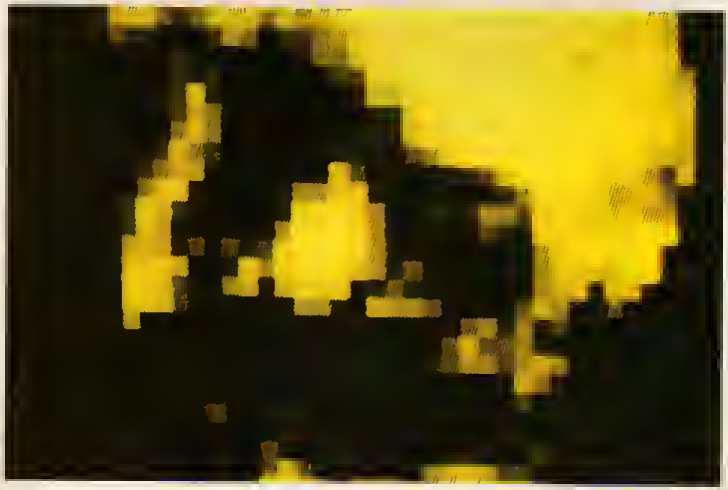


Does computer enhancement of the Virgin's cornea reveal a scene enacted 450 years ago?

THE COSMIC BURP

STARS

By Marcia Bartusiak

A strange marriage between astronomy and particle physics is reshaping our understanding of that primordial explosion known as the Big Bang. Most recently particle physicists have suggested that the universe may have begun not only with a bang but with a sort of cosmic burp—an infinitesimally brief moment of superaccelerated expansion.

Why are particle physicists suddenly interested in astronomy and cosmology? They have recently realized that the tremendously hot birth of the universe provides the perfect laboratory to test their latest mathematical musings—grand unified theories, or GUTs for short.

With GUTs, investigators of the submicroscopic world of elementary particles are beginning to show how the three nongravitational forces of nature—electromagnetism, the weak interaction that governs some forms of radioactive decay, and the strong nuclear force—are really the same. Each force acts differently at the low temperatures of our everyday life, but, say GUT theoreticians, they all become identical, or symmetrical, when energies get high enough.

Testing such ideas, however, is another matter. The energies required to achieve that wondrous symmetry are cosmic, on the order of 10^{23} electron volts. As MIT particle physicist Alan Guth points out, "Generating such energy in a lab would require a linear accelerator a light year long. This is why particle physicists eagerly turned to cosmology. The forces of nature were assuredly one during the first moments of the Big Bang."

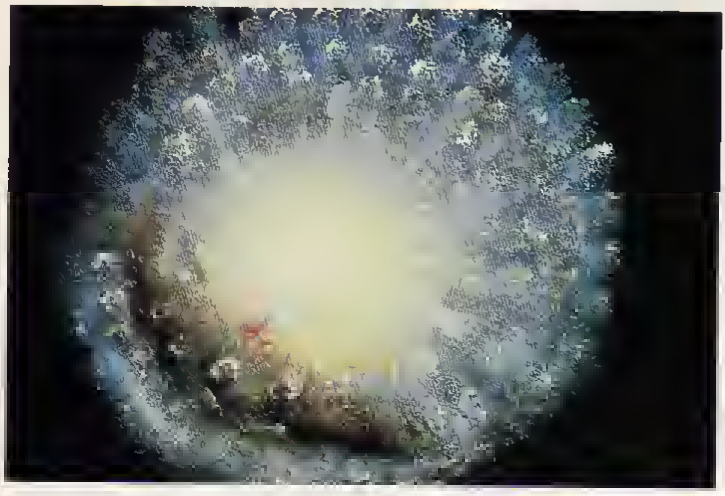
Guth was the first to suggest that at its inception the cosmos underwent a period of exceedingly rapid expansion, or inflation (the big burp). He arrived at this conclusion when he used GUTs to theoretically re-create the universe's cataclysmic birth. Guth's "inflationary" model was announced three years ago and has since been revised by particle physicists Andreas Albrecht and Paul Steinhardt, of the University of Pennsylvania, and Moscow physicist A. D. Linde. Their scenario begins 10^{-35} second after the Big Bang, when the universe was only one trillionth the size of a proton.

At that stage the submicroscopic, expanding ball of hot radiation was beginning to cool to less than 10^{27} degrees K. Normally that's the temperature at which symmetry should have broken—when the unified force would start to differentiate and subatomic particles like quarks, electrons, and neutrinos would become separate entities. But this did not happen right away. Instead, according to the inflationary model, the cosmos became supercooled and remained symmetrical as the temperature plunged, just as water can sometimes remain liquid below its freezing point. This delay in its "crystallization" placed the universe into a state of high energy that pushed it outward faster than had been postulated by previous Big Bang models. Once symmetry broke, the energy was suddenly converted into *all* the particles and radiation that surround us today.

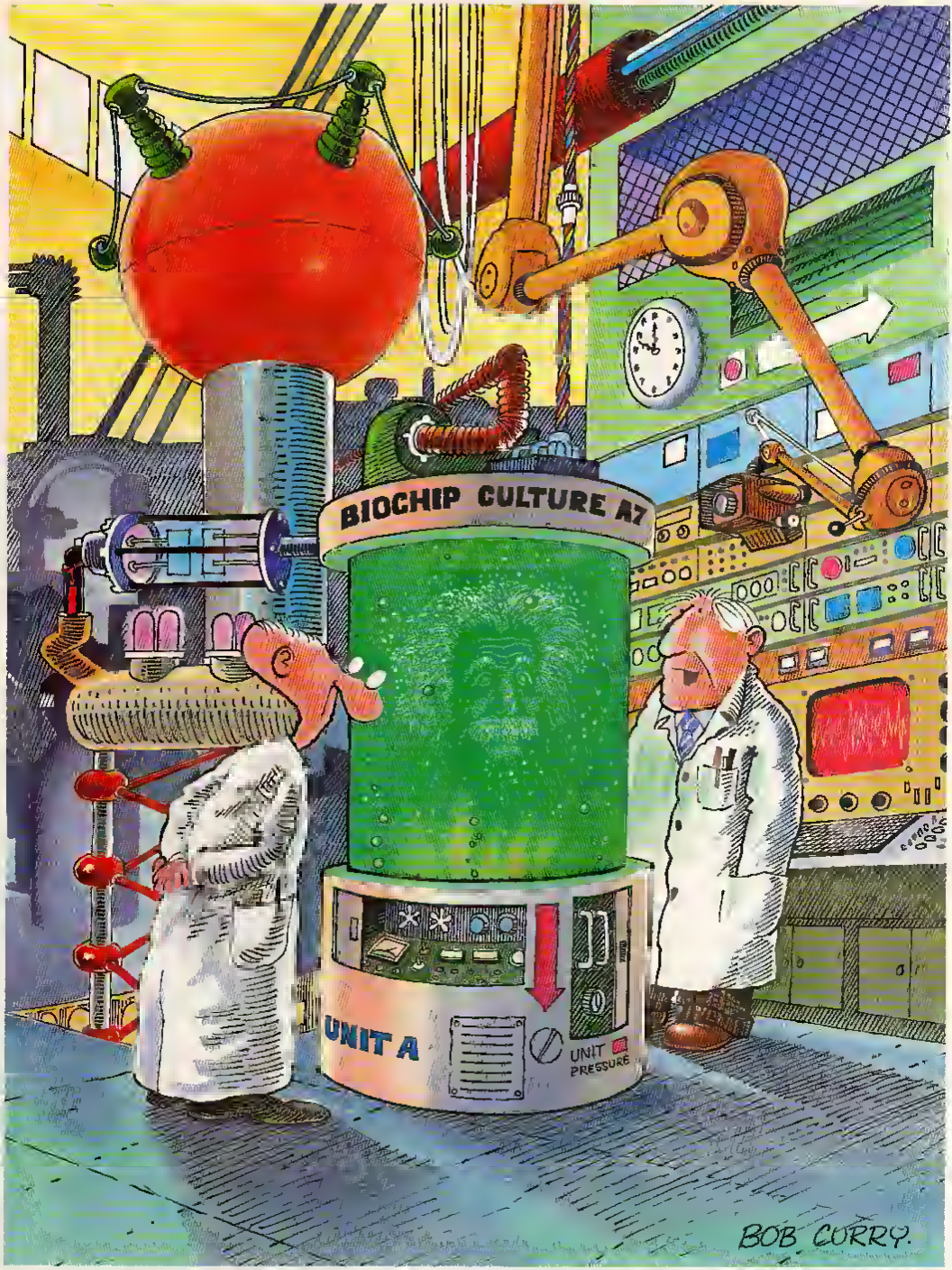
Researchers are enthusiastic about the idea because it explains some long-standing cosmological mysteries. Why is the universe so flat, that is, neither measurably open (destined to expand forever) nor closed (ready to collapse)? Guth and his colleagues suggest that if inflation had occurred at the moment of creation, space would have quickly flattened out, much as the surface of a balloon smooths out under expansion.

And there are other questions. Why are galaxies and energy distributed so evenly in all directions? Because just before inflation, our universe was a fraction the size of an atomic particle, small enough for matter to get uniformly mixed.

But one problem remains: galaxy formation. The inflationary model can explain how dust and gas eventually clumped together to begin the formation of galaxies. "According to the simplest grand unified theories, however," admits Guth, "galaxies tend to collapse into black holes at a rather early point in the universe's history." That dire prediction obviously did not come true, but supporters of the inflationary model are confident that someday they'll be able to match theory with observation.



We think the universe began with a Big Bang, but was it followed by a cosmic burp as well?



See what I mean professor? There's something darned familiar about this cluster of computer chips

CONTINUED FROM PAGE 12

publishing one of the most imaginative and thought-provoking magazines available on the market today

Lewis Bottomly
Phoenix

Another Soul Saved

I wish to thank *Omni* for changing the direction of my life Having been born a complete klutz I'd never mastered the art of tying a tie Scot Morris came to my rescue however with his item 'Tie One On' in the Games column of the April 1983 issue Therein he described a procedure so simple to master that even a total spastic like myself can be happily tying away after only a few hours of diligent practice

Once, my first question at a job interview was, "Er, what is the dress code here?" Salary and perks meant nothing if a tie was required Having suffered from years of such humiliating taunts as 'clip-on nerd' I saw no relief in that approach *Omni* has saved my life Now I can confidently move up into management head held high (no clips showing) looking toward a bright future Why, this completely justifies my two year renewal!

Don Stockbauer
Webster TX

Clearing the Air

The article 'The Greening of West Germany" by James Kitfield [Earth, April 1983] is accompanied by a photo showing a large electric-power plant with five smokestacks The air above those stacks is entirely clear, not a trace of emissions or pollution is seen coming from them Nearby are a set of large cooling towers We see that emissions are indeed coming from them Anyone who knows about power plants however, will see that those emissions are nothing but steam which does no more than add humidity to the air Clearly then this power plant represents the best available in pollution control

The photo caption reads "Pollution in West Germany has spawned a generation of youth dedicated to the environment"

Since successful efforts at controlling pollution are denounced as pollution it appears clear—as clear as the air above those smokestacks—that these West German youth are not really worried about attacking pollution Instead they are concerned with attacking industry Of course they wouldn't dream of doing without the electricity they use they just don't want it produced by power plants, no matter how advanced their pollution controls

Still, amid the fever swamps of the German left such flights from reality are far from new

At the end of World War I the Socialists took over in Berlin and canceled all contracts and payments to the Krupp firm which employed over 100 000 workers These same Socialists then decreed that no Krupp employee was to be laid off How were they to be paid? The answer from Berlin? *Irgendwie*—"Somehow"

T A Heppenheimer
Fountain Valley CA

Genetic Reversal

At Thomas Jefferson Junior High School, in Teaneck New Jersey we have incorporated the material from *Omni* into the science curriculum We have found all your articles interesting and informative particularly the ones that deal with genetic research The following poem was inspired by your publication

The scientists say we all were once
slime /way back in the past dark ages of
time /Perhaps we came out from under
a rock,/as gooey as Volvox or blue-green
Nostoc

Did you ever conjure the algal strand /
the ignominious Oscillatoria,/perhaps the
green ooze on the tip of your slide/was
once Uncle Donald or your Aunt Gloria

Now before I compose another dark
verse /just imagine evolution all in reverse /In your place the algae supreme erudite /the new *Homo sapiens*
a green Thallophyte
Imagine
Buffalo Bill Volvox shot bison with guns /
and mighty Babe Ulothrix swatted sixty
home runs /Henry Wadsworth Protococcus the American writer /and J Edgar Spirogyra the elder crime fighter

So treat the green plant with a new point
of view /Who knows it might someday
be great/to ponder Ronald Reagan Euglena as your president /or taking Victoria Gleocaspa out on a date

Love the gelatinous Anabenna do not
show disdain /for it could have been a
diatom washing you down the drain /So
doubt not my words Just let the thoughts
linger /an algal strand washing you off
its finger!

Neil Glazer
Principal
Thomas Jefferson Junior High School
Teaneck NJ

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Oughtagraphs:
signatures the way they oughta be

COMPETITION

By Scot Morris

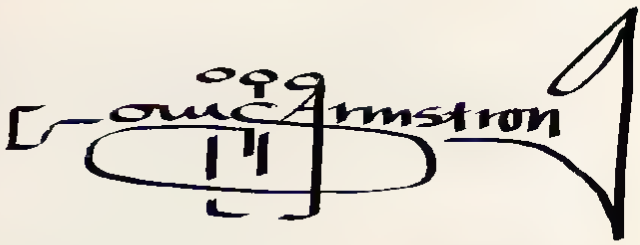
Our Competition #26, announced in the January issue, asked for "oughtagraphs"—the ways various famous personalities should have signed their names.

Many names suggested obvious presentations and were repeated often: Moses, Zeus, Mickey Mouse, Van Gogh, Johnny ¢a$h. The single name entered more often than any other: Dolly Parton.

We favored oughtagraphs that looked as if they really could be signatures, but we broke our rules in a couple of instances (Rube Goldberg and M. C. Escher) for some intricate signatures that wouldn't very likely appear on the backs of checks.

The idea and the name for this competition came from Jeffrey Scott, of Los

GRAND PRIZE-WINNER, $100



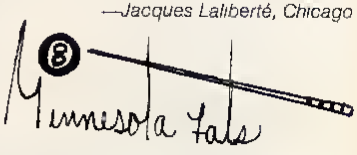
—Kristin Hagen, Alameda, CA

RUNNERS-UP, $25 EACH

—Peter Vanags, Seattle

—Jacques Laliberté, Chicago

—Brenda Petruska, East Brunswick, NJ



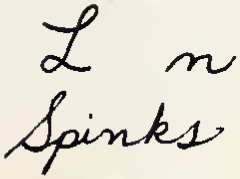
—Eleanor Klein, Los Angeles

—Melissa Jay Craig, Cleveland

—Pascal Portfolio, Huntington Beach, CA

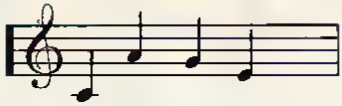
—Ken Faukenberry,
St. Simons Island, GA

—Beverly Kopp, Wayne, NJ



—Gina Bluso, Northfield Center, OH

—Howard Aho, Ferndale, MI



—Hermine Cohen, Selma, AL

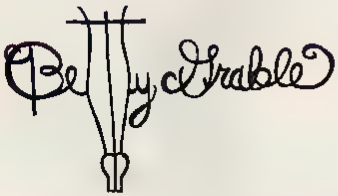
—Gordon Carleton East Lansing, MI

—Steven W Reed Ypsilanti, MI

—No name or address

—Ed Guyot Reseda, CA

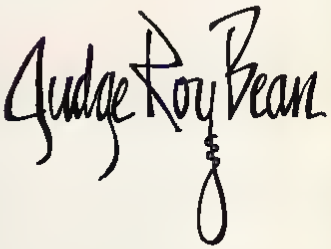
—Grand and Shirley Newlands, Newmarket, ON



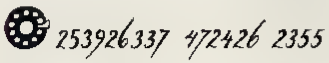
—Patricia A Burns, St Louis

—Vikki Appleton, Kansas City MO

—Diane Romatowski, East Brunswick, NJ

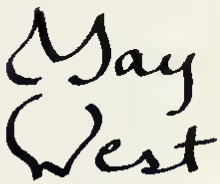


—Steve Magnuson, Cabin John, MD

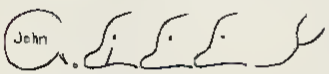


—Brenda Petruska, East Brunswick, NJ

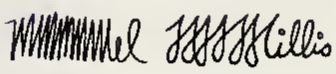
—Michael A Gapinski, Hill AFB, VT



—Melba B Stapleton, Lenoir NC



—Merrick S Ketcham, New York City



—Howard Aho, Ferndale, MI

Angeles, the originator of the animated *Pac-Man* TV series. Scott helped us choose the winners. In the January issue we printed Scott's original designs for Charles Richter, Galileo Galilei, Hermann Rorschach, Count Dracula, Uri Geller, Dr. Joseph Guillotin, and the Three Stooges. The grand prize-winner will receive $100, and nine runners-up will receive $25 each. The oughtagraphs on this page receive honorable mention.

It is worth noting that *Omni*'s female readership shone especially brightly in this competition. Six out of the ten money winners were female.

The entry from Melba B. Stapleton ("May West") gets a special booby prize. The calligraphy is well rendered; the spelling, however, merits a "dishonorable mention." Shall we take away Ms. Stapleton's *Omni* subscription? ☐☐

GAMES

ANSWERS TO GAMES (PAGE 192)

1 TUNNEL TRAIN A gravity train would indeed work Strangely enough, such a train would make all of its trips in about 42 minutes the same time it would take an object to fall through the center of the earth. The time is constant regardless of the tunnel's length

2 TILTING To compensate for the curvature of the earth

3 TOUCH Although the wrinkles and bumps on the earth's surface appear large to us—mountains that rise more than five miles up ocean trenches over six miles deep—you wouldn't be able to feel them on the miniaturized globe To the touch, in fact, the compressed earth would feel *smoother* than an ivory billiard ball

4 SHOOT Photographs show that the moon is the same size in both positions Atmospheric refraction would have the opposite effect—decreasing the apparent size of the moon The illusion is universal—it is apparent even in a planetarium, but there is still no fully accepted explanation for it Ptolemy argued that the horizon moon appears larger because we can compare it with distant trees and buildings This theory is still the most widely accepted one but it doesn't explain why sailors see the moon illusion just as vividly at sea

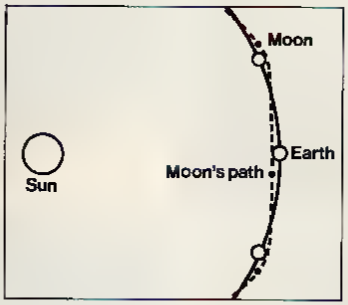
5 SURF It is convenient to speak of the moon going around the earth, but it is more accurate to say that they form a two body system that revolves around *its* center This common center of gravity is actually inside the earth because of the earth's greater mass As the earth swings around this center centrifugal force causes the ocean waters to flow away from the center producing two outward bulges on opposite sides of the globe

6 WATER POWER The earth's rotation is gradually slowing down Don't look forward to a 25-hour day or to getting a few extra minutes of sleep in the morning, however The effect is just enough to add about one second to the earth's day every 100,000 years

7 UP AND OVER About 18 5 feet It isn't the distance from the ground to the bar that is important but the distance from the jumper's center of gravity (CG) to the bar A six-foot male's CG is about 3 5 feet above the ground, so to jump his height he must raise his CG 2 5 feet On the moon he would be able to raise his CG six times as high or 15 feet By raising his legs up to clear the bar the same way he does on Earth, he could add that 3 5 feet back to the jump (just as on Earth), bringing him to the 18 feet 6 inches mark which is just over half the height that is commonly quoted

8 PULLS The moon's most pronounced orbit *is* around the sun, just as the earth's is So, in a sense, the sun *has* captured the moon The earth causes only a small perturbation in the solar orbit that the moon would have if the earth weren't here

9 ON TRACK The moon's orbit around the sun is always concave toward the sun At no time, even when it is swinging toward the back side of the earth does it ever recede from the sun The moon's annual path looks like a 13-sided polygon with rounded corners



PLANET IDENTIFICATION

A Jupiter Huge as it is, Jupiter is the fastest turning planet completing a revolution in about 9 hours, 50 minutes

B Venus It turns once on its axis in 243 Earth days In that time it has gone more than once around the sun (an orbit takes 224 7 days) Thus incredibly, Venus is the only planet with a day longer than its year

C Mercury

D Earth

E Saturn

F Neptune (Pluto's orbit is so eccentric that since January 23, 1979 it has been inside Neptune's orbit Pluto won't be farthest again until March 15, 1999 Until then the mnemonic should be "My very earnest mother just served us pickled nuts")

G Pluto The first two letters are the initials of Percival Lowell, who predicted the existence of Pluto the last two letters start the surname of Clyde Tombaugh, the man who in 1930 discovered Pluto from Lowell Observatory in Arizona

H Uranus The axis of its rotation is so nearly on the plane of the solar system that either end could be called north Because of this, one cannot say its rotation is clockwise or counterclockwise without ambiguity

I Mars The two moons that Swift predicted are Phobos and Deimos

MANY MOTIONS

A The motion of our galaxy through the universe

B Motion around the center of the galaxy

C Motion of the earth around the sun Note that this speed is faster than the next which might not have been expected

D Motion of the solar system through the galaxy (in the direction of the star Vega in the constellation Lyra)

E Revolution of a point on the equator around the earth's axis

F Continental drift North America and Europe are separating by about 3 inches per year It is estimated that the Atlantic Ocean is now 120 feet wider than it was when Columbus crossed it in 1492 ∞

PERFORMANCE

CONTINUED FROM PAGE 40

she produces music that is as disorienting in its sound as it is in its implications

Perhaps the most striking of her machinations is the tape bow violin which she first developed about four years ago It consists of a violin with a tape-playback head mounted on its bridge The bow that is drawn across it holds a strip of prerecorded audio tape instead of the conventional horsehair The speed with which Anderson draws the bow determines whether we hear a word a syllable or just a tone of what exists on the tape

As she moves from point to point across the stage adjusting and calibrating her electronic arsenal to create the 78 distinct worlds of *United States* Anderson becomes the new technological woman our digital diva Dressed in black, her dirty-blond hair glowing like silver she brings messages from the front "There are a lot of things that I say in performance," she confides "about technology and its failures But I'm using very sophisticated technology to say them"

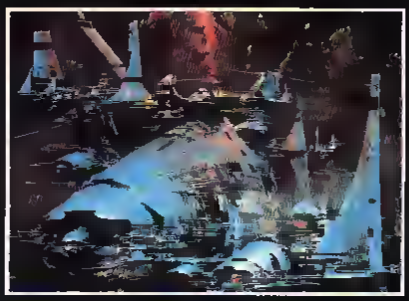
The 18 segments that make up *United States Part I*, called "Americans on the Move" were first performed in 1979 and revolve around the theme of transportation (along with electronic communication one of the *Big Science* networks) *Parts II–IV* center on politics, money and love "Really really hot topics," she adds

If *United States, Parts I–IV* can be said to be about anything it is about connections—the connection between Anderson and the audience, and the mysteriously but electrically charged spaces between her words sounds, and images Physically those spaces are energized by the connections she establishes with her machines and her fellow "technicians" In some segments she makes use of a double harmonizer a synthesizer with a repeat mode capacity that can change pitch over a range of two octaves Her engineer Bob Bielecki supervises amplification levels and acoustic design and projectionist Perry Hoberman coordinates the customized projection system that superimposes images throughout the performances In *Big Science*, the segment that closes *Part III* Anderson conducts synthesizers, engineers and photographs into a symphonic evocation of American cities and towns and the "science" that connects them "Golden cities golden towns, and long cars in long lines And great big science" Behind her mammoth architectural photographs of city buildings throb and glow in layered images on movie screens

For people who play video games watch the news and eat at the same time, and consider home computers a necessity rather than a luxury, Anderson's work hits home For a society that thrives on sensory overload she has created hieroglyphics that speak with deadly accuracy ∞

FIFTH ANNIVERSARY ISSUE
NEXT OMNI

FUTURE SHIPS

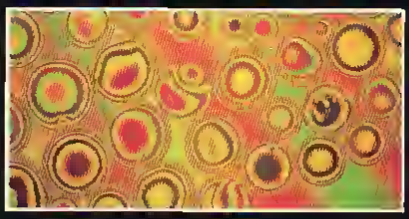


If we could fly to the moon in less then four hours, and to Mars in 55 hours, how long would it take to get to the edge of the solar system? About 16 days aboard one of the spaceships of the future. Writer James E. Oberg forecasts the lines of some of the ungainly-looking vehicles that will bring the stars within reach and make planet-hopping almost as simple as taking a weekend excursion. He reports on new developments in ion drives, on lightsails dotted with tiny holes, and on fusion and antimatter engines. And he predicts that the new technologies will have a profound effect on the way we perceive space. In the future, we'll view travel not in terms of distance but of time.

FICTION

John Updike, America's leading novelist, helps celebrate *Omni*'s fifth anniversary with a short story, "During the Jurassic." In a delightfully perceptive fantasy, Updike takes a satiric look at the cocktail set. This is one party you won't want to miss. Also in this issue *Omni* presents an excerpt from Isaac Asimov's new novel, *Robots of Dawn*. A top investigator from Earth is brought to Aurora when a robot is mysteriously murdered. Politics and intrigue run rampant in Asimov's thriller. And Dan Simmons's novelette *Carnon Comfort* concludes with a terrifying and deadly chase.

RETROSPECTIVE



Whatever became of the 1,080 Continuum items, 250 features, and 60 interviews that have appeared in *Omni*? To commemorate its fifth anniversary, *Omni* did a follow-up of the leading stories that have run since 1978. The findings reveal that *Omni* was right on target in predicting the triumph of the space shuttle, the advent of test-tube babies, and the checkered success of the artificial heart. For a retrospective of the future the way we saw it, read "Across Five Octobers."

ASTROGENESIS

Cosmic seas of interstellar gas and dust swarm with both simple and complex molecules in the largest chemistry set imaginable—the universe itself. These are the ingredients for planets and the life that flourishes on them. Isaac Asimov, a skilled biochemist as well as a famed science-fiction author, charts the progress that the young science of astrochemistry has made in piecing together the biggest puzzle of all: how random chemicals in space could have coalesced to form such a planet as ours. The clues are everywhere—in the burned casing of a meteorite, adrift in interstellar clouds, and locked in the geochemistry of the asteroids. In all these places, astrochemists are finding signs of chemical evolution.

PHENOMENA

Dewdrops appear as crystal globes of light in this fly's-eye view of a spiderweb. Nature photographer R. Hamilton Smith caught this ghostly study of light and form early one morning while searching for unusual spiderweb formations in a field in his native northern Minnesota. Working quickly, before the morning sun could burn away the dew, Smith attached a Nikkor zoom lens and a bellows unit to his Nikon FM and moved in close for a series of macrophotographs. The shallow depth of field made a constellation of lights appear in his viewfinder and in the final picture. Each point reflected the sunlight mirrored in the individual droplets strung along the fragile rigging of the web. The resulting view was decidedly unearthly. Smith says it was "like peering into another galaxy." He recorded this image on Kodachrome 64 film. DO

CONTINUED FROM PAGE 174

powered ophthalmoscope. He was astonished to see the tiny, embedded bust of a man, a finding since confirmed by a half-dozen oculists.

Of course, the human cornea reflects what a person sees at any given instant. And several doctors were convinced that the Virgin's corneas were reflecting a specific sight in Juan Diego's line of vision. Intrigued by these reports, Aste Tonsmann decided to undertake the "digitalization" of the eyes of the Virgin of Guadalupe. Tonsmann, a Cornell Ph.D. currently active in satellite image processing, first tried computer enhancement with photographs of human eyes and was able to reproduce, by magnification of the corneas, exactly what his subjects saw the instant the shutter snapped. He then applied the same method to the Virgin's corneas, dividing each square millimeter into 27,778 tiny blocks, color-coding each one and enlarging them all by a factor of 2,000. Thus a computer re-creates what the Virgin "saw" more than 450 years ago.

Tonsmann identifies the following figures in his dramatic miniature: an Indian (Juan Diego) opening his tilma before a Franciscan, the Franciscan himself (the bishop), on whose face a single tear is seen; a young man with his hand on his beard in a pose of extreme consternation; a bare-chested Indian in an act of prayer; a black woman; a family group; and other religious persons also dressed in Franciscan habits. Tonsmann argues that the Guadalupe painting is really a life-size "snapshot" of the Virgin Mary, whose eyes reflect a remarkable scene. Juan Diego opens his tilma on December 12, 1531, before the Franciscan bishop of Mexico, Juan Zumárraga, while members of Juan Diego's household look on.

To most people, all of these computer data look like a series of Rorschach inkblots open to any subjective interpretation. Tonsmann replies that the faces are better recognized by someone accustomed to image processing—easily distinguished, for example, from the enhancement of eyes taken from other paintings.

"The figures correspond amazingly well to historical records of Juan Diego's meeting with Bishop Zumárraga, when the picture first unexpectedly appeared. In fact, the most prominent Franciscan looks like Zumárraga as he was portrayed in a painting by the artist Miguel Cabrera. We also know," the excited Tonsmann continues, "that the bishop had a black female servant who can be recognized by her hair.

"When we compare the enlargements from both of the Virgin's eyes," Tonsmann claims, "we find the same figures, in the same positions, but in different sizes. This is exactly what I would expect from the enhancement of human corneas, given the difference in angle and distance between each one and the scene in question."

Image-enhancement technology is so new in art that few qualify to referee Tonsmann's work. The first successful application of digital image processing was by three scientists at NASA's Jet Propulsion Laboratory, who reconstructed the underdrawing of a Flemish masterpiece last year. One member of the team, Donald Lynn, suggests that Tonsmann's findings would be more useful if he could obtain the image of the corneas directly, perhaps through a television camera operating at much lower light levels and with a broader dynamic range than the photographs he's presently enhancing.

Lynn is trying to assemble a group of scientists and art conservators who will effect these kinds of sophisticated experiments on the Guadalupe painting.

Until more is known, however, critics will have their hands full explaining how sixteenth-century Aztecs painted microscopic Franciscans into the infinitesimal spaces of the Virgin's corneas—without underdrawings or brush strokes—on an unprepared, unprotected sacking cloth using a pigment whose origin is neither animal, vegetable, nor mineral.

It's an old story. ∞

EXPLORATIONS

CONTINUED FROM PAGE 30

has been an Akihabara merchant for more than 26 years. Take began in a small stall (from which he still sells) and has expanded his company to a modest three-store chain. Now he sells everything from calculators to reel-to-reel tape decks. "I once sold things like condensers and vacuum tubes," he recalled. "I remember in 1958 when the first transistor radios were sold here. We never thought there would be anything like an integrated circuit."

Take said the area experienced some of its biggest growth in the late Sixties, when U.S. soldiers on leave from combat duty in Vietnam flocked in to buy cameras and high-quality stereo equipment.

Today Akihabara draws huge numbers of hard-core kit builders who scour the second floor shops and busy stands for semiconductors, memory chips and diodes or liquid-crystal-display digital readouts. There are about 200 outlets for such electronic parts. Neal Ulevitch, an American living in Tokyo for the past four and a half years, has built two home computers from parts bought in Akihabara shops. Ulevitch said there is a growing market for Apple II computer knockoffs—counterfeits by all definitions—sprouting up in the back rooms of some stores. "They look exactly like the real Apple IIs, only without the Apple logos," Ulevitch said. "It's the forty-eight-K central processing unit with the regular keyboard. The software is a direct ripoff; it even says APPLESOFT when you boot it up. The price is about two hundred fifty dollars."

If you're shopping for a legitimate product in the district, there are a few suggestions that might help you obtain the cheapest price. The best way to get the salesman's attention is to begin playing with the item you're interested in. (Demo models are available everywhere, and almost every major store has at least one English-speaking salesman.)

Let's say that you see a Sony Walkman III, for instance, with a list price of 22,000 yen (about $82 at current exchange rates). The salesman may cross out the price and write 18,000 YEN on the card (about $65), saying something like "special price for you." If you point to the shop next door and shake your head—meaning you can get it cheaper down the block—you might persuade him to go as low as 15,000 yen ($55). Don't buy a camera or lens in Akihabara. There are better deals in the Ginza district, or even in the United States.

High-fidelity cassette tape is very inexpensive, and it's almost impossible to buy without seeing it cheaper someplace else in Akihabara. Be certain that electrical appliances have 110-volt outlet plugs. Many warranties are honored only in Japan, so bear that in mind if you make a major purchase. And shops with TAX FREE signs will save you a 15 percent commodity tax when you produce your passport. ∞

A hole through the earth
and questions on a cosmic scale

GAMES

By Scot Morris

Last month we presented here the outrageous 'outside-in' theory, which claims that the earth is a hollow sphere and that we are inside it along with everything else in the universe. When the geometrical operation called inversion is performed on the earth's sphere, everything formerly outside the sphere is mapped to a corresponding spot inside, and vice versa. As we explained last month, if the inversion is followed completely (which would invert the laws of physics as well as the geometry of space) there would be no practical test that could prove this cockeyed theory wasn't true.

We don't believe the outside-in theory for a moment, but one writer who does says that the only test would be to drill a hole straight through the center of the earth to the other side. If the earth is convex, as conventional views have it, the hole will come out on the other side of the earth, some 8,000 miles away. If the earth is a concave sphere, no one knows how this experiment will come out, since no one has ever drilled through the shell to the "outside" of the universe.

We're not sure this through-hole would really settle the question, and we would therefore support Senator William Proxmire and any others who might oppose federal funding for such a project.

Still, the hypothetical question is an interesting one. What would happen if you jumped down a hole that went straight through the center of the earth? One of Alice's first "wonders" occurred as she fell down the rabbit hole. "I wonder if I shall fall right *through* the earth! How funny it'll seem to come out among the people that walk with their heads downwards! The Antipathies, I think—"

The question itself goes back to Plutarch, and even Francis Bacon and Voltaire argued about it. Galileo gave the answer we accept as correct. You would fall faster and faster (increasing your speed but decreasing your acceleration), until you reached maximum velocity—about five miles per second—at the earth's center. Then you would decelerate until your speed reached zero at the other end of the hole. If you never touched the edge of the hole, and if there were no effects of air resistance, you would continue oscillating back and forth forever.

The trip would be amazingly fast—about 42 minutes for a one-way drop to the antipode, 84 minutes for the round trip.

Global thinking along these lines has inspired us to put together some other questions about our planet, its nearest companion, and our fellow travelers.

1 TUNNEL TRAIN. Lewis Carroll proposed another sort of earth hole in the second part of his fantasy novel *Sylvie and Bruno*, in which a German professor describes a train that would travel from city to city powered only by gravity. "Each railway is in a long tunnel, perfectly straight, so of course the *middle* of it is nearer the center of the globe than the two ends, so every train runs halfway *downhill*, and that gives it force enough to run the *other* half uphill."

Ignoring friction and air resistance, as before, would such a gravity train work? About how long would it take to get from, say, Los Angeles to San Francisco? From L.A. to New York?

2 TILTING TOWERS. The longest suspension bridge in the world is the Humber Estuary Bridge in England, just short of a mile long between the supports. (Opened in July 1981, it beat out New York's Verrazano Narrows Bridge.) The two towers are not quite parallel. They are 1.375 inches farther apart at the tops than at the bottoms. Why?

3 TOUCH TEST. The earth is almost a sphere, but not quite. Not only is it flattened at the poles and bulging at the equator, and slightly larger in the southern half (as who among us is not?), but it also has irregular features on its surface that anyone can see—mountains, canyons, ocean bottoms. If the earth were reduced to the size of a billiard ball, and all the oceans were dried off with a towel, what would it feel like? Would you be able to feel the mountain ranges, the ocean valleys, and the continental boundaries?

4 SHOOT THE MOON. If you want to take a picture of the full moon and get the largest possible image on film, should you shoot it when it is directly overhead (and therefore at its closest point to your position on Earth), or when it is down near the horizon? Almost everyone says that the moon is largest near the horizon. Is this an atmospheric effect or a psychological one? Does it show up in photographs?

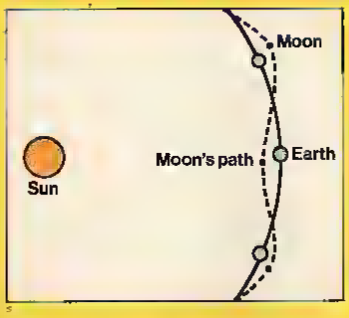
5 SURF'S UP. The ocean tides are caused by the gravitational pull of the moon and sun, mostly of the moon. But why are there *two* high tides a day? When there's a high tide on the side of the earth closest to the moon, there is simultaneously a high tide on the opposite side of the earth, farthest from the moon. How do you explain the second high tide? What makes the water bulge in a direction *away* from the moon?

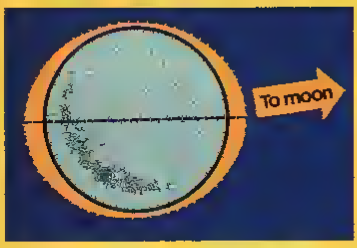
6 WATER POWER. The motion of the earth and moon causes the tides. And the ceaseless sloshing of the tides is having an effect on the motion of the earth. What's happening?

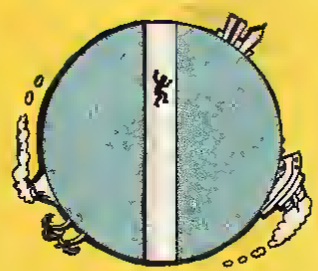
7 UP AND OVER. The moon's gravity is about one sixth that of Earth. If you weigh 120 pounds on your bathroom scale, you'll weigh a mere 20 on the moon. An object tossed straight up on the moon will go six times as high as it would on Earth if thrown with the same force.

The first Lunar Olympics will be held in an enclosed arena, warmed and air filled, so that athletes won't be encumbered by space suits. If a high jumper can clear a six-foot bar on Earth, to what height will he or she be able to jump on the moon? The answer usually given—36 feet—is incorrect.

8 PULLS. About how much do you think is the moon affected by the gravitational pull of the sun, as compared with that of the earth? The moon stays with us and doesn't go flying off toward the sun, so the earth's attraction is greater, right? Wrong. The sun pulls more than







Clockwise from lower right. How long would it take to fall through the earth (with no friction or air resistance)? Why are there two high tides every day? Why does the moon look so much bigger on the horizon than it does overhead? What is the path of the moon around the sun?

twice as hard as the earth. So why hasn't the sun stolen our moon away?

9. ON TRACK. What sort of path does the moon trace in its yearly cycle around the sun? Clearly, it stays close to the earth's orbit. The drawing at top right shows the moon wobbling back and forth across Earth's orbit. Aside from not being to scale, is the diagram approximately accurate? When is the moon's orbit convex toward the sun? In other words, about how much of the time during its orbit is the moon curving away from the sun?

PLANET IDENTIFICATION

Sure you know the planets. As in the old mnemonic: "My very earnest mother just served us nine pickles. Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto."

But do you really know them? Each of the statements below describes one planet only. Can you put each orb in its proper place?

_____ A. The planet with the shortest day—it spins on its axis more rapidly than any other.

_____ B. The planet with the longest day—it takes longer than any other planet to turn once around.

_____ C. The planet that achieves the highest velocity in its orbit around the sun, averaging over 107,000 mph.

_____ D. The densest planet. It is approximately 5.5 times heavier than an equal volume of water.

_____ E. The least dense planet. With an average density of 0.7, it would float on water if you could find a pool big enough.

_____ F. As we go to press, this planet is farthest from the sun.

_____ G. The only planet (other than Earth) with only one moon: this planet was named after a Roman god. Perhaps not coincidentally, the spelling of the name commemorates both the man who predicted the existence of the planet and the man who actually discovered it.

_____ H. The only planet on which one cannot identify a north pole, or specify unambiguously whether it is spinning clockwise or counterclockwise.

_____ I. The planet whose moons were first described in this uncanny passage from Jonathan Swift's *Gulliver's Travels*. "They [the Laputans] have likewise discovered two lesser stars, or satellites, which revolve about [the planet] whereof the innermost is distant from the centre of the primary planet exactly three of his diameters, and the outermost five, the former revolves in the space of ten hours, and the latter in twenty-one and an half."

The description is approximately accurate. What's hard to believe is that it's from a work of fiction published in 1726. The first telescope big enough to see the satellites in question was not built until 1820, and they were not, in fact, identified until 1877—more than 150 years after Swift's remarkable prediction.

MANY MOTIONS

The spot where you're sitting is moving through space in at least six different ways—the galaxy is moving through space, the star system is moving through the galaxy, the earth is revolving around the sun, and so on. Here are six estimated velocities at which you are now traveling. What does each speed represent?

A. 375 mps (miles per second, 1,350,000 mph).

B. 170 mps (612,000 mph).

C. 18.5 mps (66,600 mph).

D. 12 mps (43,200 mph).

E. Up to 1,035 mph.

F. 1.5 inches per year.

Answers are on page 184.

LAST WORD

By John Ficarra

"Is it possible we are already dead and this is the afterlife? Would this mean that giggling at funerals will suddenly become more socially acceptable?"

Of all the mysteries of the universe, death ranks among those we know least about. One reason usually offered half in jest, is, "No one has ever come back to tell us what it's like." Or has someone? Death has gotten a lot of scientific attention in the past few years. Are we on the brink of unraveling the great mystery of the hereafter? Let us briefly examine some of the theories and research.

First there is the question of when death occurs. Until recently doctors had a simple rule of thumb: When a person's heart stopped beating, that person was considered to be clinically dead. (Even if a person didn't happen to be in a clinic at the moment his heart stopped beating, the rule still applied.)

But now that medical technology can revive a person whose heart has stopped, doctors are struggling to write an entirely new definition. This is no easy task, since most doctors already have trouble reading their own writing, let alone anyone else's. Still, they now generally agree on a new criterion: Death occurs when there is no longer any brain activity. (This definition puts many a politician in immediate deep trouble.)

Then there is the hotly debated question of whether there is an afterlife. Long before the scientific community became intrigued with the possibility of a hereafter, there had been various artistic attempts to examine the question. Most notably, there were the two Broadway plays, *Life After Death of a Salesman* and *Whose Life After Death Is It, Anyway?* And of course, with somewhat lesser success, there is the television show *The Dukes of Hazzard*.

Scientists who believe in an afterlife generally agree that after a person dies, his soul leaves the body and travels to a different plane. The only exception to this rule occurs when a person dies in a plane mishap, in which case his soul will have to remain on board or he'll have to change planes in Atlanta.

Does this mean death automatically spells the end of contact with others? At the moment there is no scientific evidence to suggest that anyone is capable of making contact with someone who has died. (The same holds true for making contact with a doctor, living or dead, on a weekend.) Of course there are those who will try to contact a deceased loved one through a medium. But anyone claiming to be a medium is probably nothing more than a con man whose only interest is making contact with your wallet. Law-enforcement officials have cracked down on this scam, but people should beware. There is still a small group of mediums at large.

There is, however, one area coming under more intense scientific investigation: out-of-body experiences, sometimes known as astral projections. Many such cases have been recorded, but the most famous astral projection occurred last year in Cleveland. While in the hospital having a chronic boil drained, a forty-five-year-old Dictaphone repairman named Lance Rivers suffered a massive heart attack. His heart stopped beating for two minutes, and he was pronounced clinically dead. Rivers later reported that during those 120 seconds he felt as though he were floating up near the ceiling of the room and watching quietly as frantic doctors and relatives hovered around his hospital bed. Rivers's account of what he saw and heard is the most chilling account to date of what actually happens after death.

"I remember lying in bed and suddenly feeling this sharp pain in my chest," Rivers reports. "I went blank for a few seconds, and when I came to, I was sort of floating, slowly being lifted higher and higher. I clearly remember hearing the doctor say, 'I'm sorry. He's dead.' This was followed immediately by my brother-in-law sobbing, 'Oh, God. I just hope he has insurance.'

"'Show some respect!' my sister snapped. 'After all, he's my brother. We gotta do what's right.'

"'Yeah, sure,' my brother-in-law answered, 'as long as it doesn't cost an arm and a leg.'

"'Speaking of which,' the doctor asked, 'have you considered leaving your brother, or parts of him, to science? We have a patient just down the hall who needs a new set of knuckles desperately.'

"'I'm too upset to talk about it now,' my sister replied. 'Besides, I have to get out of here and buy a black dress before the mall closes.'

"Then everything went dark. When I awoke, I was back in my hospital bed. The doctor was gone. My sister and brother-in-law were gone. So was my watch, my transistor radio, my St. Christopher medal, my extra pair of pajamas, two fruit baskets, and my lunch tray."

Do experiences like Mr. Rivers's suggest that there is something like an afterlife? If that can be proven, is it possible that we are already dead and this is the afterlife? (Talk about your major disappointments.) Would that mean the more enterprising of us could make a small fortune in the long-term leasing of coffins as "low-maintenance, one-bedroom condos"? And most important, will this mean that giggling at funerals will suddenly become more socially acceptable? We look to science for the answers. ∞

John Ficarra, an associate editor at Mad magazine, says that as a comedy writer, he has experienced death many times.