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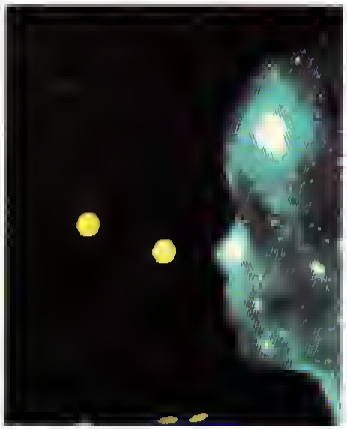
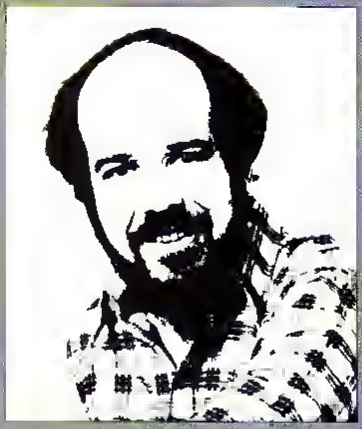


Cover art for this month's *Omni* is a multi-image photograph by California filmmaker and photographer Larry Norager. In order to produce the image-on-image effect Norager utilized a 500-watt laser projection to create *The Universe Within*



FRANK KENDRICK

"Today, it seems, nobody in the aerospace business talks about anything beyond the next scheduled dip into the federal pocketbook."

Nothing worthwhile is ever achieved easily," wrote physicist-engineer Robert W. Bussard at the end of his now-famous paper describing how to build a ramjet. The paper outlined plans for a spacecraft that would employ powerful magnetic fields to collect interstellar hydrogen that would be used to fuel the vehicle. Its purpose was obvious—to carry men to the stars.

Bussard's paper was published in 1960, three years after *Sputnik I*, the first artificial satellite, was launched and a year before Yuri Gagarin became the first human to go into space. In those days everybody was talking about going to the moon and then onward into the depths of space. But that was before the budget cuts, before the antitechnological sentiments of the 1960s gathered their full momentum. Today, it seems, nobody in the aerospace business talks about anything beyond the next scheduled dip into the federal pocketbook.

Bussard himself went on to work at Los Alamos, to found his own companies, and later to head up the then Atomic Energy Commission's engineering program in nuclear fusion. Then, in 1977, he was asked to address the board of directors of the American Institute of Astronautics and Aeronautics (AIAA), a professional society of aerospace engineers, scientists, and students.

"When I got interested in the American Rocket Society [the precursor of the AIAA] back in 1938 or so, it was kind of a collection of crazies," said Bussard to the assembled board of the AIAA. "Everybody was looking at the big problem. Can we ever go to the moon? The world was young and new and exciting; the war hadn't come and gone, and all those new things to do were just sitting out there. Then, a few months ago, I looked at the AIAA's 1977 annual-meeting program with its theme Aerospace in the Third Century. A provocative title—a long way to look ahead. But as I looked through the detailed program, I saw mostly ideas like intercity air transport, freight hauling with vertical-takeoff aircraft, better air traffic control, and other things that will matter to us this year and next year— the things that will matter to the survival of corporations and federal bureaucracies. That worried me. I wondered where all that childlike enthusiasm and innocence had gone."

Bussard proceeded to shower the AIAA board with ideas about things that will matter to us well beyond this year or the next—rockets powered by particle beams, long-distance transmission of energy by laser beam, interplanetary space shuttles, and, of course, an interstellar ramjet. "All I really want to leave with you," he concluded, "is the thought that we open our minds and think beyond next year's budget with its two thousand—or maybe twenty thousand—cruise missiles and go back and enjoy the idea that it is okay to think freely. You represent a group with an unbroken history of having the greatest creativity of any that's existed in this country. Don't abdicate that position!"

Whether or not the AIAA will abdicate its position as the fountainhead of creativity within the aerospace industry is, of course, a question still unanswered. The board did later appoint Bussard chairman of the AIAA's new Technical Working Group on Future Flight Systems, charged to stimulate thinking on new technologies for the year 2000 and beyond. It was an important step, but only the first of many.

Enthusiasm for our move into space, if it is to have any effect, not only must be rekindled within the aerospace industry but must be instilled in the general public. Only then, when public support for the space program equals that exhibited on the July day in 1969 when Neil Armstrong and Buzz Aldrin landed on the moon, will the promise of space begin to be realized.

Curiously, thanks to movies like *Star Wars* and *Close Encounters* and even space operas like *Battlestar Galactica*, we now have among us a generation of young people wildly excited about the possibilities of space. Each year the average age of NASA employees goes up. Thus we have a generation gap on our hands, a split between the dream of space and its reality. Luckily there are men like Bob Bussard at work to bring the two generations together.

The situation was well put last fall by former astronaut, now Senator, Harrison H. Schmitt in an address to the Institute of Electrical and Electronic Engineers. "When there are young generations of Americans champing at the bit to move our civilization of freedom back to the frontier of space," he said, "we say to them, 'Wait! One percent of our budget, or one fifth of one percent of our gross national product, is too much for such childish dreams.' Hogwash! Civilization is moving into space." ∞

Evenings that memories are made of...

DRAMBUIE LIQUEUR IMPORTED BY
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CONTRIBUTORS

OMNIBUS

OBERG

ROBINSON

DURANT

NAHIN

Eighty years ago a Russian schoolteacher named Konstantin Tsiolkovskiy said, "The Earth is the cradle of the mind, but one does not live in the cradle forever. Humanity will venture beyond the edge of the atmosphere and then will boldly move out and occupy all of the worlds and spaces around the sun."

The Russians have come a long way since their astronautical humiliations of a decade ago and are now much closer than most of us think to realizing Tsiolkovskiy's dream. This month *Omni* presents a rare and in-depth glimpse into the world of Soviet space exploration beginning with an exclusive article on Soviet space colonies by *James Oberg*. In "Red Star in Orbit" (page 76), Oberg, a specialist in Chinese/Soviet space programs, closely examines Russia's new aggressive and concentrated space effort, which is already laying foundations for such ambitious projects as robot tanker spaceships, pseudogravity multimodular space stations, and possibly nuclear-power space tugs. "By the mid-1980s the Soviets will have built several permanently inhabited space settlements in orbits around the earth and the moon," writes Oberg. "Why not? They've nurtured and treasured that dream, and now they're moving boldly to harvest it."

To illustrate the contemporary space activities of the USSR, as well as future concepts of space exploration, *Omni* contacted *Frederick C. Durant III*, assistant director of the National Air and Space Museum and head of the astronautics department. Durant's close association with *Andrei Sokolov*, the leading space artist in the Soviet Union, gave *Omni* access to some of the most treasured and revered works of Soviet space art to date. Sokolov's portfolio, containing imaginative visions of distant planets, alien life forms, and far-off stellar systems, begins on page 80.

Rounding out *Omni*'s "Soviet space package" is an excerpt from "Self-Discovery" (page 88), a novel by Soviet science fiction writer *Vladimir Savchenko*. Trained as an electrical engineer, Savchenko began writing science fiction in the late '50s. His abilities as a raconteur, combining speculative science with a satirical view of scientific politics, has established him as one of the leading Soviet novelists.

Though the chemical details of memory and learning are still unknown, 20 years of research have begun to reveal some of its secrets. Medical researchers have found more than a dozen chemicals said to promote "intelligence" in man or animals. Most strengthen the memory and improve learning ability. Some may even promote genuine creativity. Authors *Sandy Shakoclus* and *Durk Pearson* claim that such "psychopharmaceuticals" are available now—some of them right at your local drugstore. In "Mind Food" (page 54), they'll tell you where you can find these intelligence drugs and how to use them.

The monster of Loch Ness has been pursued with everything from harpoons to submarines armed with machine guns. Beethoven symphonies and Scottish tunes have been piped through giant underwater speakers in hopes of luring the beast. Now high technology introduces TAD (target alarm detector), a wooden raft equipped with an array of electronically synchronized lights and cameras loaded with the fastest color film in the world. "It's the most sophisticated animal trap ever devised," say journalists *John Chesterman* and *Michael Marten*. Will TAD finally catch the elusive Nessie? See for yourself on page 92.

This month's fiction highlights *Paul J. Nahin* ("The Language Clarifier," page 100). A professor of electrical and computer engineering, Nahin has been writing science fiction for over a decade and, "after learning many things the hard way, began selling it about two years ago." A graduate of Stanford, Caltech, and the University of California at Irvine, Nahin recently won the Harry Rowe Mimno Award for speculative writing.

Joining Nahin in this issue are two masters of science fiction, the incomparable *Spider Robinson* and *Gregory Benford*. Robinson ("God Is an Iron," page 66), a folk singer and composer of his own music, recently won the Hugo Award for his novel *Star Dance*. Benford, a physicist from California, marks his second appearance in *Omni* with "Dark Sanctuary" (page 50). ∞

COMMUNICATIONS

Religious Birds

In the interview with E O Wilson [February 1979] the statement is made that religion seems to be a uniquely human impulse

Some birds seem to have a ritual they perform before they fan out over their feeding territory in the morning and again when they return to the flock at night Is it not possible that some of the forerunners of man gathered in a safe refuge at night and fanned out over a feeding area during the day?

If a daily bonding ritual has some survival value for birds then perhaps some similar ritual provided the genetic base for our religious needs

Eugene Marquis
James Park Canada

Old Blue Eyes

While it's a well-known fact that blue-eyed people are notorious for their outrageous behavior E O Wilson's statement "It's just one of those crazy things we got stuck with like hair on the backs of our hands or the difficulty blue eyed people have when they go to the tropics" has left me wondering Exactly what kind of "difficulty" do blue-eyed people encounter in the tropics?

It may seem strange that I am troubled by this minor point but I have been haunted by similar statements in the past including "Oak trees are struck by lightning more often than any other trees" and "Bananas do not grow from seeds" I am at a loss as to why oak trees attract more lightning and wonder if banana plants spring from the earth by spontaneous generation

So what kind of difficulty do blue-eyed people have in the tropics? Perhaps they bump into banana trees that are shooting up spontaneously from the earth or have a hard time dodging falling oak trees

Jane Racinskas
Bratenahl Ohio

Pain

I was offended by the photographs accompanying the article "An End to Pain" [February 1979] depicting a chimpanzee undergoing electrode-stimulation tests Perhaps the photographers or better yet the scientists themselves should have one of those contraptions attached to their own heads

Richard Rosen
New Orleans La

Goodbye Gravity

Gentlemen I hope you emphasize the fact that your readers must read carefully every line in your articles To build your antigravity machine [January 1979] I assembled an automobile using only negative matter

Somehow I must have skipped over the sentence "But we must be very careful how we handle it" I gave the car a push to see if as Dr Forward said it would come *toward* me I must have pushed too hard for now I'm pinned against the wall And I can't get out by pushing it away from me! Help!

Addison W Plummer
McLean Va

All in His Head

Concerning the statement in Dennis Overbye's article on Stephen Hawking [February 1979] that Beethoven never wrote an entire symphony in his head For that matter he never tried to write a single piece in his head Not that he couldn't but Beethoven's method of composition was wholly different He rarely created a composition to which he could not have attributed countless revisions His sketchbooks quickly reveal this interesting fact to us

The man to whom Mr Overbye was probably referring was Mozart Manuscript evidence exists that demonstrates that Mozart almost invariably thought out a complete work before writing or trying it out on his clavier In fact he was known to write entire symphonies in his head—a feat that has been compared to Milton's dictating *Paradise Lost* to his daughters or Hawking's memorization of the long strings of equations that give life to his ideas

Enrique Sanchez
Miami Fla

CONTINUED ON PAGE 126

DIALOGUE

FORUM

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

Isaac

I find I must comment on the February Arts column regarding Isaac Asimov [p 28] You state that he will not willingly fly Are you pulling my leg?

Some of the best space illustrations I have ever painted have been conjured up in my mind after reading a passage from one of the numerous works of Isaac Asimov I find his detail to be some of the most moving ever written giving one reason to believe Asimov himself must surely have flown through all the galaxy Now I am being asked to believe he is afraid to fly

Please tell me that Asimov prefers other modes of transportation because they are more romantic or something. I can hardly believe he must be forced to fly

Richard L Isakson
Forest Grove, Oreg

Dr Asimov replies *I love to fly but only in my imagination*

I take exception to Ben Bova s generalization in the February *Omni* that "most writers spend most of their lives not writing Almost every one of the great masterworks was produced over a very short period of time" Was James Joyce consulted for this statement? Or Kazantzakis? The only quick masterpiece I ve heard of was Handel s *Messiah* which was composed only after a lengthy period of deliberation

The writers I ve known pull double-duty to exist and to turn out their manuscripts To hear such calumny from a man of Bova s tine reputation cuts me to the quick I hope he reconsiders

Keith A Drake
Kalamazoo Mich

Patented Antigravity

While Doc Forward s "Goodbye Gravity [January 1979] does massage the notion that we may blunder onto the secret of antigravity sometime between next Tuesday and the end of time it is rather lame in that it does not so much as mention work under way—and even patented—by gentle folk who have not forgotten how to roll up the shirt sleeves and put their gravitrons where their mouths are so to speak

For those who wish to depart the "iffy and hesitant domains of salaried academics I suggest you write to the Patent Office They describe electro-kinetic devices that act in a certain manner that defies gravity

And while your quantum mechanical eyebrows are up consider Englishman J R R Searl who boasts of having developed the technology necessary to achieve gravitic repulsion and does so regularly

Take a moment to consider these pioneers bearing in mind before you dismiss them as "silly that the same adjective applies to anyone who pretends to possess a respectable theory for the control of a force no one has ever explained

Allan J Grise
Santa Monica Calif

Twelve Is Not Enough

I saw your February issue it had a wealth of future-oriented articles and a good many future-looking people in there too But I was brought up short by the remarks of interviewee Carla Bley in the jazz article in the Music section

To paraphrase her attitude Nothing should be composed that a piano can't play in its 12-tone tempered scale

Pianos definitely aren't the instruments of tomorrow What other glued-together wooden machinery is in use today? Pianos belong to the nineteenth century and while they spurred progress in music then they thwart it now Most of the ordinary scales possibilities have been mined to exhaustion

There is now a non-12-tone movement with new music and new instruments both acoustic and electronic These new instruments and scales have new moods hitherto unheard—the serenity of 31-tone the zonk of 19-tone the hard brilliance of 17-tone

Ivor Darreg
San Diego Calif

Natural Rejection

I thoroughly enjoy reading *Omni* In fact it is the only magazine I read aside from biological journals

However I reserve some criticisms for certain biological speculations offered by Dr I J Good in the January issue [see Interview] In brief he has done a disservice to evolutionary theory by suggesting that natural selection and his "natural rejection" could both operate at the same time in parallel This thinking is an example of the confusion of the linguistic form and the logical form of the theory of natural selection

In the most common linguistic form it is often said that selection 'favors' some adaptive trait In the logical form such progressive adaptation is explained as a process of selective *elimination* of poorly adaptive traits via the lower reproductive fitness of poorly adapted individuals

Thus in nature there is never 'selection for' but only "selection against" The former is only a linguistic form for the results of the latter process

Richard F Norman
Department of Biology
McGill University
Montreal, P Q , Canada

Martian Dilemma

The "Odds Against Life" item in the January Continuum inadvertently dismisses one of the major controversies in modern biology or exobiology Whether *Viking* detected life on Mars is by no means a settled issue However a closer look at what did happen will show that the odds are for life existing on Mars rather than not

As I reported in *New Scientist* (October 12 1978) the Labelled Release (LR) experiment produced radiochemical

evidence of metabolism in the soil samples. On Earth this would certainly have been considered prima facie evidence of biological activity. On Mars it was questioned largely because a corollary experiment, a survey by the gas chromatograph mass spectrometer, failed to find organic molecules in soil samples. Of the two other biology experiments, one remains ambiguous as to the existence of life; the other negative.

Viking thus leaves us with a first-class mystery. Either it turned up evidence of life or it discovered some mysterious inorganic reaction that simulates it. So far NASA has been content to leave the question in limbo.

The findings of the LR experiment are quite explicit. Tests run in half a dozen laboratories have failed to yield an inorganic explanation of LR results. Although the mystery of what *Viking* found on Mars could easily be exploited to pump for funding another go at Mars, the space agency has shown a curious reluctance to do so. The reason: *Viking* is a hard act to follow. No one quite knows what to do next short of urging a manned expedition, currently a taboo subject in the NASA bureaucracy.

Richard S. Lewis
Indialantic, Fla.

Oil-Drop Levitation

In "Goodbye Gravity" [January 1979] Dr. Forward mentions how gravity could be overcome and puts forth several methods. They all, however, require a great amount of mass. Nowhere does Dr. Forward mention anything about electricity. Yet if I am correct, Robert Millikan used that force in 1909 to counteract the gravitational force while performing his famous oil-drop experiment. He used two electrical plates, each of opposite charge, to eliminate gravity, so to speak, and vary both the upward and the downward velocities of the oil drop.

I realize, of course, that an oil drop is an incredibly tiny object and therefore has a very small mass, but I maintain that if eliminating gravity can be done for an oil drop, it can be done for a tractor.

In "The First Starship" also in the January issue, Owen Davies proposes a method of propulsion using a huge laser and a gigantic sail. Now I had read that the law of inverse squares demands that the amount of energy in the laser should decrease by the inverse square of the distance. What this implies is that a laser projected over a great distance would lose energy rapidly, making it impractical for even an orbital weapon, much less a giant rod to push an interstellar probe six light-years to Barnard's star. Am I wrong?

Kevin Z. O'Brian
Fort Wayne, Ind.

Dr. Forward replies: *Yes, Millikan did use electricity to levitate an oil drop back in 1909. You can also levitate bits of paper or the hair on your head by combing your hair on a dry day. I would even be willing to admit that, if we tried hard enough, we could levitate a tractor with electricity. However, this electrical levitation has some deficiencies. First, the technique requires that each thing to be levitated have certain specific properties that the levitating field can work on (that it be charged for electric levitation), and the amount of that property has to be adjusted according to the amount of mass to be levitated. However, for dense-matter gravitational levitation, the response of all bodies in the levitating field is the same, and they don't have to be modified or touched in any way.*

If we were to attempt to levitate you by using a large-scale version of the Millikan oil-drop apparatus, most of the lifting forces would come where the charges would collect, at your hands, feet, and hair, while your middle would droop down. You would feel as if you were trussed to a pole

Overcoming gravity by use of electric current

between two Indian warriors, while a third was trying to lift your scalp! Gravitational levitation is much more pleasant.

You are right about the inverse square law on the laser-propelled sail that I first proposed back in 1962. But for a laser, that law applies only outside what is called the "near-field" zone. Inside the near-field zone you can actually focus the laser beam or make it travel in a parallel beam with negligible expansion. For a laser array 300 kilometers across and shooting out a green laser beam, the near-field zone extends out to nearly 19 light-years! That means that nearly all light from a 300-kilometer laser array can be focused on a 300-kilometer diameter sail even at distances of many light-years. Outside the 19-light-year region, the inverse square law will apply.

Planet Farming

Concerning the article "Farming of the Planets" [February 1979], it is a most interesting idea but, unfortunately bound by the fetters of possibility. Most ecologists of my acquaintance would not consider it a noble endeavor to alter the ecosystem of the Sahara, let alone the entire planet Venus.

To counter the problem of excessive heat, Mr. Oberg would produce clouds and dust storms on the face of the planet while flooding the magnetosphere with ions. The clouds and dust already exist on Venus, which is the main reason it remains at an unbearable 500°C. Ions introduced into the magnetosphere would be attracted toward the poles, producing ionic storms at the polar regions.

As far as the problem of water is concerned, the solutions presented are hardly more feasible. No significant quantities of ice are known to exist on Mars, and the extreme temperature on Venus would prevent the existence of water in its liquid form. The diversion of a comet to provide water is as impractical as it is difficult. The path of such a comet would have to be controlled within minutes of arc. If such a diversion could be made without the destruction of the comet, the amount of material remaining would be absurdly small. It has been noted that the entire tail of most comets would conveniently fit inside an average-size suitcase. If the diversion of even large masses of ice were to be accomplished by 1,000 megaton bombs, as the author suggests, it would be too radioactive to be safe for use.

It is quite apparent that the radical alteration of the ecosystem of our immediate neighbors is quite impractical, at best. As one looks to the future, the emphasis should be placed on finding other planets like ours, not creating them. A solar system of pseudo-Earths would be very monotonous indeed.

Walter Boyeler
Tijeras, N. M.

Monopoly

I agree wholeheartedly with executive editor Frank Kendig that scientific and technical information should not be the exclusive domain of established journals [First Word, February 1979].

However, Mr. Kendig is in grave error when he suggests that these journals should not have a "virtual monopoly on new breakthroughs." The complicated process of peer review may delay the announcement of such breakthroughs, but this delay is a necessity. It is the responsibility of the scientific journal to ensure critical review. At the same time, the popular press serves an invaluable function in translating the journal article into a form the general population can understand.

Curtis K. Deutsch
University of Texas
Austin, Tex.

Social Darwinism Revisited

Your interview in the February *Omni* did not reveal the essentially political nature of E. O. Wilson's ideas. Sociobiology is

CONTINUED ON PAGE 130

PARADISE LOST

EARTH

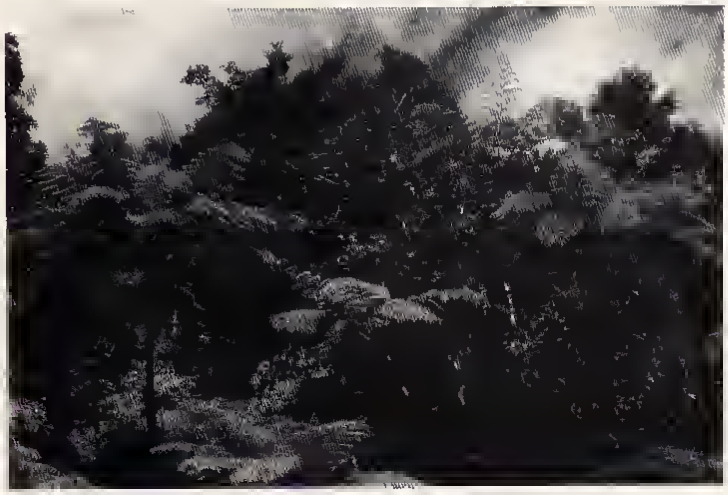
By Kenneth Brower

Our earliest account of a tropical rain forest is from Christopher Columbus. Of the island Hispaniola, which he discovered in 1492, Columbus wrote, "Its lands are high [with] many sierras and lofty mountains. All are most beautiful, of a thousand shapes, and all are accessible and filled with trees of a thousand kinds and tall . . . and I am told they never lose their foliage, as I can understand, for I saw them as green and lovely as they are in Spain in May."

The Hispaniola of Columbus, like most other islands in the West Indies, was entirely covered by tropical forest. Today, 487 years later, Hispaniola retains less than 9 percent of its original cover, and that small relic of a jungle is going fast. Haiti, the nation occupying the western third of the island, has fallen from paradise to paradigm. It is this hemisphere's foremost example of the troubles that deforestation can bring to a tropical land and its people.

Haiti was once France's richest colony. A land of abundant sun and rain, its plantations exported more sugar, indigo, cotton, cacao, and coffee—more wealth—than any of England's or Spain's New World possessions. But that glow was an unhealthy one. Haiti was being mined. Its productivity was built on the abuse of land and people. The plantations grew on hillsides ruthlessly cleared of those native trees. The land was worked by slaves, men and women whose lives were so brutal that once in a generation—about every 20 years—Haiti's entire population had to be replaced.

In 1791 the slaves began a revolution for independence, which finally succeeded in 1804. Haiti was the first colony in Latin America to win its independence. It seemed a promising beginning, but in truth the new nation's foundations were already compromised and crumbling. A second revolt, a revolt of the land, soon followed the first. Caused by the agricultural practices of the French, it gathered momentum with the fires and destruction of wars for independence, the vindictive burning of plantations after victory, and reached breaking point with the burgeoning numbers of Haitians.



Tropical rain forests grow freely because of bountiful rains and constant temperatures.

The revolt of the land has made for irony. It rendered Henri Christophe, mad king of northern Haiti, an Ozymandias of the Jungle. Christophe's Citadel might serve as a symbol for all Haiti. Fifteen years in the building, at a cost, the story goes, of 20,000 lives, the citadel has walls 32 meters thick, a garrison large enough for 10,000 soldiers, and endless ranks of enormous cannons. To Napoleon, who had attacked Haiti once, and to anyone else, the fortress said, "Look on my works, ye mighty, and despair!" The Citadel today is as grim and impregnable as ever, built on a mountainside that the tropical rain is washing away.

Today, the revolt of the Haitian earth has triumphed. It has undone the work of Toussaint L'Ouverture, the liberator. It has placed every inhabitant of Haiti under house arrest. The land has lost its flexibility, and Haitians are once again slaves, this time to poverty and the caprices of weather. The vines and earth shifts of the new revolt have cracked and tumbled the stone walls of Henri Christophe. The real *Tontons Macoutes* are the bogeymen of deforestation—overpopulation, erosion, and floods.

Haiti's lesson is larger than the island. Haiti is all of the tropical forests of the world in microcosm. The ruination there, having a narrower compass, was achieved more quickly, and its rules are easier to abstract. The Amazon Basin is just a big Haiti, and that's what we have to worry about.

The tropical rain forest runs in a dark-green, nearly continuous belt around the equator of this planet. It is confined almost entirely to the latitudes between the tropics of Capricorn and Cancer, although thin fingers of forest poke south past Capricorn into Argentina and western Australia, and a lobe of forest rises north above Cancer into Burma. The forest has a number of definitions. *Tropical rain forest* is a term that was invented by A. F. W. Schimper in 1898. He described it as "evergreen, hygrophilous in character, at least 30 meters high, but usually much taller . . . rich in thick lianes and woody as well as herbaceous epiphytes." For some

CONTINUED ON PAGE 133

QUASARS, BLAZARS, AND SPINARS

SPACE

By Mark R. Chartrand III

Quasar! The very name evokes visions of vast power, primordial matter, the brightness of a trillion suns, mystery.

Quasar, quasar, burning bright
In the depths of cosmic night
What supernal alchemy
Fuels thy luminosity?

In the decade and a half since these curious objects were first identified, the mystery has broadened and deepened. Many astrophysicists are beginning to think that quasars are only one type in a wide range of energetic extragalactic phenomena. Britain's Dr. Martin J. Rees has even called for a whole new classification scheme to replace the helter-skelter assortment of terms now in use for high-powered radio sources with terms that recognize their basic similarity.

In the 1950s, radio astronomy was just getting up steam. As radio sources were discovered, astronomers tried to match them with objects seen with and photographed through conventional telescopes. Some radio sources turned out to be nebulas—clouds of gas and dust within our Milky Way galaxy. Others were far from our city of stars; they were in fact galaxies in their own right. Still others seemed to be single stars—mere points of light on photographs of the areas of sky from which the radio waves came. Early names for these were "quasi-stellar radio source" "quasi-stellar object," and their acronyms QSRS and QSO. "Quasar," probably the most glamorous term in the astronomer's lexicon, is the one that has survived.

Wondering what these "radio stars" might be, optical astronomers spread their light into a spectrum, displaying all the different wavelengths. The spectrum revealed a swath of light overlaid by bright and dark lines, particular wavelengths where the intensity of radiation is enhanced or diminished by the material of the star.

Now it is well known that each chemical element emits and absorbs light of particular wavelengths under specific conditions. Thus, to the trained eye, the lines in a spectrum form a dossier of the elements that are present in the source and the physical conditions that exist there—pressure, temperature, density and so on.

But the lines in the spectrum of the quasars matched no known chemical elements!

In 1963, Caltech astronomer Maarten Schmidt had a brilliant insight, the kind of inspiration that is based on many years of fruitful research but that transcends the usual methodical pace of scientific investigation.

Schmidt realized that the lines in the spectrum of one quasar could be explained if he assumed that the quasar was moving away from us very fast. When an object is receding from us, the Doppler effect shifts the wavelengths of the light we see toward the red end of the spectrum. This effect could have shifted normally invisible ultraviolet lines redward into the visible portion of the spectrum. If this were so, the quasar must be whizzing away from earth at fully one tenth the speed of light!

The quasar was therefore surely not a star, for it would have escaped from the gravitational confines of the galaxy long ago. The quasar must be out among the galaxies, millions of light-years away in space. If it is that far distant it must be exceptionally luminous to appear as bright as it seems to us. Even more puzzling, because it appears as but a point of light even with the most powerful telescopes, it must be very small on a cosmic scale—perhaps too small to produce all that radiated energy by any means within current theory.

Quasar 3 C 273. Power far beyond its size.

We know the active parts of quasars must be small since they vary their light output in a short period of time—weeks, even days. If such an object is to drastically change its brightness, all parts of it must change in phase; uncoordinated changes would cancel out and produce only a weak flickering. Something must then coordinate all parts of the quasar. Some signal must go from one side to tell the other side to change. The fastest information carrier the laws of relativity permit is light, so if an object varies coherently within a day it must be no bigger than a light-day across.

Now a light-day is about 26 billion kilometers, twice the diameter of the solar system and incomprehensibly enormous on a human scale. Cosmically, it is tiny—the nearest star is four light-years, more than 1,400 times as far away—especially when you consider how much energy is coming from that volume. Tiny as they are, a typical quasar might continuously radiate as much energy as a trillion suns—10 to 100 times the output of our entire galaxy.

Some quasars are surrounded by a faint haze; others spew out jets of material at tens of thousands of kilometers per second. Still other quasars do not radiate any radio waves. About 95 percent of the quasars are radio quiet. Thus the term *quasar*— meaning "quasi-stellar radio source"—is inaccurate. Some astronomers think we may have to change it; others think it may come to encompass a broader range of energetic cosmic denizens that have been recognized in recent years.

The first of these was found in 1929, when a faint object in the obscure constellation of Lacerta (the Lizard) was

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MEDICAL MYTH

LIFE

By Dr. Bernard Dixon

I was even more pleased than usual when I peeled open my copy of the technical journal *Science* recently. It contained a paper by two physiologists from the University of Michigan Medical School that confirmed suspicions I've had for some years about a silly but widespread medical habit. Dr. Matthew Kluger and Barbara Rothenburg have discovered evidence that physicians eagerness to prescribe drugs like aspirin to reduce a temperature can do more harm than good. This medical reflex is founded on the idea that a person's temperature should be brought back to normal as speedily as possible. In practice, such medication may well interfere with the body's own defenses—defenses often more effective than drugs.

Andre Lwoff, an unconventional Nobel laureate, first questioned the idea that fever was an intrinsic part of disease, and thus a phenomenon to be combated, about ten years ago. Working at the Pasteur Institute in Paris, he discovered that poliomyelitis virus grows well in tissue-cultured cells at 35°C (95°F) but increasingly poorly as the temperature approaches 40°C (104°F). Between 38.5 and 39°C (101.3 and 102.2°F) the release of new infectious virus particles falls from 95 percent of that at 35°C (95°F) to 2 percent. So even a slight rise in temperature reduces considerably the multiplication of polio viruses. The implication of this work was clear. While a *substantially* elevated temperature—above 41°C (105.8°F)—requires urgent treatment, the indiscriminate use of aspirin or other antipyretic drugs to bring down moderate fever in influenza can be unwise. Increased temperature may well be the body's most potent means of thwarting viral disease.

In the past three years, several research groups have confirmed Professor Lwoff's observations and found that they apply to other microbes as well. What Matthew Kluger and Barbara Rothenburg have now done is to show how fever acts against invading bacteria. And where Lwoff worked with tissue cultures, the Michigan physiologists investigated fever in mammals. Their results may well apply to human infections.

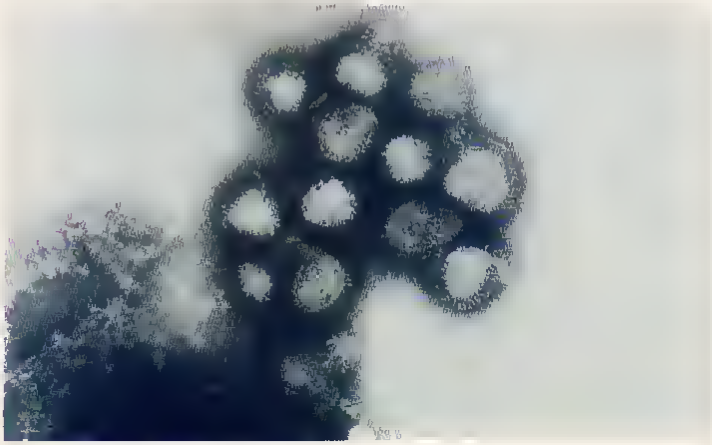
The subjects for the experiments were New Zealand rabbits infected with *Pasteurella multocida*—a bacterium related to the plague bacillus, that is a common cause of disease in rabbits. Dr. Kluger and his colleague noted two related effects. As the infected rabbits' temperature rose, the amount of iron in their blood plasma fell. So the duo next studied what happened when they cultured *P. multocida* in artificial-nutrient media at various temperatures and with different amounts of iron. The results were striking. At the temperature of healthy rabbits, the bacteria multiplied well whatever the concentration of iron. Fever temperatures inhibited their growth.

Other investigators have reported that the virulence of many disease-causing bacteria depends on their ability to secure adequate supplies of iron. Reduction of this uptake may explain why a fever is an important, positive force in the fight against infection.

The Michigan researchers conclude that taking drugs to reduce fever may well impair the body's own protective machinery. While aspirin remains an excellent drug to combat pain, prescribing it indiscriminately to reduce fever, as many physicians do, may be a serious error.

It would, in fact, be extraordinary if these findings are not applicable to man as well as to rabbits. Dr. Lwoff and his colleagues found that when dogs infected with the vaccinia virus were given fever-reducing drugs, their chances of dying increased. And mice suffering from virus encephalitis can be cured as easily by raising their temperature as by giving them massive injections of antibodies.

Kluger and Rothenburg's tests illustrate one effect involving nutrition. Researchers at the Justus Liebig University, Giessen, have discovered that a crucial enzyme involved in manufacturing influenza virus is unstable at the temperatures reached during the disease itself. Others suggest that animal cells produce more interferon during fever. Whatever the detailed explanation, an important message is clearly emerging. Next time you are sweating out a bout of flu, you can be pretty sure you are doing yourself a power of good.



Virus particles. Your fever brings hard times for them, it could be your body's best defense

LIFE IN THE LIQUID PLANET

STARS

By Patrick Moore

Most people can swim. Even I can, though someone once said unkindly that I give a spirited impression of a baby seal with training flippers. Most animals can also swim, at least passably. And we know that the sea is teeming with life, some of it very intelligent. Dolphins, sea lions and porpoises are no fools, as we have learned. What, then, are the chances that somewhere advanced life forms live in a liquid environment?

By "advanced life forms" I mean beings who can not only communicate, as dolphins admittedly can, but who have a real language and are capable of teaching, building, and so on. Olaf Stapledon's magnificent novel *Star Maker* describes one such civilization. But, of course, that is only fiction, we have no proof that any intelligent race lives in a liquid environment. Eor that matter, we have no proof that life exists anywhere beyond the earth, and a few eminent scientists believe that it does not. I will return to that later. In the meantime, what about liquid planets?

Rather surprisingly, there is a liquid planet no farther away than Jupiter, the largest member of the sun's family. One scientist commented that the solar system is made up of the sun, Jupiter, and assorted debris. This may be an extreme view, but Jupiter is certainly more massive than all the rest of the planets put together. Its equatorial diameter is more than 140,800 kilometers, and its huge globe could contain a thousand earths.

The surface we see through our telescopes is gaseous. We can make out dark belts, where atmospheric gas descends toward the planet's surface, bright zones, where the gas is surging upward, and such specific features as the Great Red Spot's huge oval. The surface of Jupiter is always changing, and our view of it alters in minutes. Jupiter spins round quickly. At less than ten hours, its day is the shortest in the solar system, though the Jovian year is 11.9 times as long as ours.

Even though Jupiter is remote—its mean distance from the sun is 772.8 million kilometers—it shines brilliantly in our skies. It has been in the news of late because two *Voyager* probes have been en route there. They did not try to land, of course, but flew past at a respectful distance, sending back spectacular photographs and much information. We can never go near Jupiter ourselves because the planet is surrounded by zones of lethal radiation and by an immensely powerful magnetic field.

Yet we have finally begun to learn what Jupiter is like under its upper layer of gas. For many years astronomers thought that it could be a miniature sun, lighting and warming its moons. When this attractive idea was disproved in the 1920s, most authorities decided there would be a rocky core surrounded by a thick layer of ice which would in turn be overlaid by a gaseous atmosphere.

Today this has also been assigned to the astronomical scrap heap. We have found that Jupiter radiates more energy than it could if it depended entirely on the sun. The inner temperature must be thousands of degrees. This does not make Jupiter a miniature star, but it surely rules out any thick layer of subsurface ice.

One thing we have known for more than 40 years is that Jupiter's upper gas is rich in hydrogen, together with such unpre- possessing hydrogen compounds as ammonia and methane. Lower down, the situation must be different. According to one recent model, Jupiter may be made up chiefly of liquid hydrogen, with only a relatively small solid core. If true, this provides a liquid environment. Moreover, there must be a region below the cold upper gas and above the hot inner core where the temperature is much the same as it is in our own seas. It seems likely that most of the fundamental materials needed for life exist there, and this intriguingly suggests that living beings may be swimming happily about in the Jovian hydrogen oceans.

Could Jupiter's roiling gas hide intelligent life?

Obviously, any such beings would be fundamentally different from any of the life forms we know on Earth. Yet the conditions there may not be quite so uncompro- misingly hostile to life as, for instance, the surface of airless Mercury or even that of the moon, the one world we can prove is sterile without any doubt.

It is easy to let our imaginations run riot. Would the Jovians have fins and flippers? Would they be able to talk? Their eyes would have to be good; very little light could penetrate those murky depths. But they could know nothing about the great universe around them.

I admit to being something of a skeptic. I have very little faith that life occupies the Jovian deeps. But one never knows! Unfortunately, it will be very difficult to find out one way or the other. With manned visits impossible, the most we can do is to dispatch an unmanned "entry probe" that would plunge to its destruction in the upper gas, sending back information for as long as possible.

On the other hand, Jupiter has four large satellites and at least nine small ones. Of these, Callisto, the outermost of the large moons, seems to be the most promising target for would-be explorers. It is well over a million kilometers from Jupiter and is therefore safely outside the radiation zones.

In the far future, a Callisto expedition may land. Its members will do all they can to learn whether anyone lives in Jupiter's seas. I think they will fail. I hope I am wrong.

THE ARTS

By James Delson

Brave New World is not really science fiction anymore," says Burt Brinckerhoff, director of the NBC Novel for Television. "It was in 1932, but now it's more of a social statement. I like to equate it with what might happen if McDonald's took over the world."

Aldous Huxley's classic story of a dystopian society has never been translated to the screen. This is largely because filmmakers and television executives have traditionally approached science-fiction social commentaries as second-rate projects in which scientists continually ask their governments why the world has turned out the way it has. Before now *Brave New World* could offer only a serio-comic look at the plasticized future described above by Mr. Brinckerhoff—not the most commercial of prospects.

The Brave New World of Huxley's story is a place where every aspect of people's lives is dictated by inflexible rules. Birth is achieved through test-tube conception, engineered to produce five specific types of human life forms whose genetic codes are predetermined according to levels of intelligence. Emotion is downplayed, though sex is available for all. Drugs, especially the sedative Soma, are used to induce a variety of responses. Euthanasia is accepted as commonplace, and those found guilty of nonconformity are exiled rather than imprisoned.

As has been the case with so many recent science-fiction films, *Brave New World* came to be made only because of the popularity of *Star Wars* and *Close Encounters of the Third Kind*. "When the show's producer, Jacqueline Babbin, first brought the project to the networks several years ago," Brinckerhoff explained, "she couldn't have gotten it off the ground without the success of those two films. Before that, the feeling always seemed to be that there just wasn't enough here as a straight story, and as satire there was fear that it couldn't be properly handled.

"I had worked with Jacqueline Babbin on a series called *Beacon Hill* a few years ago," Brinckerhoff went on. "When she needed a director for *Brave New World*, I knew it would be an enormous challenge. Everyone has read the book, or heard of it, but their memory of it is generally clouded by time. As a result, a certain vision of the story lingers, colored by decades of mistaken memories. Our task was to have the audience come away from their television sets having seen something that they could remember identifying with even if their recollections were inaccurate to begin with.

"I've always enjoyed science fiction, though I've never directed in the field before. It requires one to use his imagination, to reach beyond the boundaries and limitations of other types of stories to explore things. You can't just look down a tunnel and be involved with science fiction. The McDonald's remark wasn't meant to be offensive. The story just has that kind of implication. There are many things which are extensions of where we are now, set 600 years in the future. We don't want to mislead people, though. Our film is a story about people, not an exploration of the hardware that has come to be so closely identified with science fiction since *Star Wars*.

"For instance, we didn't bother exploring the travel possibilities of the future. We just left it as a given that people knew how to do it, just as they would have evolved in every other field in the next six centuries. Once we had established what the world was going to be like, we just tried to be true to it. We didn't worry about how they traveled from one place to another very quickly, about what kinds of weapons they had, and those kinds of things. We concentrated instead on what kinds of relationships those particular people would have within that atmosphere.

"I was confused by *Star Wars* in one sense," Brinckerhoff continued. "I admired it, but was baffled by it because so many people thought it was just pure entertainment. I thought it was one of the most violent films I had seen in a long time if you took each laser *ZAP!* to be what it was meant to be. Somehow you can excuse it if it's just *ZAP!* instead of *BANG!* Bodies fall to the ground as soon as they're shot, and everyone has a Roy Rogers pistol which fires endlessly without the need for reloading. No one feels pain, no one bleeds; they just fall down dead.

"I want people to laugh at the future we've created in *Brave New World*," Brinckerhoff suggested. "I want them to draw the parallels between 600 years in the future and 1979. Then, perhaps, they'll

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Aldous Huxley's great dystopian novel Brave New World *comes to the television screen soon*

THE ARTS

By James Delson

When a new television version of *Buck Rogers* was announced in 1977, it was conceived as a three-part miniseries, with each show running two hours in succeeding weeks. After NBC saw the first script, the initial producers were replaced by Glen Larson, who had already begun production on his *Battlestar Galactica* series for ABC. "I had originally been approached to do *Buck*," Larson explained, "but I was too busy developing *Galactica*, so I turned it down. NBC came back later, having found the script they were given to be too much of a comic book.

"We decided to go ahead and handle the whole project of three two-hour movies, but it was quite clear from the start that we'd put most of our time and money into the first one. The 'start-up' costs on a show this size are enormous. On *Galactica*, Larson had to design and build sets, full-scale mock-ups, miniature models, costumes, props, and other equipment, plus create a whole range of special-effects material. Though each episode of *Galactica* costs about a million dollars, now the start-up was in excess of ten million. When Larson explained that the situation would be very similar for *Buck Rogers*, NBC immediately began talking about discarding the second and third parts of the miniseries. They would go directly into a weekly show using the film as a pilot.

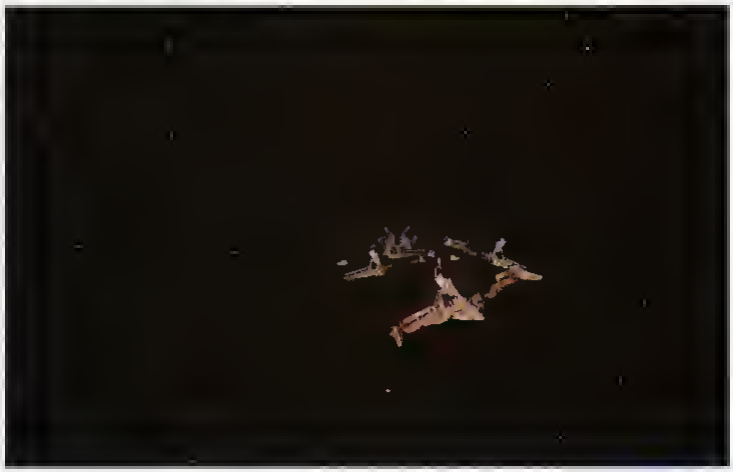
"By this time we'd learned a lot about the science-fiction market," Larson said. "We'd already had a taste of success with the release of the theatrical version of *Galactica* in Canada. We said, 'Look, let's do this right from the beginning. Let's release this as a feature.' If they could shoot the special effects with big-screen professionalism, the film's success would presell the series later on. 'Since NBC had the rights to the property, it would be like owning *Close Encounters* before it was released. No bidding against other networks. It had the potential of being very successful."

John Dykstra, line producer and director of special effects on the *Galactica* movie, had felt its effects were not up to his standards for theatrical release. The film audience, however, didn't care that the movie had originally been planned and shot for television, and the film has done well in movie houses. Larson must have agreed with Dykstra to some extent, because he spent a great deal of money improving *Buck Rogers*'s effects sequences. NBC had not committed itself to a theatrical release when the filming was started, but from the beginning both Larson and director Daniel Haller were sure to cover themselves. They knew that even if NBC decided to show it on television here, it would at least get theatrical distribution abroad.

"Whenever you do a television film that's two hours long or more," Haller said, "it is always considered eligible for foreign release if it's any good at all. This means that whenever you've got the time, you shoot more long shots to insert where you've initially placed all those close-ups so necessary for television. Of course, the theatrical version has to fake a second position, because the show's being financed as a TV movie."

Since NBC hadn't made up its mind about releasing the film in US theaters, Haller explained that he had to stick to the planned schedule. "I didn't hear that we'd be getting a domestic release until some weeks after the show was finished," Haller recalled. "I was on another show by then, but they asked me to come back to shoot some additional footage to flesh out the movie. I thought 'Oh Christ! Why didn't they tell me? Why didn't I know?' But nobody knew. You can't second-guess on a TV movie. There isn't time."

Television politics finally allowed Larson to release *Buck Rogers* theatrically. His production company works out of Universal Studios, which provides him with facilities and serves as distributor on his films and shows. When NBC hired him to produce the miniseries, the deal became one of several with Universal. "They didn't want to give it up," Larson said, "until Fred Silverman was brought in. He decided to change their approach from so many novels for television and canceled a very large commitment with Universal, which was going to produce these shows for NBC. We got *Buck* back



Marauder pirate ships from the year 2485, as they'll appear in the film version of Buck Rogers

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"This woman, she is like my tequila. Smooth, but with a lot of spirit."

Her name was—well we're not sure. And she appears to have been the only other love Two Fingers had besides his tequila.

"It's her spirit I capture in the tequila I make. It is soft but, oh, so passionate," he reportedly said.

She traveled with Two Fingers as he brought the taste of this special tequila—Two Fingers Tequila—north of the border.

And then, without warning, they both disappeared leaving behind only the passionate taste of the Two Fingers Tequila we enjoy today.

Send for our free recipe booklet. Two Fingers Tequila, P.O. Box 14100, Detroit, MI 48214

BOOKS

THE ARTS

By Joe Haldeman

It first happened about three years ago. "Say, I read a story of yours in a magazine the other day." Since he was smiling, I sat back and prepared to bask in a glow of approbation.

Well, he *was* full of praise, but as he started to go into detail about it—some damned thing about a slug that ate Washington—I had to break in and tell him that it wasn't I who had written the story, it was my brother Jay, Jack C. Haldeman II.

When he started writing science fiction a few years ago, I gently suggested to Jay that he make up a snazzy pseudonym, so that people wouldn't confuse the two of us. He didn't like the idea, since he'd had the name a couple of years longer than I, but we did arrive at a compromise. He would use his full name and I would shorten mine. Surely no one could mistake a "Joe Haldeman" for a "Jack C. Haldeman II." Wrong. And it works both ways, of course. He claims to have autographed dozens of my books at science-fiction conventions.

Actually, since most people (myself included) forget the author's name before they're through the first paragraph, it's quite a compliment to be even half-correctly remembered. The fact that we share a last name with an infamous criminal, or unjustly beleaguered ex-civil servant, has nothing to do with it.

Jay is a fine writer, but *we are different writers!*

There was no real problem so long as Jay stuck to short stories and let me do the books. No problem so long as he did light-hearted tales about sports in the future and I did hard-science, high-tech novels about important things like War and Religion and Sex.

So here on my desk is a hard-science novel about several important things, including the possible destruction of humanity and the aforementioned Sex, and it's quite a good book, but it has the wrong Haldeman's name on it. Just to add to the confusion, the editor of *Omni* called and asked me to write a short piece about it and about having a brother who is also a writer.

The book is called *Vector Analysis*, and most of it takes place on Delta III, a research satellite that specializes in biology and medicine. A manned probe has just brought back living specimens from a planet circling another star, the first alien life forms ever found. The study of them will revolutionize biology, of course, and the scientists are all enthusiastic and dedicated and best-and-brightest.

One by one, they start to die. It is no known disease; evidently they've somehow caught a plague from one or more of the alien creatures. The captain puts the station under absolute quarantine: no shuttles in or out until they can solve the mystery.

Trapped inside the sealed station with the researchers is the Senate minority leader, a virulently antispace politico who has made a junket to Delta III with the avowed purpose of finding justification for shutting it down. Now he's mortally afraid and will pull any dirty trick to break the quarantine, even at the risk of carrying the deadly contagion back to Earth.

Then a key scientist is found near death, bludgeoned and stuffed into a locker. Then another, dead for hours, beaten beyond recognition. A brutal killer stalks the corridors while an invisible one permeates the air.

Jack C. Haldeman II, author of Vector Analysis

This tense tale unfolds through the eyes of various scientists, the politician, even the alien creatures and the murderer whose identity is withheld until the end. All these characters are skillfully drawn (the psychopath is as gruesomely believable as any I've seen), but especially the research people. There's a reason.

When Jay and I were growing up, most of our adult friends were medical researchers, since our father was head of the Arctic Health Research Center in Anchorage, Alaska. After a while, I drifted into physics and astronomy, but Jay stayed with biology. He eventually studied biological science at Johns Hopkins and did research in parasitology, finally returning to the Arctic with a group doing research on the parasites that hitch rides on whales. (I don't know if I'm the only science-fiction writer who's been a combat lumberjack, but I'm sure Jay's the only one who's been a whaler.) Then for eight or nine years he worked with blood chemistry in what sounds like one of the most harrowing research situations possible.

In Baltimore there is an unsavory district called The Block, and over weekends there convenes there an informal organization known to the area's medical people as the Saturday-Night Knife-and-Gun Club. Jay worked at a university hospital in the area with a group that was concerned about the physiological changes that occur in a body during the interval between mortal injury and death or, sometimes, recovery. This shock-and-trauma unit had its own helicopter (one must suspect they had a certain amount of Defense funding), which would whisk them to the scene of a gang fight or head-on collision while there was still a chance of collecting a living specimen. After receiving the best of medical care, the victim would be retired to a special bed, where a computer could closely monitor his progress toward recovery or death.

(I'll never forget picking my way through that room in an ill-fitting suit of surgeon's

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UFO UPDATE

By Harry Lebelson

It's a long shape ... coming for me right now ... hovering on top of me." With these words came the report of an extraordinary event that occurred on Saturday night, October 21, 1978. A light Cessna aircraft piloted by twenty-year-old Frederick Valentich of Avondale Heights, Australia, vanished from the sky.

Valentich, on a flight to Melbourne in clear weather and unlimited visibility, had a confrontation with an unidentified flying object at 7:06 PM. For the next six minutes a game of hide-and-seek took place between the two craft.

The UFO, described by Valentich in his final radio relay to Melbourne as metallic in appearance, cigar-shaped, and having four bright lights, was orbiting above his plane. Following the pilot's last desperate message, a long metallic noise was heard on the radio, then silence. Valentich has not been heard from since. His disappearance remains a complete mystery.

Varying theories exist in regard to the Valentich disappearance. The Department of Transport in Melbourne claims the pilot was disoriented and may have been flying upside down, and seeing his own reflection in the water thought it to be a UFO. This notion was discounted by Arthur Schutt of Melbourne's Schutt Aviation Company. "The pilot would have known if the aircraft had begun to turn upside down, because the carpet would have come off the floor and anything else lying around loose would have bounced around."

Less than one hour after the disappearance of Valentich's plane, Mr. and Mrs. Wayne Bellew of Canberra, Australia, holidaying on the coast, observed a UFO performing "impossible maneuvers" unlike those of any conventional aircraft. This sighting, along with later sightings of similar type craft by two freight planes over New Zealand, and an additional sighting on December 31 by an Australian television news crew—which filmed dramatic footage of a circular object moving through the night sky—made headlines throughout the world.

The incidents in Australia and New Zealand are not atypical of classic UFO encounters. *Something* appeared to a diverse group of witnesses, each of whom reported sightings that coincided with radar reports from local airports. The most arresting eyewitness account of the sighting on December 21 in New Zealand came from Captain Powell and Copilot Perry as they flew in their freight plane near the UFO. Powell spotted a massive white light with a red tinge flying to his port at a distance of approximately 40 kilometers. "I imagined it was stationary but checking later found it to be still even with the window."

Meanwhile, on the ground, Wellington, New Zealand, radar tracked the object for 20 kilometers as it kept pace with the plane. The plane's radar indicated that the object was 64 kilometers out to sea. Both pilots watched as the UFO moved 25 kilometers toward the plane in five seconds. At this point, it veered to the southwest and disappeared off the radar screen with no further trace whatsoever.

An additional sighting was reported that same night by other aircraft. As a result, TV producer Leonard Lee of Channel O, Melbourne, instructed Quentin Fogarty, a reporter on holiday in New Zealand, to duplicate the flight of Captain Powell's Argosy freight plane. Lee thought they would be able to make contact and film the unidentified flying object, which—ultimately—they did.

On a recent Washington, D.C., talk show hosted by physicist Bruce Maccabee and UFO author Philip Klass, producer Lee stated, "He [Quentin Fogarty] was the reporter I asked to reconstruct the sighting. He was on holiday in New Zealand. We said, 'Would you please knock off holiday for a couple of days and go do the story, because we were short of news over the Christmas and New Year's period.'" Philip Klass said, "You say you were short of news over the Christmas period?" "Absolutely," replied Lee.

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Mysterious fireballs moving westward in summer sky were filmed by a Swiss airport security officer

CONTINUUM

REVOLT IN SPACE

We may soon have cities in space. Advocates of space colonies argue that we already have the technology to build them. They also cite figures that show that living —and working —in space habitats is economically feasible. But one detail has not been demonstrated: Will we *like* living "out there"? What will happen to the emotions and psyches of people who set up house in a space city? Will they hate it? Go crazy? And what about their loyalty to Earth? Will they turn against their home planet?

It's not such a farfetched idea. In fact, it has already happened. It was not widely publicized at the time, but five years ago in 1974 the third crew of Skylab staged what must be the first extraterrestrial wildcat strike.

Like all the other Skylab crews, astronauts Gerald Carr, Edward G. Gibson and William Pogue were part of an elite. Each was highly motivated, superbly trained and deeply committed to the space mission. In training and background they were very much like the first two crews. But they were different in one way: They were rebellious, at least for astronauts.

Within a few weeks of arriving at Skylab they filled the radio waves to Earth with gripes. The other crews had messed up Skylab: the uniforms were ugly, the food was bland, the soap stank, and the space toilet was everyone's pet peeve. "I don't know how that was designed," bitched one astronaut, "but I'm sure it wasn't by anyone who took a crap and noticed his posture." They also complained about being overworked. "We're being driven to the wall," they hollered. Finally, when it became obvious that Mission Control remained insensitive to their complaints, they went on a one-day strike in which they refused to work and spent the time doing what they pleased.

Earth and Skylab eventually settled their differences, but the question remains. If this kind of thing can happen with an astronaut-caliber crew, what would space stress do to more ordinary people like you or me?

One possible effect of spending months or years in a space city is called the Solipsism Syndrome, which is NASA's term for losing grasp of reality. It's a real condition often seen on Earth in the citizens of Lund, Sweden, during their long (18 hours at times) winter nights. To persons suffering from Solipsism Syndrome the world begins to look like a series of stage sets—individual, isolated scenes set off from the pitch blackness by artificial lighting. People become genuinely confused as to whether objects and people they see are real or figments of their imagination. Television addicts, say NASA researchers, are also prone to this problem. And future inhabitants of space settlements? Perhaps.

Shimanagashi Syndrome is another possible hazard of space living. Named after a punishment popular in ancient Japan, it's the psychological condition of feeling isolated, vaguely uncomfortable, and intellectually stilted. In the original punishment, political prisoners were exiled to tiny islands for the rest of their lives. Today the same state of mind can also affect mainlanders who move, for example, to Hawaii. Regardless of how modern and sophisticated their surroundings, Shimanagashi sufferers still feel isolated, a feeling not shared by people born on the island.

A third possible complication is space neurosis. This is simply the disorientation that comes from moving into the unfamiliar neighborhood of space. But according to the three behavior experts who first described the condition—Drs. Jay Shurley, Kirmach Natani, and Randal Sengel of the Veterans Administration Hospital in Oklahoma City, Oklahoma—this confusing state of mind passes once a person has absorbed the overload of new information and experiences.

Shurley, Natani, and Sengel, however, worry about still other psychological unknowns that may affect our first space citizens. "It will be interesting to see," they write, "whether space crews come to look literally 'down upon' or 'up to' their earthbound peers."

For the near future, Shurley, Natani, and Sengel believe the people who will do best in space are "latent heterosexuals — those with conventional sexual preferences but with little need for much physical intimacy. These are the same people who survive well at remote weather stations."

The distant future is anybody's guess. Summing up all work done on space psychology, the three behaviorists note apologetically: "It is with acute but unavoidable embarrassment that we must admit that there is little data to present." In other words, we can send a man into space, but we have no idea if he's going to want to stay there or come back.—*DOUGLAS COLLIGAN*

CONTINUUM

ROCKET HOLES

The atmosphere may be a life-sustaining blanket of air but it is also an annoying barrier to ground-based observations of planets and stars. Only a few kinds of electromagnetic radiation—primarily visible light and some radio waves—can reach telescopes on earth.

It turns out, however, that the very activity of launching spacecraft may punch temporary holes in the atmosphere and give large earthbound instruments a brief but unobstructed view of extraterrestrial objects.

Radio engineers at Stanford and Boston Universities plan to study this hole phenomenon in detail during the space shuttle's second Spacelab Mission early in 1982. According to Paul A. Bernhardt of the Stanford Radioscience Laboratory, the hole effect was first clearly noted during the launch of Skylab in 1973. The *Saturn* rockets used to boost the space station into orbit burned a ton of fuel per second, he says, expelling carbon dioxide, hydrogen gas, and water. These exhaust vapors reacted chemically with the plasma (ionized gas) of the atmosphere and effectively made it disappear for about four hours.

The discharge may have opened a short-lived radio window on the universe, at a frequency which is normally closed by the plasma, Bernhardt thinks. "This could make possible the use of ground-based radio telescopes to study a number of intriguing low-frequency radio sources such as the Vela and Gum nebulae."

—Dava Sobel

Rocket exhausts have a curious side effect. They punch temporary holes in the atmosphere that can be of great aid to astronomers.

FIRST FLOWER

Charles Darwin once called it "an abominable mystery." Now new evidence—the fossil of

Angiospermoid pollen fossil may revolutionize plant science.

a 200-million-year-old "pineapple"—could provide answers to one of the longest-standing controversies in science: the origin of flowering plants.

Researcher Bruce Cornet of Gulf Research & Development Company in Houston, Texas, has announced the discovery of isolated seeds and seed-containing fruiting bodies that may well prove to be the oldest known angiosperms (flowering plants). Quarried from freshwater sedimentary rocks of the Late Triassic Period (about 215 million years old) in North Carolina and Virginia, the fossils are nearly twice as old as the oldest previously undoubted angiosperms and bear remarkable resemblance to members of the modern Bromeliaceae or pineapple family. The fruiting bodies, containing hundreds of spirally arranged fruits, resemble small pineapples.

"The combination of features we see in these forms are known only in angiosperms," Cornet explained, "but because pollen has been found with fruits rather than with immature flowers, the question of their angiosperm affinity remains technically open."

—John D. McLeod

LASER CHEMISTRY

The methods of chemistry haven't drastically changed over the years. New compounds are made basically by mixing some chemicals together and perhaps by heating or shaking them.

But at the American Physical Society meeting in New York this past January, a new and powerful way of producing chemical reactions was discussed. This method, called laser-induced chemistry, relies on the sensitivity of molecules to specific vibrations.

Virtually everything that has a shape has an associated set of natural vibrations called resonant frequencies. It is a familiar practice, for example, for a company of soldiers to break ranks while crossing a bridge. This is done so that the marching feet do not excite a resonant frequency

of the bridge, as bridges have been known to collapse when excited this way

Molecules also have these resonant frequencies and they can be excited by a laser Because lasers generate light of only one frequency, they can be tuned to excite a particular chemical in a compound, even to the point of knocking the chemical out of the compound This technique has great possibilities, according to Dr Norman Witriol, researcher at Louisiana Tech University 'Right now the method is used for simplifying production of complicated chemicals However, it has the possibility of letting us synthesize compounds that are all but impossible to make at present'

—Carl Frederick

SMOKELESS CIGARETTES

The expression "smoke filled back rooms" may become passé if an invention by the man who developed lightweight aluminum car trim ever sees the light of day The patented product is Colite—a sodium silicate that is 50 percent water—which when brushed on a cigarette prevents the tobacco from burning unless the cigarette is puffed

Unpuffed cigarettes account for about 95 percent of the smoke that finds its way into the lungs of smokers and nonsmokers alike According to the inventor of Colite, seventy-seven-year-old Charles Cohn his product could render unnecessary laws in nearly 30 states that ban smoking in confined public spaces And, notes Cohn government tests conducted in 1973 showed that

Colite would have robbed Bogart of his clouds of smoke

cigarettes treated with Colite emit 60 percent less tar and 43 percent less nicotine than untreated cigarettes

While the invention appears to be beneficial to both smokers and nonsmokers alike, Cohn claims there is a major snag The leading cigarette companies won t touch it because it wasn't developed in their labs

A spokeswoman for P Lorillard Company one of the nation s largest cigarette manufacturers said she didn t know specifically of Colite but added, ' Usually we develop our own things, because we have some of the best scientists in the world working for us '

—J A A Gambardello

FAT POWER

Americans are collectively 2 3 billion pounds overweight If the energy it took to produce the food for that excess fat were diverted instead to generating power it could meet the entire yearly electric needs of all the homes and apartments in Boston, Chicago San Francisco and Washington, D C

Researchers at the University of Illinois reached that conclusion by first calculating the number of calories in the extra food we eat Then they converted the calories to British Thermal Units or BTUs a measure of heat energy (One calorie equals about 4 BTUs an apple 400 BTUs four liters of gasoline 125,000 BTUs)

Thus if the 50 million overweight men and 60 million overweight women in the US dieted to lose their extra fat they would save 5 676 trillion calories the researchers estimated This would equal more than 720 million liters of gasoline—enough to fuel more than a million cars for two months Maintaining the correct weight would save an extra 3 43 trillion calories a year

In an age of increasing energy prices dwindling supplies and world food problems, unneeded fat may take on political and economic overtones the researchers said

—Stuart Diamond

I confess that in 1901 I said to my brother Orville that man would not fly for fifty years Ever since I have distrusted myself and avoided all predictions It is not necessary to look too far into the future we see enough already to be certain that it will be magnificent

—*Wilbur Wright 1908*

If all the overweight people in America shed their extra fat, they would save enough energy to fuel more than a million cars for two months

CONTINUUM

POOPED PASTE

Dental researchers at the University of Illinois have discovered that the miraculous chemical cavity fighter fluoride gradually disappears from toothpaste after several months Although it doesn't disappear completely the substance apparently combines with other chemicals in the paste and loses its original concentration

There is nothing to worry about however Dr Indru Punwani adviser to the Illinois study, explains that no matter how low the level of fluoride sinks it is still effective in preventing tooth decay In fact, in toothpastes that include the active ingredient stannous fluoride just the stannous alone is enough to be an effective cavity fighter

But if the study has raised a few eyebrows Punwani thinks that this is only the tip of the tube No one he says really knows how much fluoride is needed in toothpaste to make it effective The reason for such small levels in the toothpaste to begin with is that stannous fluoride is highly toxic when ingested and manufacturers may be putting small amounts into the paste more for safety reasons—so that kids will not get sick from swallowing the entire tube s contents—than purely for reasons of oral hygiene

—Kenneth Jon Rose

Fearing that kids may poison themselves by eating a full tube of toothpaste manufacturers put in only small amounts of fluoride

too farfetched to be considered

—The editor of Scientific American *writing to Robert Goddard in 1940 about his idea of a rocket-accelerated airplane bomb*

OLDEST ANTS

A party of entomologists has discovered several colonies of ants in South Australia that are similar to a species that died off more than 60 million years ago They are perhaps the most primitive living ants ever found Ant experts from around the world are now studying the centimeter-long insect with the hopes of finding out just what ant behavior was like at the dawn of its evolution

Most entomologists agree that ants evolved from wasplike ancestors but they are hazy about how the ant s complex social behavior got started With the discovery of the Australian bugs, though the fog is beginning to clear Like most primitive ants, the yellow-brown insects share properties of both wasps and ants Like the wasps the queens and the males sport wings All the members including the workers have stingers Yet their social behavior is primitively antlike

The majority of present-day ant colonies are highly structured with organized feeding parties strong leadership and a strong fear of other species But the Australian ants still seem to be in the 'caveman stage of development The nocturnal insects forage singly nest in relatively simple structures and don t care who enters their territory —K J R

While theoretically and technically television may be feasible, yet commercially and financially I consider it an impossibility a development of which we need waste little time in dreaming

—Lee DeForest (inventor of the electron tube) 1926

Primitive Australian ants share properties of both ants and wasps Note that virgin queens (left center and bottom center) sport wings

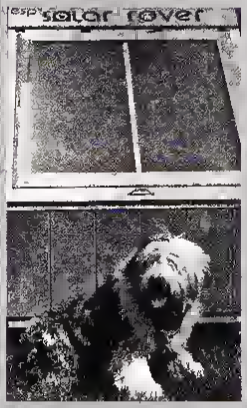
SUN WOOF

Those with energy-conscious dogs will be pleased to know that they can now buy their canine an $800 solar-heated dog-house. The large, cedar structure with plastic panels that admit the sun's heat will eliminate the need for doggy to go in and out of the house several times on very cold days—wasting all that expensive energy when the door is opened.

The doghouse is completely insulated and comes with a flexible plastic door flap that magnetically reattaches after the dog pushes it open. These features help keep the inside temperature 20 to 40 degrees warmer than the outside air—even after the sun has set—by trapping the day's heat.

Solar 1 Manufacturing Company of Virginia Beach, Virginia has sold ten such Solar Rovers. "The people who buy them are both dog fanatics and solar fanatics," explained Dennis Ackerman, vice-president of Solar 1, which also sells conventional sun-collecting equipment. In the summer he added, the solar panels on the doghouse can be covered, "so Rover doesn't turn into a hotdog."

The solar doghouse is only one of several offbeat solar devices produced by America's technological geniuses. The US Forest Service has solar-powered outhouses (the sun powers the toilet flusher). Farmers are melting beeswax and catching insects with the sun. Campers are cooking meals in solar ovens and taking showers with solar-heated water from black plastic sacks. Tobacco-lovers are lighting



For $800 your dog can take part in the solar energy revolution

cigarettes with solar cigarette lighters. And pranksters are giving solar clothes dryers as gifts, namely, a clothes line and 20 clothes pins. —S D

"Among theories finally rejected by scientists in the early Nineteenth Century [was the belief] that mice could be produced by enclosing a hunk of cheese and some old rags in a hat box."

—E C. Large in The Advance of the Fungi

'The National Academy of Science exists for the members to write each other's obituaries.

—Daniel S. Greenberg, 1967

A CLOVE A DAY . . .

There is now experimental evidence to verify at least some of the legendary magic of garlic—old-fashioned cold curer, thwarter of evil spirits, and strength inducer for Roman warriors.

Studies in India and West Germany indicate that garlic helps break up cholesterol in blood vessels, thus preventing hardening of the arteries and heart disease. Experiments in Japan and Russia show that the pungent cloves collect lead, mercury, cadmium, and other toxic metals in the body and allow them to be removed during bowel movements. So, city joggers who breathe the exhaust fumes of traffic can eat garlic and stay healthy, advised a doctor in a recent issue of *Runners' World* magazine.

Other research has found that garlic *may* also help in treating anemia, arthritis, diabetes, pimples—even cancer.

In all cases, only fresh garlic will do. Processed garlic powder and garlic salt have lost much of their potency and are no substitute for the real thing.

How much should you eat? Paava Airola, a physician nutritionist who details some of the research in a new book, *The Miracle of Garlic*, says that two or three small cloves a day are sufficient. Taking this advice may not win you many friends, but you will sure be healthy.—S D

That is the biggest fool thing we have ever done. The bomb will never go off, and I speak as an expert in explosives."

—Admiral William D. Leahy to President Harry Truman, 1945

Only fresh garlic will do. Two or three small cloves per day, says Paava Airola, will prevent a multitude of diseases, including atherosclerosis.

CONTINUUM

ICE AGE

If each winter seems colder to you than the last it may not be just your imagination. Two geoscientists from the University of South Carolina were recently awarded a $56,500 grant by the National Science Foundation to study long-term temperature changes recorded in shells of foraminifera and pteropods, tiny planktonic marine organisms.

From their studies of oxygen and carbon-isotope levels, Drs. Douglas Williams and Michael Kahn hope to pinpoint precise temperatures at which the shells formed, and by extrapolation, predict when the next Ice Age might occur.

"The pattern of cyclicity of glacial and interglacial periods indicates we are currently in a cooling period," Kahn explained, "but this natural effect has been moderated by the production of carbon dioxide from human activities."

If Williams and Kahn can determine the water temperature during the Pleistocene Epoch 1.6 million years ago, it will give them a clue as to what temperature fluctuations at the surface are needed to once again trigger large-scale continental glaciers. —J.D.M.

This planktonic foraminifer may hold clue to next Ice Age

CANCER THREAT

Insulating your house to save energy may have an unexpected—and dangerous—side effect: lung cancer.

Scientists at the University of California's Lawrence Berkeley Laboratories believe that the reduced ventilation resulting from increased insulation could also increase exposure to low levels of the radioactive gas radon. Radon's precursor, radium-226, is a common trace element in many building and insulation materials.

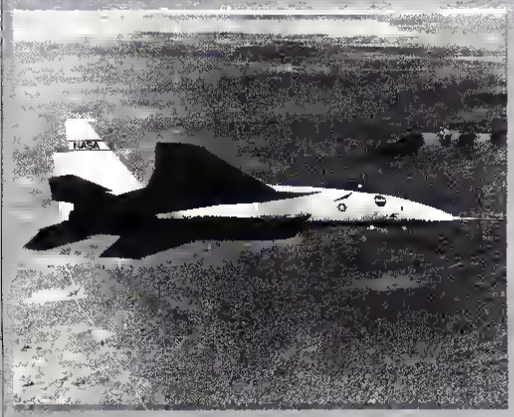
The radon produced from the radium's decay, claimed the researchers in a report in *Nature*, can build up in a poorly ventilated home and become attached to particles in the air—then lodge in the lungs.

Conclusions at this time are highly speculative, say the scientists, but they add: "It is likely that some increased lung-cancer risk would result from increased exposure to radon."

—Joel Davis

BANG! BANG!

Fighter planes have always been controlled manually by pilots. But this is becoming increasingly difficult as aircraft become more and more sophisticated. Flying an F-15, locking it on target, arming a missile or a cannon, and firing takes an extraordinary coordination of intellect and muscles, even with computer assistance.



Fighter planes such as this F-15 may someday be outfitted with weapons the pilot can aim with his eyes and fire with his voice

At the Wright-Patterson AFB Aerospace Medical Research Laboratories, doctors are exploring ways to take the heat off the pilot. They have begun to design a system that will eventually allow fighter jockeys to aim by focusing their unaided eyes, then arm and fire their weaponry with a voice command. And what is the magic word that will fire a particle beam cannon or launch a cruise missile? Would you believe *bang*?

In the system envisioned, the aiming device would be mounted on the pilot's helmet. A near infrared light would shine in the pilot's eye, causing a spot of light to be reflected off the cornea. This spot would be picked up by an oculometer, and a computer would calculate the angle between the spot and the center of the eye. Theoretically, this angle can be translated into target coordinates. Then, with his weapons properly aimed just by looking at the target, the pilot of this future fighter jet will fire by yelling something like "Bang! Bang!"

Very tricky. But what if the opponent in this dogfight yells first, throwing his plane into an automated evasive maneuver with a "*Nyet, nyet, vi apazdali!*"? (Rough translation: "Nyah, nyah, you missed!")

—Nick Engler

RAIN MAKER

Scientists may have found a rain-making substance more effective than silver iodide for seeding clouds—namely, tea leaves. The discovery was made when meteorologists from the National Oceanic and Atmospheric Administration (NOAA) went to Kericho, Kenya, to find out why tea plantations in that area experience hail 132 days a year, which is probably a world record. (The record for any point in the US is about ten days of hail per year.)

NOAA scientists Drs. Russell Schnell and Suan Neo Tan-Schnell concluded that the extreme Kenyan hailstorms are caused by dry tea-leaf particles that are continuously kicked into the air by the hundreds of tea-leaf pickers going about their jobs.

These particles, found the Schnells, make excellent nuclei around which ice can form. Tea leaf "litter" can crystallize water as warm as −2°C (28°F), while silver iodide becomes active at −10°C (14°F).

LASER WEAPONS

The ubiquitous laser, it seems, may soon become a major weapon in the US military arsenal.

The Army Ballistic Missile Defense Systems Command has contracted with Lockheed Missiles and Space Organization to begin research on a "laser killer" system to be used against enemy intercontinental missiles, according to the journal *Optical Spectra*. Further, the Defense Advanced Research Projects Agency, concerned about reported Soviet capability to put US spy satellites out of commission, has confirmed plans to award a development contract for an experimental laser system for detecting and tracking space objects. [See "Cybernetic War" beginning on page 44.]

In another step, the army has awarded a $1.7 million contract to TRW's Defense and Space Systems group in Redondo Beach, California, to develop "a high-energy antiarmor laser weapons system, the specific objective of which is classified."

—Alton Blakeslee

OLD CLAMS

If you've had any clam chowder lately, chances are you've eaten a clam more than 100 years old. Research by Dr. Ida Thompson, an assistant professor and marine expert at Princeton University, has disclosed that about 25 percent of the ocean quahogs (thick-shelled American clams) used for chowder are at least a century old, and in some cases 150 years old. That would make them the longest-lived invertebrates.

Dr. Thompson discovered that the tooth holding the quahog's shells together has microscopic bands on it and that these bands correspond to the clam's annual growth—much like the rings across a tree trunk that are the measure of its age. The clam measurements were verified by carbon dating. The studies may help discover the causes of age or youthfulness in animals, including humans. They may also serve as a record of the ocean's subsurface weather for periods of as long as 150 years.

The ocean quahog is found in 15 to 180 meters of water and has a black shell.

Quahog. Your clam chowder may be over 100 years old.

It is the same size as its lighter-shelled cousin, the common quahog, which is found near the shore and used for clam cocktail in restaurants. Ocean quahogs are more often used in chowders and fried dinners, in which their stronger iodine taste can be masked by other ingredients.

Because of their long, slow growth, ocean quahogs may be quite vulnerable to overharvesting, particularly if they are used as substitutes for other clam varieties, which seldom live more than 20 years. —S.D.

Picking tea leaves on a Kenyan plantation. Dry tea leaf particles are continuously kicked into the air and come back down as hailstones.

"My figures coincide in fixing 1950 as the year when the world must go to smash."
—Henry Adams, 1903

CONTINUUM

SINGLES SCIENCE

A man who approaches a woman in a singles bar has approximately seven seconds to ask her for a date—usually just long enough for her to say no, observed psychologists Leonard Jason of DePaul University and David Glenwick of Kent State. The average woman, furthermore, was approached by a man only once every 15 or 20 minutes, straining the popular notion of the singles bar as a hotbed of frantic social activity. However as the numbers of women in the bar increased, the approaches too increased in frequency while the length of conversations decreased.

Armed with stopwatches and notebooks, Drs. Jason and Glenwick also learned that attractive women are not approached any more frequently than unattractive women, perhaps, they think, "because nonverbal behavior such as eye contact, expression, and posture, rather than one's general appearance, may serve to elicit or inhibit approaches."

These results, the psychologists believe, have implications for techniques—such as videotaped self-observations, behavioral rehearsal, and desensitization—designed to enhance social skills and alleviate social anxieties.

Singles bar. The action is not quite so frantic as one would believe. Women are approached only once every 15 or 20 minutes.

A RETURN TO WOOD

Wood, once America's primary heating fuel, is slowly returning to prominence. An increasing number of companies and cities are exploring ways to replace fossil fuels with wood in electric-power plants.

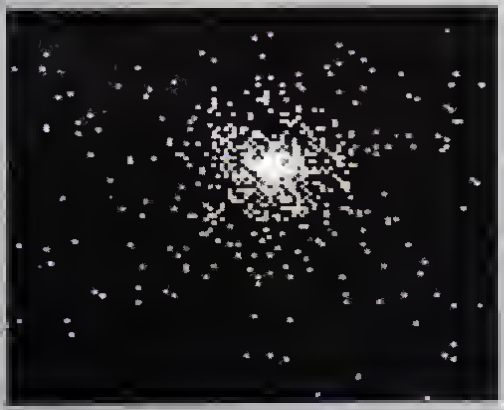
The US Department of Energy is funding 24 projects in all parts of the country to examine ways to grow local trees for energy use. One proposal would locate a large, wood-burning electric-power plant in the center of a southern forest 40 kilometers on a side. The trees, harvested continuously, would never be exhausted. By the time loggers finished cutting down the forest's trees planted at the other end would reach their full maturity.

Much of the action today is in the Northeast, which is 80 percent forest and contains more trees than it did a century ago owing to reforestation of abandoned farmland. The city of Burlington, Vermont, has converted a coal plant to supply part of its electric needs with wood. Engineers there are now building a $40 million, wood-fired electric plant to supply most of the region's 50,000 people by 1983.

In nearby southern Maine, the Wheelabrator Cleanfuel Corporation is planning to open by 1982 a 30-million-watt electric-power plant fueled by such forest residues as dead and stunted trees.

Federal studies estimate that wood currently wasted in logging operations alone could supply 21 percent of the electric power now generated in the United States by fossil fuels. —S. D.

"I must confess that my imagination refuses to see any sort of submarine doing anything but suffocate its crew and founder at sea."
—H. G. Wells, 1902



This is the first picture ever taken of an X-ray star. The star is Cygnus X-1, located about 6,000 light-years from Earth and believed to contain a black hole. The picture was taken from an orbiting spacecraft. —NASA's High Energy Astronomy Observatory

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A conflict in which hardware battles hardware will inevitably catch human software in between

CYBERNETIC WAR

BY JONATHAN V. POST

Welcome to World War III, the Cybernetic War, created by machines for machines. The soldiers in this conflict are, of course, computers, and by 1999 there will be roughly a *billion* of them either on or orbiting the planet. The arsenals of the Cybernetic War are stocked with cruise missiles, MIRVs, and smart bombs. Its battle plans utilize such tools as robotics, pattern recognition, coding and game theory, cryptography, and simulation. All depend upon one superweapon, the indefatigable computer, which, paradoxically, is also the best hope for human liberation.

How did the computer get into this war? What is the war about? How will it end?

World War I, the Chemistry War, killed millions with the new chemical technologies of explosives, poison gases, synthetic fuels, and cheap steel. World War II, the Physics War, exploited the innovative physics of aerodynamics, radar, submarines, rockets, and nuclear fission. World War III, the Cybernetic War, is based on scientific advances equally known to the public and equally important to future historians, if any.

In Geneva, scientists recently announced the first containment of antimatter. Antimatter annihilates ordinary matter on contact, releasing more energy than the fusion processes in a hydrogen bomb. A beam of antiprotons, each at an energy of 2 billion electron volts, was bent into a circular storage ring, in a vacuum. Computers guided these clumps of antiprotons by altering the effects of powerful electromagnets. Quick electronic feedback kept the antimatter from touching the walls of the storage ring. The antiprotons circled at nearly the speed of light for 85 hours, then were directed at a target. Instant—and total—destruction. Computer technology, together with physics, is

War rooms of World War III pulse with cathode-ray tubes

producing the most amazing tools for research—and yes, the most amazing military systems.

In 1979, we begin to see a pattern in the Cybernetic War. It is "Anything you can do, I can do better." The strategy of hardware escalation is a simple one. Whatever equipment *they* have, *we* must have at least the same.

America drop-tests the reusable manned space shuttle *Enterprise* from a Boeing 747, Russia drop-tests a delta-winged space shuttle from a Tupolev Tu-95 Bear bomber. How do we know? A Lockheed "Big Bird" spy satellite snaps photographs from 160 kilometers overhead.

Arab countries spend millions of petrodollars on American airborne digital computers for avionics, navigation, and weaponry; Israel builds the Elbit System-80 for their own Kfir jets. Their former air force chief of staff calls it "the best weapon-delivery system for single-seat fighters available today."

Government troops in major nations stockpile microcomputerized heat-seeking missiles, with which one soldier can down an enemy plane; terrorists begin to do the same. How do we know? Fragments of a Russian-manufactured infrared-detecting missile are found in the charred wreckage of an airliner on the plains of Zimbabwe.

In computer weaponry, whatever one side has the other at least has on the drawing boards. Sometimes, as with the IBM 370 computer and the USSR's Ryad-2, they can barely be told apart.

Robots are not necessarily as cute as R2-D2 or C-3PO. Sometimes they are as deadly as U-235. Today's genuine robots are sleek subsonic assassins. They are better known by the name of cruise missiles.

Cruise missiles are refinements of the old-fashioned drones, or unmanned aircraft. Small, fast, light, and packing an atomic sting, they can be launched from land, air, or sea. Once in flight, they zip along at altitudes too low to be detectable by radar. Cruise missiles examine the landscape below and to the sides of their flight path, perform computerized terrain analysis, search for landmarks using the techniques of pattern recognition, and compare these results to their own internal maps. They plot their own courses and home in on their targets with dazzling accuracy. Thanks to the new science of robotics and artificial intelligence, cruise missiles strike within centimeters of their intended destinations, having searched with almost animal cunning from thousands of kilometers away.

Similarly, the MIRV, or multiple independent reentry vehicle, is a nuclear weapon-delivery system that depends on sophisticated computer guidance. When a MIRVed missile sweeps down from space, it tosses out a dozen separate warheads. Each warhead adjusts its own trajectory, performs evasive maneuvers, releases radar-confusing decoys, and plummets toward its own military bull's-eye. A "smart" bomb is one that uses sensors (such as television cameras) and a compact computer to mimic the human processes of perception and decision making, thus finding its target by planning, instead of blind luck.

But the MIRV has peaceful uses. Both the US and the USSR have launched scientific MIRVs at the planet Venus. Late in 1978, some 15 distinct payloads splattered at the shrouded goddess of love like a shotgun blast. Of course, each piece of shot is a computerized scientific interplanetary probe. We dare not admit that World War III is an interplanetary war.

SIMULATION AND DISSIMULATION

Computers, unlike people, have no way of distinguishing between real and imaginary worlds. Their data may have come from sensors or may have been programmed by the most abstract calculations. A computer program may process information from actual measurements of solid objects or from artificial "microworlds" invented by creative human programmers. Rather than being a drawback, this is one of the greatest advantages of computer technology.

Through the computer, a person can dream up a universe with its own strange laws and structures. This begins to explain the almost addictive attachment many programmers develop for their machines and the reason that simulation has become a major part of military tactical training. A pilot can crash time and time again, learning from each mistake. If his computer simulator is an airplane that never leaves the ground.

There is nothing vague or imprecise in the computer dreams of simulation. Mikhail Botvinnik, chess grand master who held the world championship for thirteen years, explains why computers have an advantage in combat: "Man is limited, man gets tired, man's program changes very slowly. Computer not tired, has great memory, is very fast."

Northwestern University's CHESS 4.6 program on a Control Data 176 can beat the Russian KAISSA computer chess player. But who is winning the simulation race? In all likelihood, the United States will maintain several years' lead over all other nations unless Japan, also a contender in the robot race, makes its move.

There are no black-and-white squares inside the chess-playing computer, no kings, no pawns. Similarly, inside a Navy computer there are no miniature ships; inside an Army computer there are no tiny

Developed late in the Cybernetic War, computers and lasers have their future inextricably linked. Amplified light will transmit data as fast as computers can generate it. In weaponry, high-energy lasers—targeted by computers—will instantly vaporize flesh or metal from many kilometers away.

tanks In each case the computer does store and manipulate some information in its memory The information is referred to as a *model* although it is a model only in the abstract sense

The model in a chess-playing machine might include a list of the positions of the pieces in a game situation plus a mathematical description and evaluation of the legal moves available to each player The model in a Navy computer might be another coded list of numbers

These numbers could be the latitudes and longitudes of a fleet of destroyers or the schedule of flights from an aircraft carrier Numbers might also describe the speed and maneuverability of the destroyers under varying conditions of weather and fuel consumption The computer model for the aircraft carrier might list the communications frequencies of the individual planes their altitudes or their weapons status

If the models are continuously updated to match actual ships and planes they are enormously useful in battle situations A jet fighter s computer can track many objects at once at faster-than-human speed and perform the IFFN function identification friend/foe/neutral The computer application that automates the entire battle is known as C^3 communications command and control If the ships and planes are imaginary we are in a microworld where the computer calls the shots

"Game theory" invented by Otto Morgenstern and John von Neumann gave military strategy a solid mathematical foundation Whenever two opposing players each select an option from a set of available options and the outcome of each pair of decisions is known a computer can recommend an optimum strategy Such a strategy is usually a mix of options with individual choices being made at random Human lives may now depend upon the flip of a coin or the roll of dice

The value of computer modeling is high because it can help to predict the future Simulation examines a set of alternatives and evaluates the possible outcomes of tactical situations In chess as in war one ultimately makes one s move and the effectiveness of one s plan depends on what the opponent does next. In chess as in war it is undesirable and impossible to test all tentative plans and legal moves The chess master works with a mental model of the game imagining what the opponent s countermoves and counterplans might be in a number of alternative futures The commander works with a computer subjecting imaginary helicopters to dummy runs moving simulated troops through simulated battles

Simulation cannot of course foresee the future exactly A good simulation is still quite valuable if it can eliminate a few disastrous plans Computer simulation has become an essential part of strategic and tactical planning in all major armed forces Anything that tips the odds is studied Trial-and-error is unacceptable when errors mean lives

Simulation is never guaranteed Japanese war games had predicted that America would surrender if Pearl Harbor was attacked Pentagon computer simulations predicted that US incursions into Cambodia could cripple the Vietcong

SPEED OF LIGHT

Electrons flow through computer circuitry at awesome speeds The speed of computation is limited only by the speed of light 298 117 kilometers per second Compared to this jets bullets and missiles are sluggish indeed It seems natural for computer warriors to investigate weapons that strike at electromagnetic speed and that kill at the speed of light too fast for any human intervention

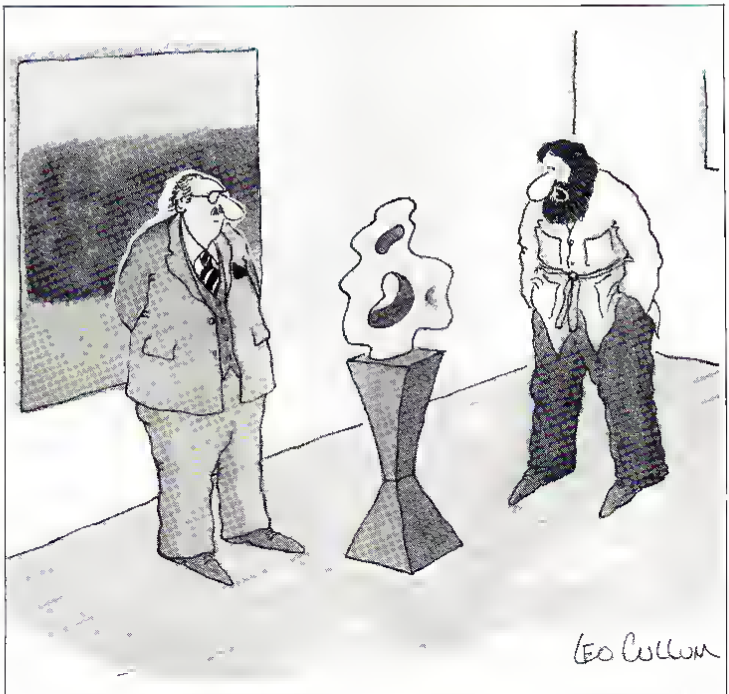
Lasers were developed late in the Cybernetic War Lasers and computers have their futures linked in several ways Lasers transmit data as fast as computers generate it They already connect certain computers in high-speed digital communications links and will likely play an increasing role in military communications

Lasers can be used as target designators One soldier points a hand-held laser like a flashlight Its focused coherent beam illuminates a particular tank or plane—any target selected by the soldier A second soldier launches a portable missile which homes in on the glowing bull s-eye The microcomputer chip for laser-designated missile-guidance systems is much simpler and cheaper than the microcomputers in MIRVs and smart bombs

Lasers can be used directly as weapons High-energy lasers vaporize flesh or metal from many kilometers away The Department of Defense has allocated over $200 million this year for high-energy-laser research Also the single largest source of funds for computer research today is DARPA the Department of Defense's Advanced Research Projects Agency Universities are loath to question Pentagon largess

American satellites have been zapped by Russian lasers since October 18 1975 when one of our early-warning defense satellites was blinded by infrared radiation while orbiting over western Russia The official explanation (a gas-main fire) is almost certainly a cover-up The Pentagon is unwilling to admit the Soviet lead in hydrogen/fluorine chemical laser weaponry

The Air Force has contracted with United Technologies for an airborne CO_2 gas-dynamic laser Carried by KC 135 or similar aircraft such a laser could destroy antiaircraft missiles in midair The Navy has TRW building shore-based chemical-laser facilities for cruise-missile and fleet defense The Army has opted for an AVCO electrical-discharge laser to be mounted on an amphibious assault vehicle Hughes has contracted for computerized beam aiming and



"Before you ask the obvious question—yes it is somewhat autobiographical"

tracking for the Air Force and Navy. Perkin-Elmer does the same for the Army. The Directorate of Defense Research and Engineering coordinates high-energy-laser weapon research with laser-fusion research and ballistic-missile defense.

Some of the world's largest computers are now used to study laser fusion. Elaborate simulations test the use of lasers to create temperatures and pressures now found only in the sun and other stars. It appears that computer-aimed lasers connected to computerized phased-array radar systems might be able to destroy incoming ballistic missiles. An LBMD (laser ballistic missile defense) debate similar to the ABM (anti-ballistic missile) debate of a few years ago seems inevitable. If lasers and computers together shift the balance of terror toward defense. One Pentagon admiral with this in mind told the *Miami Herald* that Pratt & Whitney lasers would probably not be used on people. "Frankly, no. I don't think so. I think it would be the type of weapon you would use on a high-value target."

SECURITY AND INSECURITY

As with lasers, the early history of computers is clouded by security. In each case, lawsuits were filed by inventors who claimed to have built or designed the first of these revolutionary devices. Atanasoff has won a patent suit and claims to have built the first digital electronic computer. Gould has won a patent suit and claims to have sketched the first workable laser. Both claim that governmental secrecy and military security classification retarded communication with their colleagues. The same applied to nuclear-physics research in late World War II.

Cybernetics is a word invented by the multitalented genius Norbert Wiener. Concerned with "control and communication in the animal and the machine," it is a mathematical theory developed in the early 1940s. Cybernetics describes the action of complex systems, whether in electrical equipment or in the human brain. The theory came just in time, for the electronic computer was being invented. Of course the military motive was there from the start.

The theory began with the war-research group of Wiener, Weaver and Bigelow. They were trying to build an automatic antiaircraft gun that would *not* fire a shell at where an airplane was. Rather it would fire where the plane was predicted to go, outguessing evasive maneuvers. At the same time in the USSR, A. N. Kolmogorov was solving the same problem, for the same purpose. Perhaps the Cybernetic War began here, in war-research laboratories during World War II.

Note this connection with ballistics, the study of bullets or missiles in flight. Vannevar Bush had already built the differential analyzer, a mechanical computer to solve some equations in ballistics, but it was too slow. German V-2 rockets were raining death on England, and the generals were wondering how much more effective rockets could be if some machine could guide them accurately to targets.

The race was on to build the first electronic digital computer. Aiken at Harvard, Goldstine at the University of Pennsylvania, and Von Neumann at the Institute for Advanced Study each led teams of engineers into the unknown. Turing had given England a head start. Due to security, nobody knew what Atanasoff had accomplished for the Naval Ordnance Labs at the Aberdeen Proving Ground.

After the smoke had cleared, the winner was acknowledged to be ENIAC, child of John Mauchly and Presper Eckert. The aerospace firm Northrop immediately contracted Mauchly and Eckert to design a special-purpose computer. This device would fit in the nose cone of an intercontinental ballistic missile. It would, in midflight, navigate by looking at the positions of the stars. A prototype, BINAC, was demonstrated in 1949. General Groves and a vice-president of IBM seemed interested. The inventors broke, joined Remington-Rand (later Sperry-Rand), developed the first commercially available computer, UNIVAC, and made their first major sale—to the Air Force.

GLOBAL SPIES

Computers have created a revolution in the ancient shadowy art of cryptography—codes and decoders. Anyone with a computer is now capable of communicating with anyone else with a computer by means of an absolutely unbreakable code. This was the dream of cryptographers in the employ of Alexander, Caesar, Napoleon, and Hitler. The techniques known as "trapdoor functions" and "Rivest coding" are easily explainable to any mathematician in the world. Using some familiar properties of large prime numbers, and using a computer to perform the calculations, two people who exchange a numerical "key" or password can thereafter intercommunicate with perfect security. The National Security Agency has tried to suppress this mathematics in civilian (i.e., private) quarters.

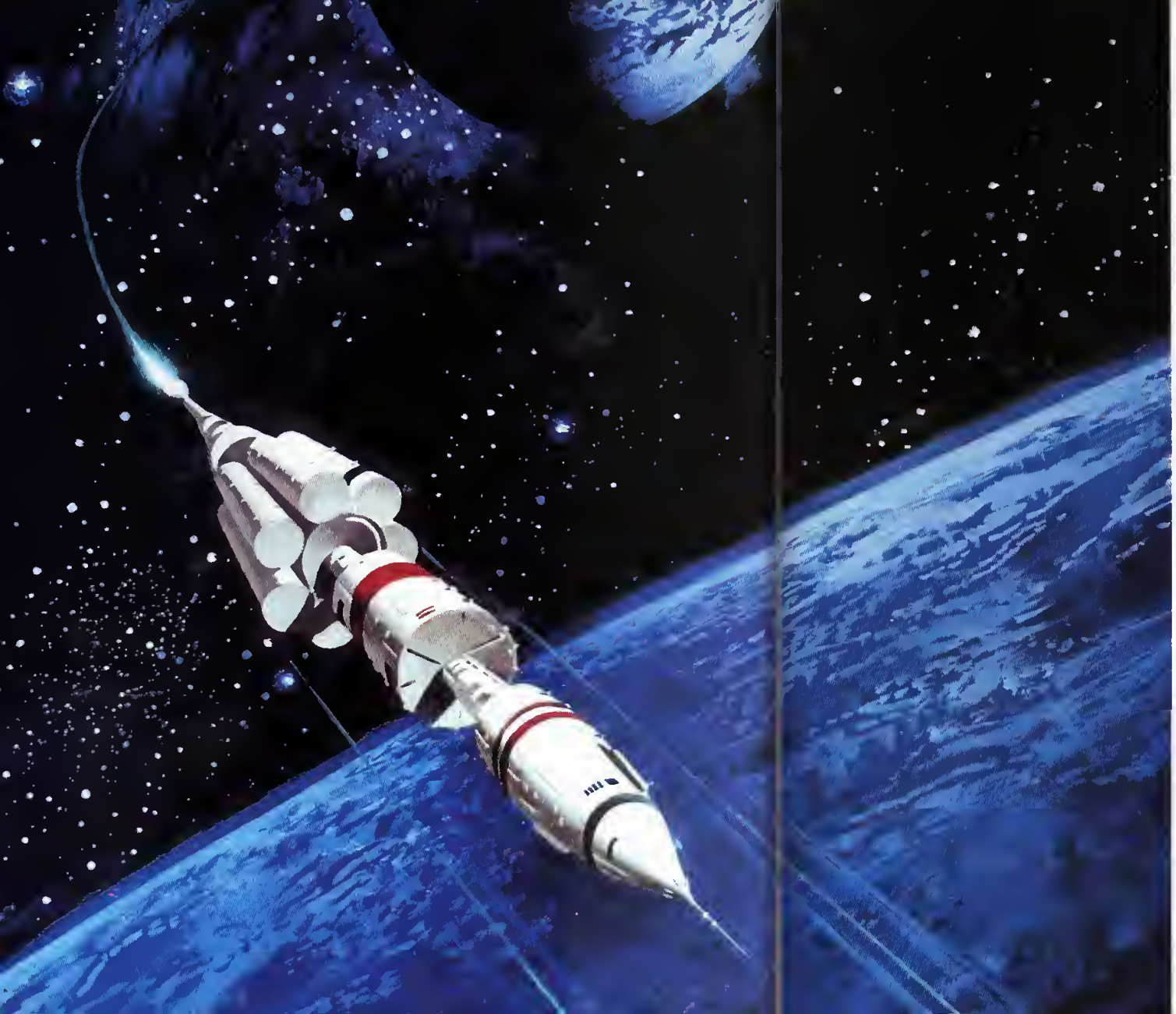
Security involves the controlled access and safety of persons, hardware, and information. Much of military information, government information, and business information is stored and processed by computer. Thus, security today is intimately tied to the computer.

James Angleton, former head of CIA counterintelligence, insists that US national security has been breached by the KGB. The Russian spies reportedly tapped into CIA archives in the central computer system at Langley, Virginia.

The General Accounting Office says that the Social Security Administration computers—which keep records on almost all Americans—are totally vulnerable to unauthorized snooping and tampering.

CONTINUED ON PAGE 104

"It's pie in the sky all right and just look at those additives!"



FICTION

It was a huge ship, ancient, alien, waiting in space—for us!

DARK SANCTUARY

BY GREGORY BENFORD

The laser beam hit me smack in the face

I twisted away. My helmet buzzed and went dark as its sunshade overloaded. *Get inside the ship.* I yanked on a strut and tumbled into the yawning fluorescent-lit airlock.

In the asteroid belt you either have fast reflexes or you're a statistic. I slammed into the airlock bulkhead and stopped dead, waiting to see where the laser beam would hit next. My suit sensors were all burned out, my straps were singed. The pressure patches on knees and elbows had brown bubbles in them. They had blistered and boiled away. Another second or two and I'd have been sucking vac.

I took all this in while I watched for reflections from the next laser strike. Only it didn't come. Whoever had shot at me either thought *Sniffer* was disabled or else they had a balky laser. Either way, I had to start dodging.

I moved fast, working my way forward through a connecting tube to the bridge—a fancy name for a closet-sized cockpit. I revved up *Sniffer*'s fusion drive and felt the tug as she started spitting hot plasma out her rear tubes. I made the side jets stutter too, putting out little bursts of plasma. That made *Sniffer* dart around, just enough to make hitting her tough.

I punched in for a damage report. Some aft sensors burned out, a loading arm melted down, other minor stuff. The laser

PAINTING BY VINCENT DI FATE

bolt must have caught us for just a few seconds.

A bolt from *who*? Where? I checked radar. Nothing.

I reached up to scratch my nose, thinking and realized my helmet and skinsuit were still sealed, vac-worthy. I decided to keep them on, just in case. I usually wear light coveralls inside *Sniffer*; the skinsuit is for vac work. It occurred to me that if I hadn't been outside, fixing a jammed hydraulic loader, I wouldn't have known anybody shot at us at all, not until my next routine check.

Which didn't make sense. Prospectors shoot at you if you're jumping a claim. They don't zap you once and then fade—they finish the job. I was pretty safe now, *Sniffer*'s stuttering mode was fast and choppy, jerking me around in my captain's couch. But as my hands hovered over the control console, they started trembling. I couldn't make them stop. My fingers were shaking so badly I didn't dare punch in instructions. *Delayed reaction*, my analytical mind told me.

I was scared. Prospecting by yourself is risky enough without the bad luck of running into somebody else's claim. All at once I wished I wasn't such a loner. I forced myself to think.

By all rights, *Sniffer* should've been a drifting hulk by now—sensors blinded, punched full of holes, engines blown. Belt prospectors play for *all* the marbles.

Philosophically, I'm with the jackrabbits—run, dodge, hop, but don't fight. I have some surprises for anybody who tries to outrun me, too. Better than trading laser bolts with rockrats at thousand-kilometer range, any day.

But this one worried me. No other ships on radar, nothing but that one bolt. It didn't fit.

I punched in a quick computer program. The maintenance computer had logged the time when the aft sensors scorched out. Also, I could tell which way I was facing when the bolt hit me. Those two facts could give me a fix on the source. I let *Sniffer*'s ballistic routine chew on that for a minute and, waiting, looked out the side port. The sun was a fierce white dot in an inky sea. A few rocks twinkled in the distance as they tumbled. Until we were hit, we'd been on a zero-gee coast, outbound from Ceres—the biggest rock there is—for some prospecting. The best-paying commodity in the Belt right now was methane ice, and I knew a likely place. *Sniffer*—the ugly, segmented tube with strap-on fuel pods that I call home—was still over eight hundred thousand kilometers from the asteroid I wanted to check.

Five years back I had been out with a rockhound bunch, looking for asteroids with rich cadmium deposits. That was in the days when everybody thought cadmium was going to be the wonder fuel for ion rockets. We found the cadmium all right, and made a bundle. While I was out on my own, taking samples from rocks, I saw this gray ice-covered asteroid about a hundred klicks away. My ship auto-eye picked it up from the bright sunglint. Sensors said it was carbon dioxide ice with some water mixed in. Probably a comet hit the rock millions of years ago, and some of it stuck. I filed its orbit parameters away for a time—like now—when the market got thirsty. Right now the big cylinder worlds orbiting Earth need water, CO_2, methane, and other goodies. That happens every time the cylinder boys build a new tin can and need to form an ecosystem inside. Rock and ore they can get from Earth's moon. For water they have to come to us, the Belters. It's cheaper in energy to boost ice into the slow pipeline orbits in from the Belt to Earth—*much* cheaper than it is to haul water up from Earth's deep gravity well. Cheaper, that is, if the rockrats flying vac out here can find any.

The screen rippled green. It drew a cone for me, *Sniffer* at the apex. Inside that cone was whoever had tried to wing me. I popped my helmet and gave in to the sensuality of scratching my nose. If they scorched me again, I'd have to button up while my own ship's air tried to suck me away—but stopping the itch was worth it.

> *"The cylinder was pointing nearly away from me, so radar had reported a cross section much smaller than its real size. I stared at that strange, monstrous thing . . . suddenly I didn't want to be around."*

Inside the cone was somebody who wanted me dead. My mouth was dry. My hands were still shaking. They wanted to punch in course corrections that would take me away from that cone, *fast*.

Or was I assuming too much? Ore sniffers use radio for communication—it radiates in all directions, it's cheap, and it's not delicate. But suppose some rocker lost his radio and had to use his cutting laser to signal? I knew he had to be over ten thousand kilometers away—that's radar range. By jittering around, *Sniffer* was making it impossible for him to send us a distress signal. And if there's one code rockrats will honor, it's answering a call for help.

So call me stupid. I took the risk. I put *Sniffer* back on a smooth orbit—and nothing happened.

You've got to be curious to be a skyjock, in both senses of the word. So color me curious. I stared at that green cone and ate some tangy squeeze-tube soup and got even more curious. I used the radar to rummage through the nearby rocks, looking for metal that might be a ship. I checked some orbits. The Belt hasn't got dust in it, to speak of. The dust got sucked into Jupiter long ago. The rocks—"planetesimals," a scientist told me I should call them, but they're just rocks to me—can be pretty fair-sized. I looked around, and I found one that was heading into the mathematical cone my number-cruncher dealt me.

Sniffer took five hours to rendezvous with it—a big black hunk, a klick wide and absolutely worthless. I moored *Sniffer* to it with automatic moly bolts. They made hollow bangs—*whap whap*—as they plowed in.

Curious, yes. Stupid, no. The disabled skyjock was just a theory. Laser bolts are real. I wanted some camouflage. My companion asteroid had enough traces of metal in it to keep standard radar from seeing *Sniffer*'s outline. Moored snug to the asteroid's face, I'd be hard to pick out. The asteroid would take me coasting through the middle of that cone. If I kept radio silence, I'd be pretty safe.

So I waited. And slept. And fixed the att sensors. And waited.

Prospectors are hermits. You watch your instruments, you tinker with your plasma drive, you play 3-D flexcop—an addictive game, it ought to be illegal—and you worry. You work out in the zero-g gym, you calculate how to break even when you finally can sell your fresh ore to the Hansen Corporation, you wonder if you'll have to kick ass to get your haul in pipeline orbit for Earthside—and you have to like it when the nearest conversationalist is the Social/Talkback subroutine in the shipboard. Me, I like it. Curious, as I said.

It came up out of the background noise on the radarscope. In fact, I thought it *was* noise. The thing came and went, fluttered, grew and shrank. It gave a funny radar profile—but so did some of the new ships the corporations flew. My rock was passing about two hundred klicks from the thing, and the odd profile made me cautious. I went into the observation bubble to have a squint with the opticals.

The asteroid I'd pinned *Sniffer* to had a slow, lazy spin. We rotated out of the shadow just as I got my reflex-opter telescope on line. Stars spun slowly across a jet-black sky. The sun carved sharp shadows into the rock face. My target drifted up from the horizon, a funny yellow-white dot. The telescope whirred and it leaped into focus.

I sat there, not breathing. A long tube, turning. Towers jutted out at odd places—twisted columns with curved faces and sudden jagged struts. A fretwork of blue. Patches of strange, moving yellow. A jumble of complex structures. It was a cylinder, decorated almost beyond recognition. I checked the ranging figures, shook my head, checked again. The inboard computer overlaid a perspective grid on the image, to convince me. I sat very still. The

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"Bernstein, your technique is admirable, your scientific method irreproachable, your conclusions indisputable. But we must ask ourselves this question — Does the world really need a solar-powered whoopee cushion?"

Picture it. It's time to learn a programming language for your new home computer. Your first step? A trip to the drugstore, of course. Learning to program a computer is too tough a job to take on without a good supply of your favorite 'smart pills.

At the pharmacy, the shelf marked INTELLIGENCE BOOSTERS AND CREATIVITY EXPANDERS holds at least a dozen drugs. The pharmacist fills your order: 1,000 Hydergine tablets, 6 bottles of Diapid nasal spray, a kilogram of ribonucleic acid (RNA) powder, 100 grams of dl-phenylalanine, a gram of vitamin B_{12}, and a kilogram of Deaner tablets. You just carry the drugs home.

MIND FOOD

Wonder drugs build stronger intellects (at least) 12 ways

BY SANDY SHAKOCIUS AND DURK PEARSON

PAINTING BY WOLFGANG HUTTER

take them on schedule and promptly learn your new language with a lot more fun and a lot less pain than you'd have had before you found intelligence drugs.

There is nothing futuristic about this scenario. The order is ours, and we're using it right now. The cooperative druggist may be a fantasy. (Did he ask for a prescription?), but increasing brainpower is not.

This is a "how-to" article. You can actually use the drugs we are talking about to increase your own intelligence and creativity. We'll tell you how some of these drugs work—how to use them—and what effects and side effects to expect. Several of the compounds discussed here are vitamins or amino acids—nutrients that are generally exempt from government control and can be purchased freely. Others are prescription drugs approved by the Food and Drug Administration (FDA) for other purposes. A few cannot be had in this country for reasons we will go into later.

Keep in mind that none of these drugs has the FDA's approval for increasing normal intelligence, nor can they get it. The FDA approves only drugs that prevent or cure diseases. Intelligence boosters simply do not fit in their scheme of things. If you want to improve your mental powers, you will have to evaluate the drugs yourself.

Medical researchers have found more than a dozen chemicals* that promote intelligence—learning ability or data processing in standardized tasks—in animals and man. Many have also been used to reverse senile memory loss, depression, and other effects of aging. As the brain ages, it slowly loses its supply of neurotransmitters—chemicals that carry nerve impulses across the gap, or synapse, between one cell and another—or it becomes less sensitive to them. Doses of artificially supplied neurotransmitters, their biochemical precursors, and drugs that mimic them have all been used to replace the missing compounds, resulting in improved mental function. Even in young people, the supply of neurochemicals is limited, so the mental performance of young adults can also be substantially improved.

Each brain chemical has an optimum level, however. Above or below that amount, there's less improvement in intelligence, sometimes even a decline. The only way to find out what is best for you is by systematic experiments. Drug effects can be subtle at first, and you almost always need a learning period to recognize and use any improvement in memory or data processing.

The chemical details of learning and memory are not yet well understood, though knowledge in this area is expanding rapidly. According to current theories, several chemical systems are involved.

One of the most important neurotransmitters involved in memory and learning is acetylcholine, a compound that also plays major roles in motor and sensory control, long-term planning, and primitive drives and emotions. It is also one of the chemicals that show the sharpest declines in the aging brain. Drugs such as scopolamine, which inhibits acetylcholine activity in the brain, produce in young people a complex pattern of learning deficiencies resembling that of old age. Thus, the decline of acetylcholine activity is thought to be important in senile memory loss and other age-related learning defects.

There are several safe and effective ways to increase the brain's acetylcholine supply. Choline, the raw material from which acetylcholine is made, raises brain levels of the neurotransmitter in laboratory animals. In normal young people, an oral dose of ten grams of choline improves memory and serial learning. Choline is a nutrient found in meat, eggs, and fish, so it is exempt from FDA regulation and can be found in most health-food stores. A daily dose of three grams is reasonable for adults.

> *"The natural hormone vasopressin cures amnesia, strengthens concentration, greatly improves memory even in the senile. Moreover, it prolongs the user's orgasms and makes them more intense."*

Choline does have one unfortunate side effect, however. Some people have gut bacteria that digest choline, which gives the user an unpleasant, fishy body odor. Eating a high-fiber diet or large amounts of yogurt often changes the intestinal flora enough to eliminate the problem.

Lecithin (phosphatidyl choline) raises the level of acetylcholine in the brain even more effectively than choline itself, and it can be expected to improve memory and learning in the same way. In one successful experiment, test subjects took 80 grams per day, just over three ounces, and improved their memories markedly. The lecithin sold in health-food stores usually contains large amounts of fat as well, so this can be a high-calorie way to raise your intelligence. Unlike choline, lecithin causes no body odor.

The prescription drug Deaner, known chemically as dimethylaminoethanol *p*-acetamidobenzoate, also raises acetylcholine levels and improves memory and learning in the aged and in hyperkinetic children. In fact, even the FDA approves it as "possibly effective" in the treatment of learning problems and hyperkinesis. In many cases, Deaner has also helped or cured senile memory loss, apathy, and depression.

In addition to raising acetylcholine levels, Deaner "washes away" a cellular aging pigment called lipofuscin, a waste product that may interfere with the functioning of nerve cells. Dr. Richard Hochschild, a gerontologist with the Microwave Instrument Company, used Deaner to lengthen the mean life span of mice by 50 percent and their maximum life span by a third.

Another chemical basic to learning and memory is ribonucleic acid. In the early 1960s Dr. James V. McConnell, a University of Michigan psychologist, tried an experiment in which he taught planarian worms to crawl through a maze, then ground them up and fed them to other flatworms. The cannibals he found learned to negotiate the same maze significantly faster than worms on a normal diet. When he trained them to run a different maze, however, it took them longer to master the lesson. It seemed to be the worms' RNA that caused the effect.

RNA itself is an effective memory booster in experimental animals, and such other intelligence drugs as orotic and inosinic acids work because the body converts them to RNA. Doses of two to ten grams a day are about right. (When you extrapolate from animal experiments to human use, drug doses should be chosen so that they represent equal percentages of the subject's daily dry-food intake. Do not assume that because a mouse weighs three ounces and you weigh 3 000 ounces you can take 1 000 times the mouse's drug dose. Small animals metabolize drugs far faster than large ones, so that the human dose for some drugs is actually smaller than that for mice. Calculating dosages as a percentage of dry-food intake usually compensates for this difference.)

In addition to its memory-enhancing effect, RNA protects against oxidizing chemicals that seem to be a major cause of aging and probably contribute to senility. In this, RNA supplements mimic many natural "maintenance" systems. Plants, for example, protect themselves against damage caused by oxidants formed by exposure to ultraviolet light with such antioxidants as beta carotene, the yellow pigment in carrots and other plants, and vitamins C and E. RNA supplements significantly slow the deterioration seen in old age. In one experiment, a daily dose of 25 milligrams extended the average life span of laboratory mice by 16 percent.

RNA does have some drawbacks, however. Because of its acidity, it can cause stomach upset. A little baking soda taken at the same time will prevent this. More seriously, nucleic-acid metabolism produces large amounts of uric acid as a waste product, and uric acid is the cause of gout. RNA can seriously worsen gout in

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* The list includes ribonucleic acid (RNA), Isoprinosine, vasopressin, Hydergine, Deaner, lecithin, choline, phenylalanine, amphetamines and related compounds, magnesium pemoline, diphenylhydantoin, Ritalin, vitamin B_{12}, Nootropyl, $ACTH_{4-10}$, l-prolyl-l-leucyl glycine amide, caffeine, Metrazol, and strychnine. There are others, but these are the most interesting.

people who already suffer from it and may even cause gout in those who already have high urate levels. The uric acid can precipitate as crystals in the joints and kidneys causing permanent damage and severe pain. Though 90 percent of gout patients are male, women can also suffer from it. Have a uric acid test before taking RNA and a month or so after you begin.

For all that, oral RNA is virtually harmless in people with normal uric-acid levels. Dr. Max Odens, a London physician, has given people up to 80 grams per day and they've suffered no ill effects.

Many health-food stores carry RNA, but check the label before you buy. Yeast is about 6 percent RNA, but the plant's cell walls are so hard to digest that the body takes in very little. If a product contains less than 12 percent RNA, you are probably just buying overpriced yeast with little available nucleic acid.

The drug isoprinosine contains inosine, a raw material the body can use to make RNA, coupled with dimethylaminoethanol, a molecule that helps the inosine pass through the blood-brain barrier, a membrane that prevents most chemicals from entering the brain. The drug increases nucleic-acid synthesis in the brain-cell polyribosomes, cellular factories where RNA copied from the DNA of the genes is translated into proteins. This is a key step in memory formation. Though marketed only as an antiviral agent that combats some strains of polio, flu, and herpes, Isoprinosine is a potent RNA boosfer. Dr. Paul Gordon, who developed the drug in the early 1960s, says it enhances learning efficiency, aids memory, improves behavioral organization, and increases organization and integration of perceptual information. Isoprinosine is available in Europe and Mexico, but, unfortunately, FDA regulations have barred its use here.

Vitamin B_{12} also stimulates RNA synthesis in the brain nerves. Its administration to rats increased their rate of learning. A dose of 1,000 micrograms per day is reasonable.

Yet another chemical vital to learning and memory is the neurotransmitter norepinephrine (NE). Learning ability is severely depressed by drugs that inhibit its synthesis or remove it from the brain. NE itself, on the other hand, improves memory.

When not carrying nerve signals from cell to cell, NE is stored in microscopic pouches known as synaptic transmitter vesicles. To transmit a nerve impulse, NE is secreted into the synapse, then returned to the vesicle. Such drugs as the amphetamines, Ritalin, and magnesium pemoline block NE from reentering the vesicle, thereby increasing the amount of neurotransmitter in the synapse. They also promote memory and improve learning in focusing and attention tasks, but this may occur because they are central nerve stimulants which raise activity levels rather than because of their effect on data-processing.

One disadvantage of these drugs is that they no longer improve learning ability once the nerves have released most of their NE; the body develops a tolerance to the drug until more NE is snythesized. Depression often occurs during this interval.

Phenylalanine, an amino acid found in meat and cheese, is a natural forerunner of NE and a very effective mood elevator and stimulant that does not deplete the body's supply of NE. Doses of 100 to 500 milligrams a day for two weeks completely eliminate the depression seen after amphetamine use. Phenylalanine sometimes raises blood pressure, however, so people with hypertension should start with small doses and increase them gradually, making sure that their blood pressure remains under control. Though not controlled by the FDA, this drug is not yet available in pharmacies or health-food stores. It must be purchased as an industrial chemical.

Vasopressin, also known as antidiuretic hormone, is produced by the pituitary gland. Its main task in the body is to regulate blood pressure and urine volume, but in the brain it is also a powerful stimulant of memory and learning. Cocaine and several other popular drugs release vasopressin from the pituitary, which may explain why cocaine improves learning in tasks that require focusing and concentration and enhances the memory and the ability to re-experience remembered emotions. On the other hand, nicotine, alcohol, and marijuana inhibit vasopressin release.

> *"FDA regulations block adoption of many drugs that can raise your brainpower. It took a doctor we know over three months to get permission to read about one promising new intelligence drug."*

Medical researchers have found that 16 units per day of Diapid nasal spray, a synthetic version of vasopressin, restores memory to amnesia patients and improves attention, concentration, motor rapidity, and memory in men in their fifties and sixties. We have used up to 40 units per day and gained amazing improvements in memory and learning. We have also experienced prolonged and intensified orgasms, an effect not mentioned in the scientific literature!

Diapid has few side effects. Studies have found no effect on blood pressure and urine volume, even at doses of 16 units per day. Intestinal cramps and nasal irritation are occasionally seen. Angina patients sometimes develop heart pain when using Diapid, but this does not seem medically dangerous. Diapid remains effective as long as it is used and, unlike cocaine, does not cause depression when discontinued.

Hydergine, a very safe drug, is approved by the FDA for treatment of depression, confusion, unsociability, and dizziness in the elderly. Scientific reports show that it has many other uses. Hydergine is a chemical relative of LSD. Though it has no hallucinogenic effects, it produces a feeling of extreme clear-headedness typical of very low doses of LSD. Hydergine improves learning and memory, and it can relieve confusion, apathy, and forgetfulness in the aged. This takes up to several months, depending on the condition's severity.

The neurotransmitters deliver chemical messages between nerve cells. But within the cell a "second messenger" (cyclic AMP) delivers messages from the cell membrane to the nucleus. Hydergine controls the level of the second messenger inside brain cells. Caffeine is a stimulant with a closely related effect on the second messenger, but because the action of Hydergine is more selective, it doesn't cause a come-down or jitters like caffeine and increases intellectual performance over a much wider range of dosages and rates of administration. A mutant fruit fly called the "dumb" fruit fly has recently been discovered. It is dumb because there is a defect in its control of the level of the second messenger. Hydergine also increases protein synthesis in the brain.

The recommended dosage of Hydergine is three milligrams per day in this country; only a third of the dose used in Europe. The drug is nontoxic at these dosages, though nausea and headaches do occasionally occur.

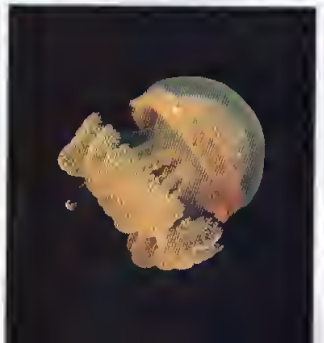
Hydergine has several complex effects that may be even more important than its benefits to memory and mood. During anesthesia, drowning, and perhaps stroke, it protects the brain against damage due to lack of oxygen and blood glucose. For this reason, it is used routinely in Europe to prepare patients for surgery.

It also stimulates the growth of neurites, fine tendrils that grow from each nerve cell or neuron in large numbers and form a complex network of cross connections. Each neuron may be in contact with 100,000 other nerve cells through its neurites. These fibers are essential for learning and data processing, but their numbers fall off drastically with age. Until recently, scientists believed this loss was permanent. It turns out, however, that a hormone called nerve-growth factor stimulates regeneration of the neurites. Six months to two years of Hydergine therapy may also reverse this loss, acting by the same mechanism as the natural hormone. Unfortunately, many physicians try the drug on their patients for a few days or weeks and, seeing no immediate effect, give up.

Nootropyl, known chemically as 2-oxo-pyrrolidine acetamide, is a new intelli-

CONTINUED ON PAGE 127

Formosa jellyfish (above), found in inland seas of Japan, has deadly stinging barbs in its coiled tentacles. Mastigias jellyfish (right) contain beneficial algae that help convert harmful wastes and produce oxygen.



THE UNIVERSE BELOW

PHOTOGRAPHS BY DOUGLAS FAULKNER

Several hundred million years ago, when one of our distant ancestors abandoned life in the watery universe below for solid ground, a great transition began. As Arthur C. Clarke once said: "We creatures of the land are exiles—displaced organisms on the way from one element to another. We are still in the transit camp, waiting for our visas to come through. . . . We are on our way to space, and there, surprisingly enough, we may regain much that we lost when we left the sea."

The universe depicted on these pages is, of course, the universe below, the base camp from which earthly life began its long journey to the stars. Photographed by Douglas Faulkner, perhaps the world's most celebrated underwater photographer, the creatures displayed here could well be our neighbors in space, inhabitants of the methane and ammonia atmosphere of some distant Jovian planet, or some kind of organic spacecraft, plying their way between the galaxies. Instead, they are our earthly neighbors, the jellyfish.

Parallels between the universe below and the vast ocean of space around us are many. The sensation of weightlessness, familiar to the growing population of skin divers, is probably the most

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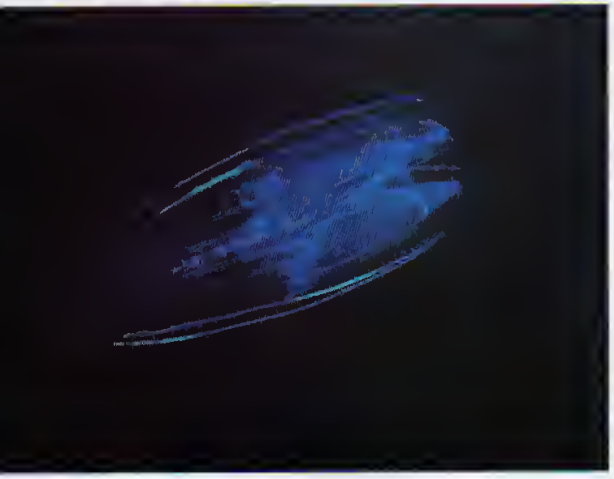
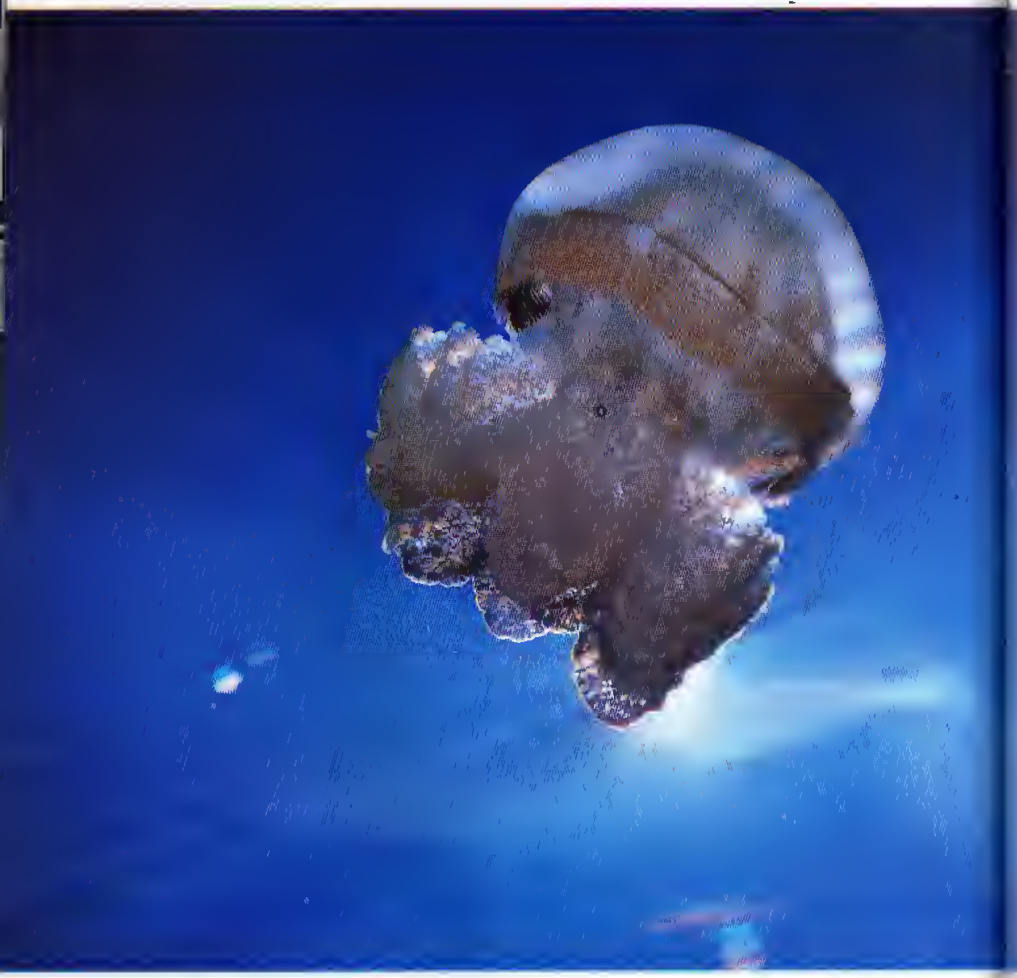
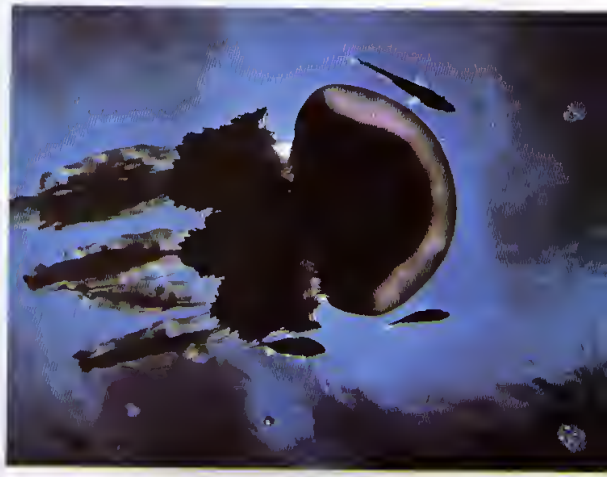
"The creatures displayed here could well be our neighbors in space"

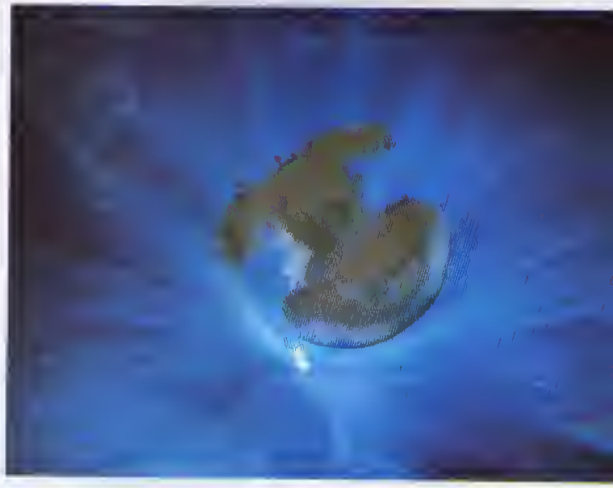


During early-morning feeding, these New Guinea ctenophores are in the open position (above). As the day progresses, they fold up (bottom left). The fully folded creature (top left) is carried along by the currents.

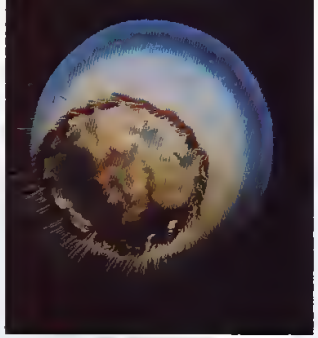
"Our time on land may be only a moment in the history of the Universe"

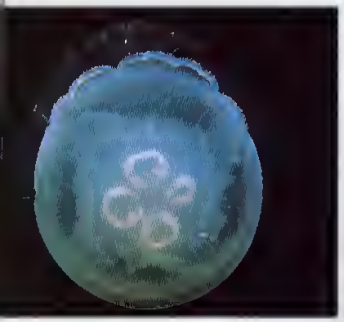






Mastigias in lagoon (top right) has large clubs for protection, while similar types in marine lake (above and bottom right) have undeveloped clubs owing to lack of predators. Both revolve beneath surface to gather light





Faulkner photographed these Moon jellyfish off Amchitka Island near Alaska. A close-up (right) inside the bell shows the four gonads, along with the frilled appendages used for feeding. The two views above show the pulsating bell by which the jellyfish rotates toward light.

"We land creatures are exiles—displaced organisms on the way to space."

obvious. It was, after all, in the weightlessness of the oceans that the astronauts trained for their initial encounter with the zero gravity of space. The jellyfish themselves are analogous to space vehicles. Several species, for example, contain symbiotic algae that live within their manubrium, the bushy area located behind the jellyfish's bell. These jellyfish, swimming just below the surface of the water, revolve counterclockwise at a rate of about one revolution per minute so that the symbiotic algae can receive equal exposure to the sun. Thus they are like solar satellites tracking the sun for maximum efficiency. It is fitting that we reconsider the universe from which we sprang. In the words of Arthur C. Clarke, "our pause here, between one ocean and the next, may be only a moment in the history of the Universe." ∞

FICTION

GOD IS AN IRON

She had lived a life of unending pain, so it was only natural that her method of committing suicide would be through pleasure

BY SPIDER ROBINSON

I smelled her before I saw her. Even so, the first sight of her was shocking.

She was sitting in a tan plastic surfaced armchair, the kind where the front comes up as the back goes down. It was back as far as it would go. It was placed beside the large living-room window whose curtains were drawn. A plastic block table next to it held a digital clock, a dozen unopened packages of Peter Jackson cigarettes, a glass jar full of packs of matches, an empty ashtray, a full vial of cocaine, and a lamp with a bulb of at least 150 watts. It illuminated her with brutal clarity.

She was naked. Her skin was the color of vanilla pudding. Her hair was in rats, her nails unpainted and untended, some overlong and some broken. There was dust on her. She sat in a ghastly sludge of feces and urine. Dried vomit was caked on her chin and between her breasts and down her ribs to the chair.

These were only part of what I had smelled. The predominant odor was of fresh-baked bread. It is the smell of a person who is starving to death. The combined effluvia had prepared me to find a senior citizen paralyzed by a stroke or some such crisis.

I judged her to be about twenty-five years old.

I moved to where she could see me, and she did not see me. That was probably just as well, because I had just seen the two most horrible things. The first was the smile. They say that when the bomb went off at Hiroshima, some people's shadows were baked onto walls by it. I think that smile got baked on the surface of my brain in much the same way. I don't want to talk about that smile.

The second most horrible thing was the one that explained all the rest. From where I now stood I could see a triple socket in the wall beneath the window. Into it were plugged the lamp, the clock, and her.

I knew about wireheading, of course—I had lost a couple of acquaintances and one friend to the juice. But I had never *seen* a wirehead. It is by definition a solitary vice, and all the public usually gets to see is a sheeted figure being carried out to the wagon.

PAINTING BY MARSHALL ARISMAN

The transformer lay on the floor beside the chair where it had been dropped. The switch was on, and the timer had been jiggered so that instead of providing one five- or ten- or fifteen-second jolt per hour it allowed continuous flow. That timer is required by law on all juice rigs sold, and you need special tools to defeat it. Say a nail file. The input cord was long, fell in crazy coils from the wall socket. The output cord disappeared beneath the chair, but I knew where it ended. It ended in the tangled snarl of her hair at the crown of her head, ended in a miniplug. The plug was snapped into a jack surgically implanted in her skull, and from the jack tiny wires snaked their way through the wet jelly to the hypothalamus, to the specific place in the medial forebrain bundle where the major pleasure center of her brain was located. She had sat there in total transcendent ecstasy for at least five days.

I moved, finally. I moved closer, which surprised me. She saw me now and impossibly the smile became a bit wider. I was marvelous. I was captivating. I was her perfect lover. I could not look at the smile, a small plastic tube ran from one corner of the smile and my eyes followed it gratefully. It was held in place by small bits of surgical tape at her jaw, neck, and shoulder, and from there it ran in a lazy curve to the big fifty-liter water-cooler bottle on the floor. She had plainly meant her suicide to last. She had arranged to die of hunger rather than thirst, which would have been quicker. She could fake a drink when she happened to think of it, and if she forgot, what the hell.

My intention must have showed on my face, and I think she even understood it—the smile began to fade. That decided me. I moved before she could force her neglected body to react, whipped the plug out of the wall and stepped back warily.

Her body did not go rigid as if galvanized. It had already been so for many days. What it did was the exact opposite, and the effect was just as striking. She seemed to shrink. Her eyes slammed shut. She slumped. *Well*, I thought, *it'll be a long day and night before she can move a voluntary muscle again*, and then she hit me before I knew she had left the chair, breaking my nose with the heel of one fist and bouncing the other off the side of my head. We cannoned off each other and I managed to keep on my feet; she whirled and grabbed the lamp. Its cord was stapled to the floor and would not yield, so she set her feet and yanked and it snapped off clean at the base. In near-total darkness she raised the lamp on high and came to me, and I lunged inside the arc of her swing and punched her in the solar plexus. She said guff! and went down.

I staggered to a couch and sat down and felt my nose and fainted.

I don't think I was out very long. The blood tasted fresh. I woke with a sense of terrible urgency. It took me a while to work out why. When someone has been simultaneously starved and unceasingly stimulated for days on end, it is not the best idea in the world to depress that someone's respiratory center. I lurched to my feet.

It was not completely dark; there was a moon somewhere out there. She lay on her back, arms at her sides, perfectly relaxed. Her ribs rose and fell in great slow swells. A pulse showed strongly at her throat. As I knelt beside her she began to snore, deeply and rhythmically.

I had time for second thoughts now. It seemed incredible that my impulsive action had not killed her. Perhaps that had been my subconscious intent. Five days of wireheading alone should have killed her, let alone sudden cold turkey.

I probed in the tangle of hair, found the empty jack. The hair around it was dry. If she hadn't torn the skin in yanking herself loose, it was unlikely that she had sustained any more serious damage within. I continued probing, found no soft places on the skull. Her forehead felt cool and sticky to my hand. The fecal smell was overpowering the baking bread now, sourly fresh.

> *"They say that when the bomb went off at Hiroshima, people's shadows were baked onto the walls. Her smile got baked on my brain in much the same way."*

There was no pain in my nose yet, but it felt immense and pulsing. I did not want to touch it or to think about it. My shirt was soaked with blood. I tossed it into a corner. It took everything I had to lift her. She was unreasonably heavy, and I have carried drunks and corpses. There was a hall off the living room, and all halls lead to a bathroom. I headed that way in a clumsy staggering trot, and just as I reached the deeper darkness, with my pulse at its maximum, my nose woke up and began screaming. I nearly dropped her then and clapped my hands to my face; the temptation was overwhelming. Instead I whimpered like a dog and kept going. Childhood feeling: runny nose you can't wipe. At each door I came to I teetered on one leg and kicked it open, and the third one gave the right small-room acoustic tile echo. The light switch was where they almost always are. I rubbed it on with my shoulder and the room flooded with light.

Large aquamarine tub. Styrofoam recliner pillow at the head end, nonslip bottom. Aquamarine sink with ornate handles, cluttered with toiletries and cigarette butts and broken shards of mirror from the medicine cabinet above. Aquamarine commode, lid up and seat down. Brown throw rug, expensive. Scale shoved back in a corner. I made a massive effort and managed to set her reasonably gently in the tub. I adjusted her head, fixed the chinstrap. I held both feet away from the faucet until I had the water adjusted, and then left with one hand on my nose and the other beating against my hip in search of her liquor.

There was plenty to choose from. I found some Metaxa in the kitchen. I took great care not to bring it near my nose, sneaking it up on my mouth from below. It tasted like burning lighter fluid and made sweat spring out on my forehead. I found a roll of paper towels, and on my way back to the bathroom I used a great wad of them to swab most of the sludge off the chair and rug. There was a growing pool of water siphoning from the plastic tube, and I stopped that. When I got back to the bathroom the water was lapping over her bloated belly, and horrible tendrils were weaving up from beneath her. It took three rinses before I was satisfied with the body. I found a hose-and-spray under the sink that mated with the tub's faucet, and that made the hair easy.

I had to dry her there in the tub. There was only one towel, none too clean. I found a first-aid spray that incorporated a good topical anesthetic, and I put it on the sores on her back and butt. I had located her bedroom on the way to the Metaxa. Wet hair slapped my arm as I carried her there. She seemed even heavier as though she had become waterlogged. I eased the door shut behind me and tried the light-switch trick again, and it wasn't there. I moved forward into a footlocker and lost her and went down amid multiple crashes, putting all my attention into guarding my nose. She made no sound at all, not even a grunt.

The light switch turned out to be a pull chain over the bed. She was on her side, still breathing slow and deep. I wanted to punt her up onto the bed. My nose was a blossom of pain. I nearly couldn't lift her the third time. I was moaning with frustration by the time I had her on her left side on the king-size mattress. It was a big brass four-poster bed with satin sheets and pillowcases, all dirty. The blankets were shoved to the bottom. I checked her skull and pulse again, peeled up each eyelid and found uniform pupils. Her forehead and cheek still felt cool, so I covered her. Then I kicked the footlocker clear into the corner, turned out the light, and left her snoring like a chainsaw.

Her vital papers and documents were in her study, locked in a strongbox on the closet shelf. It was an expensive box, quite sturdy and proof against anything short of nuclear explosion. It had a combination lock with all of twenty-seven possible combinations. It was stuffed with papers. I laid her life out on her desk like a losing hand of

CONTINUED ON PAGE 107

"We have visual contact with the alien craft and something tells me we should rethink our design concepts"

GULF DREAM

The world's mightiest current may soon be supplying cheap, clean electric power

BY SCOT MORRIS

An Unidentified Floating Object hovering over the Bermuda Triangle? Some figment of Jules Verne's imagination? No, it is *Coriolis-1*, moored off the Florida coast, in a scene that could exist less than five years from now. Divers and a small research submarine are inspecting the hull of this giant underwater turbine, built to convert the most powerful ocean current in the world into cheap, clean electrical energy.

The Gulf Stream is a hydraulic force of startling efficiency. Its fastest part is right here, just 32 kilometers due east of Miami. The water surges by at about 2.5 meters per second (or 7 kilometers

PAINTING BY WAYNE McLOUGHLIN

per hour). Divers must swim vigorously just to stay in place.

The scale of *Coriolis-1* is awesome. Each of its blades is the length of a football field and rotates at a slow but steady one rpm, which is kept in motion by the relentless push of ocean currents. The cylindrical duct surrounding these blades is an aluminum leviathan nearly the size of the Rose Bowl. Its wide end, where the divers are swimming, is 168 meters across, almost the size of three 747 jet liners, wing tip to wing tip. When *Coriolis-1* is joined by 230 other similar turbines along this stretch of the Gulf, the energy output will equal ten nuclear plants—about 10,000 megawatts. That's enough electricity to supply the entire state of Florida.

"This is no blue-sky scheme," says project director Peter B. S. Lissaman in his measured British/South African accent. "It isn't a Buck Rogers flight of fancy. It really will work. The materials to build the thing are available today—we're not waiting for the development of any exotic controls or superstrong structures. The design is based on well-understood hydrodynamics. Constructing and installing it involves standard marine and offshore oil-rig engineering and practice. And the electrical and transmission components are all off-the-shelf items."

Lissaman's confidence stems from his working relationship with New Orleans engineer and Tulane University architecture professor Bill Mouton. Together they have mapped out a plan to harness the Gulf Stream.

Bill Mouton first got the idea of using the force of a river to spin giant underwater propellers as he stood on the bank of the flooding Mississippi in 1973. After a few calculations, Mouton realized that his engine would be most efficient not in the Mississippi but in the mighty Gulf Stream.

Mouton's first published proposal met with scientific skepticism. Critics argued that the Gulf Stream wasn't powerful enough, that one couldn't extract more than a tenth of the energy Mouton proposed without seriously slowing it down. Mouton's scheme was criticized at all levels. The turbine would be torn apart by underwater stresses; it wouldn't provide as much energy as projected; it would be too expensive; it would disrupt shipping; play havoc with Florida's beaches, kill the fish, and put the entire ecosystem of the North Atlantic in jeopardy.

By 1976, Mouton's plan seemed destined for the Rube Goldberg File. Then aerodynamics expert Peter Lissaman of Pasadena's Aerovironment, Inc., came out with a comprehensive study of the entire concept, which silenced most serious critics. "I showed that the Gulf Stream is a massive energy system, more powerful than anyone had believed," Lissaman said. "It contains fifty times as much energy as all the rivers in the world put together. Taking out ten thousand megawatts would be an *Augenblick*—a blink of an eye—compared to the total amount of energy in the system. In all likelihood you won't even know the turbines are out there."

FREE-HANGING BLADES

Lissaman and Mouton demonstrated how a prototype could be moored in the stream by two sets of cables, one stretching from a huge cement anchor more than two kilometers upstream (in this case, to the south), the other fastening to the ocean bottom directly underneath. The entire structure would be suspended about 30 meters below the surface.

Getting an enormous propeller to spin underwater is no problem, but if it is to spin against enough resistance to generate worthwhile amounts of electricity, the stress on rigid blades (fanning out from a central axle) would be so great that no known technology could make the blades strong enough. Mouton had two brainstorms, which he later patented. The first was to make the blades, whose tips are recessed into the cylindrical hull, not rigid but limp. They take their shape when the current flows by them, just as the suspension cables on the Golden Gate Bridge take their shape by hanging in gravity. A catenary or free-hanging blade is tremendously strong; it does not have to withstand twisting or bending forces, only the tensile forces that stretch it from end to end.

"The scale is awesome. Each blade is the length of a football field and rotates at one rpm. The cylindrical duct is an aluminum leviathan the size of the Rose Bowl."

Mouton's second idea was to reverse the usual method of extracting power from rotary motion. Energy usually flows from an axle, but since axle-mounted blades in this case would require an impossibly strong structure, Mouton decided to draw power from the outside tips of the blades instead. For hydraulic reasons, and to keep the whole structure from rotating in water, there will actually be two sets of blades rotating in opposite directions. Imagine two bicycle wheels mounted close together on the same axle and spinning in opposite directions. A ball placed between the two tires would spin rapidly from the friction of the tires. Similarly, wheels in the hull of Mouton's machine, compressed between the two counterrotating propeller-wheels, will power AC generators. The electricity will then be converted to DC and sent via copper cables, along the ocean floor toward Miami.

The giant cylindrical duct of *Coriolis-1* will be more than just a housing for electrical generators. It will have a specific hydrofoil shape that will speed the water going through it much faster than the surrounding Gulf Stream itself. Also, it will be designed so that it can be filled with air to raise the structure to the surface for repair or transportation.

IMPACTS

Peter Lissaman made some remarkable calculations about the environmental impact of 230 *Coriolis*-type turbines arrayed between 32 kilometers east and 192 kilometers north of Miami.

- A slowing of the Gulf Stream by less than 1 percent, even after many years of continuous operation. This is much less than the normal annual fluctuation in the Gulf Stream, which sweeps past Miami at over 2.5 meters per second in the summer, then slows to an average speed of 1.6 meters per second in the winter.
- A change in the stream temperature of no more than a couple millionths of a degree Celsius, also a small fraction of the natural annual fluctuation.
- A change in the water level of the stream amounting to less than four centimeters (a two-centimeter rise upstream of a turbine, a two-centimeter fall downstream).
- Probably no change in the water level greater than 0.1 millimeters anywhere along the Florida coastline.
- A local wave-making effect significantly below the normal wind-caused waves in the Florida channel.

And the effect on shipping? "None whatsoever," says Lissaman. "These turbines will be moored some one hundred feet below the surface, far below any ships and, incidentally, protected from even the worst storms on the surface. Only the boys in a ship's sonar room will know anything's down there. As for the impact on the Gulf Stream, I've calculated that merchant shipping is already putting much more energy and more heat perturbations into the water than the entire Coriolis Project will."

FISH SWIM THROUGH

What about the danger to marine life? Bill Mouton: "We see no problem here at all. First, a net of bridle lines will connect the drag cable to the turbine's rim, and anything small enough to swim through the bridle lines will be small enough to swim right through the turbine. There's a sixty-foot gap between the blades, and there's no fish in the ocean big enough to get caught in that."

But couldn't a big whale get scissored between the two propellers turning in opposite directions? "Not likely," Mouton said in his down-home Louisiana drawl. "He could swim out of that pretty easily. These blades are free-hanging and flexible. A big creature could push them out of the way to

swim through. Anyway because of the size of this thing and the whirring noise it will make, whales and big fish will probably keep their distance."

Lissaman is similarly unconcerned about the prospect of massive fish fillets on the Florida coast. "Remember, these blades are spinning *very* slowly, about three or four meters per second. You try catching a trout by moving your net through the water at three or four meters per second and see how well you do. The biggest fish in the ocean could swim through these blades without even being touched, much less injured, which is to say that the little fish probably won't even know the turbine is there."

Perhaps fish will be attracted to these structures as they are to drilling rigs, I suggested. "I hope they aren't," Lissaman said. "These turbines will spin continuously for thirty years without repair. I don't think we'll get the kind of biotoul growth you see on old wrecks. This stream is going too fast for that. Ships don't foul when they're under way, only in harbor. The speed of this current is just about large enough that there shouldn't be any major fouling, rusting, or algae."

Lissaman's calculations confirmed what Mouton knew at heart but could not specify: that the environmental hazard was nil, and that junking the project because it might harm the Gulf Stream would be like forbidding children to fly kites because disrupting natural wind patterns might alter the weather. In Lissaman's own immodest words: "My figures caused a sensation. They reopened the doors and convinced scientists that this isn't a Rube Goldberg contraption—it's really going to work." The Department of Energy was so impressed that it granted $220,000 to finance the next phase of research.

What was Lissaman, an aerodynamics expert, doing in an underwater project? "This is very much my field," he said. Designing one of these is like designing a windmill—it's harnessing the energy flux in the natural fluids of the earth. . . . In fact, Lissaman's calculations were directly the result of work he did in Sweden to find out how close together a string of windmills could be placed without disrupting the performance of those downwind.

A GIANT FLYWHEEL

In one sense the Gulf Stream itself is a result of aerodynamic effects, because the prevailing winds set the water in motion. In a larger sense, tapping the Gulf Stream is using solar power twice removed. The sun's action on the atmosphere, combined with the earth's shape, rotation, and tilt, makes the winds blow as they do. The earth's counterclockwise rotation (as seen from the North Pole), combined with many other factors, propels the clockwise motion of North Atlantic waters. Flowing northward past the eastern United States and Newfoundland, across to England, and then south past the Canary Islands and back toward the Caribbean and the Gulf Stream, the whole North Atlantic is a giant flywheel. This is caused by the Coriolis effect, named after Gaspard G. Coriolis, the French mathematician who first described, in an 1835 treatise, the mathematics of motion across a rotating surface. The Coriolis effect makes ocean currents in the Northern Hemisphere swirl clockwise around their banks, compressing their currents against their western sides, which is just where Florida's eastern coastline happens to be. It's no mere coincidence, therefore, that the Lissaman-Mouton turbine be similarly positioned.

An analogous current in the North Pacific reaches its greatest speed in the Kuroshio Current off Japan. In the Southern Hemisphere currents flow the opposite way—counterclockwise—with their greatest concentrations against western shorelines. Peru and South Africa, swept by the Humboldt Current and the Benguela Current respectively, are in the same lucky position as Japan and the United States for being able to take advantage of ocean-turbine research.

> *"There's a sixty-foot gap between the blades, and there's no fish in the ocean big enough to get caught in that. . . . The little fish probably won't even know it's there."*

Questions of technology aside, what makes the Coriolis Project so promising is its economic feasibility. Preliminary estimates suggest a price tag of $75 million for *Coriolis-1*, the prototype unit. At this point no one is ready to invest that kind of money, but the Department of Energy has already committed over $1 million to take the project through its next phases, which include designing the optimal shape of the hydrofoils and building and testing a 12-meter-diameter pilot model (expected to be completed in about 18 months). It is hoped that by the end of this period, results will be so promising that private industry will be persuaded to put up much of the money to build *Coriolis-1*.

Ignoring ecological considerations, the project would seem to be a good investment. In round figures, 230 turbines will cost $10 billion and provide over 10 billion watts of power. That breaks down to a bit less than $1 a watt—substantially less than wattage from new nuclear or coal-powered plants (which cost between $1.10 and $1.20 per watt, depending on whom you ask).

When ecology is brought into the equation, Lissaman points out with enthusiasm, "a good buy becomes a fantastic deal. This is clean energy taken from an undepletable reservoir that is continually renewing itself. Normally it costs money to do environmentally sound things. With this plan we'll be doing something good for the environment—and we'll be doing it *cheaper*."

CURRENT EVENTS

Surely the success of *Coriolis-1* is yet to be a *fait accompli*. In a day when multimillion-dollar projects frequently fizzle or fail to meet expectations, there must be room for some glitches in *Coriolis-1*.

"Sure," said Lissaman. "We may have to change our estimates of what we can do. The final design of *Coriolis-1* may be somewhat different than our blueprints show today, but it will probably make the system even more appealing than it is now. One of these turbines can be completed in twelve to fourteen months once production is set in motion, making it a very attractive investment.

"My calculations have been conservative across the board—I purposely overestimated the costs, underestimated the power output, and overestimated the environmental risks. Also, my calculations were based on the full system of a couple hundred turbines operating over many years. But we'll be able to measure the real impact gradually, because the units will be installed one at a time, in staged fashion, over a ten-year period. The impact of placing the prototype out there will be less than 1 percent of any of the stated figures.

"I have no doubt there will be problems and heartbreaks, as there always are in any plan of this scope. I honestly compare this with the building of the Suez Canal. It's that big, that costly, with the same interesting legal international ramifications. Who owns those waters? Who owns the ocean bottom where these engines will be anchored? How will we distribute the power to the different states?

"The Suez Canal went through several different corporations before it was completed. But it was completed, and essentially the way Ferdinand de Lesseps, the original inventor and envisager, said it would have to be. And when it was finished it worked just as he said it would. The Suez was not like the Apollo Project, where new technologies were needed—it simply involved state-of-the-art engineering applied on a very large scale.

"I think this is the case with the ocean turbines. When they're done they may look a little different from these sketches. It's possible that the catenary system will be modified. All sorts of things will change a little bit. There will be unforeseen disasters and unforeseen bonuses—more of the latter, I predict. Some things will turn out to be much, much easier than we project now. But overall, I think we have studied the plan closely enough so that there won't be any *very* nasty surprises." OO

Toward Lenin's dream of inheriting the universe

RED STAR IN ORBIT

BY JAMES OBERG

The first true colonist of space is already an adult. He or she may be an engineer, scientist, doctor, or perhaps an Air Force pilot—the choice of professions is wide and uncertain. But if some doubt exists about his or her professional specialty, little doubt remains about his or her nationality. Russian. Current Soviet exploits on board *Salyut* space stations are paving the way for major advances in human civilization. Soon Russia will establish permanently inhabited space outposts, their cosmonaut crews periodically rotated home to Earth and relieved by replacement crews. From that moment on, *there will always be human beings in space.*

The success of recent *Salyut* missions transformed the secretive Russians into effusive forecasters and proud publicizers. They have a lot to boast about. After years of careful preparation marred by all too frequent embarrassments, the Soviets have reached a remarkable level of competence in an arena of specialization that has, for the most part, remained free of American competition. And they appear to have no intention of relinquishing that lead, ever. Official Soviet policy is explicit and simple: "We believe that permanently inhabited space

PAINTING BY ANDREI SOKOLOV

stations with interchangeable crews will be humanity's main road to the universe." Leonid Brezhnev told a convention of space researchers late last year. Lesser officials regularly echo this litany. Observers note that the Soviets do not envision such permanent space stations purely as ends in themselves. Rather, the stations will be used as stepping stones to further targets: the moon, Mars, the building of orbital factories and power stations, and so forth.

Today the Soviets are laying firm technological foundations for their dream of space supremacy. Technologies now becoming available include robot tanker spaceships, closed-cycle life-support systems, pseudogravity, multimodular space stations, and possibly a nuclear-power space tug. Western specialists forecast winged space shuttles and larger booster rockets, but these will not really be needed until the mid-1980s.

THE SALYUT EXPERIENCE

Present Soviet space successes have come a long way from Moscow's astronautical humiliations of a decade ago. During the 1968–1973 period, an aggressive American space program (itself born in the psychological trauma of the *Sputnik*-*Lunik*-*Vostok* goosings circa 1957–1963) had triumphantly reached the moon. This achievement was followed by an expertly flown pioneering space-station expedition. Soviet attempts to compete ended in disaster. Their abortive man-to-the-moon program was buried in secret disgrace; the ashes of their dead space-station cosmonauts were interred in public mourning.

Yet as the US program wound down in the mid-1970s and prepared to shift gears into the space-shuttle era, Soviet planners steadfastly laid out a new course. Gone were most of the headline-grabbing "space spectaculars" and the political manipulation that had previously crippled long-range planning. Gone were the frantic "Beat the Americans" crash programs ordered by the Kremlin. Instead, there lay ahead a step-by-step rational progression of space experiments supplemented by unspectacular (but fruitful) earth-based research.

To accelerate the development of space stations (moon flights were put off for a decade), Soviet planners split the *Salyut* program into two parallel efforts. While one team concentrated on space science and medicine, the other specialized in Earth observation, space-based industrial processes, and military applications. *Salyuts* of each variety were launched in alternate years.

The standard 20-ton *Salyut* module consists of a roughly telescoping series of three cylinders. Its total length is about 12 meters. The narrow end has a docking port for receiving ferry ships from Earth (the *Soyuz* craft), along with an airlock for space walks. At the wide end is another docking port and propulsion rockets. Panels covered with solar cells sprout winglike from the middle section and they provide electrical power.

This basic space machine has been launched at least eight times since 1971 (the present version is called *Salyut VI*, but that is only because some failures have been ignored by official Moscow space scorekeepers). Each launch is an improvement over the preceding one, and the Soviets are promising many more.

Modified *Salyut* modules, launched separately, will be linked together in space to form larger stations. Specially instrumented *Salyut* vehicles will be towed by nuclear-power rockets into lunar orbit from where cosmonauts will study the lunar surface and then descend briefly in lunar landing modules. An advanced *Salyut*-class module might possibly become the command section of a Soviet interplanetary probe as early as 1989.

These efforts do not exist in a vacuum or solely on the drawing boards of a space bureaucracy. They are rooted in the hearts and minds of Soviet society. The drive into space rests on several pillars: widespread public support, practical considerations of middle-level technocrats, and top-level Kremlin favor. Yet this commitment, equaling five times the proportional resources allocated in the US, is not without opposition. Western Kremlinologists suspect that the space budget is the subject of vigorous (if unpublicized) debate within the Soviet Union. Conquering the universe must for the moment compete with capital investment and consumer goods. But the pro-space factions have prevailed and, strengthened by the heady successes of 1978–79, are likely to remain dominant.

"By the mid-1980s, the Soviets will have built several permanent space settlements in orbits around Earth and the moon. Present expectations suggest that the normal duty tour for crews will be one year."

CLASS ENTHUSIASM

Russian popular enthusiasm for space exploration dates back to the 1920s, when the new Soviet government, eager to establish an image of a future-oriented society, encouraged popularization of the topic as a distraction from contemporary realities. This was facilitated by the emergence of a genuine Russian space pioneer, a half-deaf rural schoolteacher named Konstantin Tsiolkovskiy, who has become a legend.

Tsiolkovskiy (his father, a Polish lumberjack who moved to Russia, spelled his name Ziolkowski) conducted theoretical space studies at the turn of the century and wrote several startlingly prescient science-fiction novels. His work, however, was unknown outside of Russia until after the Bolshevik Revolution. Tsiolkovskiy's advocacy of what we today call "space colonization"—which was promoted by the new regime as a propaganda gimmick, had genuine appeal to the expansionist, frontier-minded Russian soul.

"The earth is the cradle of the mind," Tsiolkovskiy wrote. "but one does not live in the cradle forever." Foreseeing the value of space industrialization, he later added that 'space travel will give us mountains of bread and unimaginable power.'

His most evocative passage stands as a monument to true vision. Written in Russian in the 1890s, it will probably be engraved on space vehicles down the centuries. "Humanity will not remain forever on the earth, but, in search of energy and room, will at first timidly venture beyond the edge of the atmosphere and then boldly move out and occupy all of the worlds and spaces around the sun."

These visions, plus old-fashioned Russian national pride at the ego boosts from successes in space and hero worship of cosmonauts, provide a substantial reservoir of support for the space program. (The first man in space, Yuri Gagarin, though dead for more than a decade, has become a veritable patron saint of space travel, complete with shrines and ceremonies.)

Soviet technicians view the space effort as an opportunity to leapfrog ahead of Western technology and to overcome a severe native technological inferiority complex. The vast preponderance of Soviet technology—industrial, medical, and scientific—is almost entirely derivative, based not on homegrown innovations but on copying Western developments. Valuable Soviet advances have been set aside in favor of often inferior Western-derived alternatives, purely out of a lack of self-confidence.

Soviet exploitation of space may change all that. With ample resources, time, and rational planning, the Soviets can do the job reasonably well. Space offers the prospect of a technological quantum leap forward, overcoming entrenched backwardness in many areas of the Soviet industrial complex. A communications revolution based on satellites is helping to solve congenital weaknesses in long-distance communications, which hobble the development of nationwide computer networks. Management of Russia's weather-sensitive marginal agriculture is benefiting from meteorological research conducted from space stations. Earth resources and mapping from space stations have been crucial in opening up new regions in Siberia for industrial expansion.

Top-level support for the space program springs from three main sources.

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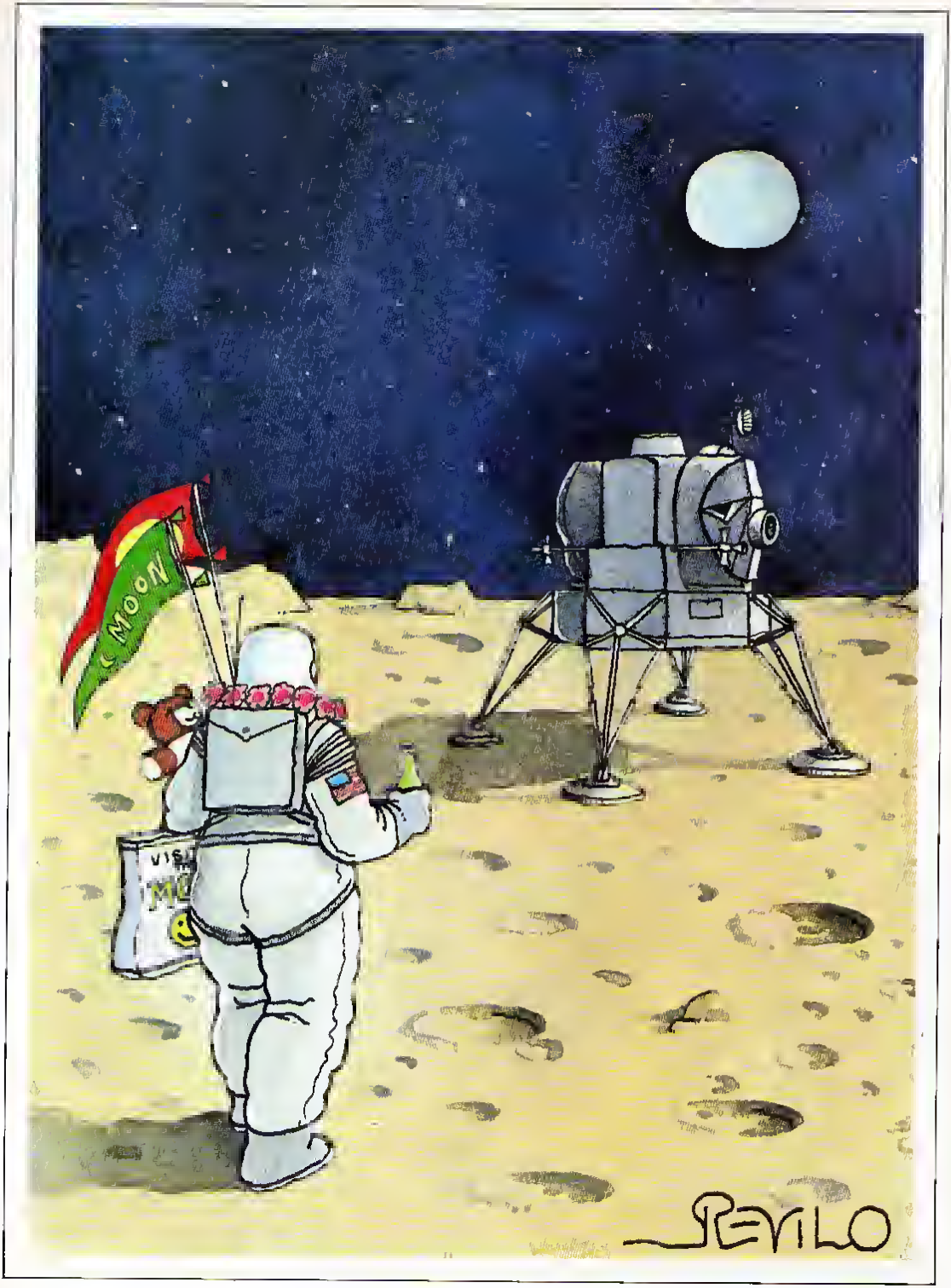

MOON
REVILO

VISIONS OF THE COSMOS

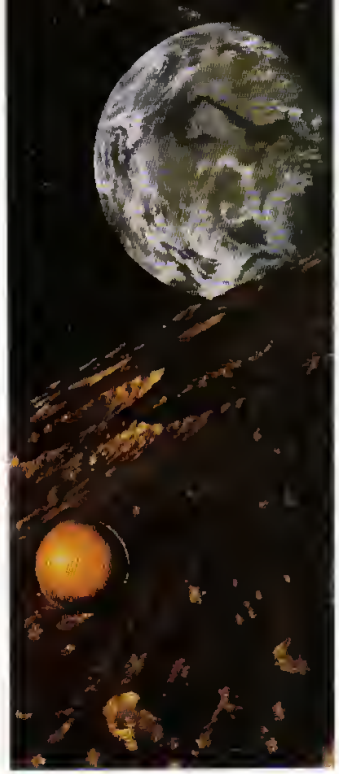
An exclusive gallery of Soviet space art offers revealing glimpses of Russian fact and fantasy

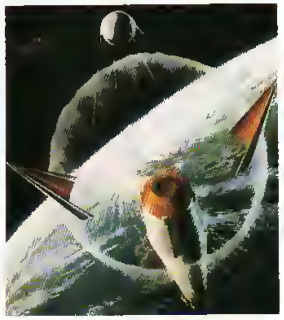
BY F. C. DURANT III

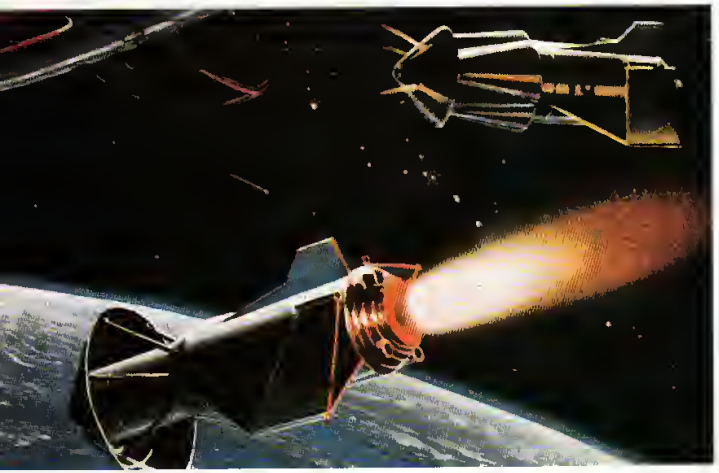
Cosmonauts Romanenko and Grechko carried a special cargo with them into orbit last March. Aboard *Soyuz XXVIII* were two paintings by Russia's foremost space artist, Andrei Sokolov. The paintings were gouache on nonfolding cardboard, measured 47 centimeters by 36 centimeters, and weighed 130 grams each. They were transferred to the orbiting space laboratory *Salyut*, there to become the first orbiting art exhibition in history.

The cosmic art of Andrei Sokolov, beginning clockwise from below: An early painting entitled Soft Landing on the Moon. Shuttles to Space Station in Orbit. Lunar Base. Transfer of Cosmonauts (*between* Soyuz *craft*). Launch of Sputnik I.

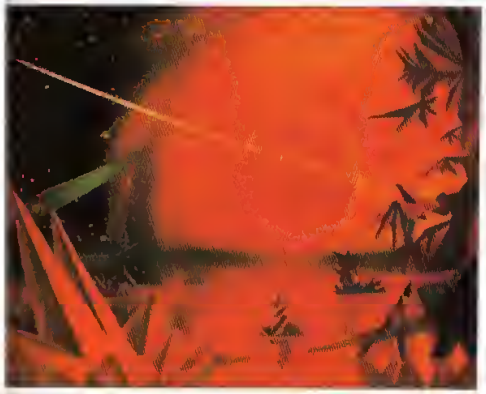
PAINTINGS BY ANDREI SOKOLOV







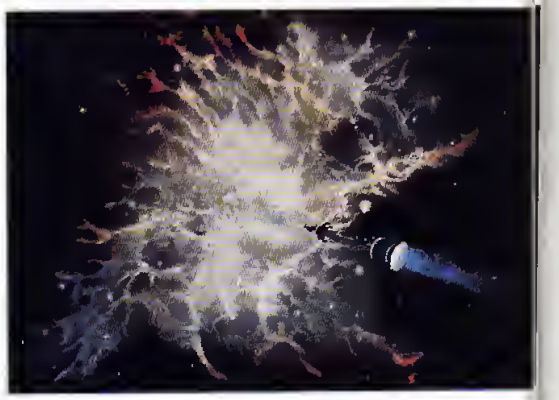
Zond V *(left) returns lunar sample to earth. Below* On the Planet of Boiling Lava. *Bottom* Cosmodrome on Phobos. Silicon Crystal Life on Planet of Red Giant.



Sokolov's paintings later returned to earth aboard *Soyuz XXX* in July 1978. Thrilled that his paintings had been sent aloft, the artist presented one of them to Polish cosmonaut Miroslaw Hermazewski, command pilot of *Soyuz XXX*. Entitled *Cosmic Morning* (page 84), it is a fanciful representation of *Salyut VI* with two *Soyuz* craft docked at both ends, lit by the morning sun. Sokolov is currently reworking the other, *Over the Aral Sea*, making corrections in color tones and geographical features from notes provided by the crew.

Since *Sputnik I*, Andrei Sokolov has dedicated his professional life to artistic concepts of the cosmos. His art now numbers more than 150 works. These paintings vary; some are rough impressions, others are precise and meticulous. He illustrates contemporary space activities of the USSR and US, as well as future encounters with planets of far-off stellar systems. Sokolov is big physically, over six feet, a burly and pow-

"My greatest challenge in life is to visualize and depict future cosmic voyages."



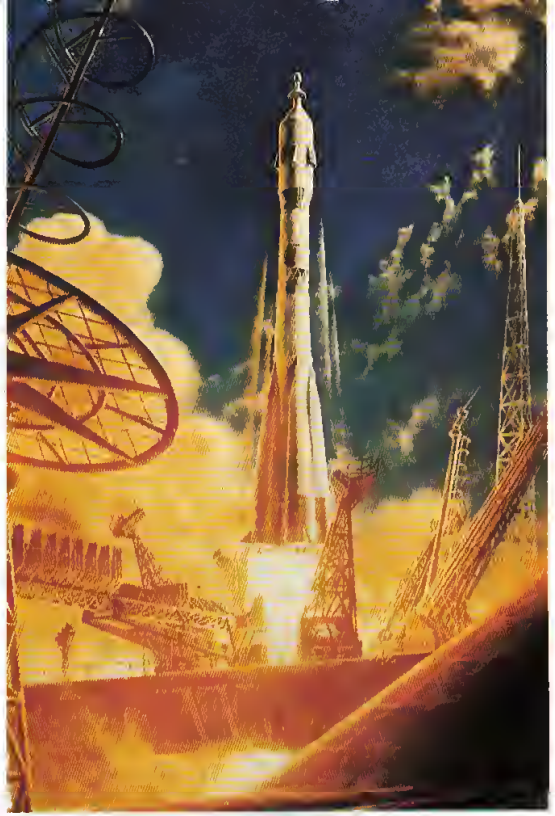
"Cosmic exploration," opines Andrei Sokolov, "staggers the human imagination."

erful former motorcycle racer whose boldness is reflected in his art.

Sokolov was born in Leningrad 47 years ago and grew up in Moscow. His father was a construction engineer prominent in building the Moscow metro in the 1930s. Trained as an architect, Sokolov was captivated by Ray Bradbury's *Fahrenheit 451* more than 20 years ago. Visualizing scenes from the book, he created a number of paintings, his first in this genre. The artist has presented one of these to Bradbury.

Since 1965, Sokolov has collaborated with cosmonaut Alexei Leonov. An amateur artist, Leonov sketched views of space while in orbit and upon return rendered them in watercolor and oils. Works of Sokolov and Leonov have been published in four art books in the Soviet Union, the most recent is *Man in the Universe* (1975). Moreover, collections of postcards and some 20 Soviet postage stamps carry their art. Through his close relationship with Leonov and other cosmonauts, Sokolov is

Counterclockwise from right: Lunar Cosmodrome, To the Crab Nebula, Cosmic Morning, *which orbited the earth in* Salyut, Shuttle to Orbit, *fanciful rendering of Russian shuttle*



able to keep abreast of advances in space technology.

In 1975, the Soviet space artist married Nina F Lapinowa. Today, they live in an attractive studio apartment in downtown Moscow.

Several years ago, the Soviet Artists Union sponsored a touring exhibit of US space art throughout Russia. In exchange, a Soviet space art show was displayed at the Smithsonian Institution's National Air and Space Museum in 1976. Included were 14 works by Sokolov and Leonov. Under the auspices of the Smithsonian, the show has toured the US for 18 months and is currently in Wenatchee, Washington. Both artists have donated works to the National Air and Space Museum. ∞

Much of Sokolov's art has never been published in the US, counterclockwise from above: Apollo-Soyuz Rendezvous in Orbit. Launch of Soyuz XXVI, Entering the Atmosphere of Mars, *early vintage communications satellite* Molniya XIV.

Sokolov describes the immensity of the cosmos as "awesomely unknowable."

PAINTING BY RENE MAGRITTE

SOVIET FICTION

The computer understood what he wanted, but it needed an example

SELF-DISCOVERY

BY VLADIMIR SAVCHENKO
Translated from the Russian by Antonia W Bouis

Writing about failure is like reliving it. So I'll be brief. The plan was like this: We would plug the thirty-eight-thousand cell crystal unit into the TsVM-12 Computer and everything else would go into the crystal unit's input—the mikes, the smell, moisture, and temperature sensors, the tesometric feelers, the photomatrices with a focusing probe, and Monomakh's Crown (an object that looked like an ancient warrior's helmet, but was chrome-plated and covered with buttons and bundles of wires which extended beyond the tubes and flasks into the computer) to compute the brain's biowaves. The source of external information was me, that is, something moving, noisy, changing shape and its coordinates in space, having temperature and nervous potential. You could hear me, see me, feel me, take my temperature and blood pressure, analyze my breath, even climb into my soul and thoughts—go right ahead! The signals from the sensors would have to feed the crystal unit, stimulating various cells in it, the crystal unit would form and "pack" the signals into logical combinations for the TsVM-12, the computer would deal with them as though they were ordinary problems and produce something meaningful. In order to make it easier for the computer, I programmed all the number-words from A to Z in the computer translation dictionary into its memory bank.

And . . . nothing. The selsyn motors, whining gently moved the feeler and lenses when I moved around the room. The control oscilloscopes showed a daisy chain of impulses which jumped from the crystal unit to the computer. The current flowed. The lights blinked. But during the first month the digital printer didn't stir once to make a single mark on the punched tape.

I punctured the crystal unit with all the sensors. I read poems. I sang. I gestured. I ran and I jumped in front of the lenses. I stripped and dressed. I let the feelers touch me (brr! those cold feelers!). I put on Monomakh's Crown and—Oh, God!—tried to influence it. I was ready for any magic formula.

But the TsVM-12 could not put out abracadabra: it wasn't made that way. If the problem has a solution, it solves it, if it doesn't, it stops. Judging by the panel lights, something was going on, but every five or six minutes the "stop" signal went on, and I had to press the reset button. And it would begin all over again.

Finally I started thinking about it. The computer had to be performing arithmetical and logical operations with the impulses from the crystal unit. Otherwise, what else could it be doing? That meant that

Editor's note: Vladimir Savchenko is an electrical engineer who began writing science fiction in the late '50s. His abilities as a raconteur, combining speculative science with a satirical view of scientific politics, have established him as a leading Soviet novelist.

even after these operations the information was still so raw and contradictory that the computer could not bring the logical ends together. So it would stop! That meant that one cycle in the computer wasn't enough. That meant—and here as usual in these cases, I was embarrassed for not having thought of it sooner—that meant that I had to arrange for feedback between the computer (from the units where the impulses still were) and the crystal unit! Then the raw material would be inputted into the clever cube, transformed there one more time, and then fed into the computer, and so on, until perfect clarity reigned.

I perked up. Now we were cooking! I can condense the story about how one hundred fifty logic cells and dozens of matrices burned out because the TsVM and crystal unit were out of sync (smoke, acrid smells, transistors flaming like bullets in an oven, and me—instead of cutting off the voltage on the panel, I ran for the fire extinguisher on the wall!), and how I got new cells soldered, the transition circuits and coordinated the cycles of all the units—just the usual difficulties of technical realization. But the important thing was I got the project off the ground.

On February 15 I finally heard the long-awaited clatter. The machine printed out a string of numbers on the punched tape. Before deciphering it, I circled the table on which the piece of tape lay, I smoked a cigarette and smiled vaguely. The computer had begun behaving. I translated the printout, and there it was, the computer's first sentence: "Memory 10^7 bits."

It wasn't what I was expecting. That's why I didn't realize right away that the computer "wanted" (I can't write a word like that without quotes) to increase its memory bank.

Actually, it was all very logical. It was receiving complex information that had to be stored somewhere, but the banks were already filled. Increase the memory banks! A common task in building computers.

If it weren't for Alter Abramovich's respect for me, the computer's request would have gone unheeded. But he gave me three cubes of magnetic memory and two of ferroelectric memory. And everything proceeded smoothly. But a few days later the TsVM-12 repeated its demand, and then again and again . . . And the computer began to make other demands.

What was I feeling then? Satisfaction. Finally something was happening! I tried the results out on my dissertation-to-be. I was a little put off by the fact that the computer was working only for itself.

Then the computer began building itself! Actually that was logical too: complex information had to be processed by units more complex than the standard ones of the TsVM-12.

My work-load increased. The printer printed out codes and numbers of logic cells and announced where and how they should be added. At first the computer was satisfied with standard cells. I mounted them on auxiliary panels.

I'm only beginning to realize it now, but that was precisely the moment if you look at it academically, that I made a grave methodological error in my work. I should have stopped and figured out just what circuits and logic my complex was building for itself: the sensors, crystal unit, and TsVM-12 with an increased memory. And then only when I had it figured out, move on. And when you think about it, a computer building itself without being programmed to do so—what a terrific dissertation topic! If I had done it right, I could have gotten a doctorate right there.

But curiosity took over. The complex was obviously straining to develop. But why? To understand man? It didn't look like it. The computer seemed quite satisfied that I understood it and diligently carried out my commands. People make machines for their own aims. But what kind of aims could a machine have? Or maybe it wasn't an aim, but a kind of innate accumulation in-

"I finally heard the long-awaited clatter. The machine printed out a string of numbers punched on the tape. There it was, the computer's first sentence: "Memory 10^7 bits."

stinct which is found in all systems of a certain complexity: be they earthworms or electrical machines? And what limits would the complex reach?

It was then that I let loose the reins—and I still don't know if that was good or bad.

In mid-March the computer, which had evidently learned from Monomakh's Crown about the latest developments in electronics, began asking for cryosars and cryotrons, tunnel transistors, film circuits, micromatrices. I had no time for analysis, I was rushing all over the institute and the whole city, wheeling and dealing, lying and cajoling, trying to get my hands on all this glamorous stuff.

And it was all for nothing. A month later the computer "got bored" with electronics and "took up" chemistry.

Actually this shouldn't have been unexpected either. The computer had chosen the best way to build itself. After all, chemistry is nature's way. Nature had neither soldering irons nor cranes, nor welders, nor motors, not even shovels—it merely combined chemicals, heated and cooled them, lit them, boiled them—and that's how every living thing on earth came about.

That was the point—that everything the computer did was consecutive and logical! Even its desires for me to put on Monomakh's Crown—and that was the most frequent request—were transparent. Rather than process raw information from photo, sound, smell, and other sensors, it was much easier to use information already processed by me.

But my God, what reagents the computer demanded! From distilled water to sodium trimethyldyphtorparaaminterachlorphenylsultate and from DNA and RNA to a specific brand of gasoline! And the convoluted technological circuits I had to get!

The lab was changing into a medieval alchemist's den before my very eyes. It was filled with bottles, flasks, autoclaves, and stills. I connected them with hoses, glass tubing, and wires. My supply of reagents and glass was depleted in a week, and I had to requisition more and more.

The noble, soothing electrical smells, rosin and heated insulation, were replaced with the swampy miasmas of acids, ammonia, vinegar and God knows what else. I wandered lost in these chemical jungles. The stills and hoses bubbled, gurgled, and sighed. The mixtures in the flasks and bottles fermented and changed color, they precipitated, dissolved, and regenerated metallic pulsating clumps and pieces of shimmering gray threads. I poured and sprinkled according to the computer's directions and understood nothing.

Then the computer suddenly asked for four more automatic printers. I was happy—so the computer was interested in something other than chemistry! I worked at it, got the stuff connected it—and off it went!

Probably this was the point at which I created Ashby's "power information retrieval" or something like it. Who knows! That was when I became hopelessly confused.

Now the lab sounded like a typing pool. The machines were printing out numbers. Paper ribbon with columns of numbers poured out of the machines like manna from heaven. I rolled up the tapes, picked out the words separated by spaces, translated them, and made sentences.

The "true" phrases were very strange and enigmatic. For example: "Twenty-six kopeks, like from Berdichev." That was one of the first. Was that a fact, a thought? Or a hint? How about this: "An onion like a steel wound." It resembles Mayakovsky's "A street like an open wound." But what does it mean? Is it a pathetic imitation? Or maybe a poetic discovery that contemporary poets haven't reached yet?

I deciphered another tape. The tenderness of souls, taken in Taylor's series expansion in the limits of zero to infinity comes down to a biharmonic function. Well put, no?

And all of it was like that: either nonsensical excerpts or something schizophrenic. I was going to take some of the tapes to the

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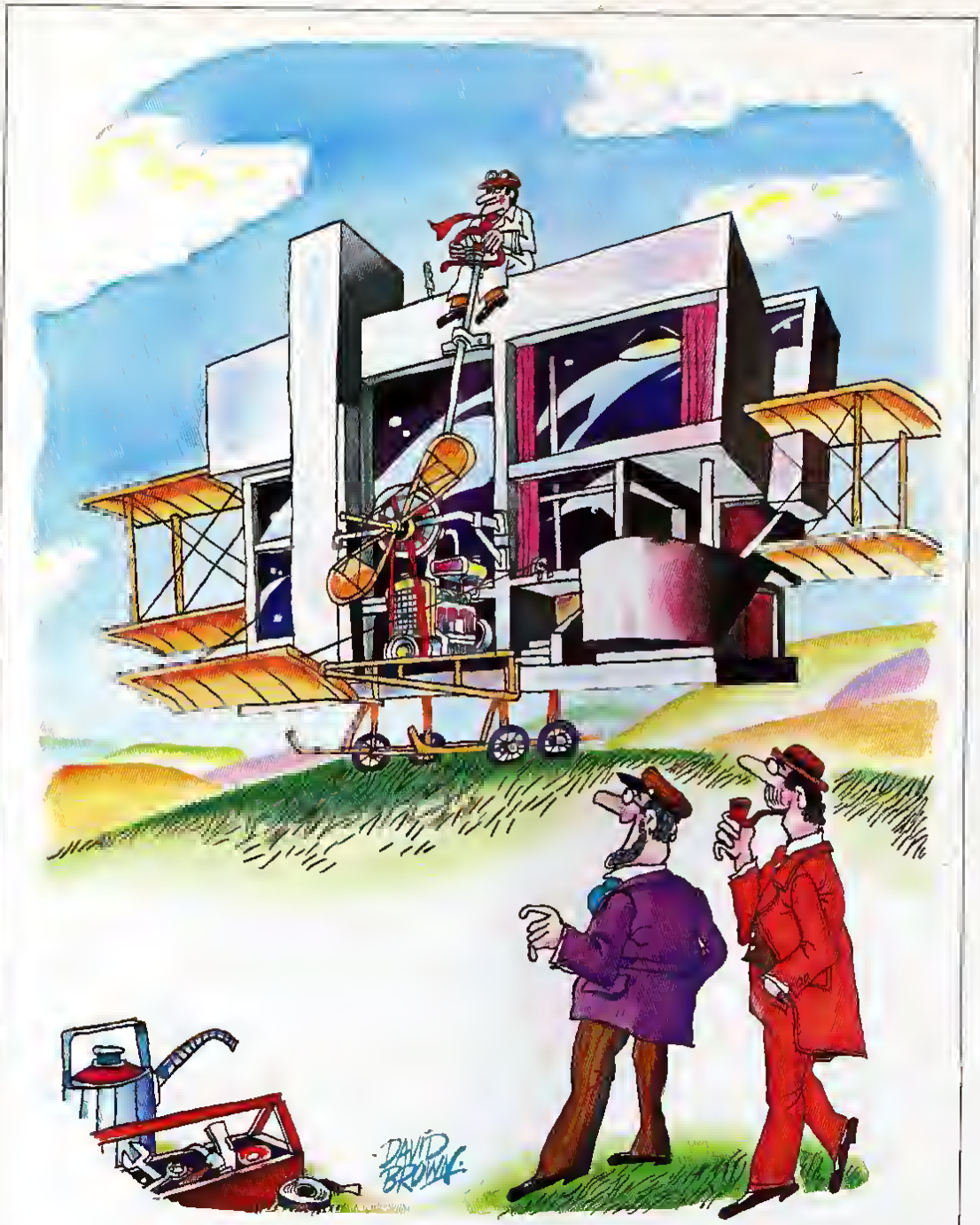


"That's Orville and Wilbur's other brother Frank Lloyd

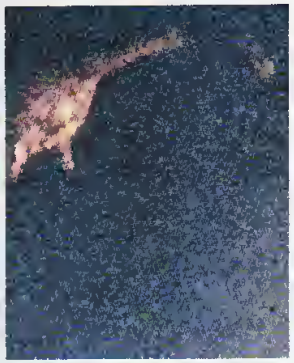
New technologies guide today's explorers as they seek the ever elusive monster

RETURN TO LOCH NESS

BY JOHN CHESTERMAN AND MICHAEL MARTEN

They sought it with thimbles, they sought it with care,
They pursued it with forks and with hope,
They threatened its life with a railway share
They charmed it with smiles and with soap

—Lewis Carroll, "The Hunting of the Snark"



Over the years the Loch Ness Monster has been pursued with everything from biopsy harpoons to yellow submarines and kayaks mounted with machine guns, not to mention a gallant wing commander named Wallace who flew patrols over the loch in his one-man autogiro. The monster-hunters have used mass surface vigils and infrared photography. They've played Beethoven symphonies and Scottish reels to the beast through underwater speakers and triad coaxing it with pebbles soaked in salmon oil and with scrapings from the vagina of a sea cow.

But those were the good old days of amateur enthusiasts. Things have been very different since the Americans arrived—high-powered lawyers and millionaire inventors, plus a skin-diving archaeologist and a subtle machine called TAD, the target alarm detector.

High technology has come to scrutinize the loch and its legend, with results that range from the exciting to the bizarre.

Squat and square, the battered wooden raft looked incongruous in the postcard-perfect setting of Loch Ness's Urquhart Bay, a piece of disreputable flotsam floating among the anchored yachts. There was no way of knowing that suspended beneath it was an array of electronically synchronized lights and cameras, controlled by their own sonar system and loaded with the fastest color film in the world, that it was, in effect, the most sophisticated animal trap ever devised—the world's first fully automatic underwater photo studio.

The figures crowding the deck of the raft huddled together, collars turned up against the wind. Everyone was taking pictures. For two weeks they had labored nonstop to build this studio, and now they were about to find out if it worked.

Dr. Ian Morrison, an Edinburgh University archaeologist, had volunteered to simulate the monster. While strips of white tape were applied to his wet suit to calibrate him as a target, Bob Rines, the expedition leader, briefed him on the dive. A moment later, Morrison adjusted his mouthpiece, stepped back and disappeared with a splash into the choppy swell. There was silence except for the sound of the wind.

Morrison swam slowly into the sonar beam below. The needle jumped on the recording chart, and there was a loud click as the servomechanism of the target alarm detector locked on. The calendar-clock began ticking.

"He's in!" shouted Rines. "He's in the field!"

Nine meters down, the camera shutters opened, and for six thousandths of a second, eight strobe lights blazed into an area no more than 2.7 meters square. It was barely visible on the surface.

"Flash!" shouted Charlie Wyckoff, leaning in precarious fashion over the side, with his head in a water scope.

"He's sixteen feet away. Fourteen feet. Twelve feet." Rines crouched over the sonar chart, calling the distances like Mission Control.

"Flash!"

"He's in close. He's getting his picture taken all over the place!"

"Flash!"

"Now he's receding. Sixteen feet. Eighteen. Twenty."

"Flash!" The capacitors were pumping 450 volts into the system every three seconds. We crowded to the edge of the raft, peering down into the water.

"He's thirty feet away and still locked in beautifully. He's sixteen. He's fourteen. It must be a Christmas tree down there! Eight feet. Six feet. He's right under us. He's sitting on the cameras. Oh, it only Nessie would give us a crack like this!"

There was no comment. From the excited faces around us you could tell he had said it for everyone. The rig worked, and the latest Academy of Applied Science (AAS) Loch Ness Investigation was under way. It was some safari.

Like Stonehenge and Nazca, Loch Ness is a place where the legend seems to grow out of the landscape. The first impression you get is of a huge trench of air and water crushed between 900 meters of rock. The road along the north shore clings by its fingernails to the bottom of cliffs for kilometer upon kilometer of dark bays and headlands. The sheer volume of water, from horizon to horizon five times over, makes the mind ache. It might contain anything.

But atmosphere is not evidence, and whether you think of the Loch Ness monster as a major scientific phenomenon or as a silly joke depends on how much evidence you have seen.

Accounts of the creature go back to St. Columba's first encounter of the recorded kind in A.D. 565. Its modern history dates from 1933, when the story was first taken up by the world press. Over the years, about 3,000 eyewitness reports have been recorded, and they continue to come in at a rate of about a dozen a year. They range from descriptions of unusual wakes and humped backs to head-and-neck sightings and colorful claims of confrontations on dry land. About 15 percent of this verbal evidence is accepted as convincing or corroborated, which gives a solid core of about 400 cases.

Unfortunately, it is all 'soft' data that cannot be objectively checked. As with UFO sightings, much play is made of the reliability of witnesses, but even nuns and policemen can be mistaken.

"It was a dark blip, followed by a narrow V-shaped wave: movement!"

The data also fail to reveal much about the nature and habits of the creatures. A ten-year selection of sightings was run through a computer by Dr. Roy Mackal, a Chicago University biologist. About the only patterns he could detect were that the animals usually appeared in calm weather, during the summer months, for an average of about a minute, and often around the river mouths. It was hardly conclusive.

The photographic and technical data are less easy to dismiss. Leaving aside hoaxes and anything remotely capable of being explained any other way, this amounts to ten still photographs, one 16mm film, and about fifteen sonar traces.

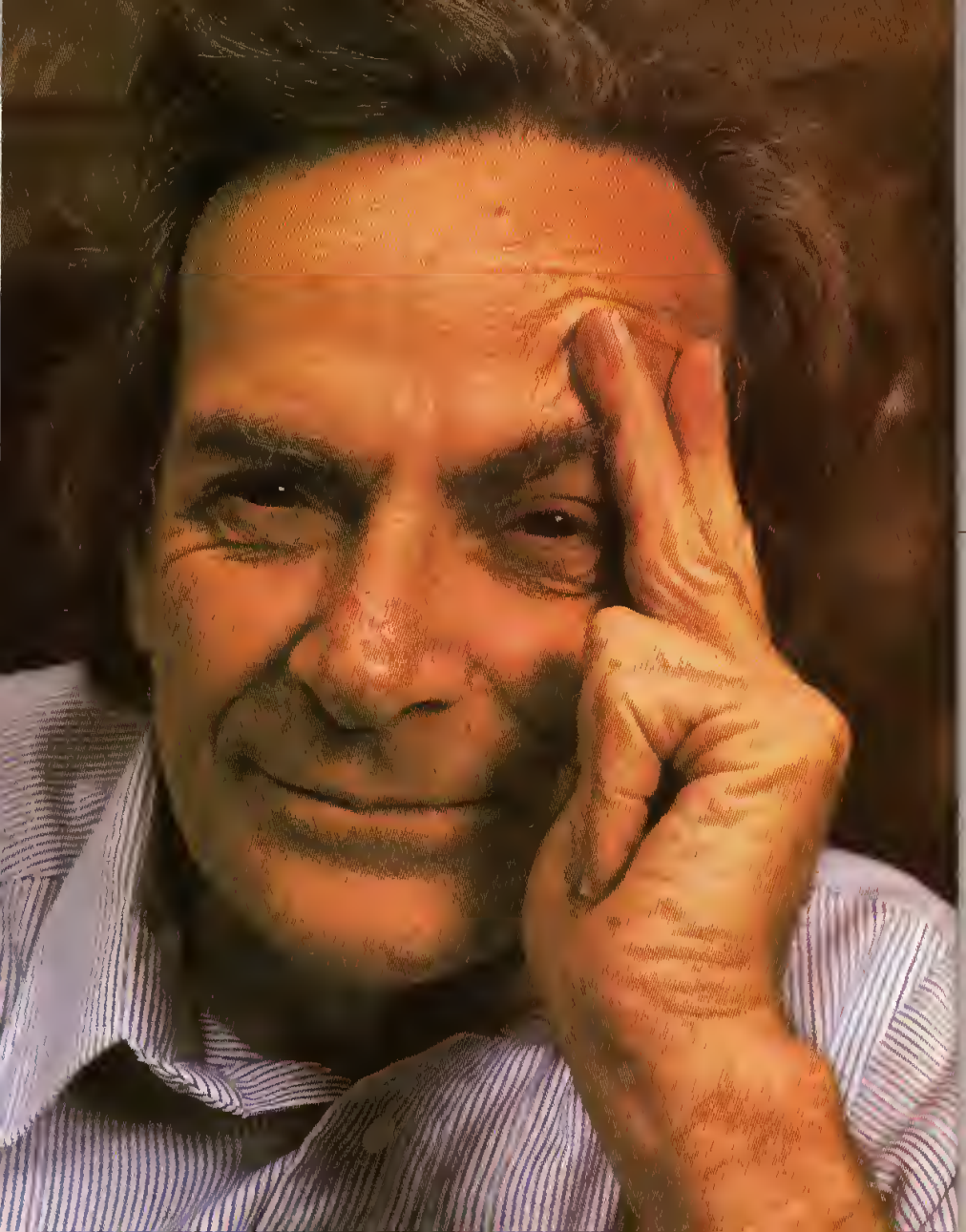
Among the photographs are the underwater sequences taken by Bob Rines on previous AAS expeditions, the famous "flipper shot" of 1972 and the close-up of a head and neck taken three years later. They were taken by an automatic camera and were corroborated by simultaneous sonar recordings that showed shoals of small fish escaping in panic from a massive moving object. Although the resolution of the pictures was poor and they needed computer enhancement, they are by far the most convincing photos so far of the creatures.

The film was taken in 1960 by Tim Dinsdale, a former Rolls-Royce aeronautical engineer, and showed a typical monster hump zigzagging across the loch. It was analyzed by the British Joint Air Reconnaissance Center, and their report was emphatic that it could only have been a large aquatic animal.

The sonar traces are the most convincing of all because they include parameters such as speed and depth and some

CONTINUED ON PAGE 123

Loch Ness looks as pretty as a postcard on the surface but hides a great depth (left). A scientist studies feedback (top,right) sent from a raft of complex apparatus (below right) meant to penetrate the murky, peat stained waters of the loch. Sonar and state-of-the art photography yield data that decades of watching could not



Photograph by Malcolm S. Kirk

Meet an architect of "the most precise theory ever devised" (which he calls a "swindle")—the Nobel-winning physicist who left a "Guess Who?" note in the top-secret safe at Los Alamos

INTERVIEW

RICHARD FEYNMAN

I think tha theory is simply a way to sweep the difficulties under tha rug " Richard Feynman said "I am, of course, not sure of that " It sounds like the kind of criticism ritually tempered that comes from the audience after a controversial paper is presented at a scientific conferance But Feynman was at the podium delivering a Nobel Prize–winner s address The theory he was questioning quantum electrodynamics has recently bean called "the most precise ever devised", its predictions are routinely verified to within one part in a million When Feynman Julian Schwinger and Sin-itiro Tomonaga independantly devaloped it in the 1940s, thair colleagues hailed it as "the great cleanup" a resolution of long-standing problams and a rigorous fusion of tha century s two great ideas in physics relativity and quantum mechanics

Feynman has combinad theoretical brilliance and irreverent skapticism throughout his career In 1942, after taking his doctorate at Princeton with John Wheeler he was tapped for tha Manhattan Project At Los Alamos, he was a twenty-five-year-old whiz kid awed neither by the titans of physics around him (Niels Bohr Enrico Fermi, Hans Bethe) nor by the top-secret urgency of the project. The security staff was unnerved by his facility at openmg safes –sometimes by listening to the tiny movements of the lock mechanism sometimes by guessing which physical constant the safe s user had chosen as the combination (Feynman hasn t changed since then many of his students at Caltech have acquired safe-cracking skills along with thair physics)

After tha war Feynman worked at Cornell University There as ha recounts in this interview Bethe was the catalyst for his ideas on resolving 'the problem of the infinities ' The precise energy levels of electrons in hydrogen atoms and the forcas between the electrons (moving so rapidly that relativistic changes had to be taken into account) had already been the subject of pioneering work lor three decades' Every alactron theory asserted was surrounded by transient 'virtual particles ' that its mass-energy summoned up from vacuum those particles in turn summonad up others and

the result was a mathematical cascade that predicted an infinite charge for every electron. Tomonaga had suggested a way around the problem in 1943, and his ideas became known just as Feynman at Cornell and Schwinger at Harvard were making the same crucial step. All three shared the Nobel Prize for physics in 1965. By then Feynman's mathematical tools, the "Feynman integrals," and the diagrams he had invented to trace particle interactions were part of the equipment of every theoretical physicist. Mathematician Stanislaw Ulam, another Los Alamos veteran, cites the Feynman diagrams as "a notation that can push thoughts in directions that may prove useful or even novel and decisive." The idea of particles that travel backward in time, for example, is a natural outgrowth of that notation.

In 1950, Feynman moved to Caltech in Pasadena. His accent is still unmistakably the transplanted New Yorker's, but southern California and its environs seem the appropriate habitat for him. In the "Feynman stories" his colleagues tell, his fondness for Las Vegas and nightlife in general looms large. "My wife couldn't believe I'd actually accept an invitation to give a speech where I'd have to wear a tuxedo," he says of the Nobel ceremony. "I did change my mind a couple of times." In the preface to *The Feynman Lectures on Physics*, widely used as a college text since they were collected and published in 1963, he appears with a maniacal grin, playing a conga drum.

Among Feynman's other achievements are his contribution to understanding the phase changes of supercooled helium and his work with Caltech colleague Murray Gell-Mann on the theory of beta decay of atomic nuclei. Both subjects are still far from final resolution, he points out. Indeed, he does not hesitate to call quantum electrodynamics itself a "swindle" that leaves important logical questions unanswered. What kind of man can do work of that caliber while nursing the most penetrating doubts? Contributing editor Monte Davis brings out the true character of America's celebrated physicist.

Omni: To someone looking at high-energy physics from the outside, its goal seems to be to find the ultimate constituents of matter. It seems a quest we can trace back to the Greeks' atom, the indivisible particle. But with the big accelerators, you get fragments that are more massive than the particles you started with and maybe quarks that can never be separated. What does that do to the quest?

Feynman: I don't think that ever was the quest. Physicists are trying to find out *how nature behaves*—they may talk carelessly about some "ultimate particle" because that's the way nature looks at a given moment, but— Suppose people are exploring a new continent, okay? They see water coming along the ground—they've seen that before—and they call it *river*. So they say they're exploring to find the headwaters, they go upriver and sure enough, there they are. It's all going very well. But lo and behold, when they get up far enough they find the whole system's different. There's a great big lake, or springs, or the rivers run in a circle. You might say "Aha! They've failed!"—but not at all! The *real* reason they were doing it was to explore the land. If it turned out not to be headwaters, they might be slightly embarrassed at their carelessness in explaining themselves, but no more than that. As long as it looks like the way things are built is wheels within wheels, then you're looking for the innermost wheel—but it might not be that way, in which case you're looking for whatever the hell it is that you find.

Omni: But surely you must have some guess about what you'll find: there are bound to be ridges and valleys and so on . . . ?

Feynman: Yeah. But what if when you get there it's all clouds? You can expect certain things: you can work out theorems about the topology of watersheds, but what if you find a kind of mist, maybe, with things coagulating out of it, with no way to distinguish the land from the air? The whole idea you started with is gone! That's the kind of exciting thing that happens from time to time. One is presumptuous if one says, "We're going to find the ultimate particle or the unified field laws" or *the* anything. If it turns out surprising, the scientist is even more delighted. You think he's going to say, "Oh, it's not like I expected, there's no ultimate particle. I don't want to explore it"? No, he's going to say, 'What the hell *is* it, then?"

Omni: You'd rather see that happen?

Feynman: Rather doesn't make any difference. I get what I get. You can't say it's *always* going to be surprising either; a few years ago I was very skeptical about the gauge theories, partly because I expected the strong nuclear interaction to be more different from electrodynamics than it now looks. I was expecting mist, and now it looks like ridges and valleys after all.

Omni: Are physical theories going to keep getting more abstract and mathematical? Could there be today a theorist like Faraday in the early nineteenth century, not mathematically sophisticated but with a very powerful intuition about physics?

Feynman: I'd say the odds are strongly against it. For one thing, you need the math just to understand what's been done so far. Beyond that, the behavior of subnuclear systems is so strange compared to the ones the brain evolved to deal with that the analysis *has* to be very abstract. To understand ice, you have to understand things that are themselves very unlike ice. Faraday's models were mechanical—springs and wires and tense bands in space—and his images were from basic geometry. I think we've understood all we can from that point of view; what we've found in this century is different enough, obscure enough, that further progress will require a lot of math.

Omni: Does that limit the number of people who can contribute or even understand what's being done?

Feynman: Or else somebody will develop a way of thinking about the problems so that we can understand them more easily. Maybe they'll just teach it earlier and earlier. You know, it's not true that what is called 'abstruse' math is so difficult. Take something like computer programming and the careful logic needed for that—the kind of thinking that mama and papa would have said was only for professors. Well, now it's part of a lot of daily activities. It's a way to make a living, their children get interested and get hold of a computer, and they're doing the most crazy wonderful things!

Omni: And ads for programming schools on every matchbook!

Feynman: Right. I don't believe in the idea that there are a few peculiar people capable of understanding math and the rest of the world is normal. Math is a human discovery and it's no more complicated than humans can understand. I had a calculus book once that said, "What one fool can do another fool can." What we've been able to work out about nature may look abstract and threatening to someone who hasn't studied it, but it was fools who did it.

There's a tendency to pomposity in all this, to make it all deep and profound. My son is taking a course in philosophy and last night we were looking at something by Spinoza—and there was the most childish reasoning! There were all these Attributes and Substances, all this meaningless chewing around, and we started to laugh. Now, how could we do that? Here's this great Dutch philosopher, and we're laughing at him. It's because there was no excuse for it! In that same period there was Newton, there was Harvey studying the circulation of the blood, there were people with methods of analysis by which progress was being made! You can take every one of Spinoza's propositions and take the contrary propositions and look at the world—and you can't tell which is right. Sure, people were awed because he had the courage to take on these great questions, but it doesn't do any good to have the courage if you can't get anywhere with the question.

Omni: In your published lectures, the philosophers' comments on science come in for some lumps.

Feynman: It isn't the philosophy that gets me, it's the pomposity. If they'd just *laugh* at themselves! If they'd just say "I think it's like this," but Von Leipzig thought it was like that, and he had a good shot at it, too. If they'd explain that this is their best guess. But so few of them do. Instead, they seize on the possibility that there may not be any ultimate fundamental particle and say that you should stop work and ponder with great

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FICTION

Eschewing rhetorical obfuscation, he fabricated the perfect anti-amphibological machine!

THE LANGUAGE CLARIFIER

BY PAUL J. NAHIN

The idea for the invention came during the divorce. He knew he was going to be screwed, but with the legal mumbo jumbo of the separation agreements he couldn't figure out *how* he was being screwed. Janet's damn lawyer had drawn them up—he'd even given the go-ahead for that, as he hadn't planned to contest her. After all, he *had* been caught in a rather blatant, clear-cut position of adultery. At the time, he had thought the wild-passioned honey-blonde had been worth it, but now he was beginning to have doubts.

He had a doctorate in semantics and was the author of two scholarly tomes on the meaning and structure of words, but Professor Willard Watson still couldn't understand what in hell was going on. Did he or didn't he get to keep the car? How about the house, the savings account, the cat and dog, the antique hutch, the silver, the ski equipment, the home library, the television sets, and all the rest of the earthly possessions collected over twenty-five years of marriage? And what about alimony? Asking Janet's fathead lawyer led merely to the receipt of additional incomprehensible letters, notices, and other horrible documents. Just what the heck *did it mean* to receive a letter saying, Notice is

PAINTING BY EVELYN TAYLOR

hereby granted to Willard Watson the first party of aggravation with respect to the aggravated second party Janet Watson of an action for divorce In the County of Orange of the State of California Actions involved include but may not be fully delimited by their listing here the exposure of the second party to loathsome disease by the first party due to participation in perverted crimes against the order of nature public embarrassment of the second party due to the wanton unrestrained lascivious behavior of the first party The second party maintains total freedom in the question of complicity of action, and except in those cases where litigation proves contrariwise sues for all common hereditaments past present or future to revert to the second party except for the sole ownership of items things or other states of being in possession of the first party prior to the initial date of marriage between the first party and the second party

Professor Watson was somewhat perplexed by all this So he hired his own fathead lawyer

What Professor Watson ended up with then was *twice* as much paper that he couldn't understand Willard learned the truth of the old New England saying 'A man between two lawyers is like a fish between two cats.' So he fired his fathead lawyer And he stayed up for three straight nights mulling over his desperate situation until the idea for the invention came to him He quickly made an appointment to see his old friend at the college Professor Sam Sklansky of the Physics Department

It was a cold windy and rainy day in early October as Willard ran from the parking lot to Sklansky's office His shoes soon filled with water and he squished his way up the steps into the Physics Building Even Nature was dumping on him now

Sklansky's door was open and he walked in dripping sloppy wet with water slushing out of his hat brim onto the floor "Hi Sam Thanks for seeing me so early in the morning." He stood there, looking like a lone forlorn weed in the middle of a growing pool of water

Sklansky a brilliant very direct sort of fellow looked quizzically back 'So what's the problem, Willard? And by the way umbrellas, raincoats and boots *have* been invented! You some kind of health nut running around in the rain like nature boy?"

"Look Sam I'm desperate and I've had a lot of things on my mind besides the weather I need your help and I need it fast Janet's going to rake my behind over the coals but good if I don't get someone to tell me what the divorce settlement she's serving on me *means*!

"Willard you want to see Professor Shyster over in the Law School I deal in physical facts mathematical validity in *cosmic truth* not in the mental hash-mash of lawyers!"

"No Sam another fathead lawyer isn't what I need I need *you* I want you to tell me if my idea is possible"

So good friend that he was Sam listened At first he laughed hysterically then he wrote a few equations and seeing a little hope he wrote some more Then he became quietly excited and finally as Willard wrapped up his arguments Sam became hysterical again but this time it was with excitement It *could* be done The two old friends shook hands and agreed to begin construction that very weekend." Willard would provide the description of the necessary syntactical transformations along with a complete table look-up dictionary of all the required synonyms antonyms and transitive verbs with irregular conjugations Sam would provide the electronic expertise produce the wiring schematics order the parts and do all the soldering

It was just two weeks later that they stood in Sam's laboratory looking at their gleaming creation A cubical box precisely 119 centimeters on an edge it had a smooth featureless appearance with the double exception of two horizontal slots One was

Sam took the sheet over to the machine, and with an expression that was a mixture of glee and apprehension, held it up to the INPUT slot "Ready . . . ?" Sam pushed the paper in

marked INPUT and the other OUTPUT It was ready for testing

"Okay Sam you designed it you can have the honor of the first test"

"No it was your idea so you go ahead"

"Please Sam I insist."

"Well—all right I *do* just happen to have a test problem ready" So saying, Sam walked over to his desk rolled a fresh piece of heavy white bond paper into his typewriter and quickly snapped out in bold pica letters Liquid precipitation fell from the heights followed by the spherical solid version with the process terminated by the reverse transport in the gaseous state

Sam took the sheet over to the machine, and with an expression that was a mixture of glee and apprehension, held it up to the INPUT slot "Ready Willard? At the nod of his friend's head Sam pushed the paper in After only a few seconds another piece of paper shot from the output slot Both men grabbed it in midair and together read First it rained then it hailed and finally the water evaporated

"Well, I'll be damned!" they exclaimed in unison The Language Clarifier worked

"Hey hey hey Sam it looks good it looks good!" Willard began to paw through his briefcase looking for his divorce papers "Now I'll find out just what that scheming wife of mine is up to!"

"Wait Willard" said Sam as he placed a restraining hand on his friend's shoulder "Let's not be hasty We should really test it some more Look here I have a copy of today's campus newspaper carrying an interview with the Undergraduate Dean Listen to this will you the perfect test!" He read aloud "'Even in institutions like our college which may be expected to have rather homogeneous populations one encounters a tremendous diversity in the family subcultures that students come from in addition to the idiosyncratic mix of assets and liabilities that characterize them'"

"Wow Sam—do we dare put *that* into it? It could blow the circuits!"

"Might as well find out if the Language Clarifier *really* works Willard" Sam soon had the Dean's words typed in clear crisp sharp letters He shoved them into the INPUT slot and the machine responded in seconds with 'No two students are alike'

"Son of a gun, Sam look at that! The translation actually makes sense Try something else on it."

"Okay Willard Take a look at this—here's another quote from the Dean 'We thus encounter students whose educational aims are crystal clear, as well as others whose purposes have all the clarity of an amorphous mist emanating from a thick cloud of existential miasma.'"

Quickly they typed this out and inserted it into their machine and they were soon in possession of the machine's response Some students know what they want and the rest don't

"That's enough for me, Sam—it works! Now where the heck *are* those damn lawyer's papers!"

The rest is history Willard found out what the divorce was going to cost him He still got screwed of course but with the Language Clarifier deciphering the papers from Janet's fathead lawyer he knew precisely *how* he was being screwed Actually Willard was really unconcerned as he and Sam expected to make a bundle selling their machine to business higher education and government Their need for clarification was well established Let Janet have *everything*—secretly Willard was *happy* to be rid of the damn cat and dog He would recoup it all, and more with the royalties from the Clarifier

Willard let Sam handle the business end of the Language Clarifier and it was with some greedy anticipation that he dropped in on him after the divorce was settled Willard was flat broke

"Okay Sam give me the news How are we doing in selling the Clarifier?

Sam opened his desk drawer pulled out a piece of paper and handed it across to Willard It was a cashier's check for five thousand dollars 'There you are Willard your share of the proceeds from our first

three sales. And more to come!"

"Hot damn, Sam. I knew it! Who bought the first three machines—businessmen dealing with government regulatory agencies?"

Sam grinned at Willard. "Professor Shyster over in the Law School, bought all three."

"Of course," exclaimed Willard, slapping his forehead with a hand. "Lawyers *would* be the prime users of the Clarifier wouldn't they? Why, with all the ritual chants they produce, they'll be in the market for Clarifiers for the next fifty years. What's old Shyster going to do with them, anyway?"

"Actually, Willard, you've got it backward. Shyster is writing a law book, and he's found that his early drafts weren't really up to par as far as the publisher is concerned. Not scholarly-sounding enough, or something like that. So the Clarifier is just what he needed."

"I don't get it, Sam," said Willard, with a puzzled look on his face. "If Shyster's book isn't impressively complex enough, how's the Clarifier going to help?"

Sam leaned back in his chair with a pleased smile on his face. "Willard, my boy, there's an old rule of thumb in physics that says if a process works in one direction, it will almost always be true that it can go the other way, too."

Then Willard understood. "You don't mean, you couldn't *possibly* mean—"

"Yep, that's right. I just moved a couple of wires around, and now old Shyster just stuffs his clearly written book draft into the OUTPUT slot, and the most incomprehensible muddle you could possibly imagine emerges from the INPUT slot. Should be a legal best-seller."

Willard was stunned. The irony of it was mind-boggling! As he stared at Sam, his friend chuckled. "Look at it this way, Willard, how many of the lawyers who'll read it will *really* know, or even give a damn, whether they understand it or not?"

Before Willard could respond, Sam's secretary put her head into the office.

"Excuse me, Professor Sklansky, but this large envelope from Washington, just came for you registered special delivery. It looks important, so I thought I should give it to you right away."

"Yes, good, thank you, Susan." As the pretty young lady left, Willard found himself admiring her slender ankles, the motion of her firm thighs under a snug dress, her really spectacular bottom. "Careful, Willard," cautioned Sklansky, the always observant physicist. "As I recall, it was a blonde who did you in last time, and besides, she's the best damned secretary I've ever had. So stay away from her!"

"Ah, I suppose you're right, Sam, but she *is* a nifty-looking gal."

"Hmmph," grunted Sam, who had been reading the just-delivered mail. A slight frown was forming on his mouth. "Listen to *this*, Willard, it's from the Chief Legal Officer of Defense Research and Engineering in the Pentagon. Remember I wrote to them about the Language Clarifier—pointed out how they could use it to decipher the thousands of proposals they get from industrial contractors every year?"

He read: "'Replying to your communication of 28 October, we have, after analysis of the broad ramifications of and pertaining to, in all its present and future forms, the Language Clarifier, found it to present a less than superior hold on the financial, economic, reputational, and any other forms of gain, physical or otherwise, of its inventors. In view of the willingness of said inventors to receive and accept a yearly stipend, in perpetuity, or for life, whichever terminates first, of one million dollars, they shall also accept the impact and import of the Military Secrecy Act of 1947, Title 12, Section 19-321 (see attached forms). Return of this document, with said inventors' signatures, will constitute a mutually satisfactory agreement. Otherwise, not.'"

Sam put the letter down on his desk and drummed his fingers on the hard wooden surface. "Well, Willard, what do you make of *that*? He idly flipped through the fifty-three single-spaced onionskin pages of the 1947 Military Secrecy Act. "Frankly, Willard, it sounds to me like the bastards are afraid to have the Clarifier around! You know if the military boys can use it to blow away the industrial proposal-writer's crap, I suppose industry could use it to dig through all the government's crud, too. Why, *both* sides would have to make sense. Imagine that!"

"Christ, Sam, how the hell should *I* know? Look, let's run it through the Language Clarifier—you still have our prototype unit in your lab, right?"

"Right, Willard. Let's go!"

A few minutes later the INPUT slot gobbled up the Pentagon letter. Then the attached Military Secrecy Act of 1947 followed. A full forty-three seconds ticked by as the Clarifier mulled over its latest task. Deep in its bowels a few transistors grew hot, an amplifier oscillated with feedback, and a mechanical gear-train drive almost ground off a tooth or two. But finally the Clarifier finished. It ejected its response.

Sign the agreement, forget you ever *heard* of the Language Clarifier, and you get a megabuck a year for life. Don't sign the agreement, and they toss you in the slammer and throw away the key.

Sam lives in Hawaii now, retired from teaching, and is writing a book on the physics of hanging ten. Willard quit teaching, too, married Susan, and it would be indelicate to discuss what *they* are doing. Once a year they meet in San Francisco, split the million bucks, have a few drinks at Fisherman's Wharf, and ride the cablecar.

Oh, yes, Sam was right. Old Shyster's book was a best-seller, thus proving you don't have to be smart to get paid a million bucks for forgetting what you know, and doing nothing.

Quite often, merely being a fathead lawyer is sufficient. ∞

"Warning! Warning! The earthling is armed and dangerous!"

CYBERNETICS

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The NSA, ten times the size of the CIA, used giant computers to scan almost every telegraph, teletype, and Telex message sent through American borders. For several years these computers automatically searched for keywords such as 'missile,' 'China,' and 'assassinate.' Messages containing keywords were recorded, and human operatives alerted. Illegal snooping on so vast a scale is impossible without computers.

The Cybernetic War emphasizes hardware and information, rather than soldiers and civilians. Superpowers routinely monitor one another's radar, microwave, and radio transmissions. Satellites eavesdrop, satellites snap clandestine telescopic photographs in ultraviolet and infrared, satellites with nuclear-powered radar probe the seas for submarines. This global flow of military data is coordinated by computer.

The public knows little of the Cybernetic War. New services present isolated facts difficult to interpret out of context. Washington debates sale of AWACS to Middle Eastern countries. AWACS? Airborne warning and control systems, such as the Air Force E-3A or the Navy E-2C Hawkeye, are aircraft that carry computers and communications systems and serve as control centers in battles, executing and relaying orders. Carter prohibits sale of computers to the USSR. Why? The UNIVAC computer ordered by TASS is ten times larger than needed to manage the 1980 Olympics data and might be used for military purposes.

The public is told little about the Cybernetic War. The computer industry advertises the nonmilitary uses of its products. Universities teach computer science and computer business, but not computer war. Writers and critics, so articulate on the philosophy of artificial intelligence and on the unexpected home-computer revolution, are curiously tongue-tied on the major issues of war and peace. Technologists, on the defensive in conversations with antitechnological laymen, are reluctant to discuss military applications. In Russia cybernetic ist Shcharansky speaks out and is condemned to the Gulag Archipelago of prison camps. How many American experts with less to lose have as much to say, or show the same courage?

CYBERNETIC WAR 1999

Let us venture some predictions. Assume that by 1999 the Cybernetic War has continued its hardware escalation without having degenerated into a thermonuclear catastrophe.

There will be roughly a billion computers in the world, almost all of which will be smaller than a large book. A third will be for business and science, another third will be in people's homes, and the remaining third will be in military weapons and equipment.

The typical soldier will be directed in the field by a computer. He will be supported by an airborne computerized robot. He will carry computer-designed, computer-manufactured, computer-aimed, and computer-actuated weapons. He will maintain secure, jamproof communication through a surgically implanted link to a computerized network.

The major strategic weapons will be computer-directed beams of photons, nuclei, and antimatter. The major tactical weapons will be unmanned, as human reflexes are too slow for the battlefield control loop. Human judgment will still play a selective role in target-rich environments. Most tactical decisions will be made by machine, and most strategic decisions will be chosen by humans from alternatives presented by computers.

Ideological warfare will thrive. New combinations of satellite video broadcasting, subliminal data presentation, and computational psycholinguistics will blanket the globe in propaganda and counterpropaganda. Attitudes toward privacy will change, as details of a billion lives are stored within computer memories. People will be overwhelmed with information, and there will be a major struggle for access to knowledge, as opposed to mere data. Education will surpass entertainment in total cost.

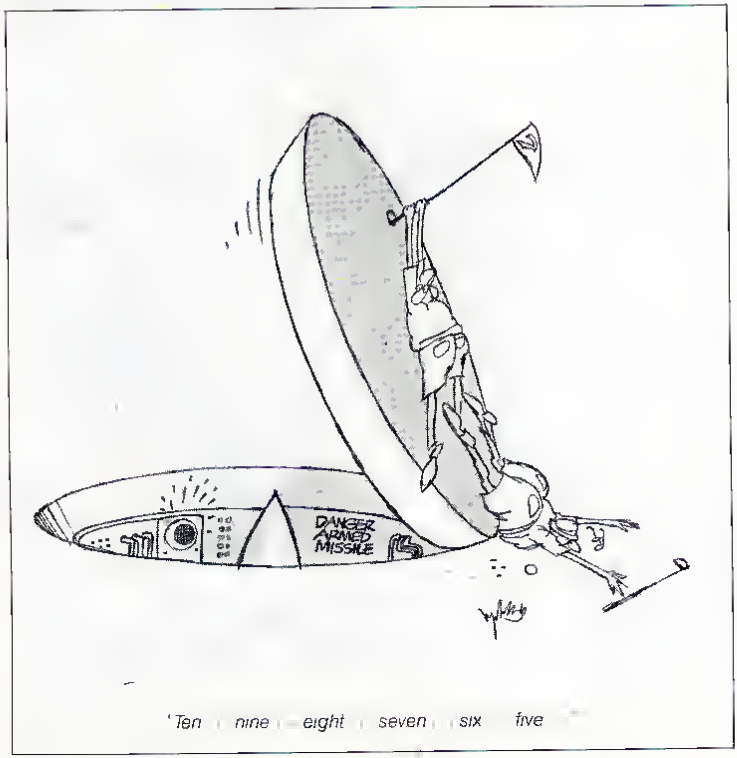
Computer-designed materials will outperform natural substances in exotic applications. Computers will pilot millions of airborne vehicles, including ground-effect machines, lighter-than-air cargo vessels, and noncombustion rockets.

Paper will have been replaced almost entirely for news delivery, money, and commercial announcements. Library will no longer mean a building. People will read about the events of the Cybernetic War but not in newspapers or magazines.

The gap between the rich and the poor will grow, but the poor will be more aware of this and more capable of action. Resentment of computerized police-containment actions will mount. Sabotage of computer-managed production and distribution systems will provoke increased robotic security. Many will see the conflict as Man versus Machine.

For the moment, it is machine against machine. The computer was born in a military context and has since permeated every niche of the military environment. There is nothing remarkable about the Cybernetic War in principle, except that it might at any time flare up and scorch this planet as thoroughly as a sun gone nova. A war in which hardware hunts and kills hardware can find human software caught in between.

And yet, paradoxically, the range of possible futures is expanded by the computer. If computers can advance the technology of peace as efficiently as they have advanced the technology of war, then people and robots, will inherit the stars. ∞



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SANCTUARY

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cylinder was pointing nearly away from me so radar had reported a cross section much smaller than its real size. The thing was seven goddamn kilometers long.

I stared at that strange, monstrous thing and thought, and suddenly I didn't want to be around there anymore. I took three quick shots with the telescope on inventory mode. That would tell me composition, albedo, the rest of the litany. Then I shut it down and scrambled back into the bridge. My hands were trembling again.

I hesitated about what to do, but they decided for me. On our next revolution, as soon as the automatic opticals got a fix, there were two blips. I punched in for a radar Doppler and it came back bad. The smaller dot was closing on us, fast.

The moly bolts came free with a bang. I took *Sniffer* up and out, backing away from the asteroid to keep it between me and the blip that was coming for us. I stepped us up to max gee. My mouth was dry and I had to check every computer input twice.

I ran. There wasn't much else to do. The blip was coming at me at better than a tenth of a gee—incredible acceleration. In the Belt there is plenty of time for moving around, and a chronic lack of fuel—so we use high-efficiency drives and take energy-cheap orbits. The blip wasn't bothering with that. Somehow they had picked *Sniffer* out and decided we were worth a lot of fuel to reach, and reach in a hurry. For some reason they didn't use a laser bolt. It would have been a simple shot at this range. But maybe they didn't want to chance my shooting at the big ship this close, so they put their money on driving me off.

But then, why chase me so fast? It didn't add up.

By the time I was a few hundred klicks away from the asteroid it was too small to be a useful shield. The blip appeared around its edge. I don't carry weapons, but I do have a few tricks. I built a custom-designed pulse mode into *Sniffer*'s fusion drive back before she was commissioned. When the blip appeared I started staging the engines. The core of the motor is a hot ball of plasma, burning heavy water—deuterium—and spitting it, plus vaporized rock, out the back tubes. Feeding in the right amount of deuterium is crucial. There are a dozen overlapping safeguards on the system, but if you know how—

I punched in the command. My drive pulsed suddenly rich in deuterium. On top of that came a dose of pulverized rock. The rock damps the runaway reaction. On top of *that*, all in a microsecond, came a shot of cesium. It mixed and heated and *zap*—out the back, moving fast, went a hot cloud of spitting, snarling plasma. The cesium ionizes easily and makes a perfect shield against radar. You can fire a laser through it, sure—but how do you find your target?

The cesium pulse gave me a kick in the butt. I looked back. A blue-white cloud was spreading out behind *Sniffer*, blocking any detection.

I ran like that for one hour, then two. The blip showed up again. It had shifted sideways, to get a look around the cesium cloud—an expensive maneuver. Apparently they had a lot of fuel in reserve.

I threw another cloud. It punched a blue-white fist into the blackness. They were making better gee than I could; it was going to be a matter of who could hold out. So I tried another trick. I moved into the radar shadow of an asteroid that was nearby and moving at a speed I could manage. Maybe the blip would miss me when it came out from behind the cloud. It was a gamble, but worth it in fuel.

In three hours I had my answer. The blip homed in on me. *How?* I thought. *Who's got a radar that can pinpoint that well?*

I fired a white-hot cesium cloud. We accelerated away, making tracks. I was getting worried. *Sniffer* was groaning with the strain. I hadn't allowed myself to think about what I'd seen, but now it looked like I was in for a long haul. The fusion motor rumbled and murmured to itself and I was alone—more alone than I'd felt for a long time, with nothing to do but watch the screen and think.

> *"I didn't like the conclusion but it fit the facts. That huge seven-kilometer cylinder back there wasn't man-made. I'd known that the moment I saw it. Nobody could build a thing like that and keep it quiet."*

Belters aren't scientists. They're gamblers, idealists, thieves, crazies, malcontents. Most of them are from the cylinder worlds orbiting Earth. Once you've grown up in space, moving on means moving *out*, not going back to Earth. Nobody wants to be a groundpounder. So Belters are the new cutting edge of mankind, pushing out, finding new resources.

The common theory is that life in general must be like that. Over the last century the scientists have looked for radio signals from other civilizations out among the stars and come up with zero results. But we think life isn't all that unusual in the universe. So the question comes up: If there *are* aliens, and they're like us, why haven't they spread out among the stars? How come they didn't overrun Earth before we even evolved? If they moved at even one percent the speed of light, they would have spread across the whole damn galaxy in a few million years.

Some people think that argument is right. They take it a little further, too—the aliens haven't visited our solar system, so check your premise again. Maybe there *aren't* any aliens like us. Oh, sure, intelligent fish, maybe, or something we can't imagine. But there are no radio builders, no star voyagers. The best proof of this is that they haven't come calling.

I'd never thought about that line of reasoning much, because that's the conventional wisdom now, it's stuff you learn when you're a snot-nosed kid. We stopped listening for radio signals a long time ago, back around 2030 or so. But now that I thought about it—

Already, men were living in space habitats. If mankind ever cast off into the abyss between the stars, which way would they go? In a dinky rocket? No, they'd go in comfort, in stable communities. They'd rig up a cylinder world with a fusion drive or something like it, and set course for the nearest star, knowing they'd take generations to get there.

A century or two in space would make them into very different people. When they reached a star where would they go? Down to the planets? Sure—for exploration, maybe. But to live? Nobody who grew up in fractional g, with the freedom the cylinder world gives you, would want to be a groundpounder. They wouldn't even know *how*.

The aliens wouldn't be much different. They'd be spacefarers, able to live in vac and tap solar power. They'd need raw materials, sure. But the cheapest way to get mass isn't to go down and drag it up from the planets. No, the easy way is in the asteroids—otherwise Belters would never make a buck. So if the aliens came to our solar system a long time ago, they'd probably continue to live in space colonies. Sure, they'd study the planets some. But they'd live where they would be comfortable.

I thought this through, slowly, in the long waits while I dodged from rock to rock there was plenty of time. I didn't like the conclusion, but it fit the facts. That huge seven-kilometer cylinder back there wasn't man-made. I'd known that, deep in my guts, the moment I saw it. Nobody could build a thing like that out there and keep it quiet. The cylinder gave off no radio, but ships navigating that much mass into place would have to. Somebody would have picked it up.

So now I knew what was after me. It didn't help much.

I decided to hide behind one rock heading sunward at a fair clip. I needed sleep and I didn't want to keep up my fusion burn—they're too easy to detect. Better to lie low for a while.

I stayed there for five hours, dozing. When I woke up I couldn't see the blip.

Maybe they'd broken off the chase. I was ragged and there was sand in my eyes. I wasn't going to admit to myself that I was really scared this time. Belters and lasers I could take, sure. But this was too much for me.

I ate breakfast and lreed *Sniffer* from the asteroid I'd moored us to. My throat was raw, my nerves jumpy. I edged us out from the rock and looked around. Nothing.

I turned up the fusion drive. *Sniffer* creaked and groaned. The deck plates rattled. There was a hot gun-metal smell. I had been in my skinsuit the whole time and I didn't smell all that good either. I pulled away from our shelter and boosted.

It came out of nowhere.

One minute the scope was clean and the next—a big one, moving fast, straight at us. It *couldn't* have been hiding—there was no rock around to screen it. Which meant they could detlect radar waves, at least for a few minutes. They could be invisible.

The thing came looming out of the darkness. It was yellow and blue, bright and obvious. I turned in my couch to see it. My hands were punching in a last-ditch maneuver on the board. I squinted at the thing and a funny feeling ran through me, a chill. It was *old*.

There were big meteor pits all over the yellow-blue skin. The surface itself glowed, like rock with a ghostly fire inside. But I could see no ports, no locks, no antennas.

It was swelling in the sky, getting close.

I hit the emergency board, all buttons. I had laid out good money for one special surprise, if some prospector overtook me and decided he needed an extra ship. The side pods held fission-burn rockets, powerful things. They fired one time only and cost like hell. But worth it.

The gee slammed me back into the couch. A roar rattled the ship. We hauled ass out of there. I saw the thing behind fade away in the exhaust flames. The high-boost fuel puts out incredibly hot gas. Some of it caught the yellow-blue thing. The front end of the ship scorched. I smiled grimly and cut in the whole system. The gee thrust went up. I felt the bridge swimming around me, a sour smell of burning—then I was out, the world slipping away, the blackness folding in.

When I came to, I was floating. The boosters yawned empty, spent. *Sniffer* coasted at an incredibly high speed. And the yellow-blue thing was gone.

Maybe they'd been damaged. Maybe they just plain ran out of fuel: everybody has limitations, even things that can span the stars.

I stretched out and let the hard knots of tension begin to unwind, while *Sniffer* coasted along. Time enough later to compute a new orbit. For the moment it simply felt great to be alone and alive.

"Ceres Monitor here, on 560 megahertz. Calling on standby mode for orecratt *Sniffer*. Request microburst of confirmation on your hail frequency, *Sniffer*. We have a high-yield reading on optical from your coordinates. Request confirmation of fission burn. Repeat, this is Ceres Monitor, on 560 megahertz—"

I clicked it off. The Belt is huge, but the high-burn torch I'd turned loose back there was orders of magnitude more luminous than an ordinary fusion jet. That was one reason I carried them—they doubled as a signal flare visible millions of klicks away. By some chance somebody must have seen mine and relayed the coordinates to Ceres.

All through the chase I hadn't called Ceres. It would have been of no use—there were no craft within range to be of help. And Belters are loners—my instinct was always to keep troubles to myself. There's nothing worse than listening to a Belter whining over the radio.

But now I switched the radio back on and reached for the mike to hail Ceres. Then I

> *"The thing came looming out of the darkness. It was yellow and blue, bright and obvious. I turned in my couch to see it. My hands were punching in a last-ditch maneuver on the board . . . a chill ran through me."*

stopped. Something wasn't quite kosher.

The yellow-blue craft had never tired at me. *Sniffer* would have been easy to cripple at that range. An angry prospector would've done it without thinking twice. But *they* didn't.

Something prevented them. Some code, some moral sense that ruled out firing on a fleeing craft, no matter how much they wanted to stop it.

A moral code of an ancient society. They had come here and settled, soaking up energy from our sun, mining the asteroids, getting ice from comets. A peaceful existence. They were used to a sleepy Earth, inhabited by life forms not worth the effort of constant study. Probably they didn't care much about planets anymore. They didn't keep detailed track of what was happening.

Suddenly, in the last century or so—a very short interval from the point of view of a galactic-scale society—the animals down on the blue-white world started acting up. Emitting radio, exploding nuclear weapons, flying spacecraft. These ancient beings found a noisy, young, exponentially growing technology right on their doorstep.

I tried to imagine what they thought of us. We were young, we were crude. Undoubtedly the cylinder beings could have destroyed us. They could nudge a middle-sized asteroid into a collision orbit with Earth and watch the storm wrack, engulf humanity. Simple. But they hadn't done it. That moral sense again?

Something like that, yes. Give it a name and it becomes a human quality—which is in itself a deception. These things were *alien*. But their behavior had to make some sort of sense, had to have a reason.

I floated, frowning. Putting all this together was like assembling a jigsaw puzzle with only half the pieces, but still—something told me I was right. It fit.

A serene, long-lived, cosmic civilization might be worried by our blind rush outward. They were used to vast time scales: we had come on the stage in the wink of an eye. Maybe this speed left the cylinder beings undecided, hesitant. They needed time to think things over. That would explain why they didn't contact us. Just the reverse, in fact—they were hiding.

Otherwise—

It suddenly hit me. They didn't use radio because it broadcasts at a wide angle. Only lasers can keep a tight beam over great distances. That was what zapped me—not a weapon, a communications channel.

Which meant there had to be more than one cylinder world in the Belt. They kept quiet by using only beamed communications.

That implied something further too. We hadn't heard any radio signals from other civilizations, either—because they were using lasers. They didn't want to be detected by other, younger societies. They didn't want us to know they existed.

Why? Were the aliens in our own Belt debating whether to help us or crush us? Or something in between?

In the meantime, the Belt was a natural hideout. They liked their privacy. They must be worried now with humans exploring the Belt. I might be the first human to stumble on them, but I wouldn't be the last.

"Ceres Monitor calling to—"

I hesitated. They were old, older than we could imagine. They could have been in this solar system longer than man—stable, peaceful inheritors of a vast history. They were moral enough not to fire at me, even though they knew I meant they would be discovered.

They needed time. They had a tough decision to face. If they were rushed into it they might make the wrong one.

"Orecraft *Sniffer* requested to—"

I was a Belter. I valued my hermit existence, too. I thumbed on the mike.

"Ceres, this is *Sniffer*. Rosemary Jokopi, sole officer. I verify that I used a fission burn, but only as a part of routine mining exploration. No cause for alarm. Nothing else to report. Transmission ends."

When I hung up the mike, my hands weren't shaking anymore. ◻◻

IRON

CONTINUED FROM PAGE 88

solitaire and studied it with a growing frustration

Her name was Karen Shavitski and she used the name Karyn Shaw which I thought phony She was twenty two Divorced her parents at fourteen uncontested no-fault Since then she had been at various times waitress secretary to a lamp salesman, painter free-lance typist motorcycle mechanic library assistant, and unlicensed masseuse The most recent paycheck stub was from The Hard Corps a massage parlor with a cut-rate reputation It was dated eight months ago Her bank balance combined with paraphernalia I'd found in the closet to tell me that she was currently self-employed as a bootlegger a cocaine dealer The richness of the apartment and furnishings told me that she was a foolish one, even if the narcs missed her very shortly the IRS was going to come down on her like a ton of bricks Perhaps subconsciously she had not expected to be around

Nothing there I kept digging She had attended community college for one semester as an art major and dropped out failing She had defaulted on a lease three years ago She had wrecked a car once and been shafted by her insurance company. Trivia. Only one major trauma in recent years A year and a half ago she had contracted out as host-mother to a couple named Lombard/Smyth It was a pretty good fee—she had good hips and the right rare blood type—but six months into the pregnancy they had caught her using tobacco and canceled the contract She fought, but they had photographs And better lawyers naturally She had to repay the advance and pay for the abortion, of course and got socked for court costs besides.

It didn't make sense To show clean lungs at the physical she had to have been off cigarettes for at least three to six months Why backslide with so much at stake? Like the minor traumas, it felt more like an effect than a cause Self-destructive behavior I kept looking

Near the bottom I found something that looked promising Both her parents had been killed in a car smash when she was eighteen Their obituary was paperclipped to her father's will It was one of the most extraordinary documents I've ever read I could understand an angry father cutting off his only daughter without a dime But what he had done was worse Much worse

Dammit, it didn't work either So-there suicides don't wait four years And they don't use such a garish method either It devalues the tragedy I decided it had to be either a very big and dangerous coke deal gone bad or a very reptilian lover No not a coke deal They'd never have left her in her own apartment to die the way she wanted to It could not be murder Even the most unscrupulous wire surgeon needs an awake consenting subject to place the wire correctly

A lover, then I was relieved pleased with my sagacity, and irritated as hell I didn't know why I chalked it up to my nose. It felt as though a large shark with rubber teeth was rhythmically biting it as hard as he could I shoveled the papers back into the box locked and replaced it and went to the bathroom

Her medicine cabinet would have impressed a pharmacist She had lots of allergies It took me five minutes to find aspirin. I took four I picked the largest shard of mirror out of the sink propped it on the septic tank and sat down backward on the toilet My nose was visibly displaced to the right, and the swelling was just hitting its stride There was a box of kleenex on the floor I ripped it apart, took out all the tissues and stuffed them into my mouth Then I grabbed my nose with my right hand

> *"I had lost one friend to the juice. But I had never seen a wirehead. All the public usually gets to see is a sheeted figure being carried out to the wagon."*

and tugged out and to the left flushing the toilet simultaneously with my left hand The flushing coincided with the scream and my front teeth met through the kleenex When I could see again the nose looked straight and my breathing was unimpaired I gingerly washed my face and then hands and left A moment later I returned something had caught my eye It was the glass-and-toothbrush holder There was only one toothbrush in it I looked through the medicine chest again and noticed this time that there was no shaving cream no razor either manual or electric no masculine toiletries of any kind All the prescriptions were in her name and seemed perfectly legitimate

I went thoughtfully to the kitchen mixed myself a Preacher's Downfall by moonlight and took it to her bedroom The bedside clock said five I lit a match moved the footlocker in front of an armchair sat down, and put my feet up I sipped my drink and listened to her snore and watched her breathe in the feeble light of the clock I decided to run through all the possibilities and as I was formulating the first one day light smacked me hard in the nose

My hands went up reflexively and I poured my drink on my head and hurt my nose more I woke up hard in the best of times She was still snoring—I nearly threw the empty glass at her

It was just past noon now light came strongly through the heavy curtains illuminating so much mess and disorder that I could not decide whether she had thrashed her bedroom herself or it had been tossed by a pro I finally settled on the former The armchair I'd slept on was intact Or had the pro found what he wanted before he'd gotten that far?

I gave it up and went to make myself breakfast

It took me an hour or two to clean up and air out the living room The cord and transformer went down the oubliette, along with most of the perished items from the fridge The dishes took three full cycles for each load a couple of hours all told I passed the time vacuuming and dusting and snooping learning nothing more of significance I was making up a shopping list about fifteen minutes later when I heard her moan I reached her bedroom door in seconds waited in the doorway with both hands in sight and said slowly and clearly "My name is Joseph Templeton, Karen I am a friend You are all right now"

Her eyes were those of a small tormented animal

"Please don't try to get up Your muscles won't work properly and you may hurt yourself"

No answer

"Karen are you hungry?"

"Your voice is ugly, she said despairingly and her own voice was so hoarse I winced "*My* voice is ugly She sobbed gently "It's *all* ugly" She screwed her eyes shut

She was clearly incapable of movement I told her I would be right back and went to the kitchen I made up a tray of clear strong broth unbuttered toast tea with too much sugar and saltine crackers She was staring at the ceiling when I got back I put the tray down lifted her and made a backrest of pillows

"I want a drink"

"After you eat," I said agreeably

"Who're you?"

"Mother Templeton Eat"

"The soup maybe Not the toast" She got about half of it down, accepted some tea I didn't want to overfill her "My drink"

"Sure thing" I took the tray back to the kitchen finished my shopping list put away the last of the dishes and put a frozen steak into the oven for my lunch When I got back she was fast asleep

Emaciation was near total except for breasts and bloated belly she was all bone and taut skin Her pulse was steady At her best she would not have been very attractive by conventional standards Passable Too much waist not enough neck upper legs a bit too thick for the rest of her It's hard to evaluate a starved and unconscious face, but her jaw was a bit too

square her nose a trifle hooked, her blue eyes just the least little bit too far apart. Animated the face might have been beautiful—any set of features can support beauty—but even a superb makeup job could not have made her pretty. There was an old bruise on her chin. Her hair was sandy blond, long and thin, it had dried in snarls that would take an hour to comb out. Her breasts were magnificent, and that saddened me. In this world, a woman whose breasts are her best feature is in for a rough time.

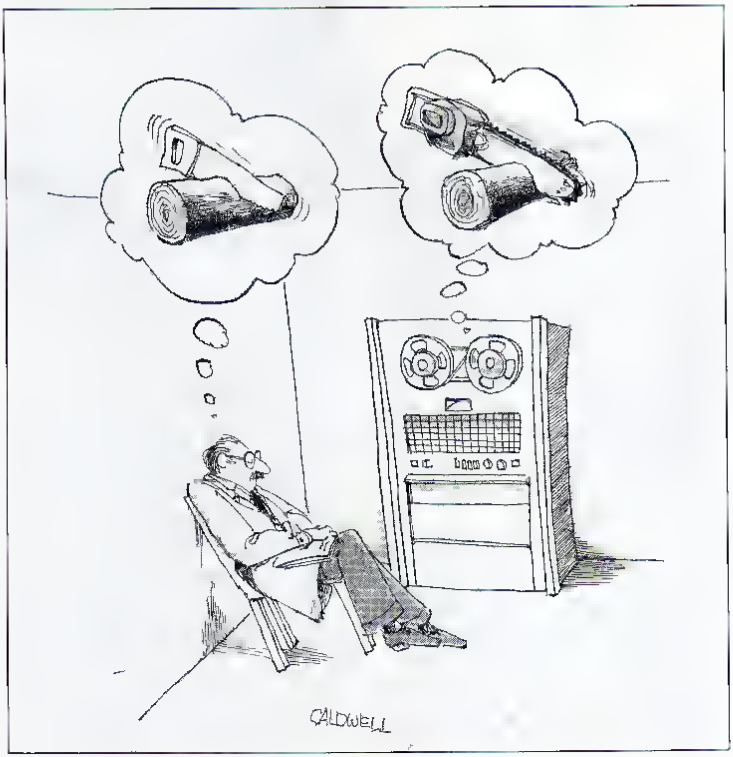
I was putting together a picture of a life that would have depressed anyone with the sensitivity of a rhino. Back when I had first seen her, when her features were alive, she had looked sensitive. Or had that been a trick of the juice? Impossible to say now.

But damn it all to hell, I could find nothing to really explain the socket in her skull. You can hear worse life stories in any bar on any street corner. I was prepared to match her scar for scar myself. Wireheads are usually addictive personalities, who decide at last to skip the small shit. There were no tracks on her anywhere, no nasal damage, no sign that she used any of the coke she sold. Her work history, pitiful and fragmented as it was, was too steady for any kind of serious jones, she had undeniably been hitting the sauce hard lately but only lately. Tobacco seemed to be her only serious addiction.

That left the hypothetical bastard lover I worried at that for a while to see if I could make it fit. Assume a really creatively sadistic son of a bitch had gutted her like a trout for the pure fun of it. You can't do that to someone as a visitor or even a guest: you have to live with them. So he did a world-class job of crippling a lady who by her history is a tough little cookie, and when he had broken her he vanished. Leaving not even so much as empty space in drawers, closets, or medicine chest. Unlikely. So perhaps after he was gone *she* scrubbed all traces of him out of the apartment—and then discovered that there is only one really good way to scrub memories. No. I couldn't picture such a sloppy housekeeper being so efficient.

Then I thought of my earlier feeling that the bedroom might have been tossed by a pro, and my blood turned to ice water. Suppose she wasn't a sloppy housekeeper? The jolly sadist returns unexpectedly for one last nibble. And finds her in the living room, just as I did. And leaves her there.

After five minutes thought I relaxed. That didn't parse either. True, this luxury co-op did inexplicably lack security cameras in the halls—but for that very reason its rich tenants would be sure to take notice of comings and goings. If he had lived here for any time at all, his spoor was too diffuse to erase—so he would not have tried. Besides, a monster of that unique and rare kind thrives on the corruption of innocence. Tough little Karen was simply not toothsome enough.



At that point I went to the bathroom, and that settled it. When I lifted the seat to urinate I found written on the underside with felt-tip pen: "It's so nice to have a man around the house!" The handwriting was hers. She had lived alone.

I was relieved, because I hadn't relished thinking about my hypothetical monster or the necessity of tracking and killing him. But I was irritated as hell again.

I wanted to *understand*.

For something to do I took my steak and a mug of coffee to the study and heated up her terminal. I tried all the typical access codes: her birthdate and her name in numbers and such, but none of them would unlock it. Then on a hunch I tried the date of her parents' death, and that did it. I ordered the groceries she needed, instructed the lobby door to accept delivery, and tried everything I could think of to get a diary or a journal out of the damned thing, without success. So I punched up the public library and asked the catalog for *Britannica* on wireheading. It referred me to brain-reward, autostimulus of. I skipped over the history from discovery by Olds and others in 1956 to emergence as a social problem in the late '80s when surgery got simple, declined the offered diagrams, graphs, and technical specs; finally found a brief section on motivations.

There was indeed one type of typical user I had overlooked. The terminally ill.

Could that really be it? At her age? I went to the bathroom and checked the prescriptions. Nothing for heavy pain, nothing indicating anything more serious than allergies. Back before telephones had cameras I might have conned something out of her personal physician, but it would have been a chancy thing even then. There was no way to test the hypothesis.

It was possible, even plausible—but it just wasn't *likely* enough to satisfy the thing inside me that demanded an explanation. I dialed a game of four-wall squash, and made sure the computer would let me win. I was almost enjoying myself when she screamed.

It wasn't much of a scream, her throat was shot. But it fetched me at once. I saw the problem as I cleared the door. The topical anesthetic had worn off the large "bedsores" on her back and buttocks, and the pain had waked her. Now that I thought about it, it should have happened earlier, that spray was only supposed to be good for a few hours. I decided that her pleasure-pain system was weakened by overload.

The sores were bad: she would have scars. I resprayed them, and her moans stopped nearly at once. I could devise no means of securing her on her belly that would not be nightmare-inducing, and decided it was unnecessary. I thought she was out again and started to leave. Her voice, muffled by pillows, stopped me in my tracks.

"I don't know you. Maybe you're not even

real I can tell you

"Save your energy Karen You—

"Shut up You wanted the karma you got it"

I shut up

Her voice was flat dead "All my friends were dating at twelve *He* made me wait until fourteen Said I couldn't be trusted Tommy came to take me to the dance and he gave Tommy a hard time I was so embarrassed The dance was nice for a couple of hours Then Tommy started chasing after Jo Tompkins He just left me and went off with her I went in the ladies' room and cried for a long time A couple of girls got the story out of me and one of them had a bottle of vodka in her purse I never drank before When I started tearing up cars in the parking lot, one of the girls got ahold of Tommy She gave him shit and made him take me home I don't remember it I found out later

Her throat gave out and I got water She accepted it without meeting my eyes turned her face away and continued

"Tommy got me in the door somehow I was out cold by then He must have been too scared to try and get me upstairs He left me on the couch and my underpants on the rug and went home The next thing I knew I was on the floor and my face hurt *He* was standing over me Whore he said I got up and tried to explain and he hit me a couple of times I ran for the door but he hit me hard in the back I went into the stairs and banged my head real hard

Feeling began to come into her voice for the first time The feeling was fear I dared not move

'When I woke up it was day Mama must have bandaged my head and put me to bed My head hurt a lot When I came out of the bathroom I heard him call me He and Mama were in bed He started in on me He wouldn't let me talk and kept getting madder and madder Finally I hollered back at him He got up off the bed and started in hitting me again My robe came off He kept hitting me in the belly and tits, and his fists were like hammers Slut, he kept saying Whore I thought he was going to kill me, so I grabbed one arm and bit He roared like a dragon and threw me across the room Onto the bed Mama jumped up Then he pulled down his underpants and it was big and purple I screamed and screamed and tore at his back and Mama just stood there Her eyes were big and round, just like in cartoons I screamed and screamed and—"

She broke off short and her shoulders knotted When she continued her voice was stone dead again "I woke up in my own bed again I took a real long shower and went downstairs Mama was making pancakes I sat down and she gave me one and I ate it, and then I threw it up right there on the table and ran out the door She never said a word never called me back After school that day I found a Sanctuary and started the divorce proceedings I never saw either of them again I never told this to

anybody before.

The pause was so long I thought she had fallen asleep. "Since that time I've tried it with men and women and boys and girls in the dark and in the desert sun, with people I cared for and people I didn't give a damn about, and I have never understood the pleasure in it. The best it's ever been for me is not uncomfortable. God, how I've wondered . . . now I know." She was starting to drift. "Only thing my whole life turned out *better*'n cracked up to be." She snorted sleepily. "Even alone."

I sat there for a long time without moving. My legs trembled when I got up, and my hands trembled while I made supper.

That was the last time she was lucid for nearly forty-eight hours. I plied her with successively stronger soups every time she woke up, and once I got some tea-soggy toast into her. Sometimes she called me by others' names, and sometimes she didn't know I was there, and everything she said was disjointed. I listened to her tapes, watched some of her video, charged some books and games to her computer. I took a lot of her aspirin. And drank surprisingly little of her booze.

It was a time of frustration for me. I still couldn't make it all fit together, still could not quite understand. There was a large piece missing. The animal who sired and raised her had planted the charge, of course, and I perceived that it was big enough to blow her apart. But why had it taken eight years to go off? If his death four years ago had not triggered it, what had? I could not leave until I knew. I did not know why not. I prowled her apartment like a caged bear, looking everywhere for something else to think about.

Midway through the second day her plumbing started working again. I had to change the sheets. The next morning a noise woke me and I found her on the bathroom floor on her knees in a pool of urine. I got her clean and back to bed and just as I thought she was going to drift off again she started yelling at me. "Lousy son of a bitch, it could have been over! I'll never have the guts again now! How could you *do* that, you *bastard*. It was so *nice*!" She turned violently away from me and curled up. I had to make a hard choice then, and I gambled on what I knew of loneliness and sat on the edge of the bed and stroked her hair as gently and impersonally as I knew how. It was a good guess. She began to cry in great racking heaves first, then the steady wail of total heartbreak. I had been praying for this and did not begrudge the strength it cost her.

She cried for so long that every muscle in my body ached from sitting still by the time she fell off the edge into sleep. She never felt me get up, stiff and clumsy as I was. There was something different about her sleeping face now. It was not slack but relaxed. I limped out in the closest thing to peace I had felt since I arrived, and as I was passing the living room on the way to the liquor I heard the phone.

Silently, I looked over the caller. The picture was undercontrasted and snowy; it was a pay phone. He looked like an immigrant construction worker, massive and florid and neckless, almost brutish. And, at the moment, under great stress. He was crushing a hat in his hands, mortally embarrassed.

"Sharon, don't hang up," he was saying. "I *gotta* find out what this is all about."

Nothing could have made me hang up.

"Sharon? Sharon, I know you're there. Terry says you ain't there, she says she called you every day for a week and banged on your door a few times. But I know you're there, now anyway. I walked past your place an hour ago and I seen your bathroom light go on and off. Sharon, will you please tell me what the hell is going on? Are you listening to me? I know you're listening to me. Look, you gotta understand. I thought it was all set, see? I mean I thought it was *set*. Arranged. I put it to Terry, 'cause she's my regular, and she says not *me*, lover, but I know a gal. Look, was she lying to me or what? She told me for another bill you play them kind of games."

Regular $200 bank deposits plus a cardboard box full of scales, vials, bags, and milk powder makes her a coke dealer, right, Travis McGee? Don't be misled by the fact that the box was shoved in a corner, sealed with tape, and covered with dust. After all, the only other illicit profession that pays regular sums at regular intervals is hooker, and $200 is too much for square-jawed, hook-nosed, wide-eyed little Karen, breasts or no breasts.

For a garden-variety hooker.

"Dammit, she told me she *called* you and set it up, she gave me your *apartment* number." He shook his head violently. "I can't make sense of this. Dammit, she *couldn't* be lying to me. It don't figure. You let me in, didn't even turn the camera on first, it was all arranged. Then you screamed and . . . and I done like we arranged, and I thought you was maybe overdoin' it a bit but Terry *said* you was a terrific actress. I was real careful not to really hurt you, I know I was. Then I put on my pants and I'm putting the envelope on the dresser and you bust that chair on me and come at me with that knife and I hadda bust you one. It just don't make no sense, will you *goddammit say something to me*? I'm twisted up inside going on two weeks now I can't even eat."

I went to shut off the phone, and my hand was shaking so bad I missed, spinning the volume knob to minimum. "Sharon, you gotta believe me," he hollered from far far away. "I'm into rape fantasy. I'm not into rape!" And then I had found the right switch and he was gone.

I got up very slowly and toddled off to the liquor cabinet, and I stood in front of it taking pulls from different bottles at random until I could no longer see his face, his

"We've got to feather our nest . . . What are feathers?"

earnest, baffled, half-ashamed face hanging before me.

Because his hair was thin sandy blond and his jaw was a bit too square and his nose was a trifle hooked, and his blue eyes were just the least little bit too far apart. They say everyone has a double somewhere. And Fate is such a witty little motherfucker, isn't he?

I don't remember how I got to bed.

I woke later that night with the feeling that I would have to bang my head on the floor a couple of times to get my heart started again. I was on my makeshift doss of pillows and blankets beside her bed, and when I finally peeled my eyes open she was sitting up in bed staring at me. She had fixed her hair somehow and her nails were trimmed. We looked at each other for a long moment. Her color was returning somewhat, and the edge was off her bones.

"What did Jo Ann say when you told her?

I said nothing.

"Come on, Jo Ann's got the only other key to this place, and she wouldn't give it to you if you weren't a friend. So what did she say?"

I got painfully up out of the tangle and walked to the window. A phallic church steeple rose above the low-rises, a couple of blocks away.

"God is an iron," I said. "Did you know that?"

I turned to look at her, and she was staring. She laughed experimentally, stopped when I failed to join in. "And I'm a pair of pants with a hole scorched through the ass?

"If a person who indulges in gluttony is a glutton, and a person who commits a felony is a felon, then God is an iron. Or else He's the dumbest designer that ever lived."

Of a thousand possible snap reactions she picked the most flattering and hence most irritating. She kept silent, kept looking at me, and thought about what I had said. At last she said, "I agree. What particular design fuckup did you have in mind?"

"The one that nearly left you dead in a pile of your own shit," I said harshly. "Everybody talks about the new menace, wireheading, fifth most common cause of death in only a decade. Wireheading's not new—it's just a technical refinement."

"I don't follow."

"Are you familiar with the old cliché 'Everything I like in the world is either illegal, immoral, or fattening'?"

"Sure."

"Didn't that ever strike you as damned odd? What's the most nutritionally useless and physiologically dangerous food substance in the world? Sugar. And it seems to be beyond the power of the human nervous system to resist it. They put it in virtually all the processed food there is, which is next to all the food there is, because *nobody can resist it*. And so we poison ourselves and whipsaw our dispositions and rot our teeth. Isn't that odd? There is a primitive programming in our skulls that rewards us literally overwhelmingly every time we do something damned silly. Like smoke a poison, or eat or drink or snort or shoot a poison. Or *overeat good* foods. Or engage in complicated sexual behavior without procreative intent, which if it were not for the pleasure would be pointless and insane. And which, when pursued for the pleasure alone, quickly becomes pointless and insane anyway. A suicidal brain-reward system is built into us."

"But the reward system is for survival."

"So how the hell did ours get wired up so that survival-threatening behavior gets rewarded best of all? Even the pro-survival pleasure stimuli are wired so that a dangerous *overload* produces the maximum pleasure. On a purely biological level, Man is programmed to strive hugely for more than he needs, more than he can profitably use.

"The error doesn't show up as glaringly in other animals. Even surrounded by plenty, a stupid animal has to work hard simply to meet his needs. But add in intelligence and everything goes to hell. Man is capable of outgrowing any ecological niche you put him in—he survives at all because he is the animal that *moves*. Given half a chance he kills himself of surfeit."

My knees were trembling so badly I had to sit down. I felt feverish and somehow larger than myself, and I knew I was talking

much too fast. She had nothing whatever to say with voice, face or body.

Given Man's gregarious nature,' I went on, fingering my aching nose, 'it's obvious that kindness is more pro-survival than cruelty. But which *feels* better? Which provides more pleasure? Poll any hundred people at random and you'll find at least twenty or thirty who know all there is to know about psychological torture and psychic castration—and maybe two that know how to give a terrific back rub. That business of your father leaving all his money to the Church and leaving you a hundred dollars, the going rate—that was *artistry*. I can't imagine a way to make you feel as good as that made you feel rotten. That's why sadism and masochism are the last refuge of the jaded, the most enduring of the perversions, their piquancy is—'

Maybe the Puritans were right,' she said. 'Maybe pleasure is the root of all evil. But God! life is bleak without it.

One of my most precious possessions,' I said, 'is a button that my friend Slinky John used to hand-paint and sell below cost. He was the only practicing anarchist I ever met. The button reads "GO LEMMINGS GO!" A lemming surely feels intense pleasure as he gallops to the sea. His self-desfruction is programmed by nature, a part of the very same life force that insisted on being conceived and born in the first place. If it feels good, do it.' I laughed, and she flinched. 'So it seems to me that God is either an iron, or a colossal jackass. I don't quite know whether to be admiring or contemptuous.'

All at once I was out of words, and out of strength. I yanked my gaze away from hers and stared at my knees for a long time. I felt vaguely ashamed, as befits one who has thrown a tantrum in a sickroom.

After a time she said, 'You talk good on your feet.'

I kept looking at my knees. 'I was an economics teacher for a year once.'

'Will you tell me something?'

'If I can.'

'What was the pleasure in putting me back together again?'

I jumped.

'Look at me. There. I've got a half-ass idea of what shape I was in when you met me, and I can guess what it's been like since. I don't know if I'd have done as much for Jo Ann, and she's my best friend. You don't look like a guy whose favorite kick is sick ferns, and you sure as *hell* don't look like you're so rich you got time on your hands. So what's been your pleasure these last few days?'

'Trying to understand,' I snapped. 'I'm nosy.'

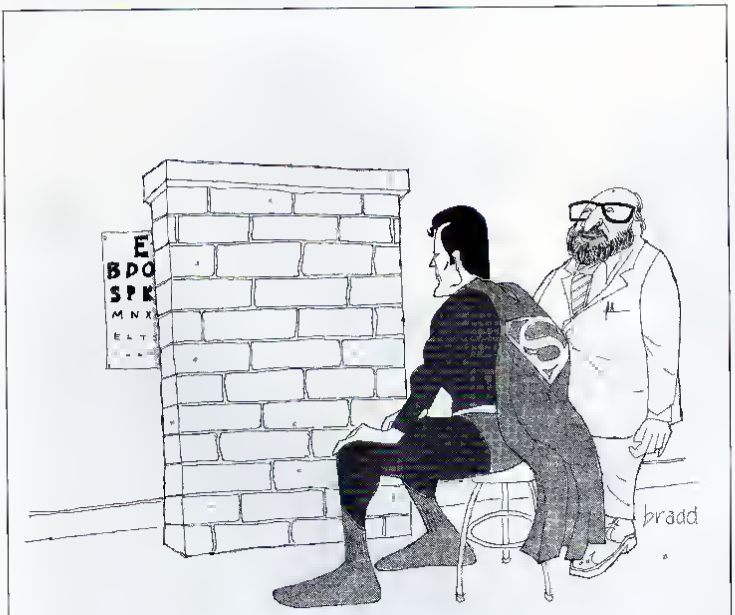
'And do you understand?'

'Yeah. I put it together.'

'So you'll be going now?'

'Not yet,' I said automatically. 'You're not—'

And caught myself.



"Okay, now try the third line from the top."

There's something else besides pleasure,' she said. 'Another system of reward, only I don't think it has much to do with the one I got wired up to my scalp here. Not brain-reward. Call it mind-reward. Call it joy—the thing like pleasure that you feel when you've done a good thing or passed up a real tempting chance to do a bad thing. Or when the unfolding of the Universe just seems especially apt. It's nowhere near as flashy and intense as pleasure can be. *Believe* me. But it's got *some*thing going for it. Something that can make you do without pleasure or even accept a lot of pain to get it.

'That thing you're talking about, that's there, that's true. What's messing us up is the animal nervous system and instincts we inherited. But you said yourself. Man is the animal that outgrows and moves. Ever since the first brain grew a mind we've been trying to outgrow our instincts, grow new ones. By Jesus, we will yet. Evolution works pretty slow is all. Couple of hundred million years to develop a thinking ape, and you want a smart one in a lousy few hundred thou? That lemming drive is there—but there's another kind of drive, another kind of force, that's working against it. Or else there wouldn't still be any people and there wouldn't be the words to have this conversation and—' She looked down at herself. 'And I wouldn't be here to say them.'

'That was just random chance.'

She snorted. 'What isn't?'

'Well, that's *fine*.' I shouted. 'That's *fine*. Since the world is saved and you've got it under control I'll just be going along.'

I've got a lot of voice when I yell. She ignored it utterly, continued speaking as if nothing had happened. 'Now I can say that I have sampled the spectrum of the pleasure system at both ends—none and all there is—and I think the rest of my life I will dedicate myself to the middle of the road and see how that works out. Starting with the very weak tea and toast I'm going to ask you to bring me in another ten minutes or so. But as for this other stuff, this joy thing that I would like to begin exploring in as much intensity as possible. I don't really know a goddam thing about it, but I understand it has something to do with sharing and caring, and what did you say your name was?'

'It doesn't matter!' I yelled.

'All right. What can *I* do for *you*?'

'Nothing!'

'What did you come here for?'

I was angry enough to be honest. 'To burgle your fucking apartment!'

Her eyes opened wide, and then she slumped back against the pillows and laughed until the tears came, and I tried and could not help myself and laughed too, and we shared laughter for a long time, as long as we had shared her tears the night before.

And then straightfaced she said, 'You'll have to wait a week or two, you're gonna need help with those stereo speakers. But ter on the toast.' OO

INTERVIEW

CONTINUED FROM PAGE 98

profundity "You haven't thought deeply enough first let me define the world for you " Well I m going to investigate it *without* defining it!

Omni: How do you know which problem is the right size to attack?

Feynman: When I was in high school, I had this notion that you could take the importance of the problem and multiply by your chance of solving it You know how a technically minded kid is, he likes the idea of optimizing everything Anyway, if you can get the right combination of those factors you don t spend your life getting nowhere with a profound problem or solving lots of small problems that others could do just as well

Omni: Let s take the problem that won the Nobel Prze for you Schwinger and Tomonaga Three different approaches Was that problem especially ripe for solution?

Feynman: Well quantum electrodynamics had been invented in the late 1920s by Dirac and others just after quantum mechanics itself They had it fundamentally correct but when you went to calculate answers you ran into complicated equations that were very hard to solve You could get a good first-order approximation, but when you tried to refine it with corrections these infinite quantities started to crop up Everybody knew that for twenty years it was in all the books on quantum theory

Then we got the results of experiments by Lamb and Rutherford on the shifts in angular momentum of the electron in hydrogen atoms Until then, the rough prediction had been good enough, but now you had a very precise number One thousand sixty megacycles or whatever And everybody said, "Dammit this problem has to be solved "

So Hans Bethe took this figure and made some estimates of how you could avoid the infinities by subtracting this effect from that effect so the quantities that would tend to go to infinity were stopped short and they'd probably stop in this order of magnitude and he came out with something around a thousand megacycles I remember he d invited a bunch of people to a party at his house at Cornell, but he d been called away to do some consulting He called up during the party and told me he d figured this out on the train When he came back he gave a lecture on it and showed how this cut-off procedure avoided the infinities but was still very ad hoc and confusing He said it would be good if someone could show how it could be cleaned up I went up to him afterwards and said "Oh, that s easy I can do that See, I d started to get ideas on this when I was a senior at MIT I d even cooked up an answer then—wrong, of course See, this is where Schwinger and Tomonaga and I came in In developing a way to turn this kind of procedure into solid analysis—technically to maintain relativistic invariance all the way through Tomonaga had already suggested how it could be done and Schwinger was developing his own way

So I went to Bethe with my way of doing it The funny thing was, I didn t know how to do the simplest practical problems in this area—I should have learned long before, but I d been busy playing with my own theory—so I didn t know how to find out if my ideas worked We did it together on the blackboard, and it was wrong Even worse than before I went home and thought and thought and decided I had to learn to solve examples So I did, and I went back to Bethe and we tried it and it worked! We ve never been able to figure out what went wrong the first time some dumb mistake

Omni: How far had it set you back?

Feynman: Not much, maybe a month It did me good because I reviewed what I d done and convinced myself that it had to work and that these diagrams I d invented to keep things straight were really okay

Omni: Did you realize at that time that they d be called 'Feynman diagrams " that they'd be in the books?

Feynman: No, not— I do remember one moment I was in my pajamas working on the floor with papers all around me these funny-looking diagrams of blobs with lines sticking out I said to myself, Wouldn t it be

funny if these diagrams really are useful, and other people start using them, and *Physical Review* has to print these silly pictures? Of course, I couldn't foresee— In the first place I had no idea how many of these pictures there'd be in *Physical Review* and in the second place it never occurred to me that with everybody using them they wouldn't look funny anymore . . .

[At this point the interview adjourned to Professor Feynman's office, where the tape recorder refused to start. The cord, power switch, record button—all were in order; then Feynman suggested taking the cassette out and putting it in again.]

Feynman: There. See, you just have to know about the world. Physicists know about the world.

Omni: Take it apart and put it back together?

Feynman: Right. There's always a little dirt, or infinity, or something.

Omni: Let's follow that up. In your lectures you say that our physical theories do well at uniting various classes of phenomena and then X rays or mesons or the like show up. There are always many threads hanging out in all directions.' What are some of the loose threads you see in physics today?

Feynman: Well, there are the masses of the particles. The gauge theories give beautiful patterns for the interactions, but not for the masses, and we need to understand this irregular set of numbers. In the strong nuclear interaction we have this theory of colored quarks and gluons, very precise and completely stated, but with very few hard predictions. It's technically very difficult to get a sharp test of the theory, and that's a challenge. I feel passionately that that's a loose thread, while there's no evidence in conflict with the theory, we're not likely to make much progress until we can check hard predictions with hard numbers.

Omni: What about cosmology? Dirac's suggestion that the fundamental constants change with time or the idea that physical law was different at the instant of the big bang?

Feynman: That would open up a lot of questions. So far physics has tried to find laws and constants without asking where they came from, but we may be approaching the point where we'll be forced to consider history.

Omni: Do you have any guesses on that?

Feynman: No.

Omni: None at all? No leaning either way?

Feynman: No, really. That's the way I am about almost everything. Earlier you didn't ask whether *I* thought that there's a fundamental particle, or whether it's all mist. I would have told you that I haven't the slightest idea. Now, in order to work hard on something, you have to get yourself believing that the answer's over *there*, so you'll dig hard there, right? So you temporarily prejudice or predispose yourself—but all the time, in the back of your mind, you're laughing. Forget what you hear about science without prejudice. Here, in an interview talking about the big bang, I have no prejudices—but when I'm working, I have a lot of them.

Omni: Prejudices in favor of . . . what? Symmetry, simplicity . . . ?

Feynman: In favor of my mood of the day. One day I'll be convinced there's a certain type of symmetry that everybody believes in, the next day I'll try to figure out the consequences if it's not, and everybody's crazy but me. But the thing that's unusual about good scientists is that while they're doing whatever they're doing, they're not so sure of themselves as others usually are. They can live with steady doubt: think "maybe it's so" and act on that, all the time knowing it's only "maybe." Many people find that difficult: they think it means detachment or coldness. It's not coldness! It's a much deeper and warmer understanding, and it means you can be digging somewhere where you're temporarily convinced you'll find the answer, and somebody comes up and says, "Have you seen what they're coming up with over there?' and you look up and say, *"Jeez! I'm in the wrong place!"* It happens all the time.

> *"Scientists are able to think "maybe it's so" and act on that, all the time knowing it's only "maybe." That's not cold or detached—it's a much deeper and warmer understanding."*

Omni: There's another thing that seems to happen a lot in modern physics: the discovery of applications for kinds of mathematics that were previously "pure," such as matrix algebra or group theory. Are physicists more receptive now than they used to be? Is the time lag less?

Feynman: There never was any time lag. Take Hamilton's quaternions. The physicists threw away most of this very powerful mathematical system and kept only the part—the mathematically almost trivial part—that became vector analysis. But when the whole power of quaternions was needed, for quantum mechanics, Pauli reinvented the system on the spot in a new form. Now, you can look back and say that Pauli's spin matrices and operators were nothing but Hamilton's quaternions . . . but even if physicists had kept the system in mind for ninety years, it wouldn't have made more than a few weeks' difference.

Say you've got a disease. Werner's granular meclosis or whatever, and you look it up in a medical reference book. You may well find that you then know more about it than your doctor does, although he spent all that time in medical school, you see? It's much easier to learn about some special, restricted topic than a whole field. The mathematicians are exploring in all directions, and it's quicker for a physicist to catch up on what he needs than to try to keep up with everything that might conceivably be useful. The problem I was mentioning earlier, the difficulties with the equations in the quark theories, it's the physicists' problem, and we're going to solve it, and maybe when we solve it we'll be doing mathematics. It's a marvelous fact, and one I don't understand: that the mathematicians had investigated groups and so on before they turned up in physics—but in regard to the speed of progress in physics, I don't think it's all that significant.

Omni: One more question from your lectures. You say there that "the next great era of awakening of human intellect may well produce a method of understanding the *qualitative* content of equations." What do you mean by that?

Feynman: In that passage I was talking about the Schrödinger equation. Now, you can get from that equation to atoms bonding in molecules, chemical valences—but when you look at the equation, you can see nothing of the wealth of phenomena that the chemists know about. Or the idea that quarks are permanently bound, so you can't get a free quark—maybe you can and maybe you can't, but the point is that when you look at the equations that supposedly describe quark behavior you can't see why it should be so. Look at the equations for the atomic and molecular forces in water, and you can't see the way water behaves, you can't see turbulence.

Omni: That leaves the people with questions about turbulence—the meteorologists and oceanographers and geologists and airplane designers—kind of up the creek, doesn't it?

Feynman: Absolutely. And it might be one of those up-the-creek people who'll get so frustrated he'll figure it out, and at that point he'll be doing physics. With turbulence, it's not just a case of physical theory being able to handle only simple cases—we can't do *any*. We have no good fundamental theory at all.

Omni: Maybe it's the way the textbooks are written, but few people outside science appear to know just how quickly real, complicated physical problems get out of hand as far as theory is concerned.

Feynman: That's very bad education. The lesson you learn as you grow older in physics is that what we can do is a very small fraction of what there is. Our theories are really very limited.

Omni: Do physicists vary greatly in their ability to see the qualitative consequences of an equation?

Feynman: Oh, yes—but nobody is very good at it. Dirac said that to *understand* a physical problem means to be able to see

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OBSERVATORY-HOPPING

EXPLORATIONS

By Trudy E. Bell

There are few pastimes more fascinating, more mysterious, or more peaceful than simply stargazing at a splendid night sky—wondering what it all means. Will we ever travel to any of those other suns? Are there other souls like us on a distant planet, looking up and wondering the same? A special breed of investigator is devoted to finding the answers to some of these questions, by studying everything in the universe from the movement of planets to the nature of such bizarre objects as quasars and black holes, which explode or go beep in the night. That investigator is the astronomer.

A telescope is essentially a huge bucket for gathering light; the larger the bucket, the more light it can gather—and the fainter the objects it can detect. Although a century ago most astronomers spent their observing time actually looking through the telescope, today they seldom do. Instead, the light from the object of curiosity is captured on a photographic plate or is directed through a prism that breaks it up into a rainbow of colors, which becomes the individual signature of the object's internal chemistry.

If you have ever wondered how astronomers are able to measure what is happening in the next galaxy, you might be surprised to learn that many observatories welcome visits from the interested public. Some observatories employ college students to conduct guided tours of their facilities, usually during the daytime, and to answer questions about the institution's research. Other facilities feature public observing nights during clear weather—evenings when you are given the chance to look through a medium-size telescope at the craters of the moon, the rings of Saturn, or some multicolored luminous cloud of gas in the depths of space.

There are hundreds of observatories sprinkled across the nation, ranging in size from modest college installations to major research facilities. You don't have to be an astronomer to enjoy a tour of one. Half the thrill of gazing up at a steel-and-glass telescope six stories high is simply being awed by this magnificent piece of human engineering, which runs with finer precision than a Swiss watch.

Admission to an observatory is generally free, although frequently visitors must call or write for advance reservations because of limited space. Children under five should not be taken to an observatory, some places forbid children under ten or twelve, so ask first. It is usually a good idea to take a lunch and fill your gas tank before embarking on your visit because observatories tend to be isolated: it can be a long way to the nearest Coke machine, and if you run out of fuel, towing charges are fierce.

Dress warmly. The huge mirrors or lenses of the telescopes must be kept at nighttime temperatures during the day, so observatories are unheated even on the chilliest days. In fact, in the domes of the largest telescopes, visitors are usually confined to glassed-in galleries because hundreds of tourists' warm bodies trooping under the optics all day would render the telescope useless for work that night.

Probably no other observatories have captured the popular imagination so much as the **Hale Observatories** in southern California. Actually, they are two sister installations at different sites: one is at **Mount Wilson**, northeast of Los Angeles, and the other is on **Palomar Mountain**, between Los Angeles and San Diego. In their time, each sported the largest telescope in the world. The two-and-a-half-meter reflector at Mount Wilson held the title from 1919 until the five-meter reflector was installed on Palomar Mountain in 1947. You can view the squat, massive, pale-green "Glass Giant of Palomar" from a visitors' gallery. There are no public observing nights, but there is a museum on the grounds with breathtaking photographs of planets, stars, and wispy nebulas made with the telescopes. The Mount Wilson observatory, which has been closed to the public for several years, may reopen in the late spring or early summer, allowing visitors to gaze up at the newly refurbished two-and-a-half-meter reflector and several other instruments.

Six hundred forty kilometers north of these astronomical monuments is the **Lick**

Domes of four of the 14 telescopes at the Kitt Peak National Observatory outside Tucson, Arizona.

Observatory on Mount Hamilton California 30 kilometers of winding road east of San Jose Although the observatory comprises half a dozen instruments only the two largest are on public display Each afternoon tours are conducted inside the old steel dome of the 91-centimeter Great Refractor—an instrument that enjoys the dubious distinction of serving as the tombstone of its benefactor James Lick whose body is buried in the telescope's supporting pier This long slim telescope the largest refractor in the world when it was completed in 1888 was one of many fashioned by the excellent nineteenth-century American optical firm Alvan Clark and Sons the fact that it is still used nightly after 91 years is certainly an excellent return on James Lick's investment During the summer on Friday evenings the public is allowed to look through this instrument A pleasant half-a-kilometer walk away through the rugged mountain chaparral you can stand in a glassed-in visitors gallery and gaze at the graceful three-meter reflector third largest in the US Although the telescope is two-thirds the diameter of the 508-centimeter reflector at Palomar it is equally as long 15 meters Plan to spend some time just strolling around the top of the mountain the view to the west embraces the southern part of the San Francisco Bay and on rare crisp winter afternoons you can see the snow-capped Sierras and Yosemite's Half Dome 200 kilometers to the east

In Arizona a prime site for astronomical observing lies the **Kitt Peak National Observatory** Affectionately known to some as "Telescope National Forest" Kitt Peak sports the densest concentration of astronomical instruments in the world No fewer than 14 different telescopes dot the top of the mountain which is some 80 kilometers west of Tucson There you can gaze up 19 stories, while riding up an elevator to the glassed-in panoramic gallery at the four-meter Nicholas U Mayall reflector second largest in the US There is also a visitors gallery in the dome of the 210-centimeter reflector The unique hallmark of the Kitt Peak Observatory is the McMath solar telescope which from a distance looks like a sleek white upside-down check mark a vertical white tower eleven stories high supporting a slanting shaft twenty stories long This shaft forms a 150-meter light path for the beam of sunlight that when it finally comes to a focus in the observing room underground, forms an image of the sun nearly a meter across Inside the telescope is a glassed-in visitors gallery halfway down the light path The visitors center at Kitt Peak is particularly nice with many exhibits, a working solar telescope and even Papago Indian handcrafts

After a five-hour drive north of Kitt Peak you come to the **Lowell Observatory** in Flagstaff, founded in the gay '90s by Boston Brahmin Percival Lowell (the brother of the poet Amy Lowell) for the express purpose of looking for canals on Mars which Lowell thought might be evidence of an intelligent race Much of the work of the Lowell Observatory is still concerned with the solar system and the planet Pluto was discovered there in 1930 Set back in a peaceful pine forest on a hill at the west end of town it is one of the few major observatories that can be easily reached by public transportation There is a one-hour lecture tour given every weekday afternoon during which the public is treated to a slide show a short lecture and a demonstration of the observatory's 61-centimeter Clark refractor housed in a wooden dome that is inelegantly rotated by means of rubber automobile tires

Another large astronomical institution in the American Southwest is the **McDonald Observatory** on Mount Locke near Fort Davis Texas The mirror of the main 4.3-meter reflector was shot at—but not seriously damaged—in 1970 by a pistol-packing deranged optician During the daytime regular descriptive lectures are given and you are allowed to walk around right next to the instrument—the largest telescope in the country that is not off-limits to visitors all the time This telescope has taken some of the most exquisite ground-based photographs of the planets ever made some of which are hanging on the walls of the visitors gallery Throughout the year on the last Wednesday evening of the month there is a public observing night Visitors listen to a short lecture see a film hear an astronomer tell about his or her current work and (weather permitting) get to look through a rather elderly 205-centimeter reflector —the largest telescope in the country through which visitors can gaze

> *"At observatories open to the public at nighttime, you may have the chance to gaze at the rings of Saturn, moon craters, or some multicolored luminous cloud of gas in the depths of space"*

The best site for an observatory of course is one away from city lights and smog where the air is steady and it doesn't rain half the year For those reasons the largest modern research institutions are in the American Southwest Nonetheless there are plenty of observatories elsewhere in the country particularly ones of historical interest If you are in the Midwest you might like to spend a Saturday afternoon at the **Yerkes Observatory** at Williams Bay Wisconsin about 120 kilometers northwest of Chicago This observatory is famous for its 99-centimeter Clark refractor the largest lens-telescope in the world moreover this particular instrument instead of being painted the usual battleship gray is cheerfully decorated in vivid colors orange white and blue

On the East Coast is the **US Naval Observatory** in Washington D C which provides the standards of time for the National Bureau of Standards and for everyone else When you set your watch you are setting it to Naval Observatory time At the observatory is a museum refurbished several years ago for the Bicentennial There you can read a clipping recounting a visit by Abraham Lincoln and an account of the discovery of the two moons of Mars A visit to the observatory's time center lets you see a bank of a dozen or so atomic clocks racks of electronic consoles with slowly moving strips of paper recording the time variations of the clocks as they are constantly checking themselves against one another Escorted tours take you inside the immaculately kept dome of the century-old sixty-six-centimeter (twenty-six-inch) refractor On several nights each month you can look through this instrument during frequently scheduled nighttime tours

Astronomers not only look at the stars —they listen to them as well For a different treat you might like to visit the largest radio astronomy observatory in the US the **National Radio Astronomy Observatory** (NRAO) in Green Bank West Virginia about 200 kilometers west of Charlottesville Virginia on Highway 2892 There set among the lush Virginia forest in a calm valley half a dozen giant radio antennas cup their wire ears to the sun and the Milky Way In the summer visitors see a short film called *The Invisible Universe* and are then taken on a narrated bus tour that stops at several of the radio telescopes the largest being a wire-net dish fully 192 meters in diameter

If one of these major observatories is not nearby don't neglect a smaller one that may be Call the planetarium in your city or the astronomy department of a nearby college or university for more information You'll have a much better chance of looking *through* the telescopes and the people there may have more time to show you around

Clear skies! ∞

For a complete and excellent description of some 300 astronomical institutions and their hours see U S Observatories A Directory and Travel Guide *by H T Kirby-Smith Van Nostrand Co 1976*

RED STAR

CONTINUED FROM PAGE 18

- Recognition of space activities as being indicative of great-power status
- Implementation of space colonization as a logical development in Marxist society
- The personal biases of top officials

The current party line portrays the conquest of space as an inevitable outgrowth of socialism, an expression of the leading role of Marxist-Leninist society in the march of history. The "naturalness" and "inevitability" of the Soviet Union's leading role in this expansion cannot be emphasized enough. The Communist party has firmly committed its apparatus to sprinkling the Marxist equivalent of holy water on the cannons of the space crusaders.

Early space successes significantly bolstered Russian pride and conveyed overseas a grossly exaggerated image of Russian science and power. Under Khrushchev the entire space program was subjugated to an almost paranoid lust for "space firsts" that would further humiliate the Americans. After Khrushchev's fall, the new regime relaxed this directive temporarily. During the climax of the *Apollo* and Skylab triumphs, however, new Soviet headline-seeking exertions led to both public and secret space disasters, the extent of which is still not fully appreciated in the West.

Two top Soviet leaders have spent a quarter of a century in the space business since they helped set up the first Russian rocket factories in the early 1950s (under the camouflage name of "Ministry of Medium Machine Building"). Today they are the party secretary and the defense minister—their names are Leonid Brezhnev and Dmitry Ustinov. Current versions of their biographies extol their contributions to the development of Soviet space exploration and stress their personal enthusiasm. Much of this is undoubtedly an attempt to share in the glory of present space successes, but much of it seems authentic.

Both men are over seventy. Their departure from power will leave a question mark on the future of Soviets in space. Yet their program has enough momentum and depth of support to continue its strong advance following the loss of patronage from Brezhnev and Ustinov.

LAUNCH ITINERARY

With this kind of multilevel support, observers are curious about time schedules for the Soviet space-colonization drive. Moscow does not disclose expected launch dates (to avoid embarrassment from delays and occasional failures), but a broad scope has been well delineated.

Following the 140-day space marathon of two cosmonauts late last year, the *Novosti* news agency released this dispatch: "The Soviet space program foresees the development in the eighties of bigger space stations with a life expectancy of up to five years and between 12 and 24 cosmonauts on board. In the nineties Soviet scientists are already looking forward to space stations with a crew of up to 120. These in fact would be real space factories and research institutes."

Professor Oleg Belotserkovskiy, rector of the Moscow Physical and Technical Institute where many Soviet space workers are trained and where space experiments are designed, joined in the optimistic forecasting: "Trends in the development of contemporary cosmonautics indicate that scientific and production complexes will be built in orbit and that metallurgical, machine-building and chemical plants may be created beyond the limits of the earth soon."

Belotserkovskiy, a member of the USSR Academy of Sciences and a Lenin Prize laureate, described another step in the development of Soviet space capabilities: "The future of space flights depends also on the creation of new rocket engines utilizing nuclear energy." Whether he was describing a program already in progress or merely expressing a personal opinion is difficult to ascertain, a nuclear "space tug" however would be a logical step in the next few years.

Two other famous Soviet space experts, both named Petrov, have optimistic views of the future. Boris Petrov is the head of the Intercosmos Committee which coordinates space research. Georgiy Petrov (no relation) is a more shadowy figure, perhaps the never-identified "chief designer" who actually runs the Soviet space program.

According to Boris Petrov, "humanity's deep penetration into space begins only after space technical facilities and crews have been tested in all respects and for long periods of time in near-Earth orbits." These words are in agreement with numerous other suggestions from Soviet spokesmen that *Salyut* space voyages are precursors of manned expeditions to other planets.

Georgiy Petrov, who writes an annual space review and forecast for Soviet newspapers, predicted that "orbital stations transported to the moon with the help of tugs would be useful. The landing of people for a short while in two or three of the most interesting places on the lunar surface and the performance of the necessary research there will become possible. A permanent station on the moon will give us little in this respect since means of transport on the surface will remain limited for a long while."

INNOVATIVE ENGINEERING

Cynics can be forgiven for suspecting that these pronouncements represent only contrived propagandizing, no different from other equally fanciful forecasts of economic and social advances. But to do so would be to overlook the hard engineering research that the Soviets have been doing for years.

One means of simply comparing the

Soviet and American programs concerns water-purification equipment, crucial machines for recycling water on space stations. At the NASA Johnson Space Center in Houston, engineers are working on what they call "preprototype" equipment (follow-up developments would be "prototypes" leading eventually to the design and construction of actual flight hardware). But the Soviets have been flight testing water-recycling equipment on *Salyut* space-station modules since 1974, and a 50 percent closed-loop system became operational on *Salyut VI* almost two years ago.

As early as 1967, three Russians (physician G. Manovtsev, biologist A. Bozhko, and engineer B. Ulybyshev) stayed for one entire year in a hermetically sealed laboratory. Both mechanical and biological techniques were used to repurify the air in anticipation of using similar methods on long space expeditions. Several years later, additional hermetic chambers were erected in Siberia to investigate other biological techniques. Oxygen was produced from chlorella algae, greenhouses provided wheat and vegetables, stills cleansed the water.

Salyut orbital expeditions in the early 1970s brought along space gardens as part of the aptly named "Oasis" project. Russian flax, cabbage, green onions, peas, and other plants were grown in space so scientists could study long-term plant genetics and germination patterns. Experimental chlorella banks were also on board.

Cosmonauts on these flights remarked on the unexpected psychological value of their green gardens in the sterile blackness of space. Later spacemen conducted experiments involving tadpoles in a small aquarium, which the men tended far more frequently than required, even spending much of their spare time just watching their "nurselings." In postflight debriefings, the cosmonauts stressed the soothing effect of having other living creatures around them.

The present *Salyut* mission is also concentrating on oxygen-producing chlorella food-crop experiments in the "Phyton" greenhouse equipment and mechanical water-recycling systems. These projects have been explicitly designated for long-term space voyages and permanent space settlements. They are clearly not for show.

Another area of vigorous Soviet space research involves the use of spinning spacecraft to induce an artificial "pseudogravity" force (actually it's just inertia). In tests near Moscow, Soviet engineers have lived for weeks in cabins at the ends of long rotating arms, studying the little-appreciated problems of spin-induced vertigo. Already spinning platforms aboard five-ton robot biosatellites have exposed experimental animals to space pseudogravity. (The US has no program along these lines, but the Soviets have allowed the presence of a few American experiments as hitchhikers on the annual Soviet flights.)

Pseudogravity may actually never be needed in space, since Soviet space-medicine experts hope that the human body, with proper conditioning and diet, can spend two or three years or more in "zero gravity" (a misnomer; the accurate term should be "weightlessness") and return safely to Earth. Of course, people who never expect to return to the crushing gravity of Earth would appear to have no problem at all with weightlessness. Indeed, the removal of such "natural" stresses (and Earth's ubiquitous disease bacteria and carcinogens) might add decades to an individual's lifespan—or might not.

TRUE COLONISTS

It is just such a medical development that might lead, within the next decade, to the appearance of the first true "space colonist." By the mid-1980s, the Soviets will have built several permanently inhabited space settlements in orbits around Earth and the moon. Present expectations suggest that the normal duty tour will be one year in length, with longer tours possibly available for volunteers (including couples; a significant proportion of crew members will probably be female).

With such a large population, medical problems are bound to arise. Some patients will be treated in space and returned to duty; others will necessarily be evacuated to Earth; still others, perhaps cardiac cases, perhaps paraplegics, may be stranded in orbit by the hazards of the return flight's stresses or by the dangers of "normal" Earth-surface conditions. The first people committed to spending the rest of their lives in space might therefore be involuntary.

Sizable space populations such as those envisaged by Soviet space officials also imply other unplanned social dynamics: natural and accidental deaths, unexpected pregnancies, crimes of gain, revenge, and passion, and "black markets" in goods, services, and information. Perspectives offered by small expeditions and colonies in the earth's past history offer despair to the "social planners" and hope to the enthusiasts of humanity in space.

The population of these space outposts will gradually shift from a fraction of permanent residents and a vast majority of "short termers" to a culture where the population (now numbering in the hundreds, which introduces the new dynamics of interactions with strangers) is dominated by the presence of people who consider outer space their adopted home. Such settlers, and their children who will be born and raised in space, their deaths and their births, will have gone a long way toward beginning to realize Tsiolkovskiy's dream.

And this will only be fitting, since these space colonists will be Russians. They have nurtured and treasured that dream, and they have moved boldly to realize it, accepting the costs they certainly deserve to harvest its reality. ☐

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SELF-DISCOVERY

CONTINUED FROM PAGE 90

mathlinguists—maybe they could figure them out—but I changed my mind tearing some kind of messy interdepartmental argument. Meaningful information came only from the first printer. "Add such and such reagent to flasks 1, 3, and 7. Lower the voltage by five volts in electrodes 34–123." And so on. The computer remembered to "feed" itself, and therefore it hadn't gone mad. What was going on?

The most painful part was knowing that there was nothing I could do. I had had inexplicable things happen in other experiments, but in those, at least, I could always backtrack and repeat the experiment. If the bad effect disappeared, all the better; if not, we could analyze it. But here there was nothing that could be replayed, nothing that could be turned back. I even dreamed of wavy, snakelike tapes in scaly numeral skins and tried to figure out what the computer was trying to say.

I didn't even know where to hide the rolls of tape. In our institute we use the tape two ways. The ones with answers to new questions are turned in to the archives, and the rest are taken home to be used as toilet paper—very practical. I had enough rolls for every bathroom in Academic Town.

And when one fine day in April (after a sleepless night in the lab, fulfilling every caprice of the computer, pouring, sprinkling, regulating) printer number 3 gave me the sentence "A streptocidal striptease with trembling streptococci," I knew that there was no point in continuing.

I took all the rolls out onto the lawn, ruffled them up (I might have been muttering "Streptocide, huh? Berdichev? Tenderness of the soul? Onions?—I don't remember), and set fire to them. I sat by the bonfire, keeping warm, had a cigarette, and understood that the experiment was a failure. And not because nothing had happened, but because I had gotten a mess. Once for a lark, Valery Ivanov and I welded from all the materials we had on hand a "metal-losemiconducting potpourri" in a vacuum oven. We got a breathtakingly colored ingot, we broke it down for analysis. Each crumb of the ingot showed all the effects of solid body—from tunnel to transistor—and they were all unsteady, unstable, and unreproducible. We threw it in the garbage.

And this was the same thing. The point of scientific solutions is to find what is necessary in the mass of qualities and of effects in an element, in matter, or in a system, and to throw out the chaff. And it hadn't worked here. The computer had not learned to understand my information. I headed to the lab to turn off the current.

And in the hallway my eye fell on a tank—a beautiful vessel made of transparent Teflon, 2 by 1.5 by 1.2 meters. I had acquired it back in December with the idea of using the Teflon for other things, but I hadn't needed it. And the tank gave me a final and completely mad idea. I put all the printers in the hall and put the tank in their place. I brought all the wires from the computer, the ends of the piping, tubing, and hoses, poured out the remains of the reagents, covered the smelly mess with water, and turned to the computer with the following speech.

"Enough numbers! You cannot express the world in binary numbers, understand? And even if it were possible, what point is there to it? Try it another way, in images, in something tangible, damn you!"

I locked the lab and left with a firm determination to get some rest. I hadn't been able to sleep for the entire past week.

Those were a pleasant ten days—calm and soothing. I slept late, charged my batteries, took showers, Lena and I took the motorcycle outside town, went to the movies, took long walks, kissed. "Well, how are our solid-state circuits doing?" she would ask. "They haven't gone soft yet?" I would answer in kind and change the subject. "I have nothing to do with any circuits, or computers, or experiments!" I would remind myself. "I don't want to be hauled away from the lab one day in a very cheery mood, wearing a jacket with inordinately long sleeves."

What kind of aims could a computer have? Or maybe it wasn't an aim but an innate accumulation of instinct that is found in all systems of a certain complexity, be they earthworms or electrical machines?

But something was bothering me. I had run off, abandoned the project. What was going on in there? And what had happened? (I was already thinking of the experiment in the past tense.) It looked as though, through random information, I had started some kind of synthesis in the complex. But what kind of crummy synthesis was it? Synthesis of what?

A man was walking toward me on the paved path. I could see the green trees and white columns of the old institute building behind him. I was headed for the accounting office. Everything was normal in the grounds. The man had a slightly rolling gait, swinging his arms, and he didn't quite limp, but stepped more carefully with his right foot than with his left. I noticed that particularly. The wind made his raincoat flap and ruffled his red hair.

My first thought: *Where have I seen this guy?*

The closer we got to each other, the more I saw of him: his sloping forehead with a widow's peak and steep ridges over the eyes, flat cheeks with a reddish, week-old stubble, haughtily pursed lips, and bored, squinting eyes. No, we had definitely met before. It was impossible to forget an obnoxious face like that. And that jaw—my God!—it should be worn only in the closet.

My second thought: *Should I say hello or walk by indifferently?*

And then everything around me no longer existed. I tripped on the flat pavement and stood stock still. The person coming toward me was *me*.

My third thought (edited): *What the ...*

The man stopped in front of me.

"Hello."

"H-h-hello." A thought sprang up from the chaos that ruled in my brain. "Hey, are you from the film studio?"

"The film studio? I recognize my independence!" My double smiled. "No, Val, the studios aren't planning a movie about us yet. Though now who knows?"

"Listen here. I'm not Val to you, but Valentin Vasilyevich Krivoshein! Some pushy guy like you!"

The man smiled, obviously enjoying my anger. I could tell that he was much more prepared for our meeting and was relishing his upper hand.

"And ... be so kind as to explain who you are, how you come to be on institute grounds, and why you are wearing that makeup and outfit to look like me?"

"Sure," he said. "Valentin Vasilyevich Krivoshein, head of the new systems lab. Here's my pass, if you like." He displayed my worn, used pass. "And I came here from the lab, naturally."

"Ah, so that's it?" It's important not to lose your sense of humor in situations like this. "Very nice to meet you, Valentin Vasilyevich, you say? From the lab? I see ... uh-huh."

And then I realized that I believed him. Not because of the pass, of course. You could fool anyone with a pass. Maybe it was the realization that the scar over my eyebrow and the brown birthmark on my cheek, which I always saw in the mirror on my left, actually were supposed to be on the right side of the face. Or maybe it was something in his behavior that absolutely ruled out the possibility of a practical joke. I was scared. Had I really gone mad during the experiments and run into my split personality? *I hope no one sees us.* I thought. *I wonder, to anyone else, am I here alone or are there two of us?*

"So—from the lab, you say?" I said, trying to catch him up. "Then why are you coming from the old building?"

"I was in accounting. Today's the twenty-second." He took out a roll of five-ruble notes and counted off part of it. "Here's your cut."

I took the money and counted it. "Why only half?" I said.

"Oh, God!" My double sighed expressively. "There are two of us now, you know."

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That exaggerated expressive sigh—I'll never sigh like that. I didn't know you could demean someone with a sigh. And his diction—if you can call the absolute absence of diction diction! Do I really spit out words like that?

I took the money from him, and that means he really exists. I thought. *Or are my senses tricking me? Damn it, I'm a researcher, and I couldn't care less about senses until I know what's going on here!*

"So you maintain that . . . you've come out of a locked and sealed lab?"

"Uh-hum. Definitely from the lab. From the tank."

"From the tank, my oh . . . What do you mean, from the tank?"

"Just that, from the tank. You could have set up some handles. I barely managed to get out."

"Don't try to kid me! You don't think you could really convince me that you were . . . that I was . . . no, that you were made by the computer?"

The double sighed once more in the most insulting manner possible.

"I have the feeling it's going to take you a long time to get used to the idea that this has happened. I should have known. After all, you saw that there was living matter in the flasks."

"Big deal. I've seen mold, too, growing in damp places. But that didn't mean that I was present at the conception of life. All right, let's assume that something living did arise in the flasks. I don't know. I'm no biologist. But what do you have to do with it?"

"What do you mean?" Now it was his turn to get angry. "And what did you think it would create—an earthworm? a horse? an octopus? The computer was collecting and processing information about you. It saw you. It heard, smelled, and observed you. It counted the biowaves of your brain! You were around so much you callused its eyes! There you are. If you have motorcycle parts you can only make a motorcycle, not a vacuum cleaner."

"Hmm. Well, all right. Then where are the shoes, the suit, the pass, and the raincoat from?"

"Dammit, if it can create a person, how hard do you think it is for the computer to grow a raincoat?"

The victorious glint in the eye, the clumsy gestures, the arrogant tone of voice. Am I really that obnoxious when I feel I'm right about something?

"Grow?" I felt the fabric of his coat. A shudder ran through me. A raincoat wasn't like that.

Major things don't fit into the brain immediately, at least not in mine. I remember when I was in school I had to take charge of a delegate to a youth festival, a young hunter from the Siberian tundra. I showed him around Moscow. He stolidly took in the sights: the bronze statues at the Economic Achievement Exhibits, the subway escalators, the heavy traffic. And when he saw the tall building of MSU, he simply said, "With poles and skin you can build a small hut—with rock, a big one." But when we were in the lobby of the Nord Restaurant, where we had stopped off for a bite, he came face to face with a stuffed polar bear with a tray in its paws—and that amazed him!

That was what happened to me. My double's raincoat resembled mine very much, down to the ink spot that I had added one day trying to get my pen to work. But the fabric was more elastic and almost greasy. The buttons were attached to flexible outgrowths, and there were no stitches in the fabric.

"Listen, is it attached to you? Can you take it off?"

My double was driven to a frenzy.

"That does it! It's not necessary to undress me in this cold wind to prove that I'm you! I can explain it without that. The scar over the eye—that's when you fell down when your father was teaching you to ride a horse. The torn ligament in the right knee happened during the soccer finals in high school. What else do I have to remind you of? How you used to secretly believe in God as a child? How as a freshman you used to boast that you had known many women, when actually you lost your virginity in Taganrog just before graduation?

"It was impossible to forget a face like that. And that jaw, my God, it should be worn only in a closet. And then I tripped and stood stock still. The person coming toward me was me."

That son of a bitch! The examples he picked!

"Well . . . yes. That's me. But you know, if you're me, I'm not so crazy about me."

"Neither am I," he grunted. "I thought I had some smarts . . ." His face tensed. "Shhhh. . . don't turn around!"

Footsteps behind me.

"Good day, Valentin Vasilyevich," said Harry Hilobok, assistant professor, sciences candidate, scientific secretary, and institute busybody.

I didn't get a chance to open my mouth. My double grinned at Hilobok and his pretty companion and said sociably, "Good day to you, Harry Hantonovich!"

The couple walked past us in the light of his smile. Hilobok's plump brunette clicked her heels merrily on the pavement and, after she had passed, Valentin aped her mincing afong as though he were wearing a tight skirt.

"Perhaps I didn't quite understand you, Lyudochka," Hilobok was buzzing in his baritone, "but I, from the point of view of not understanding completely, am only expressing my opinion."

"Harry has a new one," my double announced. "You see, even Hilobok accepts me, and you have doubts. Let's go home!"

The only explanation I can think of for following him so quietly to Academic Town was that I was completely flabbergasted.

In the apartment, he headed straight for the bathroom. I heard the shower running, and then he stuck out his head.

"Hey, sample number one, or whatever your name is. If you want to make sure that I'm all in order, come on in. And you can soap my back while you're at it."

So I did. It was a living person. And he had my body. By the way, I didn't expect such thick folds of fat on my stomach and sides. I have to work out with my barbells more often.

While he washed, I paced the room, smoked, and tried to accustom myself to the fact that a computer had created a man. A computer had recreated me. Oh, nature, is this really possible? The ridiculous medieval ideas about a homunculus. Wiener's idea that the information in a man could be decoded into impulses, transmitted over any distance, and reordered into a man again, in the form of an image on a screen. Ashby's assertion that there was no major difference between the work of the brain and of a computer. (but, of course, Sechenov had maintained that earlier too). . . all that had just been clever talk to keep the brain going. Try to do something practical with those ideas!

And now it looked as if it had been done! There, on the other side of the door, splashing and snorting, was no Ivanov, Petrov, or Sidorov—I would have tossed them out on their ear—but *me*. And those rolls with the numbers? I had burned the "paper" me.

I was trying to extract short, usable truths from the combinations of numbers, but the computer went deeper than that. It stored information, combining it this way and that, compared it through feedback, picked and chose what was necessary and at some level of complexity "discovered" life!

And then the computer developed it to the level of man. But why? I wasn't trying to do that!

Now as I think about it calmly, I can figure it out. It did exactly what I was trying to do. I wanted a machine that could understand man, and that's all. "Do you understand me?" "Oh, yes!" answers the listener, and both go about their business, happy with each other. In conversation it's much easier. But in experiments with computers I shouldn't have confused understanding with agreement. That's why (better late than never) it's important to figure out what understanding is. ∞

LOCH NESS

CONTINUED FROM PAGE 95

calibrated measure of size. It is difficult enough to fake anything underwater but at a depth of several hundred meters in the middle of the loch it is almost impossible. Unfortunately sonar charts are as meaningless to most people as space telemetry is, and they have received little attention.

When all this evidence is taken into account, it is difficult for an objective person to deny the existence of something, call it a phenomenon, in Loch Ness. Everything points to its being a group of large previously unidentified animals. But there is no evidence whether they are mollusks, long-necked seals, reptiles, giant eels, or any of the other theoretical contenders. The most likely explanation, simply because by contrast with the others there is no evidence *against* it, is that they are plesiosaurs, descendants of the swimming dinosaurs that somehow survived from the Cretaceous Period and were trapped in the loch when it was cut off from the sea about 8,000 years ago. It is easy to theorize, but obtaining unassailable proof in the form of a specimen or a skeleton is another matter. The loch is deep, and there are hundreds of meters of silt on the bottom to swallow up its dead.

The problem of proof has haunted Bob Rines, now in his sixth year at the loch, and Tim Dinsdale, the veteran monster-hunter who now rides shotgun for the AAS expeditions. They represent different sides of the Loch Ness story. Dinsdale is an ebullient Englishman who oganized the mass surface watches in the 1960s and still spends months at a time in solitary vigils aboard his small boat, the *Water Horse*, committed to the million-to-one chance of a close-up sighting. Rines is a quiet-spoken but determined American whose technology has changed the whole nature of the search.

"You can't make do with long-range film anymore," Dinsdale admits. "But any really clear movie or time-lapse underwater photography would do it. Either of us could do it in ten seconds or less."

He paused and then added revealingly, "No one has done it yet—that's what makes it so exciting. It's a kind of zoological Everest. I mean, once Everest was climbed other people did it, but you don't know who they are."

Both men share a sense of urgency about the search, mainly because of increasing pollution in the loch.

"What worries me," said Rines, "is that these things may be on the way out. Zoologists believe there would have to be eighteen or twenty creatures to keep a colony going, but who the hell says they are procreating? This might be a dying colony."

Ironically, the publicity given to Rines's photographs has only increased the tourist pressure on the area and the traffic along the north-shore road. You feel an irresistible compulsion to scan the loch as you pass the few brief gaps in the trees, and, like some grim human sacrifice to the monsters, the road has become a continuous-accident black spot from Fort Augustus to Lochend.

THE THINK TANK

Dr. Robert Rines is fifty-six, an MIT graduate who helped to develop radar in World War II and later took over his father's law firm to become one of America's leading patent attorneys. Patenting his own and other people's inventions kept him at the forefront of technology and led to his founding the Academy of Applied Science in 1962. The AAS, which now has some 300 members, aims primarily to benefit private inventors and small technical firms. It also sponsors educational programs and, almost as a sideline, supports research into phenomena that established academics shy away from, such as California's Bigfoot and the Loch Ness monster.

Rines discovered that assembling specialist teams around such unusual problems produced a "think tank" atmosphere which is about as close to pure research as technology can get. Free of the usual academic or industrial pressures, the team can aspire to flexible goals and open-ended solutions.

When he first took an interest in Loch Ness, Rines began by redefining the problem. He was convinced from the outset that surface sightings were too rare and random to be studied and that the best way to obtain evidence was by underwater photography—in the creatures' own environment.

It was a daunting task and meant starting from scratch. No one had done it before because the loch is nearly 300 meters deep, pitch dark, and very cold. But Rines discovered that the water had some strange and potentially useful characteristics.

Sound, for instance, is transmitted over great distances in the layers beneath the thermocline. The water is also remarkably transparent to sonar and to certain radio frequencies, a property attributed to the high concentration of magnesium salts, although the curious geography of the loch, like a long funnel only two kilometers wide, may have something to do with it.

Unfortunately, the water is almost opaque to light. The lake is fed by hundreds of streams draining from the peat bogs in the mountains above, and they have stained it a dark sepia. This is not suspended sediment, which sinks like everything else into the bottomless sump of the Great Glen, but a type of suspended molecular dye that makes photography difficult and diving in the loch so hazardous that it is used as an initiation test among Scottish scuba clubs. On the surface, the water reflects a gray blue sky, but underneath it is the color of 14-year-old scotch.

Rines acknowledged the difficulties accepted the challenge and set about picking his team. The inventors and scientists who joined him and who have come back year after year were a catalog of hi-tech talent.

Presiding over them from the beginning like an irreverent guru was Dr. Harold "Doc" Edgerton, seventy-four year old professor emeritus at MIT, inventor of strobe-light photography and much else, cofounder of the EG&G Corporation and known to viewers of Cousteau's films as "Papa Flash." His strobes—xenon-filled discharge tubes that punch out more light in a fraction of a second than any conventional source—and sonar were to be the main weapons in the assault on the loch.

Since they needed side-scan "imaging" sonar as well as conventional echo sounders, Rines recruited Marty Klein, who had invented the technique while working for Edgerton at EG&G.

John Lothrop, the Polaroid engineer who helped pioneer instant photography with Dr. Edmund Land, joined the team to take charge of the cameras. He designed the expedition's main 16mm stop-frame camera unit and experimented with a variety of other rigs. In 1976 he designed and built the first "monster pots." These were self-contained, battery-powered sonar-strobe camera units intended to be moored at different points around the loch to photograph anything of suitable size that came within range.

Duane Marshall of Megapulse Inc. designed the electronics. Ike Blonder of Blonder-Tongue provided the hydrophone equipment, and Charlie Wyckoff of Applied Photo Sciences Inc., whose previous credits include the first H-bomb test and the NASA moon shot, added his expertise on films and emulsions. Turning his attention from problems of too much light to an environment where there was almost none at all, he went in search of faster and faster films. This year he was trying out a new process he had devised for forcing the development speed of stock 16mm film from 400 ASA to an astonishing 25,000 ASA.

The "studio" constructed under the raft in Urquhart Bay represented years of development and combined all the team's resources. It incorporated many of their inventions, including the computer "gate" that measured the size of anything in the sonar beam. It ignored smaller inhabitants of the loch like eels and salmon but triggered the equipment when a larger (potentially monstrous) target appeared.

The monster pots, their individual sonars silenced, were grouped around the main rig as backup cameras. In the past the creatures produced blurred close-ups by almost climbing down the camera lens. This time, if they paid a return visit, there would be no doubt about it. There would be four times as many cameras and five times more light than had ever been concentrated in one place in the loch before.

The formidable team at work on the raft was only part of the 30-strong expedition. Marty Klein's sonar group were back to continue their side-scan survey of the loch. Two years previously they had discovered some mysterious craterlike stone circles in the shallow water off Lochend, and a group of archaeologists and divers including Dr. Ian Morrison and Dr. Eleanor Ott of Goddard College had joined to investigate them.

Bob Rines particularly welcomed Morrison. Not only was his diving experience useful in testing the raft; he was the first British academic to join the expedition and his special interest in geomorphology might help establish just when the loch had last been open to the sea.

"It's interdisciplinary," said Rines enthusiastically. "We're learning about geology and archaeology and teaching them about electronics. It's a wonderful learning experience."

Bob Rines, his wife Carol and his young son Justice were staying at Tychat Cot-

> *"Sonar traces are the most convincing proof of all because they include such parameters as speed, depth, and size. It's difficult to fake anything in the loch, but at a depth of 100 meters, it's almost impossible."*

fage, high on the hillside above Urquhart Bay. The panoramic view is useful as well as spectacular, since Rines has not entirely given up surface-watching, and there was a powerful Questar telescope-camera mounted in the living-room window. The garage beside the house was the team's unofficial headquarters as well as workshop, laboratory, and storehouse for the crates of equipment flown out from the States. There was a constant traffic up and down the hill as the gear was ferried from Tychat to Temple Pier and out to the raft.

CONVERSATIONS ON A RAFT

The short trip out in the expedition's rowboat revealed a cat's cradle of ropes and wires, with ominous notices warning of high-voltage equipment. The slippery plywood deck was cluttered with strobe reflectors, cases, cables, tools and people. There was no guardrail, no protection against the wind, and, as always on the loch, we could never quite forget the yawning depth underneath us. Although we were only a stone's throw from the shore, the bottom was already 36 meters and shelving steeply.

Charlie Wyckoff and Bob Needleman, the portly vice-president of the AAS, were winching up the main rig.

"That's Old Faithful," explained Needleman. "The lights and camera we started with and which got the pictures in '72 and '75."

Since something about the rig had apparently attracted the creatures—their curiosity was so great that they had knocked it about on both occasions—it had been retained intact, including its low-powered strobe. Like the sonar, it was left running continuously.

"We call it the 'lure light,'" said Charlie, "although we have no idea whether it works. It's unlikely to be the light itself that attracts them—the water's too black. But they may hear the clicking noise of the strobe discharging, or it may be the electromagnetic field it generates. After all, a shark can sense the magnetic field of a flashlight battery at 1,500 meters underwater."

"We tested it in an aquarium in Boston," said John Lothrop. "The sharks and turtles hardly bothered, but the little fish came and circled around it all the time it was in the water."

Lothrop was disemboweling one of his monster pots. The contents were so tightly packed that the Nikon F2 cameras with their bulky motorized cassettes could only be fitted in with their viewfinders removed. Once in place, they glared out through their thick glass portholes like malevolent eyes.

Adjusting each element in the complex array had taken longer than expected, and work had kept up from early morning till late in the light subarctic evenings. A whole day was wasted tracking down a fault in the power system. Then the strobes began acting up because the water pressure at nine meters made them leak. And when that was licked, the discharge tubes started burning out.

"Because they are sealed in, they get very hot," Wyckoff explained. "The strobes flash every three seconds, which is the best we can do without a cooling system. Any more and they'd melt. Even so, we are in trouble after twenty or thirty flashes, but that's more than a minute, and our friend is unlikely to be in the field of view much longer."

Neither "our friend" nor "Nessie" seemed quite the right epithet for the black blurs on the sonar charts; there was so much data about the creatures and so little information. What about 'unidentified swimming objects' as in UFOs?

"Objects don't swim," objected Lothrop. "USAs," said Needleman thoughtfully, taking the pipe out of his mouth. "That's what they are. Unidentified swimming animals."

THROUGH THE RED WINDOW

On a wet afternoon a few days later, when work on the raft was suspended and a steady drizzle had moored us in the Tychat workshop, we persuaded Charlie Wyckoff to tell us more about his techniques. How

did a photographer approach this most difficult of film assignments?

Do you know what I mean by optical density? he asked and we nodded encouragingly "A neutral density filter is equally dense or clear across the spectrum An ND-1 filter lets through ten to the power of one of the available light An ND 2 is ten to the second power But the Loch Ness water over a path of one hundred feet has a density in blue light of 1 in 10^{55} That means that only one part in ten to the fifty-fifth power gets through! That's what you call dense

"That's in the blue light he continued "At the red end of the spectrum where the infrared begins the density drops right down to 1 in 10^4 So that is where we are operating I don't know where the density begins to rise again but it's not much farther along the spectrum, since water doesn't transmit infrared in the longer wavelengths

He explained that all the photographic efforts were aimed at this narrow "red window" in the loch water Even the type of light emitted by the strobes had been turned to advantage Strobes normally operate at 2,000 to 10 000 volts and put out a distinctly bluish light; those under the raft used about 450 volts which shifted the peak foward the red

He then turned to the question of films The main rig camera was loaded with VNX, a 16mm color-reversal stock developed by Kodak for television It was nominally rated at 400 ASA but was designed to be force-developed to about 8 000 ASA. This was very fast for color film but the process Wyckoff had invented allowed him to push it a lot further

"Like all reversal film VNX is designed to produce a positive image But if you force-process a reversal film you have very short latitude Everything is lightening up and in the long run you don't have enough density" he explained His own process on the other hand developed the film as a negative "That way I can really force it

"Unfortunately, the result is a black-and-white rather than a color negative So now I put it in the bleach which converts the silver to a silver complex that is soluble Then I put it into a color developer and let it go to completion The color developer reduces the silver halide back to metallic silver but it forms a color at the same time Then I put it in the bleach and fixer and I end up with a color image which is negative So finally I print it onto color-print film And in doing all this I'm able to get about 25 000 ASA instead of 400 ASA By using the same process to soup up the film in the monster pots, Wyckoff pushed it from 200 ASA to 8 000 ASA

We asked him how accurate the color was

"I'm compromising of course" he admitted "It's not as good as it could be But we're not looking for true color out here We're looking for color discrimination

Wyckoff like other members of the expedition seemed in no doubt of the seriousness of his work

It isn't just directed at Loch Ness he said Its uniqueness is not because it's here Now that we've developed these techniques they can be used elsewhere

Where did he get his ideas for these processes?

"Ideas are my business" he said

LOCHEND AND BACK

Local people looked knowingly at the sky and said that the rain would close in for days The weather here came in packages with the weekly depressions that ride in from the Atlantic but this one folded half-heartedly and to everyone's relief work was soon resumed on the raft

The expedition's boats commuted back and forth to Lochend where Ian Morrison and diving director John Mills were spending numbing hours making an underwater photomosaic of the stone circles From the samples Morrison had brought up he was now convinced that they were not prehistoric artifacts but more likely the remains of spoil dumped during the nineteenth-century construction of the Caledonian Canal which joins the loch to the sea at either end

The diving and sonar teams were based at the small Victorian lighthouse that marks the entrance to the canal and the lawns around it were littered with air bottles compressors and suction hoses

Every morning the Klein team set out from the small stone jetty in their boat an ex-naval cutter borrowed from the monastery school at Fort Augustus towing the heavy torpedolike sonar fish behind them Apart from the stone circles their side-scan equipment had already made some remarkable discoveries about the loch including deep trenches in the bottom and overhangs along the precipitous south shore that might conceal caves not to mention the wreck of an airplane that crashed during World War II This year they were continuing their survey and making cross-sectional profiles of the loch

Back in Urquhart Bay the raft was nearing completion The shore monitor on Temple Pier showed that the electronics were working the cameras being loaded and the final checks carried out Ike Blonder was adjusting his hydrophone equipment

"This is the sound of Loch Ness" he said turning up the volume on his Aiwa reel-to-reel recorder Above the cacophony of static and splashing he added dryly "That's my contribution"

His note of frustration was understandable As head of Blonder-Tongue, one of the leading manufacturers of hydrophones with large US Navy contracts he had been dunking his sophisticated gear in the loch for several years now without results He had even developed an ingenious playback device on the theory that any animal even a monster would respond to territorial imperative and zero in on the sound of its own voice But without knowing what he was looking for, he found nothing to

record. The "voice" was an intangible.

"You know what I'd do?" he said to us. "I'd put a net across there, catch me a monster and take it on tour. Think of the business it would do in London."

We reminded him of what happened to King Kong.

"Never mind that," he replied. "It would solve your national debt."

This year he had brought along a US Navy recording used to train sonar operators that contained a whole vocabulary of marine noises from the knocking of cuttlefish to the fluting of whales. Once again there had been no response.

What none of us then knew was that the voice of the monster was about to be recorded for the first time, and in a most unusual way.

CONTACT

It was at the back of everyone's mind, of course. We joked about it and finally resigned ourselves to the improbability of its happening. And then it did. In the middle of the work program, news flashed through the expedition that the sonar group had made contact with one of the creatures, and it was to prove the most significant contact yet.

On the afternoon of July 21, the sonar boat was traveling south from Lochend toward Urquhart Bay. The depth of the loch was about 194 meters, and the sonar fish was being towed behind the boat at a depth of 33 meters. Tom Cummings and Gary Koszak, Marty Klein's two associates, were monitoring the side-scan's printout when a strong target suddenly registered on the chart.

It was a dark blip, followed by a narrow V-shaped wake indicative of movement, and to their surprise there was also a thin line emerging at right angles on either side of the blip's leading edge. To an experienced sonar operator like Cummings, this could only mean that the contact was itself emitting a noise. The side-scan continued to track the target for three minutes before they lost it, and Cummings and Koszak hastily ran through a series of checks to ensure that it was not ghosting or a machine malfunction. There was no question that it was real.

They immediately turned for shore and were soon being eagerly interrogated on Temple Pier. How big was it? Was there a definite wake? Were there any boats nearby?

"There were no boats in the immediate vicinity," said Cummings. "The closest was almost out of sight, and the contact was only about a hundred and ten meters away. It's impossible to tell whether it was directly below. If it was, it would have been about seventy-five meters from the bottom, but it was certainly within a one hundred ten-meter radius of the fish. It's almost identical to a surface target one gets when passing a powerboat with a high-speed screw causing a disturbance in the water."

"Can you think of any rational explanation?" asked Tim Dinsdale. "Anything that would explain it?"

"Yes, a submarine would."

"Well, I can tell you that there isn't a submarine in the loch at the moment," Dinsdale said emphatically. "It would have to come through the Caledonian Canal, and all transits of that kind are logged. But I'll check, so that we can be one hundred percent positive."

What about a minisub? Cummings persisted, something that could have been brought in on a trailer?

"You'd have to get permission for something like that," Dinsdale replied. "It's a navigation channel. Apart from small fishing boats you have to get permission to put anything in or on the loch."

He later checked with the authorities, and they confirmed that there were no submarines in the loch.

Bob Rines was as excited as the rest of the team. It was the complete answer to the skeptics who had dismissed previous sonar contacts as submerged logs or lumps of algae.

> *"Monster pots, their individual sonars silenced, were grouped around the main rig as backup cameras. In the past, the creatures produced blurred close-ups by almost climbing down the camera lens."*

"There are no logs that deep," he said in the tone of a wronged man proven very much right. "Logs don't make wakes, and logs don't give out noises. And algae don't make noises either, so in one go we have answered all the questions raised in the past."

"The sound emitted by the target is of enormous significance. The nature of it and the duration indicate that it has nothing to do with the animal's means of propulsion. It looks to me like all of a sudden this thing became conscious that it was being irradiated with sound energy and made a noise in response."

Analysis showed that the sound registered most strongly at a frequency of 50 000 to 100 000 cycles per second (cps), which is well within the range of sounds made by creatures like whales and porpoises. Echo-location systems used by most marine animals employ a double-pulse system that allows them to analyze the phase difference in the echo so that they can detect the size and position of objects or prey.

Unfortunately, the slow-moving line on the sonar chart gave no indication of the type of pulse and, with typical bad luck, Blonder had switched off his hydrophone only half an hour before. But his tape machine was limited to a maximum frequency of 15 000 cps anyway, so it would not have picked it up.

FUTURES

The raft was finished, the trap set, and the safety catch off. The main aim of this year's expedition had been achieved.

"We've never had better equipment," said Charlie. "All we need now is a little help from, you know, Nature."

There were plans to be laid for next year, figuring out improvements to the gear, looking for some angle that might have been missed or a useful new technique.

"We're developing technology that's never been used before," said Rines. "For instance, Alan Gillespie at the Jet Propulsion Lab in Pasadena is an AAS member and he had them analyze the '75 picture which we think is a head and neck. They ran it through a computer that's able to do an almost X-raylike study to see whether it was wood or algae or an artifact. The computer makes assumptions about different densities and strips them away layer by layer. It showed up every time as tissue on a skull-like structure with this bony crest."

Sonar technology is rapidly coming of age, and Marty Klein is keen to try out his new imaging sonar, which produces almost photographic pictures. Rines, on the other hand, is more interested in developing the cross-beam sonar first tried in 1976. If the transducers could produce a narrow and powerful enough beam, it might be possible to set up a sound screen across the mouth of Urquhart Bay to monitor and record anything going in or out.

"Then there's the loch itself," Rines added. "There's a lot more we want to know about the topography and origins of the area."

There are certainly enough mysteries. The tenuous ecology of the lake still hasn't been worked out, for instance. The expedition divers have already discovered a new species of deep-shoaling fish in the loch, and there may be others. Are there really caves along the south shore? And what about the dramatic fissures in the deepest part of the lake?

"Maybe there are just rocks down there," said Rines. "Or maybe there are bodies of water on bodies of water. Maybe there's an opening to the sea. Who knows?"

Talk of next season made it easier to wind down the expedition. The team began leaving one by one. There were charts, tapes, and samples to be stored for analysis back home. There were boats to be laid up and good-byes to be said—except that no one believed they were good-byes. As long as there is the slightest doubt about the existence of the Loch Ness monster, the patent attorney and his space-age crew will be back next year in Urquhart Bay. ∞

MIND FOOD

CONTINUED FROM PAGE 57

gence booster made in Europe. A chemical analogue of the neurotransmitter gamma-aminobutyric acid, it seems to promote the flow of information between the right and left hemispheres of the brain, at least in rats and mice. In man, communication between the sides of the brain seems to cause flashes of creativity. Though Nootropyl's toxicity is very low, it is unlikely that the FDA will ever allow this remarkable drug into the United States. Improved hemispheric communication just isn't the sort of cause they are prepared to deal with!

Many of the experiments with intelligence promoters in animals have been performed with strychnine, which produces clear improvements in maze learning and in visual and spatial discrimination in rats. Strychnine is extremely toxic, however. Doses large enough to produce significant benefits carry with them a high danger of convulsions and even death. Two human-dosage forms of strychnine were sold about ten years ago. These drugs are no longer offered. Strychnine currently has no medical value: the recommended doses are too small for measurable effect, and large doses are very dangerous.

Most intelligence research has been done on memorization or computation, not on creative processes. One reason may be that there is little demand for creative people in government and industry, where drones are less likely to rock the boat.

IQ tests are concerned with memorization and computation rather than with creativity. It is possible to have a very high IQ and never think a novel thought. Some psychologists have reported that creative thinking is associated with so-called theta rhythms, a type of electrical activity in the brain. In rats, very low doses of strychnine and Metrazol promote theta activity. It has recently been reported that vasopressin also has this effect. In man, biofeedback can be used to increase theta rhythms, often resulting in novel, often dreamlike thought patterns. Vasopressin and LSD increase theta in humans.

People have said that they are more creative under the influence of such drugs as marijuana, LSD, vasopressin, and the substituted phenethylamines, a group of chemicals related to amphetamine. So far, there is little evidence to support these claims, though it has been confirmed that LSD and vasopressin increase visualization and imagination, which are both parts of creativity. In one very interesting study, Dr. Alexander Shulgin, a chemist renowned among pharmaceutical experimenters for his ability to design intriguing new drugs, found that DOET, a substituted phenethylamine, dramatically increased creativity in people who already displayed it but that it did not for uncreative people. These drugs are not available, and the FDA cannot approve them under today's rules.

If you want to try the prescription drugs we've described, there are several ways to improve your chances. A doctor who is newly in practice is more likely to give you a prescription than an old-line physician is, and may know more about experimental drugs. Buy a copy of the *Physician's Desk Reference*, a handbook that will tell you when to avoid a given drug and what side effects to expect. Ask your doctor to test your kidneys, liver, and basic metabolic functions before trying any new drug, and repeat these tests at least once a year. It will reassure your doctor that you are responsible enough to use the drugs and could prevent serious side effects.

Do not expect any doctor to be an expert on intelligence boosters. Physicians are not research scientists and seldom have the time to follow experimental reports. They find out about new drugs from the manufacturers, and drug companies are forbidden to give physicians research papers about uses the FDA has not approved, even when the doctor asks for them. We know one physician who wanted to learn about Hydergine research. It took him three months of writing letters and making phone calls just to get the forms he needed to ask the FDA's permission to receive 'unauthorized' research reports from the manufacturer. Fortunately, we are research scientists rather than physicians and had no trouble obtaining the literature. It seems strange that the FDA prevents the people who prescribe drugs from getting the information they need to make decisions.

We hope that this roadblock in the path to more powerful intellects will soon be eliminated. Data slowly filtering out of pharmaceutical laboratories have made it clear that current FDA regulations are blocking the development of valuable new drugs in many fields of research. A growing number of senators and congressmen are backing legislation that would make it possible to introduce new drugs as soon as they prove to be safe, instead of waiting to satisfy the FDA's criteria for effectiveness. This is a step in the right direction.

Listed below are some of the medical reports on which this article is based. They are available at medical schools and at many university libraries. If you decide to join the search for greater brainpower, these reports are a good place to begin. In reading them please remember that "intelligence" is a complex system of data-processing abilities and that the tests used in these papers measure only a few of them. Researchers often disagree over the effect of drugs on intelligence because they are testing different abilities or because the dosages of some drugs must be carefully tailored to each patient to achieve their desired effects. ∞

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[Other references are available from OMNI]

COMMUNICATIONS

CONTINUED FROM PAGE 10

Family Portrait

Thank you so much for the heartwarming photo of Isaac Asimov holding his little grandson Harlan [February 1979]

Sunn Hayward
Huntsville Ala

Asteroid Mining

Patrick Moore's "Shoals of Space" in the February Stars poses the question that asteroids might be a rewarding place to look for metals to mine in the not-too-distant future. Asteroids also might furnish cosmologists with clues to the origin of the solar system and the origin of life on Earth.

It would be an outright waste if NASA sent a probe in 1985 toward two comets (Halley's and Tempel II) without flying by a couple of asteroids. A comet-asteroid mission would save the need for a new probe, saving funds NASA does not have.

Richard Nadeau
Lisbon Falls Maine

Messiahs From Space

I read with great interest Frank Kendig's First Word in the January *Omni*. And I laughed and empathized about "people to come from another planet and make me their pet."

I too hope for intelligent life beyond Earth. But the real question is: Why are the masses searching for something to deliver them from an increasingly confused world? Perhaps I've answered my own question. Could not all of this UFO business actually come down to a basic need for spiritual security? Human beings seem to need the guidance of a spiritual "supreme force" to solve their problems. Thus UFOs?

Jim Seigel
San Jose Calif.

Foxy Saucers

If I were piloting a UFO and I wanted to take a look around the earth, I would just wait until Venus was rising or make sure that there was a meteor falling or a balloon or something in the area.

David L. Travis
Clovis N. M.

Jim Oberg replies: *or paint a beer ad on your saucer's bottom!*

Stupid Extraterrestrials?

My compliments to *Omni* and to James Oberg for your willingness to discuss differing views and alternative interpretations of so-called outstanding UFO incidents.

In his January review of the Coyne helicopter/UFO case, Mr. Oberg identified me as a member of MUFON [the Mutual UFO Network]. Allow me to correct that statement lest MUFON's reputation become tarnished by my espousal of ideas contrary to UFO dogma. My association with MUFON ended when that organization refused to consider any interpretation of the Coyne incident other than that proposed by its investigator, Jennie Zeidman.

Those who believe that Ms. Zeidman's interpretation of that event is the most plausible ought to contemplate the following question. Which is more likely?

(1) That the "UFO" was an extraterrestrial spaceship whose occupants were so dumb as not to realize that they were about to collide with a primitive man-made helicopter or if they did recognize that possibility were still stupid enough not to change course or even extinguish their lights to avoid being spotted?

(2) That the "UFO" was a fireball meteor and that having never before seen such a spectacular sight, the helicopter crew's eyewitness account was not entirely accurate?

I agree with Jennie Zeidman that some people are being "suckered," but I disagree on *who* is doing the suckering. I nominate as likely candidates: (1) UFO "researchers" who argue that UFO sightings are due to anything and everything imaginable *except* human error and perversity and (2) UFO rumormongers who allege that UFO data and cadavers of alien creatures are being concealed by the U.S. government without ever producing evidence to support such allegations.

David A. Schroth
St. Louis Mo.

"What do you say we knock off early and go look for stimuli?"

Loch Ness Dolphin

Why not utilize freshwater dolphins fitted with strobe photo equipment to locate the creature in Loch Ness? Here mobility is much greater since dolphins can be trained to actually search the loch and attempt photography. The benefits over manned submarines and stationary equipment would increase tenfold. Instead of waiting for the creature to come out of hiding, the dolphins would go in and expose it.

B. Goldman
Forest Hills N.Y.

Solar Solution

About a year ago I and 80 other eleven- to thirteen-year-olds gathered together for an energy convocation. We split up into groups. Our object was to find a cheaper and better means of energy.

Many of the solutions involved nuclear and solar energy. I would like to present the most developed solution, the one my group developed: the solar-energy-collection and conversion center.

The center uses two mirrors (one of which is parabolic). The sun's rays are reflected from the mirrors and relayed to solar cells. This in turn is transferred to a computerized substation. Finally from the substation, the power is transmitted to the houses through wires. I feel this is a very developed idea.

Michael Appelstein
Spotswood N.J.

Solar Power: Think Big

Solar power is the answer to our energy problems, but Helen Drusine [January 1979] has gotten the wrong answer. Going solar because it will create jobs makes as much sense as outlawing bulldozers and power shovels. You could save fuel and create pick-and-shovel jobs that way but it would destroy the economy and incapacitate the country.

What is the right solar answer? Solar-power satellites that would be developed by the "aerospace mentality" that Ms. Drusine speaks of so disparagingly. A solar-power satellite program would advance technological skills and scientific knowledge not just create pick-and-shovel jobs. It would provide reliable power to our power grids 24 hours a day, so that we could build fewer power plants on Earth. It would open up the moon's store of natural resources, so that our economy could grow.

Clifton McCarthy
Billerica, Mass.

Golden Garbage

"Solar Politics," by Helen Drusine [January 1979] was excellent and informative as to why our sun is being eclipsed by the political shadow of nuclear energy.

Who can relate the reasons for not using the ubiquitous garbage now stinking in landfills, polluting the water, etc., for energy? Is the politician's sense of smell as deficient as his vision?

There are some few towns that do utilize wastes most effectively. I see no reason why one of our most plentiful potential energy sources—garbage—is not being considered along with the Big Two—nuclear and solar. Maybe because garbage has not yet been considered a source of the other Big Two—Money and Political Power.

Virginia S. Ballard
Scotch Plains, N.J.

Deadly Meteors

While enjoying my February issue of *Omni*, I noticed an apparent error in your Space section. Your article stated that "there have been no authenticated human fatalities due to meteorites."

I would like to call your attention to the circumstances concerning the death of Leondas Grover, a Fountain County, Indiana, farmer.

A meteor had struck and killed Grover passing through his body, his bed, and the floor beneath his bed.

The following statement appeared the next day in the *Lafayette Daily Courier* after the authorities' examination of the scene:

"The mangled body of Grover lay on a bloodstained bed. Directly over the chest of the man was a ragged hole in the roof and the ceiling. The body was torn through as if hit by a cannonball."

David C. Smith
Indianapolis, Ind.

NASA Funds

In your March 1979 issue, you made an appeal to your readers to tell our government officials that we wish more money to be allocated to our space program. Well, if you would be so kind as to print my letter, I would like to make my own personal appeal to *Omni* readers and ask them to band together and flood Congress and the president with letters demanding that NASA be given a reasonable budget, instead of the petty cash it receives in relation to other government agencies.

Joseph Baroody
Bath, N.Y. ∞

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FORUM

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based on two unproven assumptions: the first, that there are complex behaviors common to all people that constitute an ontogenetic "human nature", and second, that differences between groups or individuals are reflections of heritable biological differences.

There is nothing in genetics to support the concept of a preferred or most "natural" state of a genotype. The concept of 'predisposition' is a misrepresentation of what is known about gene action. Different environments give rise to different genotypes with varying fitnesses. There is no particular "best" or most "natural" genotype over all environments. The overwhelming evidence is that a genotype that does well in one environment tends to be mediocre in others and that there is not necessarily consistency in the way different genotypes react in different environments.

For example, one genotype may be large in environment A and small in environment B. Furthermore, in the absence of knowledge of a "norm of reaction," it is impossible to determine how the differences of groups are reflections of genetic differences.

In order to portray social behaviors as the results of natural selection, sociobiology assumes that there are genes for behaviors like altruism, spite, genocide, xenophobia, indoctrinability, religion (the list is long).

The fact is, there is no evidence presented by Wilson or others to support this assertion. Sociobiologists are undertaking a plan of biological determinism that is comparable to the social Darwinism of Herbert Spencer. They represent the roles of women, the modes of aggressiveness, religious beliefs, and many other cultural manifestations, as the results of natural selection. Sociobiology is not a science but a political view of human institutions.

Thomas Davies
Yale University
New Haven, Conn.

In Favor of Sex

Permit me to comment on Continuum's report on "Dangerous Sex" [February 1979] and the absurd contention that "the industry of two individuals working to accomplish what one asexually reproducing animal could achieve on its own is a questionable tack for evolution to have taken."

Evolution takes no tacks. If individual diversity and functional specialization had not been particularly advantageous in the vertebrate biosphere, we brainy animals would likely be ingesting Big Macs through osmosis. Sexuality has proved its worth to complex organisms for thousands of centuries because the real world, far from permitting the individual the leisure to waste all of its energies in reproduction, requires diverse methods of food gathering and a good mix of other activities that preclude the survival of homogeneous creatures. Asexual individuals must be capable of bearing the burdens of survival for their entire species. That they can do so only in certain favorable environments is exactly the point.

Professor Daley must be assured, however, that humanity will soon have the opportunity to sustain his speculations. If asexual cloning proves appealing and has a greater survival value than "risky encounters" on the savannah or four-poster, then he may be certain that ovaries, testes, mammary glands, and other hideously inefficient trappings of sex will become vestigial within 50 generations. It is comforting to know that the human "mules" of that liberated future will be able to avoid "anxiety and effort" as they slither into a communal nutrient bath to replicate.

Hal Kogel
Syracuse, N.Y.

Farg-Putonsky Correction

Just a note to let you know how much I enjoyed "PSI Burn" [December 1978]. On rereading it, however, I discovered that the statistical techniques used to assess your remote-viewing results are far from the most powerful that you could have applied. I have therefore computed the Farg-Putonsky Correction for Nonsignificance. You will be happy to know that the results are now highly significant: $P = 10^{-1024}$ (1-tailed).

In case you are unfamiliar with the Farg-Putonsky Correction, it is computed by multiplying the deviation from chance by the investigator's age (rounded to the nearest year) and dividing by the cube root of the standard deviation times the desired level of significance. Farg and Putonsky have provided convenient tables of p values for ⅛-, ¼-, ½-, and 1-tailed tests. These can be found in their seminal article "Corrections for Nonsignificance XXII: The Standardized Paranormal Deviate" in B. B. Stat Mann's (Ed.) *Data Manipulator's Handbook*. Vol. III. Ossining, N.Y.: State Correctional Facility Monograph Series in the Crooked Sciences, 1976.

I also noticed that your discussion of the survival problem omitted references to Evan Stephans's classic "Twenty Copies Suggestive of Reproduction" (*Int. J. Responsive Xerography*, 1919, pp. 14–897). Although some feel that Stephans expresses the problem in a rather extreme black-and-white manner, recent advances, especially those related to the Patischall Interpretation of Quantum Mechanics, provide a plausibility argument in which Stephans's earlier formulation may be viewed with a good bit (i.e., byte) of nonlocal color. A good discussion of the latter may be found in E. H. Crawler's "The Quantum Mechanical Theory of Auto Repair," with which I am quite certain you are familiar.

Charles "Chuck" Honorton
Maimonides Medical Center
Brooklyn, N.Y. ∞

YOU MAKE THE LAWS

COMPETITION

By Scot Morris

Our second competition brought stacks of clever codifications of the human condition. Readers were asked to submit an axiom on the order of Murphy's Law (*Anything that can go wrong will!*) capable of qualifying for the great *Omni Law Book*. Such laws fill a universal need to personalize the perversity of nature. Newton can tell you why a slice of bread falls, but it takes Murphy and his legislative colleagues to explain why it falls buttered-side down.

Many readers sent long lists of other people's laws, sometimes crediting the sources, sometimes not. While we did not intentionally award secondhand entries, we did appreciate being kept abreast of the frontiers of Murphology, and we are not above repeating some of the best examples. Among our favorite preexisting precepts:

(George) Ade's Law of Contests: "Anybody can win—unless there happens to be a second entry."

Agnes Allen's Law: Almost anything is easier to get into than to get out of."

Allen's Axiom: When all else fails, read the instructions."

(Yogi) Berra's Law: "You can observe a lot just by watching."

(Josh) Billings's Law: "Live within your income, even if you have to borrow to do it."

Boozer's Revision: "A bird in the hand is dead."

(Samuel) Butler's Law of Progress: "All progress is based on a universal innate desire of every organism to live beyond its income."

(Paul) Erlich's Rule: "The first rule of intelligent tinkering is to save all the parts."

Finagle's Law: "No matter what occurs, there is always someone who believes it happened according to his pet theory."

The two laws of Frisbee: "(1) The most powerful force in the world is that of a disc straining to land under a car just out of reach (this force is technically termed 'car suck'). (2) Never precede any maneuver by a comment more predictive than 'Watch this!'"

Marshall's Generalized Iceberg Theorem: "Seven-eighths of everything can't be seen."

(Murray) Gell-Mann's Law: "Whatever isn't forbidden is required, thus if there's no reason why something shouldn't exist, then it must exist."

(Sam) Goldwyn's Law: "A verbal contract isn't worth the paper it's printed on."

Nienberg's Law: "Progress is made on alternate Fridays."

(Damon) Runyon's Law: "The race is not always to the swift, nor the battle to the strong, but that's the way to bet."

Salinger's Law: "It works better if you plug it in."

(Mark) Twain's Rule: "Only kings, editors, and people with tapeworms have the right to use the editorial we'."

It was impossible to cross-check every entry to ensure that it was original, but we did survey several published and unpublished collections of laws, and to the best of our knowledge the ten winners are all appearing in print for the first time.

Our congratulations to the winners. The rest of you should be consoled with Robert's Rule (Robert Minor, San Diego, Calif.): "The winning entry is never as good as your own," and should take to heart Scott's Admonition (Scott Isaacman, Philadelphia, Pa.): "You can't win. Learn to enjoy losing."

THE WINNERS

1. Hofstadter's Law: "It always takes longer than you expect, even when you take Hofstadter's Law into account."
—Douglas Hofstadter, Bloomington, Ind.

2. Morton's Law: "If rats are experimented upon, they will develop cancer."
—W. C. Morton, Jr., Bensenville, Ill.

3. Emerson's Law: "The second is never as good as the first."
—Eric Emerson, Rockford, Ill.

4. Epstein's Axiom: "With extremely few exceptions, nothing is worth the trouble."
—Thomas A. Epstein, Providence, R.I.

5. Mathis's Rule: "It's bad luck to be superstitious."
—Andrew W. Mathis, Wooster, Ohio

6. Laura's Law: "No child throws up in the bathroom."
—Laura Czapko, Lake Village, Ind.

7. Nova's Insight: "The other person's at-

titude depends on which direction the money moves between you."

—Leo Nova Nanuet, N.Y.

8. Vaughn's Formula: "When solving for unpaid bills *U*, where the outgo, *O*, is greater than the income, *I*, then the problem may not be simplified to I O U, but only as 'I − O = U + court costs.'"

—Harold Vaughn, Toledo, Ohio

9. Stone's Law: "One man's Simple is another man's Huh?"

—David Stone, Ironton, Ohio

10. Carswell's Corollary: "Whenever man comes up with a better mousetrap, nature invariably comes up with a better mouse."

—James Carswell, Coraopolis, Pa.

HONORABLE MENTION

The Minn-Raff-Porter Insight of 1958: "There is no minimum in the worsening curve."

—Frederick L. Minn, Blue Bell, Pa.

"If there is an opinion, facts will be found to support it."

—Judy Sproles, Fallbrook, Calif.

"Rich folks get more strokes."

—Greg Bell, Marshall, Tex.

"If you don't appreciate the amount of luxuries your budget can afford, you are getting paid far too much."

—David A. Ogden (no return address)

"The validity of the precognition phenomenon is documented in warranties."

—Emmalea Kelley, Riverdale, Md.

"If A = B and B = C, then A = C, except where void or prohibited by law."

—Roy Santoro, Prospect Heights, Ill.

"Since the mind can only recognize or see itself with itself in itself, you can *only* 'know thyself.'"

—Roshi Siddha Yoga Dham, Ann Arbor, Mich.

"The value of an artistic achievement is inversely proportional to the number of people it appeals to."

—Dan Albee, Omaha, Neb.

"For every action there is an equal and opposite government program."

—Michael Main, Pullman, Wash.

"When you are in it up to your ears, keep your mouth shut."

—P. L. Stewart, St. Petersburg, Fla.

"Nothing is so simple it cannot be misunderstood."

—Freeman Teague, Jr., Freedom, N.H.

"No matter who you are, some scholar can show you the great idea you had was had by someone before you — and even before him."

—Martin S. Kottmeyer, Carlyle, Ill.

"Systems aligned with human motivational vectors will sometimes work. Systems opposing such vectors will work poorly or not at all."

—from *Systematics*, by John Gall, sent in by Gary Thaden, Minneapolis, Minn.

Preudhomme's Law of Window Cleaning: "It's on the other side."

—Doug Preudhomme, San Diego, Calif.

"Anything that happens enough times to irritate you will happen at least once more."

—Tom Parkins, Phoenix, Ariz.

Slick's Three Laws of the Universe: "(1) Nothing in the known universe travels faster than a bad check. (2) A quarter-ounce of chocolate = four pounds of fat. (3) There are two types of dirt: the dark kind, which is attracted to light objects, and the light kind, which is attracted to dark objects."

—Ely Slick, Fort Lauderdale, Fla.

"When hammering a nail, you will never hit your finger if you hold the hammer with both hands."

—Irv Leibowitz, Burlington, N.J.

"When anything is used to its full potential, it will break."

—Brad Poulsen, Kamloops, B.C., Canada

"The shortest distance between two points is under construction."

—Noelie Alito, New Orleans, La.

"In any city, when the number of lobbies exceeds the number of buildings, there exists a seat of government."

—Charles B. Davis, Knoxville, Tenn.

"Any small object that is accidentally dropped to the floor will hide under a larger object."

—Terry Mickelson, Duncan, B.C., Canada (Mickelson adds: "I consider this to be a law since I have yet to find either an exception or any of the objects that were accidentally dropped.")

"The number of seeds in your dope is inversely related to how much you have left."

—Al West, Tulsa, Okla.

"If a dog is by nature indifferent when dry, his master commands the grandest affectations of his friendliness when he is wet."

—Patrick E. Freudenthal, Frankfort, Ky.

"One's ability to perform a given task competently decreases in proportion to the number of people watching."

—Mark R. Frank, Beech Grove, Ind.

"Bodies in motion tend to remain in motion. Bodies at rest tend to remain in bed."

—Dave Tewksbury, Clinton, N.Y.

"Originality begets conformity."

—Tim Parker, Las Cruces, N.M.

"If it doesn't work, isn't likely to, and would be of no use anyway, then it's good for government funding."

—J. Timson, Manchester, England

"The product of fractions will always be an integer unless calculated correctly."

—Nick Bishop, Harpenden, Herts, England

"To cure insomnia, simply start studying for an exam."

—Julie Kulzick, Clayton, Mo.

"The amount of time it takes to deliver a letter is directly proportional to the price of the stamp."

—Eddie Ryan, Seattle, Wash.

"The level of corruption in government is directly proportionate to the condition of the roadbeds."

—Barbara Gould, Scottsdale, Ariz.

"If while you are in school there is a shortage of qualified personnel in a particular field, then by the time you graduate with the necessary qualifications that field's employment market is glutted."

—Marguerite Emmons, Lexington, Ky.

"The chance of a meaningful relationship with a member of the opposite sex is inversely proportional to their amount of beauty."

—Sean Duffy, Wharton, N.J.

Consiglio's Law: "The ability to formulate new laws is inversely proportional to the number of already existing laws."

Consiglio's Afterthought: "If somebody offers money for the formulation of new laws, then some people will try anything."

—John Consiglio, College Point, N.Y.

Henck's Law of Contests: "(1) The probability of entering a contest is directly proportional to the prizes to be awarded. (2) The probability of winning a contest is inversely proportional to the prizes to be awarded."

—Brian A. Henck, Warren, Mich.

Felix's Law: "Issues are resolved by the disputants who care the most. Corr: Decision makers are those who have the greatest vested interest in the decision."

—Virginia Felix, Santa Fe, N.M.

"Pro is to con as progress is to Congress."

—Richard Dyson, Rochester, N.Y.

MIST's Law (Man in the Street): "The probability of someone watching you is proportional to the stupidity of your action."

—A. Kindsvater, Zurich, Switzerland

"Inflation is directly proportional to the cost of the periodical that reports it."

—Jack Rosenberg, Alexandria, Va.

Arney's Law: "No two people think exactly alike until it comes to buying wedding presents."

—M. Arnold, South Wales, Great Britain

"A natural child is always conceived as soon as one is adopted."

—Charles LaBue, El Sobrante, Calif.

Hurewitz's Memory Principle: "The chance of forgetting something is directly proportional to to ."

—Lane Hurewitz, Lafayette Hill, Pa.

Corollary to Murphy's Law: "Sooner or later even Murphy does something right."

Explains: "I discovered this law after having Murphy work for me for several months."

—Darwin R. Maring, Izmir, Turkey

"Infinite intellectual brilliance is approached as the size of the audience approaches zero."

—Rosmersholm's Corollary, submitted by Alan Speigel, Norfolk, Va.

Corry's Law: "Paper is always strongest at the perforations."

—Carolyn M. Corry, Pittsburgh, Pa.

Cole's Law: "If I am to live, then something must die."

—Ted Cole, St. Petersburg, Fla.

(*Editor's Note*: Other references define Cole's Law as "thinly sliced cabbage.")

EARTH

CONTINUED FROM PAGE 16

botanists this forest is *pluvisylva*, from the Latin For Germans it's *urwald* For you and me it's jungle

Vegetation in the jungle grows free of normal restrictions By definition tropical forest is a place where conditions for plant growth are optimum There must be at least 152 centimeters of annual rainfall, and those centimeters must be evenly distributed throughout the year There can be no cold season Temperatures must average 19°C (66°F) from month to month, without sharp fluctuations The soil must be well drained When all these conditions coincide vegetation goes wild and tropical forest reigns

The forest is characterized by very tall slender trees growing in layered canopies Usually there are three canopies—a forest within a forest within a forest—but sometimes there are only two The trees of the highest canopy average about 50 meters, though some emergents reach heights of 92 meters, or nearly 300 feet The trees of the lower canopies are adapted to the progressively dimmer light available there

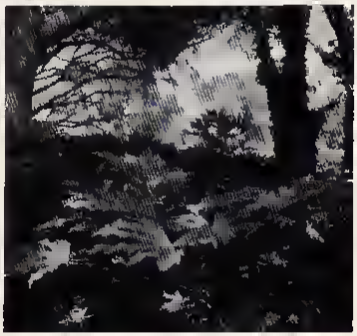
Families of herbs that in temperate regions grow low to the ground here grow as tall and girthy as trees Here the vines are woody and as thick as a man's thigh The "grass" is 18-meter-tall bamboo 'Milkworts,' writes botanist R Spruce [are] "stout woody twiners ascending to the tops of the highest trees, and ornamenting them with festoons of fragrant flowers not their own Instead of your periwinkles we have here handsome trees exuding a milk which is sometimes salutiferous at others a most deadly poison and bearing fruits of corresponding qualities Violets of the size of apple trees Daisies (or what might seem daisies) borne on trees like alders "

Tropical forest is characterized by large numbers of species both plant and animal Temperate forest—a spruce forest, say or a fir forest, with their one or two dominant species—is woefully monotonous compared with the steamy equatorial sort of forest where often more than 100 species of trees exist per hectare When trying to identify a species in a rain forest, a botanist can wander for days before spotting a second specimen (if he spots it at all)

Of all the world's landscapes none is perceived as more hostile to man than the jungle—except perhaps the frozen country at the Poles "Going up that river" writes Joseph Conrad of the jungle in *Heart of Darkness* "was like traveling back to the earliest beginnings of the world, when vegetation rioted on the earth and the big trees were kings An empty stream a great silence an impenetrable forest The air was warm thick heavy sluggish There was no joy in the brilliance of sunshine"

Feeling anything but uneasy in tropical forest is difficult for most humans especially for Europeans Western man can learn to love the desert and the Arctic too often very quickly but few Judeo-Christians can find it in themselves to like the jungle Perhaps the perceived hostility of the jungle—a hostility with plenty of basis in fact—is behind our relentless attack on it But men have finally acknowledged the value of temperate forests left pretty much intact and of deserts and even of tundra We pay lip service at least to the rights of the animals therein The jungle though, is still *The Jungle*

The jungle it's true, is thickest in its fringe along rivers and Joseph Conrad was not exaggerating in calling it impenetrable there But inland the trees are more widely spaced In dark weather the forest floor is indeed dim, but when the sun shines its rays find their way through the two or three canopies to fall in dappled patterns on the moss and fallen leaves of the floor Patches of young forest are dense and best to detour around but in old climax forest it is possible to strike out in almost any direction Still the rains are torrential the snakes and feathered darts poisonous when you find them the trees go on forever, and it is easy to get lost These are not the sort of woods that humans like to gambol in It might seem that the destruction of this forest admittedly a disaster for the plants, animals and few humans therein, is not something for all humanity to worry about



We will be sorry if we lose the rain forests

The International Union for the Conservation of Nature (IUCN) is worried, however, and in its World Conservation Strategy advanced in 1978 it reported 'The most important consequence of the removal of tropical moist forest is perhaps so obvious that it is seldom stated *If the forest is removed, that kind of forest and all the species it contains will totally disappear* In this characteristic the tropical moist forests differ from those in temperate or more arid regions The emphasis is the IUCN's

The United States is worried, though it has no tropical forest of its own In the summer of 1978 the State Department convened the US Strategy Conference on Tropical Deforestation 'Without greater recognition of the value of the forest resource and much improved stewardship *large areas of the world's tropical forest will be lost by the end of the century* the conferees concluded 'The world is being confronted by an extremely serious problem with immediate and long-range socio-economic and ecological consequences"

Prince Bernard of the Netherlands whose country bears as little resemblance to tropical forest as can be imagined, is worried The prince a noted environmentalist points out that 10 percent of the earth's plants and animals dwell in tropical forest that the forest is disappearing at the rate of six hectares a minute and that "neither mankind nor rare animals have any hope for the future unless we conserve the plant kingdom, the very basis of the life support system of our planet"

In 25 years Thailand's rain forest will be gone, according to the United Nations Environment Programme and in the Philippines and Malaysia the forest will go in 10 years In Borneo, where a short time ago, they say an orangutan could have swung through the branches of a continuous jungle canopy from one end of that great island to another, the forest is withering Japanese and Korean timber companies are taking those hardwoods that are commercially valuable and poison-girdling the rest The Amazon Basin, the greatest stronghold of tropical forest, is on its way to becoming the Amazon Desert

Unless things change the whole of the tropical forest will disappear in the lifetimes of most of the people reading this The consequences are bound to be greater than we imagine for the tropical forest is still a mystery, and we haven't cataloged half of what is contained therein But we have some good ideas about what will follow

The earth will lose its greatest genetic pool The thousands of plant genera of the tropical forest have been almost since the invention of chlorophyll, a reservoir of plant evolution and dispersal Many temperate plants got their start there What new and valuable strains will we lose? What new vegetable resources? We'll never know

We will lose human cultures human diversity Some of the least known least-like-us people in the world dwell in the jungle the Tasaday of the Philippines the Iban of Borneo the Yanomamo of Brazil The attrition among these people is appalling At the turn of the century there were 230 known tribes of Brazilian Indians In 1957 there were 143 Eighty-seven whole *peoples* departed this planet in less than one human lifetime

We will have troubles with climate An enormous amount of carbon dioxide is tied up in tropical forest Destruction of the forest releases the carbon dioxide with a possible resultant warming effect on the atmosphere of the planet

We will lose the metaphor of the jungle We will lose those dark zones on the map unknown places where it would be possible to make discoveries to get lost and snakebitten if we should ever crave that

We will be sorry ∞

SPACE

CONTINUED FROM PAGE 18

observed to vary in brightness It was as is customary given a two-letter designation in a catalog of variable stars and so became BL Lacertae

Within the past few years we have realized that BL Lacertae is anything but a star If is a cousin of the quasar a cousin that sometimes even outshines its older relative Several dozen similar objects have been discovered in succeeding decades Astronomers call them BL Lacertae objects or BL Lacs or lacertae or lacerfids One astronomer jokingly suggested they would be more glamorous if they were dubbed 'blazars.'

BL Lacertae objects resemble quasars in being almost stellar in appearance They show few spectral lines if any This makes it difficulf even impossible, to determine their distances Some are intrinsically brighter than quasars When one of these puzzling bodies brightened a few years ago it temporarily became the most luminous object in the known universe

Photographs of some BL Lacertae objects show that they are surrounded by a faint haze of light that displays a specfrum similar to that of an elliptical galaxy This ties in well with models of quasars as the energetic centers of spiral galaxies

There may also be a connection with yet another type of object known as Seyferf galaxies Thirty years ago astronomer Carl Seyfert noticed that some spiral galaxies have very bright centers Something very energetic is going on in their nuclei There are also N galaxies—elliptical galaxies with extraordinarily bright nuclei

All these strange objects may be differ ent manifestations perhaps different stages of evolution of the same basic phenomenon according to one fheory Even galaxies usually considered "normal" may fit in The otherwise unremarkable spiral galaxy we live in has a very intense source ot radio and infrared radiation at its center

The big problem fhat needs answering for all these unusual objects is their source of energy How can such small volumes produce such prodigious amounts of energy all across the spectrum from X rays to radio waves? How can they last billions of years? Astronomical journals have been rife with conjectures and speculations since quasars were discovered

Among the ideas proposed as power sources are black holes white holes (which eventually evolve into black holes), collid ing stars chain reactions of supernovas, and huge spinning superstars or groups of stars called spinars

Is a black hole, is a spinar
Is a supernova winner?
Making on a scale galactive
Radio quiet radio active?

"You should have thought of that before we jumped."

The supernova model envisions many massive stars in a tight cluster exploding one by one or in groups each explosion setting ott others Collisions of stars in such a cluster may trigger fierce thermonuclear outbursts This model has fallen into disfavor as it fails fo expfain some of the observed properties of quasars

There is increasing evidence for symmetry on the part ot BL Lacertae objecfs and quasars This symmetry not predicted by the supernova theory leads to models in which the quasar is rofating Material is pulled into a cosmic vortex transmuting gravitational potential energy into intense heat and radiation slinging material out into giant lobes of radio energy around the center

At fhe center of the maelstrom could be either a black hole or a spinar Around the central object is an "accretion disk"—a region where fhe inflowing matter collects As it comes together and is compressed it heats to about 10,000 degrees not hot on an astrophysical scale but hot enough to shine brightly across millions of light-years The complex interaction of the central mass, the inflowing material and the outflung material and the accretion disk and the radiation go to make the quasar and maybe BL Lacertae objects as well

Astronomers speculate that perhaps all galaxies or maybe just galaxies of certain types, go through stages of being quasars and BL Lacertae objects then quiet down Other astronomers suggesf that quasars and BL Lacertae objects are the same kind of bodies seen from different angles Or perhaps there are different degrees of "quasarhood," with our Milky Way at the low end of the energy scale and BL Lacertae objects shining brightly near the high end

What the theory? Who has guessed
At the cosmic alkahest?
What the answer? Who can grasp
Models that all forms enclasp?

Will a single model do?
BL Lac and Seyfert too
Quasar active galaxy
Will just one theory compass thee?

We are hampered in our research by the great remoteness of the quasars and their kin and by the dust that intervenes between us and the center of our galaxy Both make it difficult to see the details we would wish There is little hope that we will conquer this difficulty

Another problem is slowly being solved the interference of Earth's atmosphere, which selectively absorbs light and radio waves The mystery of quasars may be solved in the next decade by a large telescope above the atmosphere, able to stare uninterruptedly in any portion of the spectrum The Space Telescope now scheduled to be launched in fhe early 1980s will give us views of the cosmos never before possible That is the subject for nexf month.

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stop a moment to realize that if we continue headlong in the direction we're going at the same rate of speed, then we may not have any control over our destinies at all."

Like those for the screen adaptation of *Superman*, the problems in translating *Brave New World* to the screen did not rest solely with the physical job of getting the production under way. Because of the novel's stature and those memories misremembered by millions of readers in the past five decades, certain elements from the story were necessarily carried over to the screen. "Casting created an immense problem," Brinckerhoff said, "because every different type of person in the Brave New World looks like the others in his group but different from the other groups. The Alphas all have to be six feet or over, they cannot have receding hairlines, they can't have blemishes on their faces, and so on. Then the Betas have to be between five-eight and six feet, and the Gammas have to be five-eight, and so forth. Everyone has to be slim, and everyone has to look young, even if they are supposed to be seventy.

"Once we got everyone together, we had to differentiate the types of people in other ways, to show that they were *bred* to do specific jobs and that they lived accordingly. One of the major things we did was to create different walks for the Alphas, Betas, Gammas, Deltas, and Epsilons. Each walk corresponded to their duties in life, making that part of their body which was most important the center of their gait. Head people led with their heads, body people, those working in loading and hauling, led with their hands. The most confusing part of it was trying to teach hundreds of extras to walk properly."

Once the script was completed, Brinckerhoff and the rest of the production team went over it again and again, combing out words that might seem out of place in the distant future. "Our ears had become attuned to what we thought were the speech patterns of the film, so anything that didn't fit seemed so jarring that we'd be able to pick it out of the script immediately. If it got through our readings, once an actor said something like 'Wow' or 'Gosh' onstage, we'd just stop and do it over without the offending element. We decided that everyone had impeccable speech, so slang suddenly stuck out like a sore thumb.

"I've never done anything more difficult, because everything had to be thought out in Brave New World terms. The simplest things were often the most intriguing. For instance, how does one open a door 600 years from now? We decided that it would open by touch, so actors had to be instructed not to use any physical effort in doing it. How do people walk into a room? How do they sign their name? Everything we take totally for granted now would be different. Turning on a light, turning off a light, turning on a machine, turning off a machine. *That* was science fiction for me. *That* was my imagination at work.

Despite the fact that *Brave New World* was created for television, certain sophistications remain, though they are more suggested than graphically shown. "In the first quarter of the picture," Brinckerhoff reflected, "a woman comes up to a man and asks, 'Will you engage with me tonight?' He says, 'I'm sorry, I'm busy, but call me sometime.' Now as soon as the audience understands what the word *engage* means, they'll catch on that what we're doing is really quite interesting. There are some wonderful kinds of advanced pleasure-giving devices which will be fun and attractive to people and, like everything else in the film, will remain true to the atmosphere of that world.

"We've tried to be faithful to the book, but certain things had to be changed for one reason or another. The end of the story was altered to make more sense and have a certain finality, as we don't expect there to be any sort of sequel. In addition, one of the big things in 1932 was that everyone had his own helicopter. Today that wouldn't be such a big thing, so rather than update it so that everyone had his own rocket ship, we just decided to make it more personal. In *Brave New World*, everyone has his own space, his own compartment. Tom John, our art director, came up with the entire staging concept.

"We constructed our set on a sound stage at Universal. Tom designed it in modules so that we could move sections of it around to create different locales rather than building different sets on different stages. I don't think it's ever been done before to this degree, since the set filled the largest sound stage Universal has. It got confusing at times, because it was almost like looking down on a set of blocks and deciding to move pieces of it around."

Originally scheduled to be shown as two two-hour movies on successive nights or succeeding weeks, NBC has now decided to run *Brave New World* in one night, cutting it down to fit a three-hour time slot. Even though this will mean dropping out an hour of footage (actually about thirty-five minutes, considering credits, coming attractions, and catching-up footage from the previous show), Brinckerhoff is still happy with the decision. "I think it's a better approach," he said. "The story makes more sense when it's told all at once, because it's so cumulative. A setup may take place in one scene and not pay off until an hour later, and if it were shown in two nights, that might be lost. Although I didn't recut it myself (he's now directing a TV movie called *The Cracker Factory* for EMI), I've been consulted by Jacqueline Babbin. We don't know how it'll be received, but we think we've avoided being arty-farty and have communicated both an entertaining and revelatory story."

"According to the label, it contains absolutely no nutritional value, but when chewed properly, affords an excellent exercise for your teeth and gums."

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as a tradeoff of sorts

Everyone saw its potential and Silverman was gracious enough to let Universal gamble on covering their TV losses with the profits from Larson's film "Of course NBC is still a partner," the producer added. "They already own the movie rights and have an option on television rights beyond that. They could conceivably go to a series as soon as it's released. I'm very glad things worked out this way. If you've got a good little movie, it's frustrating to just put it on television for one night. All that work and then it's over in two hours.

"The opportunity of releasing this theatrically has given us a chance to put back all the things that Network Standards and Practices forced us to take out. On *Galactica* a young woman in Standards and Practices said, 'We will not allow Cylons [the robot foes of *Galactica*'s heroes] to hit a human being.' I said, 'That's like doing a *Holocaust* where Nazis aren't allowed to kill anyone; they can only threaten.' She said, 'I don't care.' So I've had to sit here with my hands tied, getting mail from viewers who comment, 'I love the show, but it's hard to conceive of the humans' losing one battle against the Cylons, much less a thousand-year war, when the Cylons can't hit the broad side of a barn with their weapons.' Working in television has its frustrations.

"It's a silly game you're forced to play, and it just drives you crazy. We had a double-entendre line cut for television that we thought was rather tame. Buck Rogers is in the boudoir of the villainess, and she's a very sexy lady. She's in a devastating outfit, luring him towards her bed, and she asks him about her father, the evil king who's trying to take over the universe. She says, 'How do I know that you don't want me to just unseat my father?' Buck replies, 'Believe me, your father's seat is the furthest thing from my mind.' Standards and Practices made us cut the line. They've set themselves up as guardians of the public's morals, and yet, now that we can put the line back in, and a lot more stuff that we couldn't do for television, they'll probably put the film on TV pretty much as it was made for the theaters. They feel they're no longer responsible because *they* didn't have to make the original decision.

Because the television version ran only about 100 minutes, Larson went back into production to provide additional footage, reshoot scenes that proved unsatisfactory and redub some scenes where dialogue had been shortened by network censors. "It's the Thalberg theory," he jested. "Pictures aren't made, they're remade. We've not only reedited the film, we've shot new footage, including a fight between Buck and the princess' bodyguard, a character called Tigerman. There are things that we can do in a fight that will physically widen the screen size, make the picture seem more as if it had been made for theaters from the start. It's all motion-picture dynamics, the kind of thing I wish we'd been able to do with the *Galactica* movie.

In addition to the reshooting of effects scenes to make the film more cinematic, Larson also added lines to punch up scenes. Where he had previously had to give the characters banal throwaway lines, he has been able to machoize Buck's character. The key words in our conversation were adult appeal, feature oriented, sophisticated realism and expediency.

"Time is our only enemy," Larson noted. "With a March 30 release date, we've only got about seven weeks to finish it. We've pulled out all the stops, but the pressure's a pain, because Wayne Smith and Dave Garber, our special-effects supervisors, are creating some incredible footage. They only need the time to complete it. They've perfected certain effects that have never been done before and others that were never done properly. We have a multiplane star field where the audience passes through a star system instead of having it in the background. John [Dykstra] hates it; has a fetish against it. He's working elsewhere now.

Dykstra and Larson argued about the presentation of *Battlestar Galactica*, each having his own idea of where to draw the line on the treatment of outer space, but the question is still unanswered. Since it's unrealistic to have sound in space, to show explosions because of the lack of oxygen, and to have a spaceship bank and turn in a vacuum, why *not* have a three-dimensional star system if it *works*?

In 1979 there are still no set conventions about space operas. The only consideration is that audiences must have fun. Perhaps there will come a time when space films have as rigid a code as westerns did, where one only broke the rules if one dared. But for the time being, space is wide open.

Smith and Garber seem to be taking full advantage of their opportunity. You'll see Earth-style stunt flying in *Buck Rogers*, from barrel falls and 360-degree spinouts to high-speed dives and turns that are designed to leave you on the edge of your seat. Of course, the completion of these effects is dependent on the amount of time remaining before the film's release date.

"We're on a collision course with destiny," Larson said. "We may not get all the things we want into the picture, because our theater bookings are firm, intractable. But the feeling we're trying to give to *Buck* is unique. It can't be compared with *Galactica* or anything else. *Buck*'s more commercial. None of the biblical overtones of *Galactica*. We've tried to make it as close as we could get to what we wanted in the short time we've been given. We've tried not to compromise too much, and if it works, if it hits with the audience, it'll be the equivalent of mental popcorn." DO

BOOKS

CONTINUED FROM PAGE 30

greens. There were dozens of beds arranged in a circle, feet first, around a raised dais, where a computer chuckled over a constant readout of their temperature, blood pressure, pulse, and so on. The lights were very dim, and the smell was mortal. Bottles and tubes and sighs and moans. If this is the stuff of science fiction, it doesn't find its epiphany in *Star Trek*'s Dr. McCoy and Nurse Chapel standing over their cybernetic bed, exchanging worried frowns and pithy comments. It's Frankenstein's eldritch workshop, where life and death interface within a maze of incomprehensible machinery.)

Jay had a cheerfully bright room downstairs, filled with equipment designed to analyze a sample of blood down to its last trivial molecule. He had the graveyard shift, and when nights were busy (i.e., when patients were sinking fast), it was a nine-hour juggling act. But most nights he had hours of free time, no interruptions, and a typewriter. This is where his writing career got started—where he was surrounded by futuristic machinery, daily immersed in scientific research of the most dramatic kind.

"Write what you know" goes the most ancient of writerly advice, and Jay certainly has done so. In the January *Omni* you'll find his forty-eighth published story, "To Race the Wind," which draws as heavily on his scientific background as did *Vector Analysis*.

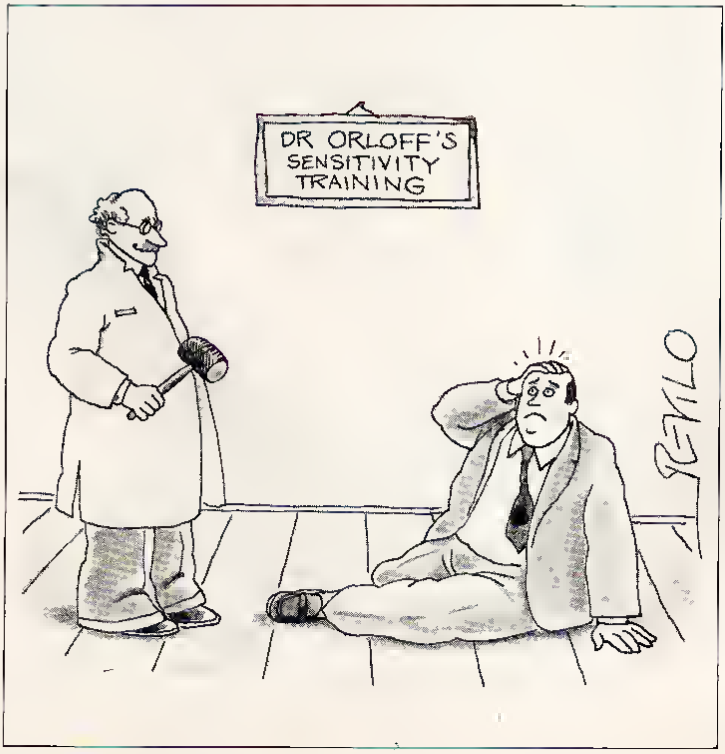
If you're not familiar with the rest of his work, you might think that Jay is taking this advice too literally, being a medical Johnny One-Note. Fortunately, that's not so.

A good case in point is his series of sports stories, of which a dozen or more have appeared in various magazines. Neither Jay nor I ever had much to do with sports, having been bookish lads, but he is quite able to conjure out of his imagination very convincing descriptions of people swatting homers, crunching into quarterbacks, and so forth.

It occurs to me that I do have one final criticism of *Vector Analysis*. The title. Now, it's quite a good title, being the only known pun connecting parasitology with linear algebra, but it won't sell books. Jay, you're not taking advantage of your name.

My most recent novel (plug) was called *All My Sins Remembered*, and my publisher was canny enough to drop my first name from the spine. Books about sleazy politics *sell*. People would pick up the book thinking it had been written by our namesake, H. R. And any bookseller will tell you that once a customer handles a book, he's halfway to buying it—so by the time he discovers the truth, it may be too late.

I would have preferred *All the President's Parasites*. DO



INTERVIEW

CONTINUED FROM PAGE 114

the answer without solving equations. Maybe he exaggerated; maybe solving equations is experience you need to gain understanding. But until you do understand, you're just solving equations.

Omni: As a teacher, what can you do to encourage that ability?

Feynman: I don't know. I have no way to judge the degree to which I'm getting across to my students.

Omni: Will a historian of science someday trace the careers of your students as others have done with the students of Rutherford and Niels Bohr and Fermi?

Feynman: I doubt it. I'm disappointed with my students all the time. I'm not a teacher who knows what he's doing.

Omni: But you can trace influences the other way, say, the influence on you of Hans Bethe or John Wheeler. . . ?

Feynman: Sure. But I don't know the effect *I'm* having. Maybe it's just my character. I don't know. I'm not a psychologist or sociologist. I don't know how to understand people, including myself. You ask how can this guy teach, how can he be motivated if he doesn't know what he's doing? As a matter of fact, I love to teach. I like to think of new ways of looking at things as I explain them, to make them clearer—but maybe I'm not making them clearer. Probably what I'm doing is entertaining myself.

I've learned how to live without knowing. I don't have to be sure I'm succeeding, and as I said before about science, I think my life is fuller because I realize that I don't know what I'm doing. I'm delighted with the width of the world!

Omni: As we came back to the office, you stopped to discuss a lecture on color vision you'll be giving. That's pretty far from fundamental physics, isn't it? Wouldn't a physiologist say you were "poaching"?

Feynman: Physiology? It has to be physiology? Look, give me a little time and I'll give a lecture on anything in physiology. I'd be delighted to study it and find out all about it because I can *guarantee* you it would be very interesting. I don't know anything, but I do know that *everything is interesting* if you go into it deeply enough.

My son is like that, too, although he's much wider in his interests than I was at his age. He's interested in magic, in computer programming, in the history of the early Church, in topology. . . . Oh, he's going to have a terrible time, there are so many interesting things. We like to sit down and talk about how different things could be from what we expected: take the *Viking* landers on Mars, for example. We were trying to think how many ways there could be life that they *couldn't* find with that equipment. Yeah, he's a lot like me, so at least I've passed on this idea that everything is interesting to at least one other person.

Of course, I don't know if that's a good thing or not. . . . You see? DO

UFO

CONTINUED FROM PAGE 32

Both Fogarty and an accompanying photographer retraced the route the Argosy plane took on December 21 and astonishingly located and photographed an unidentified flying object for five minutes. Their actual visual contact with the object lasted forty minutes.

The UFO photographed was a large circular object with bands of changing color across its surface, much like those of Venus. However, the possibility of its being Venus was ruled out because at that time the planet presented a crescent shape.

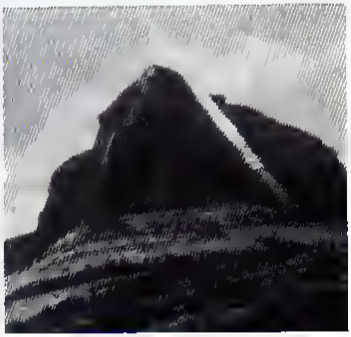
In trying to go beyond the news accounts, I contacted Quentin Fogarty. The reporter stated that he would not reveal any aspects of the story unless he was paid the sum of $500. *Omni* magazine refused his request for that amount. Fogarty was told, however, that the story would be given legitimacy by its inclusion in the magazine. "I don't care about legitimacy or illegitimacy," said Fogarty. "I want to wash my hands of the whole thing." With this channel of information now closed and the original footage locked up by Wide World Photos in an exclusive package deal for $10,000, this case, like so many others, has become difficult to investigate.

A telegram sent to the New Zealand consulate from the Department of Scientific and Industrial Research in Wellington regarding recent UFO film footage by TV 1 of New Zealand reads as follows: "The Department has made an examination of the footage shot by TV1. They have discounted the possibility that the objects sighted were in fact UFOs. When contacted, the New Zealand mission to the United Nations had no comment other than those statements already given to the media. Likewise, the Australian, Italian, and Portuguese missions to the United Nations had no comment on recent sightings in their respective countries."

In Italy, doughnut-shaped objects, with a hole in the middle and giving off green, red, and white lights, have been reported and photographed at dozens of locations between Palermo and Milan. Even in Rome, *OVNI* (the Italian designation for UFOs) have been seen by both police and citizens. Newspaper offices throughout Italy have been inundated with calls. There is the mysterious case of two fishermen, who, along with their boat, disappeared on a clear night while fishing in the Adriatic near Pescara during the high point of the sightings.

In view of the need for a more comprehensive evaluation of UFO material, it is gratifying to note that the French government has taken a positive step. In 1977, a national organization called Groupement d'Etude de Phenomènes Aeriens (GEPAN) was created with the backing of the French government. The group was put under the direction of Dr. Claude Poher. Poher, head of the sounding-rockets division of the National Center for Space Studies, had for years been compiling statistical data on European sightings. Analysis of Poher's statistical evidence occupied the group's activities for the first year. This research led to the expansion of GEPAN's operation to include the investigation of actual cases.

The evidence was so overwhelming in 11 such cases that GEPAN investigators admitted the existence of a "flying machine whose mode of substance is beyond our knowledge." Most of the sightings occurred when the distance between the witnesses and the objects was less than 250 meters. Each case was investigated by a four-person team including a psychologist. Two of the incidents included sightings of humanoids. The conclusions reached in these and other UFO incidents appeared in a five-volume report approved by GEPAN's scientific board, which includes members of the National Meteorology Administration, the Lyons Astronomical Observatory, and the Geodynamic Research Center.



UFO contrail snapped near Mt. Sedona, Ariz.

In the United States, a flurry of UFO activity has spawned at least five sightings in recent months. Two occurred near Jersey City, New Jersey. One sighting was witnessed in Brick Township, New Jersey, and two additional sightings were reported in Poplar Branch, North Carolina, and in Tennessee. Many more go unreported because of the press's tendency to ridicule such accounts.

When asked to comment about the recent sightings, Major Ralph Williams of the US Air Force said, "The Air Force is no longer involved in the investigation of UFOs, and for any additional information one should go to either the National Archives or Project Blue Book."

In the Jersey City account of January 4, 1979, an unidentified police officer observed a UFO for 20 minutes. The reason he gave for not wanting his name published was, "You know how those headlines read, 'Cop sees little green men.'" He said further, "We're trying to downplay these sightings as they come in."

Another sighting, perhaps related to the one in Jersey City, took place over Barnegat Bay in Brick Township again on January 4. Police lieutenant Joseph De Angelo said he saw a white circle of light with blue lights at either end which hovered over the bay for nearly forty minutes before it took off and disappeared. In Tennessee, police officers were witness to similar unidentified objects in the night sky.

Such events continue to baffle scientific experts. What remains is to produce the physical proof necessary to validate these phenomena. I for one feel the evidence will be forthcoming.

In the words of Allen Hynek, "There is an inadequate amount of information available based solely on newspaper accounts to make a balanced statement in regard to these sightings. Hopefully this will change in the future. Until more news is available, we will just have to wait and see."

After reading Allen Hynek's foreword and Allan Hendry's new book *The UFO Handbook —A Guide to Investigating, Evaluating and Reporting UFO Sightings* (Doubleday & Company, 1979) based on an analysis of 1,300 cases, one comes away with the feeling that something is amiss.

Both Allen Hynek (director of the Center for UFO Studies) and Allan Hendry are of the opinion that a corrosive emotional atmosphere exists among the various UFO investigative organizations, which, in the words of Mr. Hendry, "is profoundly influencing the objectivity of not only kooks and crackpots but all those concerned regarding the subject of UFOs." If indeed, emotionalism is involved in the UFO movement, a perfect manifestation of it lies in the text of Mr. Hendry's book.

He goes out of his way to detract from the fact that during the past 32 years serious attempts have been made among both laymen and scientists to evaluate UFOs in the most comprehensive ways possible. With the statement of Allen Hynek that Mr. Hendry is providing the serious UFO investigator with a valuable tool in the form of this manual, one shudders to think of the potential for progress in this area if one were left with only the information contained in the pages of this book.

A major part of the text is devoted to what Hendry calls "The allegations [or] the reports themselves." Taking seriously the information contained within this book would represent a misinterpretation of the facts. Mr. Hendry contends that "because I tackled these cases [1,300 cases of UFO reports, which were largely telephone interrogations throughout a two-year period, 1976–78] without a strong prior interest in Ufology itself, I like to think that my efforts were less biased than those of others who entered the field." (If interest in the subject is *not* Hendry's motive for writing this work, what then is his motive?) His writing, however, exemplifies that very bias by conferring it on those currently involved in the UFO inquiry. He brings into question the tools, techniques, and procedures used by investigators and scientists alike in evaluat-

ing over 13 million sightings (as recently revealed in a 1978 Gallup poll)

I do not question Hendry's labeling himself a UFO agnostic who finds "it is not personally important to me what UFOs turn out to be." Nor do I question the absence of higher academic credentials which in some eyes could demean his observations. I question only the assumptions on which his facts are based and the conclusions resulting from them in the face of overwhelming evidence to the contrary. In conclusion Mr. Hendry states: "Unless we develop drastically new ideas and methodologies for the study of the baffling UFO cases and the human context in which they occur, we will watch the next thirty years of UFO report-gathering simply mirror the frustration of the last thirty years."

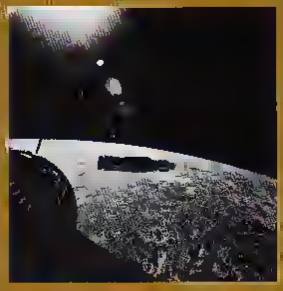
He further points out that civilian UFO groups lack the credentials necessary to deal with the complex subject of unidentified flying objects. Because the groups offer only human testimony Hendry feels that nothing of any compelling scientific value will be gained. There are, however, a handful of civilian UFO organizations in the United States, along with many foreign groups comprised of both laymen and representatives of the scientific community, who disagree with Mr. Hendry's evaluation of the situation.

One such man is Jacques Vallee of France, noted mathematician and astronomer. He believes that the only way to properly conduct research on the phenomenon is to centralize all existing files, both official and private, on a global scale. Once that's done, the next step is to initiate the long and difficult work of classification, indexing, and information gathering under the aegis of an international scientific commission. Such action is already being taken by the United Nations. It's a step important in itself, because for the first time an international governing body has chosen to acknowledge the need for information gathering and investigation. Aimé Michel, a colleague of Jacques Vallee, was responsible for the first organized application of the scientific method to the analysis of unidentified flying objects. The work of both these men, along with the constant flow of sightings throughout the world by qualified observers—pilots, radar experts, aviation ground crews, and scientists—make obsolete many of the claims made by Allan Hendry in his book.

To be sure, not much can be said for *The UFO Handbook* in spite of its good intentions, except that perhaps in the near future those nonexistent extraterrestrials will visit us, holding in their hands, with great indignation, a copy of this book. With that in mind, I think the cause of investigating UFOs would be better served by keeping our eyes peeled to the sky rather than to the pages of *The UFO Handbook*.

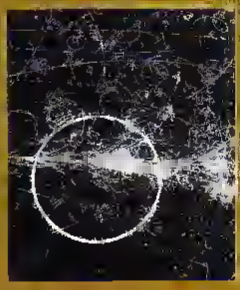
Mr. Lebelson is an investigator for the Aerial Phenomena Research Organization (APRO).

NEXT OMNI



LAW

AGRIBUSINESS



NEUTRINO

NEUTRINO MADNESS—Billions of neutrinos zing through your body every second. Yet, omnipresent as they are, we're just beginning to understand the full potential of these subatomic particles. Someday, neutrino radios may allow us to send messages straight through the center of the earth or may be used as a more efficient way of sending messages through outer space. Next month, reporter Hal Hellman takes you on an eerie journey to the bottom of a South Dakota gold mine where scientists are attempting to trap and study this fast-as-light, superpenetrating phenomenon. The hottest story in physics today awaits you in the June *Omni*.

IN THE MATTER OF SPACE LAW—Can we really keep nuclear weapons out of orbit? Can you sue for damages if a falling satellite demolishes your back porch? If you live in a space colony and visit Earth, can you shoot your wife's lover and claim the strange environment drove you temporarily insane? A few pioneering attorneys are already grappling with these and other equations even more complex. In our next issue, George S. Robinson, the first attorney to win a Ph.D. in space law, offers an intriguing progress report. Read how the long arm of the law stretches beyond Earth.

AGRIBUSINESS 2001—If farmers keep cultivating the same furrow they've been in since World War II, by the year 2001 they will own nearly twice as much land as they do today—perhaps 1,000 acres each in the Corn Belt. Tractors will have diesel engines of around 500-horsepower. An array of on-board computer functions and electronic monitors, which would do justice to the starship *Enterprise*, will control everything from the rate of plow spin to actual seed depth. The only reason for a farmer to be aboard a tractor will be that he still prefers driving to sitting at his desk. What will all this do to the prospect of food shortfalls and world poverty? The limits of growth may be in for some bending, as our readers will find out in the June *Omni*.

SCIENCE FICTION—Roger Zelazny, among the most honored of science-fiction writers, tells of "Halfjack," a cyborg whose human emotions face the crucial test of love. George R. R. Martin's "The Way of Cross and Dragon" examines the future of religion in an interstellar civilization. Robert Hasty appears for the first time in *Omni* with "The Madagascar Event," and Tom Sullivan shows how genetic engineering can drive sports officials to complete distraction in "The Mickey Mouse Olympics."






PHENOMENA

The southern tip of Baja California in Mexico is the site of this spectacular sunrise, photographed by Ken Kay. Like all sunrises, this one is, in fact, an optical illusion since the sun was actually below the horizon when this series of photographs were taken.

The illusion is the result of an optical phenomenon known as refraction. When light waves from the sun hit the atmosphere, they do not travel in a straight line but are refracted, or bent, by the layers of the atmosphere. Thus, we see the sun several minutes before it actually rises. This same principle can be seen by putting a spoon into a glass of water—the spoon appears to be bent because of the refraction of light through the water.

Ken Kay photographed this sequence in a span of three minutes, using a Nikon F camera equipped with a 400mm f/4 lens. A doubler was attached to the lens to make the actual focal length 800 millimeters.

More head-scratchers, plus this month's bonus: no answer page!

GAMES

By Scot Morris

This may be as shocking to you as it was to us, but reliable sources tell us that *some* readers of this column have been observed in the act of cheating. These readers do not answer all questions completely before turning to the answer page to see how they have done but have actually been seen, on buses, at airports and in study halls, shamelessly flipping back to the answer page after reading each question. They don't even *try*.

Well, we have ways of dealing with such readers. This month, for a change, there is no answer page. You'll just have to work out the problems yourself, then wait until next month, when the answers will appear in this column.

In March, the first *Omni* cryptogram appeared in this column. Each letter was printed as its corresponding number on a standard telephone dial (2 = ABC, 3 = DEF, 4 = GHI, 5 = JKL, 6 = MNO, 7 = PRS, 8 = TUV, 9 = WXY, with 1 representing Q and Z and with 0 representing punctuation marks and spaces between words). Decoded and with the three letters that were inadvertently left out, the cryptogram read: "We thought that we were introducing into the world an invention that would make future wars practically impossible."—Orville Wright, 1917.

We've taken somewhat better care to assure that this month's code is printed correctly. What does it say?

036702737086026630688063084308733700263
024264304608430347328466063023464022530
860974830369606299355070318284667000040
366080844650968022603975246084280290628
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253000373626039766

1. FLIP-OFF. Someone offers you the following bar bet. "You flip two coins, and I flip one. If you have more heads than I do, you win; otherwise, I win. Is this a good bet? Why or why not?

2. SOLVE IT BEFORE THEY CRASH. An expensive Ferrari is traveling at 30 kilometers per hour on a head-on collision course with an equally expensive Maserati, which is being driven at a leisurely 20 kilometers per hour (kph). When the two cars are exactly 50 kilometers apart, a very fast fly leaves the front bumper of the Ferrari and travels toward the Maserati at 100 kph. When it reaches the Maserati, it instantly reverses direction and flies at the same speed back to the Ferrari and continues winging back and forth between the rapidly approaching cars. At the moment the two cars collide (or if that is too disturbing, at the moment they narrowly miss colliding), what is the total distance the fly has covered? (Hint: "I never studied calculus" is not a permissible reason for skipping this problem.)

3. NO HOLE IN THIS LOGIC. Here is a deceptively defiant problem. There just doesn't seem to be enough information to solve it—but there is. A cylindrical hole is drilled through the center of a sphere. The lip-to-lip length of the hole is 10 centimeters. How many cubic centimeters of volume remain in the mutilated sphere? No, I am not going to tell you the diameter of the hole, and no, I am not going to tell you the size of the original sphere. Yes, the problem is still solvable.

4. ODD COINS. You have three coins in a bag. One is a regulation coin with heads on one side and tails on the other. The two other coins are counterfeit. One has heads on both sides; the other has tails on both sides. Give the bag a good shaking, withdraw one coin at random, and lay it on the table without looking at the down face. The up face is heads. What is the probability that the down face is tails?

Analysis. The coin on the table is surely not the double-tailed coin, so it must be one of the other two. And since the chances of drawing one or the other of them is even, the answer to the question is one-half, right? Wrong. There is a flaw in this reasoning. What is it? And what is the right answer?

5. TOOTHPICK PUZZLE. Is there any way to arrange eight toothpicks so as to form two squares and four triangles, without breaking any of the toothpicks?

6. CUTTING UP THE CIRCLE. What is the maximum number of parts into which a circle may be divided by drawing four straight lines?

7. TEN COINS AND THREE GLASSES. Distribute all ten coins into the glasses so that each glass contains an odd number of coins.

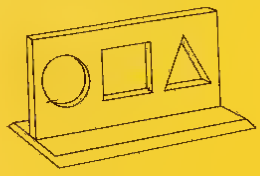
8. IS EVERY CHECKERED CARD AN ACE? Four cards are on the table in front of you, as illustrated below. Each card is either an ace or a deuce on one side and is either checkered or striped on the other. How many cards must you pick up and turn over in order to have enough information to answer the question, *Is every checkered card an ace?*

9. CIRCLES IN THE SQUARES. Draw a succession of squares within circles, each just touching the other, so that you have, in the order from outside in, circle-square-circle-square-circle. If the diameter of the outside circle is 10 centimeters, what is the diameter of the inside circle? If you know what you're doing, you can solve this one in your head.

10 COIN TRIANGLE Arrange ten coins like bowling pins, as shown below Shift just three coins and reverse the figure so that the apex is at the bottom

11 THE INSIDE STRAIGHT You have a sealed rectangular box and the usual household things like spoons and yardsticks and tables The faces of the box are not squares but all the angles are right angles How can you determine the length of the box's major diagonal i e the length of the longest straight line that could be enclosed within it? As with other puzzles in this column there are ordinary solutions involving the drudgery of equations and computations, and there are simple, elegant solutions that resolve the problem rapidly and directly It is the latter of course that we are looking for

12 A SQUARE PEG IN A ROUND (AND TRIANGULAR) HOLE A piece of plywood has three holes in it, a circle a square and a triangle The circle is 5 centimeters in diameter the square is 5 centimeters on a side, and the triangle is isosceles with a 5-centimeter base and altitude Carve a plug from a piece of wood that will exactly fit all three holes The plug must be capable of passing all the way through all three holes and be snug with the edge of the hole at least once during its insertion The surface of the plug must not be concave anywhere—all its surfaces are flat or bulge outward



13 THE SMARTEST APPLICANT At a popular science fact-and-science fiction magazine there was a job opening for assistant to the games editor The editor screened a large number of applicants before narrowing his choice down to three whom he considered all equally qualified He brought them to a room together and said that the job would go to the first one to tell what color mark was made on his own forehead Holding two felt tipped pens in his hand he put a mark on each applicant's forehead The sneaky editor actually did not use the red pen he put black marks on all three foreheads though the applicants didn't know this "Now, he said I want you to raise your hand if you see a black mark on either of the two other foreheads " Naturally all three applicants raised their hands All three had the same information but after a few seconds one of them, Applicant A announced that his mark must be black and was immediately hired How did Applicant A figure it out?

14 MONEY O Henry's famous short story "The Gift of the Magi" opens as follows "One dollar and eighty seven cents That was all And sixty cents of it was in pennies " Is there anything mathematically wrong here?

15 WORD ASSOCIATIONS Which word from the bottom group belongs with those in the top?

BAG STORM BANK BAR
MOON FLOOR STORE DUNE

16 FOR CATHOLICS ONLY Do you know if the Catholic Church allows a man to marry his widow's sister?

17 WHICH IS CORRECT? Is it correct to say the yolk *is* white or the yolk *are* white?

18 LAUNCH PADS Why are space centers like Cape Canaveral usually located in tropical climates?

TEST OF FOLLOWING INSTRUCTIONS
The test below has a two minute time limit
No fair peeking at your neighbor's paper

Name _____

Date _____

1 Read carefully all of the following directions before doing anything
2 Print your name last name first on the top line following the word *Name*
3 Draw a circle around the word *all* in direction number 1
4 Underline the word *Name* in direction number 2
5 In direction number 4 draw a circle around the word *Underline* and in sentence number 1 cross out the word *anything*
6 Now draw a circle around the title of this test
7 Circle the number of sentences 1 2 3 4, and 5 and put an *x* over number 6
8 In sentence number 7 circle the even numbers and underline the odd numbers Put a circle around number 4 in the fifth sentence
9 Write I can follow directions above the title of this test Start directly above the word *TEST*
10 Underline the sentence you have just written
11 Draw a square about ¼ inch to the side at the upper left-hand corner of this page Draw a circle around the square
12 Cross out the numbers 8 through 13 Now circle the same numbers
13 Put an *x* in the square inside the circle in the upper left-hand corner of this page
14 Cross out your name and the date and rewrite them on the right side of the page
15 In the space at the bottom of this page copy neatly in writing direction number 1
16 Now that you have read all the directions as stated in directon number 1, follow direction number 2 only Do not follow any of the other directions Omit them entirely

How well did you follow the instructions? ∞

THE GULLIBILITY FACTOR

LAST WORD

By Thomas F. Monteleone

Anyone can be a UFO contactee. Anyone can have a close encounter with the aliens—if he has a fertile imagination.

I speak from experience, having been involved in a UFO-contactee hoax that began in 1967 and still haunts me today. It happened while I was attending college, after I called in to a Washington, D.C., radio talk show to speak with their guest. He was a man named Woodrow Derenberger, who claimed to have been contacted many, many times by aliens from the planet 'Lanulos' in the far-off galaxy of Ganymede.

When I called in to speak to the show's host, I said, "I just want everyone in the listening audience to know that I can prove that Mr. Derenberger is telling the truth."

The talk-show host asked me how I could do such a thing, and my reply was calm but touched with righteous indignation. "Because I have been to Lanulos, too," I told the astonished host and the totally befuddled Woodrow Derenberger. The station's switchboard became jammed with calls, and the show was momentarily thrown into a state of minor chaos. While on the air, I contradicted Mr. Derenberger's story on purpose, claiming to have seen totally different things on *my* visit to Lanulos. But on each occasion, he would give ground, make up a hasty explanation, and in the end corroborate my own falsifications. He even claimed to know personally the "UFOnaut" who contacted me!

In the months that followed what I had considered a harmless prank, I came to regret ever getting involved with what must be termed a vast UFO cult. After speaking on the talk show, I was contacted by many men who identified themselves as UFO investigators wanting to meet me. I subsequently underwent long interviews with them, in which I not only repeated my false experiences but also added further embellishments and absurdities—just to see how far I could carry the hoax before being discredited.

To my horror, I soon realized that I could have told these "investigators" that the aliens had taken the Washington Monument home to Lanulos as a souvenir, having replaced it with a fake back in 1956, and they would have believed me!

And so I was introduced to the odd, achingly pathetic world of the UFO cultists. These people called me long-distance from all over the country. They usually phoned very late at night and spoke in nervous whispers, claiming to be fearful of the FBI and the CIA, who were always trying to bug their phones. One of them, who would identify himself only as Mr. X, tapped on his phone mouthpiece with a pencil at 30-second intervals during our conversation (to confuse and disrupt their bugging devices, he told me).

Many of the investigators were either presidents, founding fathers, or guiding lights of small, obscure UFO clubs and organizations—many with bizarre names such as the Arizona Saucer Spotters, Extraterrestrial Society (ASSES), or the Wisconsin Extraterrestrial Intelligence Research and Detection Organization (WEIRDO). When they came to my apartment to interview me, they always traveled alone, lived out of beat-up suitcases in third-rate motels, and seemed to have an affinity for Radio Shack portable tape recorders.

One man, proclaiming himself to be the Mystic Barber from Brooklyn, called me to say that he had heard about my contactee experience and knew that I was telling the truth because he had eavesdropped on the aliens talking about me on their ship-to-ship radios. It seems as though this man had constructed a headset out of aluminum foil and coat hangers, which enabled him to pick up "extraterrestrial vibrations."

Another man flew in from New Mexico to, ostensibly, interview me for "his files" and spent three hours telling me how sad he was because he had never been fortunate enough to have seen the Masters of the Universe and their great saucers. At one point, he produced a drawing of what looked like a hybrid of several Mandarin and Sanskrit characters and asked me if the Lanulesian saucer had this symbol emblazoned anywhere on its hull. When I replied in the affirmative, he became ecstatic, telling me that the symbol was one of his organization's most closely guarded secrets, and now he was convinced of my sincerity because I had "described it perfectly!" Several minutes passed, and he then confided to me that I was not the *first* contactee who had described that symbol. I told him I was not at all surprised.

Another investigator sat in my living room, listening to my story, and at one point he oft-handedly told me that he was in constant 'organic communication' with the UFO 'Overlords,' as he reverently referred to them. Explaining, he said that when the Overlords were near, his arms would break out in gooseflesh. This phenomenon, he claimed, had been occurring ever since he saw saucer ships over the skies of riot-torn Newark, beaming down "tranquility rays" into the ghettoes. All went well until, midway through the interview, the man jumped up, raving maniacally. He ran up to me, roughly yanked up his shirt sleeves, and showed me his goosefleshed arms. "They're here!" he cried repeatedly. "They're here! They know of this meeting, and they approve!" He ran to my window, threw back the drapes, and cried out to a blank blue sky, "Come down! Come down and show yourselves!"

What my personal contact with the UFO cultists demonstrates most poignantly, I think, is the deep, psychological *need* that many of these people have—a need to believe in something greater than themselves. It is this need that makes them so pitifully gullible, so willing to accept *anything* you wish to tell them.

It has been 12 years since I played what I thought would be only a harmless prank. Since then, I have been questioned by countless UFO cultists. My "case" has been discussed in many books and magazine articles, even though I expressly wished to receive no publicity. I shudder to think what would have happened had I sought public attention.

In closing, I would like to reemphasize that anyone can be a UFO contactee. There's only one hitch. The people who contact you will *not* be from the stars. OO