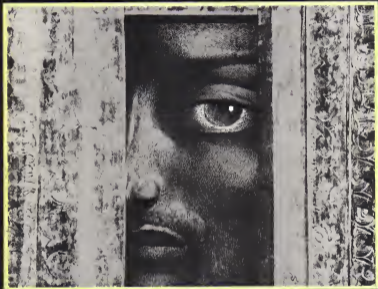


SCIENCE FICTION

MARCH 1979 \$2.00



ARTHUR C. CLARKE: EXCLUSIVE INTERVIEW
SPACE CITIES OF THE FUTURE
ANNOUNCING THE FIRST REAL HUMAN CLONE
EINSTEIN: THE NEXT 100 YEARS

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Cover art for this month's *Omni* is by Giorgio de Chirico. The *Threshold of Contemplation*. The drawing was done in 1970 by the dean of the Vienna School of Fantastic Realism: Ernst Fuchs. Fuchs lives in Vienna.

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BEN BOVA

• We have held NASA to budgets that allow little more than one major program at a time. The result is that we've fielded a team for space missions that has practically no backup capability. •

Despite NASA's best attempts, it now appears certain that Skylab will blaze back to Earth sometime before the end of the year. Pieces of the 87.5-ton spacecraft will survive reentry and hit the earth's surface—pieces as large as the 2,350 kilogram airlock around and the 1,400-kilogram load vault in which film was stored. At all, some twenty to twenty-five tons of debris may hit the surface.

Where? Anywhere on Earth, from 30 degrees north to 30 degrees south latitude. The impact "footprint" will be about 8,400 kilometers long and 100 kilometers wide. Anyone within the "footprint" will be in danger.

For the past several months, working under specific directives from the White House, NASA has considered a handful of plans for saving Skylab and averting a possible catastrophe caused by the falling debris. NASA has discarded all the plans and is now standing by helplessly with crossed fingers.

The NASA engineers can't boost Skylab to a higher orbit. They can't even control the spacecraft so that it will reenter the atmosphere at a predetermined spot such as an empty stretch of the Pacific, because Skylab's systems no longer respond to ground commands.

In answer to suggestions that they ask the Russians for help (see "Pride and Prejudice in Orbit," *Omni*, December 1976), NASA says that the Soviets do not have the proper equipment for the task. So Skylab will crash to Earth.

How did we get into this fix? Why don't we have the ability to save Skylab?

The major reason is that we, the voters, and our representatives in the Congress, have not given NASA the funds to do the whole job. Since the astounding success of the Apollo program, we have held NASA to budgets that allow little more than one major program at a time. The result is that we've fielded a team for space missions that has practically no backup capability at all. It's like putting a baseball team on

the diamond with no bench strength, no relief pitchers, no pinch hitters.

We are now paying the price for this "pony-wise, pound-foolish" attitude. If anyone is hurt by a piece of debris from the falling Skylab, it will be because we have skimped on our investment in space.

The time to make amends is now.

It's too late to save Skylab, just as it was too late to save the *Aurora* or *Pearl Interceptor*. But it is not too late to renew our efforts in space, to make certain that we never again have to stand by helplessly and run the risks we face today.

Our space program is in the doldrums mainly because we—you and I, the voters and taxpayers—have not insisted on less achievable, practical goals for NASA, goals that result in a payoff for us. The Carter administration's plans for NASA's immediate future are as nebulous as the predicted impact point for Skylab.

And there is a goal that we can achieve, one that would have enormous practical benefit for us all.

We face a continuing energy crisis, as petroleum and natural gas supplies dwindle and the prices for these fuels escalate out of sight.

Solar-power satellites can convert sunlight into energy in orbit, and beam that energy down to Earth cleanly, cheaply, safely. Analyses have shown that solar-power satellites can be the most effective way to solve our long-range energy problems.

It should be our national goal, then, to produce at least 10 percent of the United States' energy needs from solar-power satellites by the year 2000.

Such a goal would focus our space efforts as they have not been focused since 20 July 1969. Such a goal transcends White House and congressional politics. Achieving such a goal will give us the technology and the team to make certain we are never caught short in space again.

Tell your congressman about it. Tell your Senator. Tell your president. ☐

CONTRIBUTORS

OMNIBUS



HELLMAN



ERIC



CARD



KIRK



SCHWARTZ

In October we asked our readers to predict the future. We did it through something called the Delphi Poll, a highly sophisticated polling system designed by experts to accurately reflect how people view the future. Using today's political, economic, and social climates as a barometer, we found that over 20,000 readers projected a variety of trends with astounding similarity. The results compiled by contributing editor Dr. Christopher Evans and later analyzed by computer are at last ready for publication (see p. 131). What we felt as most gratifying was that our readers' predictions corresponded amazingly well with the vision *Omnis* presents to you each month.

In this issue, for instance, we bring you an article on psychic research. Readers predicted that by the year 2000, such research would become an integral element of science and technology. "Deep Quest Experiment in Psychic Research" (p. 94) by Stephen A. Schwartz is any indication we may not have to wait that long. It's the story of how a unique team of psychics and researchers known as The Mebus Group were able to locate a specific archeological site, never previously recorded, ninety meters (300 feet) below the Pacific Ocean.

The furor last year over David Perlick's book in *As Imag* apparently did not convince readers that cloning has taken place. According to the Delphi Poll, *Omnis* readers don't expect the first successful clone until the late 1980s or 90s. Perhaps

after they read contributing editor Bill Stucky's piece "The Clone Doctor" cloning will become a reality in readers' minds, not just fantasy. Dr. Landrum Shettle, famous for the work with test-tube babies, has apparently taken those "first steps toward cloning a human person." In fact, writes Stucky, "He's been taking them since back in 1975 night; there is his little down-the-block laboratory in Randolph, Vermont." (See p. 76.)

Many readers predicted that tickets for space travel would be available to the public by the 1990s, much like airline tickets today. "A pretty fair guess," writes G. Harry Stone, scientist and expert on space industrialization, in "Ticket to Space" (p. 44). Stone describes how several major aerospace corporations are already laying the groundwork for space tourism. "What Stone, 'These tickets are only twenty years down the road. And what a maze, they'll be sold at a price we can all afford.' Stone's astute understanding of the industrialization of space forms the second part of this article, to appear in the April issue.

Our interview this month is with one of the greatest names in science fiction, Arthur C. Clarke. Now in retirement and living in Sri Lanka, Clarke took an afternoon to talk with *Omnis* correspondent Malcolm Kirk about telecommunications, dolphins, his writings, and what he's planning for the future (p. 100).

In fiction, we mark the return of *Omnis* Scott Card, winner of the prestigious John W. Campbell Award for best science-

fiction writer of the year (1978) and considered by many to be the hottest SF writer of the decade. Card has four new books coming out in the near future and has just completed a collection of his works for Capital Press—including *A Thousand Deaths* (see the December *Omnis*). See "Unaccompanied Sonata" (p. 90).

Other works of fiction include *Dearling's "Down and Out on Elvive Prime"* (p. 82), French author Pierre Guic's "Eyes on Butterflies' Wings" and "The Great Mow-woy Jam" by newcomer John Koofover.

Someone once said of Albert Einstein: "He was unable to obtain his self-imposed goal of completely understanding the universe. But his brilliance will continue to survive and benefit all of us for centuries to come." This month marks the hundredth birthday of this great physicist. In "Einstein's Legacy" (p. 54), Dr. Robert L. Forward explores those breakthroughs for which Einstein was little-known, but whose implications will be with us for centuries.

Rounding out this month's issue is "Ultrasound," a primer on all the ways in which science can peer into the body using an astounding collection of lenses recently developed for diagnostic imaging. Hal Hellman provides the text beginning on p. 66. Good reading!

Note: Last month, in Next *Omnis*, we said that "The World's Hardest IQ Test" would appear in this issue. Unfortunately, the editors are still being the test, so we are holding it until next month. ☐



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Evolutionary Fallout

After reading Frank Kendig's First Word in the December *Omni*, I'm curious as to why man is not as smart as reptiles were. I don't understand why we have invested so much time, money and energy in developing mechanical means of flight when we could, by simply jumping out of trees, off buildings, or any high place, gradually evolve natural flight abilities.

Perhaps it is true that we have been around only 3.5 million years as compared to the 150 million of the reptiles, but since man, according to Mr. Kendig, is more advanced, we should have started jumping out of trees long ago. By now our hind legs would be much stouter and our arms would be showing signs of becoming wings, our skin leathery.

Obviously one of the disadvantages of beginning the evolutionary process would be the high mortality rate, but if reptiles survived, no doubt man would. The contribution we, as a generation, could make to the evolution of flight is phenomenal if we could only convince people to start the process by taking out and off of things!

I wonder how much television advertising it would take to convince people that the pain of hitting the ground over and over again would be considerably less in 100 million years, making it worthwhile. If we could only be as smart as reptiles!

Dalila Conger
Norwalk, IA

The reptile in question was, after all, able to glide if only in a crude manner. Who knows how many other creatures had this feat, perhaps an envy and displayed the aerodynamics of a stone? Somewhere along the line, I'm sure, man had the same thing, arms flapping. Perhaps the most evident mark of our "advancement" is that, on occasion, we learn from our mistakes.—Ed

The Cancer Industry

Omni is a fantastic magazine, and I enjoy reading it, but why you printed "The Cancer Scare" in December *Continuum* is beyond me. That clown Dr. Pollak is not only misleading the public but is also a detriment to the education of people exposed [practically all of us] to possible cancer-producing elements. Does Dr. Pollak actually think that the thousands of chemicals poured into the environment have little effect on society? And that cancer statistics can be compared to those of almost eighty years ago?

More than 350,000 people have died from cancer every year for the past four years, and the frequency is escalating at such a rate as to suggest only that what we are eating, drinking and breathing has substantial bearing on those numbers.

Despite medical research and the agencies set up to protect Americans, the bulk of the urban industrialized population continues to be plagued by the dread

disease. We are, in fact, the most fertile ground pigs of cancer research. And I wonder what industry Dr. Pollak works for.
Robert Varticovski
Hicksville, NY

Ignorable Savages

In "Whale Pilots" (November *Omni*), the Brothers painted Steve Sipman and Kenneth LeVasseur in a decidedly heroic fashion for their release of two Atlantic bottle-nosed dolphins being studied at the University of Hawaii. It should be noted, however, that following their release one of the dolphins was seen inshore, suffering from wounds and in an extreme state of agitation. No sign of either dolphin has been seen since. The survival record for wild animals released in any other than their native habitat is poor. Usually the animal dies. The release of the Atlantic bottle-nosed dolphins in mid-Pacific waters is tantamount to the capture of North American humans Sipman and LeVasseur and their subsequent release in the Amazon jungle. Their motive, while noble, lost a lot in practice.

John M. Garty
Evanston, IL

Flight: Good and Bad Winds

"A Flyer for the Masses" (December *Omni*) is really upbeat on its great little flying machine the Flyer. But to propose that it can be everyman's flyer is quite an extreme. I've made six hours of flight time on my Para-Pole Strato Star, a sport parafoil, and on one occasion "bad wind" grabbed it and twisted me ninety degrees off my flight path. I've witnessed a fellow parachutist experience complete canopy collapse and then free-fall until descent speed caused reorientation forty feet further down. Fortunately we escaped further complications with turbulence and landed safely with our enriched gals and now use greater discretion in making skydives on windy days.

Skydivers have made millions of jumps on parafoils; however, a tribute to their sound design, stability and reliability. Indeed, the flyer is a terrific fun machine but it can be enjoyed only under optimum weather conditions, which is why it will never leave its California playground. After our entire society? Not the design. Only a portable antigravity machine will do that.

Andrew Eichenauer
US Parachute Assn
New Haven, CT

I am an avid hang-glider pilot and I would like to point out that your pictures of gliders in the December *Omni* were probably taken no later than 1974 or 1975. Since then, the improvements in the performance capabilities, safety and handling of ultralight gliders have progressed in quantum leaps. As an example, witness the fact that in July 1977 Jerry Katz flew his hang glider a distance of 103 miles in four hours using thermals to

gain as much as 9,800 feet of altitude flying downward to the next thermal. In July 1978 Gary Palmor thermaled up from 6150 ASL (at sea level) to 16,250 ASL for a world record of 10,200 feet.

Second, today's gliders are certified by the Hang-Glider Manufacturers Association according to the same criteria as the Federal Aviation Administration's standards for commercially manufactured airplanes and sail planes. The certification covers not only structural adequacy but also the aerodynamic qualities of positive pitching moments and roll rates. Most modern gliders are pitch positive to negative 25° attack. The poor pitching-moment curves of the outdated gliders were responsible for the instability.

Third, a study by the U.S. Hang-Gliding Association, which is a member body of the National Aeronautics Association and the Fédération Aéronautique Internationale, showed that the ratio of lift-to-drag to number of aircraft was higher for light-powered aircraft than for hang gliders.

Finally, Dennis Meredith ("Man Powered Right") omitted any mention of powered hang gliders, which have flown from mainland California to Catalina Island and across the English Channel and Long Island Sound and get up to 300 miles per gallon. I'm hoping *Omni* will give a much maligned sport a badly needed break by eliminating some of the more popular misconceptions surrounding foot-launched ultralight aircraft.

Steve Custerwald
Las Vegas, NE

I am a professional hang-glider pilot who has been practicing this unbelievable sport for the last four years, and it is my firm belief that hang gliding is the sport of the twenty-first century. In answer to your December article's comment: "Incorrect body movements have caused many hang gliders to become unstable and plummet to earth, killing their pilots," here is a true fact: The hang gliding magazine *Glider Aider* in November reports on the trials of the American Cup and the competition season of 1978. Much to the dismay of one local hospital (Dade County, Georgia), high velocity injuries of catastrophic nature failed to materialize, keeping clean the record 36,000 injury-free flights of the U.S. Hang-Glider Association-sanctioned competition.

Ed Vasquez
New York, NY

Free-Fall

I wonder how a publication of such scope and style could devote an entire issue to flight without mentioning the skydivers. Perhaps when the grand family of aviators we are still considered the bastard children, it is unfortunate.

Reg Clayton
Abbotsford, BC
Canada

FORUM

Cervical Scandal

I think Orin provides a fine service, both to the public and to the scientific community. However, I was shocked and dismayed to read Bernard Dixon's account "Hennetta's Legacy" in the January issue. Dixon treats the cloning of Mrs. Lacks's cervical tumor as if it were some kind of triumph of clinical biology, whereas this act, and the subsequent distribution of Mrs. Lacks's cells all over the world, is one



Henrietta Lacks. The first human clone

of the most shameful incidents in the history of medical science.

Dr. Dixon conveniently neglects to mention that Mrs. Lacks was a black woman and that it is still in doubt whether or not she understood exactly how her body was going to be exploited.

Perhaps was Mrs. Lacks brought back to life—an idea that Dixon admittedly finds repulsive—she would express great pride in the fact that her cancer has furnished the aims of research. But perhaps not.

I am of the opinion that if Mrs. Lacks had been an upper-middle class white woman, say, a woman of a social status equal to that of Mrs. Bernard Dixon, the cloning of her cervix would never have taken place.

Jackson A. Whitmore
Syracuse, NY

Patent on Life?

Concerning Kathleen McAuliffe's "Who Owns Life?" in November *Continuum*: Congress will not have to address itself to the problem of defining life. Constitutionally it has neither the religio-philosophical authority nor the scientific acumen to do so. With regard to the questions at hand, furthermore, it has no clause to do so.

The cases in question are not concerned with naturally occurring life forms but with scientifically created ones that have no natural representation outside the laboratories. In this sense they are artificial structures fabricated for specific purposes, as any inventions are.

Where science can identically manufacture or duplicate naturally occurring life forms, logically there can be no patent or legislative action to guarantee a monopoly to any individual. However, where a specialized, artificial form of life is created, which by its nature is not of the "given" universe but is a development of the mind of humankind, using what is available (as with any other invention), there should be no impediment to recognition of the achievement and guaranteeing its author full possession of it.

Gregory Komrochuk
Noroton Heights, CT

This letter is being answered by Stephen A. Bant, a graduate student in biology at the University of Connecticut. Mr. Bant has been following this issue closely and has prepared a case note on Chakrabarty.—Ed.

Mr. Komrochuk may have overstated his case. The U.S. Constitution mandates that Congress "promote the progress of science and useful arts" by granting to inventors and authors an exclusive right to their creations. The legislative branch therefore enjoys a *coad potestatem* to establish and modify patentability standards and otherwise dictate the range of patentable subject matter. (Whether it has the technical resources to exercise this power widely is another question.)

The Plant Patent Act of 1930 is an

example of Congress's flexing its legislative muscle in this area, and it may well do so again regarding the general patentability of living matter (however it chooses to define "living").

Moreover, by referring to the modified organisms in question as "artificial structures," Mr. Komrochuk begs a potentially crucial question, i.e., to what extent can any living product derived from raw material that was alive to begin with be considered artificial? The answer may not be the same for different "altered" aggregates of living matter, since one modification may be novel and innovative while another merely reflects existing technology. The classification for patent purposes of products as *in natura* or *artificial* (or as *artificial/in natura*) represents a misleading oversimplification.

Our Chicken Little Problem

Thanks for the very informative article "Pride and Prejudice in Orbit" in the December Orin. I am concerned about the subject, but that doesn't mean I'm going to scurry around like Chicken Little thinking the sky is going to fall down any second.

So it's really that bad, huh? You stated that we have only just about a year before Skylab, our first true space station, will (via gravity) crash down on our (or some other terribly unfortunate country's) head. I hope, though, that NASA's right—at least 1983 is far enough away to give us some time to get our act together so that we can do something about our Chicken Little problem.

Asking the Russians to help would not be right. I consider it a slap in the face, as far as our self-sufficiency is concerned.

I know the proliferation of science and technology is spit upon by many politicians. Senator Proxmire, that insouciant blob, along with his "Golden Fleece" award, is doing all he can to propagate antitechnological feelings.

What this country needs, Mr. Bant, is a science-oriented Congress. I'd bet anything that if we'd had one all along (or at least since 1957) we would have to

CONTINUED ON PAGE 107

PLANET ANTARCTICA

EARTH

By Kenneth Brower

An almost inevitable adjective in any description of Antarctica is "otherworldly." The courageous polar explorers who have succumbed and used the word should feel no shame. The Antarctic is another world, an alien planet at the bottom of the habitable one we know.

Watching that planet to this one was some sort of colossal mistake. The Antarctic continent seems to know that and want to rectify it. On our lopsided Earth, Antarctica is the highest of continents, a protuberance that corresponds to the Arctic's slight depression. Our southern pole bulges, as if trying to break the surface tension of the globe and emerge to become a small world in its own right, returning to its proper orbit in some frigid region farther from the sun.

Antarctica's cold is otherworldly—Saturnian or Jovian. The lowest temperature on Earth, -52°C , was recorded on a high Antarctic plateau. Weather stations in the Antarctic have recorded temperatures of -86°C , more than twenty degrees lower than those reported anywhere else on Earth. This is cold so intense that steel

shatters, mercury becomes solid metal, and human explorers, once they've given up the ghost, freeze solid in seconds. The effect of such Stygian cold is compounded by a horrendous wind-chill factor. At places on the coast, wind speed can average 112 kilometers per hour for an entire month, with gusts up to 272 kilometers per hour. High winds and low temperatures combine to produce cold as lethal, for most practical purposes, as that of deep space. The Antarctic explorer lost outside his hut becomes a silver statue as quickly nearby as the astronaut whose suit heat hat on the sunless side of Neptune. The explorer's forehead rings just as metallic, if you tap him there. The difference is that the explorer freezes at a forty-five-degree angle, leaning into the gale that has killed him.

If Antarctica could indeed secede from its union with us, becoming an independent planeted, its nearest sisters would be Callisto and Tron, those moons of Jupiter and Saturn covered by thick outer layers of ice. Antarctica contains 90 percent of the world's snow and ice. The thickness of its ice sheet, which averages

2,099 meters, is testimony to the continent's enduring cold, for those few kilometers of ice have built up on land with the annual precipitation of a desert—five centimeters or so on the central plateau. The Antarctic ice sheet covers 14.3 million square kilometers, twice the area of Australia. If Antarctica were remodeled as a planeted, that surface area would fit a globe a third the size of our moon, half again the size of the asteroid Ceres. It would be a beautiful little planet. The white brilliance of Antarctica is, according to astronauts who have seen it from space, Earth's most striking feature. The planet Antarctica would be a ball of milky crystal outshining our moon.

For travelers on the ground, in good weather, Antarctica has an unearthly clarity. Peaks 480 kilometers distant stand out clearly, as if they were on a world with no atmosphere. Underwater in winter the same clarity is the rule. Before the plankton bloom of Antarctic summer, the visibility underwater is 119–149 meters, a transparency unknown in any other sea. After the bloom, visibility is feeble, for plankton multiply more quickly in Antarctic waters than anywhere else on Earth. The Southern Ocean, which constitutes only 5 percent of the world's salt water, accounts for 20 percent of all marine photosynthesis.

Antarctica's simplified pelagic ecosystem, in which enormous harvesters the size of spacecraft—blue and fin whales up to thirty meters long and weighing 150 tons, the largest creatures to have existed on the planet—mow their way through meadows of any kind, is as improbable a system as any imagined in science fiction.

The phenomena of Antarctica, the coastal mirages, the aurora australis, the perihelia that form in airborne ice crystals, the tabular icebergs the size of cities, the pale icebergs colored green by plankton—all belong on some other sphere.

The planet Antarctica, half again the size of Ceres and considerably closer at hand, was not discovered until 1820, nineteen years after the discovery of the asteroid. Antarctica, in its nearly celestial remoteness, was the one continent Stone



Only penguins can withstand the otherworldly cold of Antarctica, where temperatures can reach -86°C .

Age men did not tread upon. The Arctic, a temperate place by comparison, had been settled for millennia before Antarctica was even imagined. (The magnate was Aristotle, whose sense of symmetry required a southern landmass to balance Europe and Asia in the North. The Greeks named Antarctica and mapped it, and somehow they were right. Thanks to them, the Western world expected an Antarctica, a terra australis incognita, for more than two thousand years before the smallest proof of such a place existed. Perhaps those two millennia were enough for the expectation to become a kind of racial memory. That memory guides even present day planet imaginers like Frank Herbert, for whom the southern poles are the poles of mystery and possibility.)

The planet Antarctica is separated from the rest of Earth by an unbroken belt of low-saltd water that encircles the entire lower end of the globe. These are the coldest seas in the world. Advanced technology was a prerequisite of conquering those seas, and the permanent habitation of Antarctica began in the International Geophysical Year of 1957-58, the same year the Space Age began.

The Antarctic, like space, has its ray-sayers. Cook, whose circumnavigation of the Southern Ocean proved that no part of Aristotle's continent intruded into temperate latitudes, said of that elusive landmass: "I make bold to declare that the world will derive no benefit from it."

Will Antarctica be the dry run for man's adventure in space?

If so, it appears that our use of space will be pure exploitation. Man will not benefit from it, rich men will. Extraterrestrial resources will not narrow the gap between haves and have-not nations; they will broaden it.

Antarctica like space, is accessible only to countries with high technology and capital to invest. A krill trawler costs be-

tween 10 and 20 million dollars. The protein hungry nations that need krill most cannot afford that. The thirteen member nations of the Antarctica Treaty—those nations that have staked out claims in the Antarctic—are all wealthy nations. They have taken a proprietary stance on the last continent and show no interest in sharing the wealth. In 1977, the Food and Agriculture Organization proposed a six-year program to "explore, exploit, and utilize" Antarctic resources for the whole world with special consideration for the poor countries. The Antarctica Treaty nations rejected that proposal, and it was withdrawn.

If Antarctica is to be the dry run, then the awesome beauty of space will be forgotten for the raw materials to be mined there. In 1972, at the Second World Conference on National Parks, it was suggested that the Antarctica Treaty powers establish the continent as the first world park. The treaty powers found the suggestion too foolish for response. In 1975, Maurice Strong of the United Nations Environment Programme suggested that the treaty members consider a moratorium on development in Antarctica. The members refused.

If Antarctica is to be the dry run, then extraterrestrial animals had better watch out. If there really are harmoniums on the planet Mercury, we will make them into protein paste. If there really are giant squidwoms on the planet Duna, we will halpenn them for their oil and crystal tools.

If Antarctica is the dry run, then any planetary ecologist arguing for a total-ecosystem approach to this sphere will be out of luck. In the Antarctic, with the demise of the really big animals, industry has turned to smaller whales, like the sei and minke, and is gearing up for a campaign against krill. Japan, Norway, Chile, the USSR, Poland, the Germans, and Taiwan have begun programs of exploratory krill harvesting.

Next to nothing is known about krill biology or about the dynamics of the system for which krill is the base or about how harvesting will affect those systems; but that sort of ignorance has never stopped us before and will not stop us now.

In Antarctica, as in space, we have agreed to be peaceful and not test our weapons. That is fine, but we need to move on now to harder problems of international cooperation. We can agree on nuclear bombs (there are still plenty of underground test sites in Nevada and Siberia), but can we agree on the equitable division and wise use of Antarctic resources? Antarctica demonstrates, among other things, how poorly fisheries conventions protect international waters. The International Whaling Commission—lootless like all international regulatory bodies—has been unable to check the precipitous decline of whale populations in the Antarctic or anywhere else. We need to find ways to pass good environmental law with provisions for international enforcement. Antarctica is the opportunity to prove that we can stop the free-for-all, that we can make sensible use of the resources, rationally and otherwise, that we hold in common.

The starship Enterprise and countless other fictional spacecraft are manned by multinational crews that get along cheerfully—the racial jokes about the Vulcan's ears are more or less friendly—and they always come to strange worlds in peace. Nothing in the testing ground of Antarctica justifies that view of our future. Many non-fictional thinkers hope that the energy and the raw materials in space will provide solutions to old human problems. Nothing in our early exploration of Antarctica justifies those hopes.

But there is still time for Antarctica. Perhaps advocates of space exploration owe it to the mother planet to see that here, for once, we do it right, before stepping on to the stars.

The next year is crucial for Antarctica. The members of the Antarctica Treaty will decide on a regime for management of the continent's living resources. The U.S. is in a strong position to guide the new regime in the right direction. Our government should commit itself to an international program that respects the integrity of the Antarctic ecosystem and the rights of the international community to share in its wise use. We should oppose the use of krill as livestock feed and fight for wise management of the krill resources on which Earth's vanishing baleen whales depend. The man to write to is:

Ambassador John Negroponte
Deputy Assistant Secretary for Oceans
and Fisheries Affairs
Department of State
Washington, D.C. 20520

The President
The White House
Washington, D.C. 20500 **DD**



The Antarctic is another world, an alien planet adjoined at the bottom of the habitable one we know.

WHIRLPOOLS IN THE SKY

SPACE

By Mark R. Chartrand III

What will our galaxy look like in 20 billion years? Will the beautiful spiral arms wind up and disappear? What causes these cosmic whirlpools, anyway?

Two scientists at IBM's Thomas J. Watson Research Center, Dr. Humberto Gerola and Dr. Philip E. Selden, have taken a step toward the answers. They have made computer models of galaxies based on the hypothesis that chain reactors of exploding stars produce the galaxies' spiral features. The results are computer "portraits" of several galaxies that quite closely resemble the real ones after which they were modeled.

HOW GALAXIES ARE FORMED

Recipe for a spiral galaxy: Take stars of all brightnesses, sizes, and ages, mix with interstellar gas and dust, add radiation fields of light, radio waves, x-rays, and cosmic rays (very lightly) and let the ingredients mix gravitationally for several billion years. Voil!

It is easy to be misled when looking at photographs of a spiral galaxy. Among the things we are not seeing are the faint

stars and the cool clouds of gas and dust. We see and photograph only the very brightest stars, some clusters of stars (which at this distance are hard to distinguish from single stars), and a few bright clouds of hot gas that shine because of radiation from the bright stars. Only 1 percent of all the material in the galaxy is producing all the light we see (you can compare this to taking an aerial photograph of a city at night. You might record only the bright lights but not the buildings and other things that make up most of the city).

From studies of our own Milky Way galaxy we know that most of its material is spread almost evenly over a large, disc-shaped region. The galactic disc is 100,000 light-years across, about 1,000 light-years thick, and has a central bulge—the galaxy's nucleus—that is a few thousand light-years thick. In proportion to its diameter, however, most of the galaxy is thinner than a dime.

For some reason, the conspicuous stars and gas clouds tend to be aligned along spiral streamers. But the spiral features are far from simple structures. There are

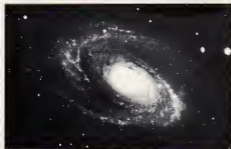
multiple arms, branches, gaps, and other irregularities. The question is why there are spirals, and any explanation must account for the variations as well.

Our galaxy is ten or so billion years old, and it still has spiral arms. In that time the sun has orbited the nucleus of the galaxy twenty or twenty-five times. (Some people call the 250-million-year period it takes the sun to orbit the galaxy once a "cosmic year.") So any theory of a galaxy's spiral structure must explain why the arms last for so long without winding together.

Since spiral arms stretch from the nucleus of a galaxy to the outermost parts, astronomers have sought to explain the arms as some global property of galaxies, some pattern superimposed on the overall distribution of stars and gas.

The spiral arms are regions with a slightly higher density of stars and gas. The bright stars are explained by the fact that when gas is compressed, the chances are increased that some gas clouds will contract and become stars. The very brightest stars formed from such gas clouds have very brief lives—only a couple of million years—and so don't move very far around the galaxy from where they were formed. Thus these very bright stars delineate the regions of higher density. The longer lived stars drift away from these regions.

Several astronomers have suggested that the shock waves produced when very massive stars explode or become supernovas could trigger the collapse of nearby gas clouds and cause stars to form. A supernova is a massive star that catastrophically explodes at the end of its life. Most of the material of the star is spewed out into space as a cloud of gas, a supernova remnant. It expands so fast that it forms a shock wave, somewhat like a sonic boom. The wave and gas travel outward, enriching the interstellar gas with elements made in the explosion. If the shock wave plows into a nearby cloud of gas, it heats and compresses the gas. If a gas cloud is compressed beyond a certain point it will continue collapsing under the force of its own gravity and form a star or a group of stars. A few of these stars may be



This spiral galaxy (M 81) was photographed through the Hale Observatories' 200-inch telescope.
20 OMN



Micro TV Breakthrough

Remember the \$400 Sinclair Micro TV? Here's the story on the greatest TV value ever.

That Sinclair TV shown above is small—the smallest TV in the world!

And when it was first introduced last year, it made history. So did its high price—\$395.

Our company never sold the unit for two reasons: 1) It was being promoted as a pocket TV and we felt it would not fit in most pockets and 2) We felt \$395 was too high a price for the unit regardless of its quality, size and features.

But we were wrong. Thousands of them were sold and it was selected as one of the most exciting new products of the year.

WE BOUGHT ONE

A few months ago we purchased a Sinclair TV and discovered another feature we didn't like. The unit included a 220-volt converter for European operation. This meant that every American who bought the set had to pay extra for the converter even though every American would be taking their TV to Europe.

So we came up with an idea. We went to England and purchased thousands of sets directly from the factory without the converter. We were also able to save money by eliminating the normal mark ups by importers, wholesalers and distributors.

We can now offer you the unit for only \$249.95 and if you want the 220-volt converter your cost is only \$19.95 extra.

LESS THAN WHOLESALE

J&A would be offering the exact same Sinclair TV at a price less than Sinclair's actual wholesale price in the United States and we would still make enough profit to pay for the cost of this advertisement!

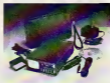
There is one feature we liked very much about the set. Its rechargeable batteries are built into the unit. Larger portable TV's offer 560 optional rechargeable battery packs that must be purchased separately. Ours is built in and included in the price.

The Sinclair TV comes complete with an American AC adapter and charger and phone carrying case, rechargeable batteries and a built-in antenna for both VHF and UHF. It

also comes with a separate lighter power converter, so you can watch all your favorite TV channels from your boat, plane, motor home or car without even using your batteries.

PHOTOGRAPHIC QUALITY

We were well aware of Sinclair's advanced electronics and quality features. But what we found particularly exciting was its picture tube. Even though the 2" (measured diagonally) tube is small, the TV's resolution resembles that of a larger sharp photograph. You can even read small telephone numbers when they're flashed on the screen.



The Sinclair unit is offered at the advertisement with the same accessories available at the \$395 system with the exception of the 220-volt power converter.

The Sinclair is also convenient! You can take it on trips and entertain the kiddies while you fly or drive. You can keep it on your desk at work and monitor the latest news or stock market reports. And you can use the sofa opposite as you work around the house. We even took care to the ball game to watch those instant replays.

BIG POCKETS

But don't expect to carry it in your pocket—it won't fit unless you have big pockets! The unit measures 1 1/2" x 4" x 8 1/2" and weighs just 28 ounces which includes the built-in battery.

The TV is serviced in the United States by Sinclair's service-by-mail facility. If service is ever required during its one-year limited warranty, just slip it in its handy mailer and send it to them for repair. Your 220-volt unit should operate for years without a problem, but if it ever needs repair, it's good to know that service is an important part of our program.

For \$249.95, the Sinclair Micro TV is worth your test. Order one from J&A. Take it with you on a trip, bring it to your office, or carry it with you around the house. See how clear and sharp the picture is and how closely it resembles a black and white photograph. Then decide if you want to keep it. If not, no problem. Simply return your TV within 30 days for a prompt and courteous refund. We just want you to prove to yourself the miracle of space-age electronics before you decide.

AMERICA'S LARGEST

Sinclair Radiance is one of England's largest electronics manufacturers and J&A is America's largest angle source of space-age products—further assurance that your smart investment is well protected even though the unit is offered at such a bargain price.

To order your Sinclair Micro TV simply send your check for \$249.95 plus \$3.00 postage and handling (Illinois residents please add 5% sales tax) to the address shown below or credit card buyers may call our toll-free number below. But please act quickly!

The Sinclair TV is an outstanding product that was priced too high. If you felt like we did and you wished your feeling is perfect. Order a Sinclair Micro TV at no obligation today.

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IRKSOME VACCINE

LIFE

By Dr. Bernard Dixon

What could possibly link the theology of Protestantism with rivalry between Jonas Salk and Albert Sabin over their respective polio vaccines?

A minor tragedy that occurred in 1978 provides the answer. For the second time in eight years, a fundamentalist sect in the small Netherlands town of Staphorst was ravaged by poliomyelitis, which struck down and paralyzed severely nine people. Although the overall immunization rate in Holland is more than 95 percent, members of this close-knit community refuse vaccination on religious grounds. The Staphorst tragedy dramatizes the confusing disagreement among scientists as to precisely what sort of vaccine should be administered to safeguard us against one of life's most harrowing maladies. Two varieties of polio vaccine are now used in different parts of the world.

There is the vaccine that was pioneered in the 1950s by Dr. Jonas Salk and that contains inactivated (killed) virus and has to be injected. The alternative is a much more popular version, developed later by Dr. Albert Sabin, which is given orally. It

consists of a living but weakened virus that colonizes the human gut—just as poliovirus does—but without invading the nervous system.

Over the years, some mighty deputations have argued about the merits of these two rival products. The United States controversy unresolved to the day, goes back to the early 1960s, when Basil O'Connor decided to throw the weight of the National Fund for Poliomyelitis Research behind Sabin's vaccine rather than Salk's version. The recent Dutch experience underlines one of the arguments for that switch in policy. A person inoculated with the Salk vaccine simply becomes immune to polio. Someone given the Sabin vaccine however is likely to shed the virus in his feces. Inevitably, the microbe spreads around the community, and many other people become immunized without even knowing it.

Hence the significance of the tragedy in the Netherlands, where the authorities have elected to use the Salk vaccine. There is an excellent chance that if they had chosen Sabin's product instead, at

least some members of Staphorst's rigid Protestant sect would have unwittingly become invulnerable to poliomyelitis. Calamity might have been averted.

However, there are points on the other side of the argument.

From the beginning of Salk and Sabin's rivalry, independent experts warned that a vaccine containing living virus (as does Sabin's) posed a unique theoretical hazard. The virus might mutate and become capable of paralyzing recipients just as the deadly agent from which it was originally derived does. With a killed vaccine, such danger is virtually unthinkable.

We now know that these risks are not simply hypothetical. In recent years, a genuine poliomyelitis has been caused in both the United States and Britain by a virus derived from that used in the Sabin vaccine. Although the numbers are exceedingly small (some five a year in the USA) when compared with the millions of people immunized, they confirm that a living vaccine can indeed be more hazardous than a dead one.

The only virus of what happened at Staphorst is that it highlights one aspect of the controversy in a somberly explicit fashion. Killed vaccine undoubtedly bestows a high level of resistance to polio so we can overlook one of the earliest arguments against its use: that live vaccine is much more potent in triggering the manufacture of antibodies. If the Dutch government had selected the Sabin vaccine, the virus would surely have spread in the population, and at least some adherents of a fundamentalist religious group would have been immunized without ever knowing it. Some would also have been spared lifelong handicap. We must, however, also reckon with the remote chance of some members contracting polio as a direct result of the vaccine's being given to other people. It is a perplexing dilemma, and the most that the prestigious British weekly *The Lancet* could say recently about the subject was that while "such involuntary vaccination is undesirable... it is preferable to having large outbreaks." **CC**



The debate between advocates of Dr. Sabin (above) and Dr. Salk is again generating controversy

STARS

By Patrick Moore

Last year ended with a concentrated attack on the planet Venus. Several probes arrived there and sent back some illuminating information. But they did much more than that. In a way, they ended a dream. The Pioneer and the Soviet probes have proven once and for all that Venus bears no resemblance to the romantic planet we believed it to be in the years before the first rockets flew.

It was not unreasonable to portray Venus as a lovely world. After all, Venus is the most brilliant of all the planets and at its brightest can cast a perceptible shadow. This is partly because it is so close to us—Venus can come within 40 million kilometers (25 million miles) of Earth. Another reason for Venus's brightness is its considerable reflective qualities. The planet is cloud covered which explains its high albedo, or reflective power.

This cloud cover has been the source of much of Venus's mystery through the years and the cause of much of our misunderstanding of the planet. The clouds never clear, and therefore no observer on Earth—even with a powerful telescope—has ever seen the surface of Venus.

Given, then, that mere observation was not notably helpful in describing the planet's surface—pre-Pioneer astronomers had to turn to other means. One phenomenon that caused a great deal of argument was the Ashen Light. This was the name given to the faint visibility of Venus when her nightside is turned toward us and she shines as a crescent. The Ashen Light was first detected by Johann Schroeder, the first great planetary observer of near modern times. The same sort of feature seen on the moon is due to light reflected from the earth onto the lunar surface. But Venus has no satellite, and the Ashen Light was not easy to explain. Franz Von Paula Gruthuisen, a German astronomer of the first half of the nineteenth century, however, felt he had the answer: forest fires.

He suggested that the light could be coming from vast forest fires lit on the planet by the local inhabitants to celebrate the election of a new government. Now it is more generally thought that the light is caused by local effects in the upper atmosphere of Venus and not by large-scale postelection bonfires.

Still, hopes for life on Venus remained strong. An obvious objection was its

presumably intense heat, considering the closeness of Venus to the sun. But proponents of Venusian life suggested that the thick atmosphere might act as a protective screen, leaving the surface only pleasantly warm.

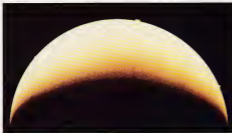
Further hope came from two eminent American astronomers, F. Whipple and D. H. Menzel, in the years immediately before the Space Age began. They believed Venus was covered mainly with water. If true, the carbon dioxide in the atmosphere would have leached the water, resulting in oceans of soda water (though the astronomers did not go so far as to suggest there would be any whiskey to go with it). If this had been proven, then Venus might have resembled our earth in a pre-Cambrian days—500 million years ago—and it would have followed that life might just be beginning there.

All these ideas are attractive, but alas, science is not always romantic. The first successful Venus probe bypassed the planet in 1962 and discovered that the surface temperature there is on the order of 462°C (862°F); that the atmospheric pressure is some ninety times that of our own air at sea level; that the amount of carbon dioxide is considerable, and that in all probability the clouds contain large amounts of sulfuric acid. This means that there may be a deadly sulfuric acid "rain" in the middle atmosphere, though it may evaporate before reaching the actual surface.

Far from being benign, Venus has turned out to be the most hostile planet in the solar system. It's worse than airless Mercury or, and, chilly Mars. Russian pictures of the surface obtained from soft-landing probes have shown a desolate, rock-strewn landscape that makes a moon desert seem inviting.

As for going there, well, I would not recommend trying it. Land on Venus today, step outside your spacecraft, and you will at once be squashed, poisoned, cooked and corroded.

We have learned much during the past couple of decades, but it is disappointing to learn that we will never find those seas of acid water. ☐



Venus, as photographed last December by the Pioneer Orbiter, from 66,000 kilometers

THE ARTS

Dracula. Bram Stoker's classic novel of horror has been filmed many times, in many countries, and under many different names. The Transylvanian count has surfaced regularly in films, never disappearing from the screen for more than a couple of years before being raised from the dead and set to walk the earth again, surviving by drinking the blood of the living.

A Dracula revival has been developing in the country for the past year. No longer relying on the blood and the horror aspects of the story, the current wave of vampires has emerged as sexually vibrant, almost dashing romantic figures, their bared fangs inviting sights of pleasure instead of screams of fear. This trend, most notably represented by the Edward Gorgey-designed New York stage production that featured Frank Langella as the epitome of the seventies Dracula, will see its culmination in a slew of 1979 films featuring sexually oriented vampires.

Though the screen version of the Gorgey-Langella production will draw the most attention in the press—unless humor prevails and kudos go to an elegantly stilled George Hamilton, starring in a vampire spoof entitled *Love at First*

Bite—the most interesting interpretation expected is a faithful rendition of the original Stoker novel, *Nosferatu*, directed by German filmmaker Werner Herzog.

Best known for his most recent films, *Aguirre: The Wrath of God*, *Stroszek*, and *Kaspar Hauser*, Herzog has been an important director in Western Europe for a decade, with seventeen low- and moderate-budget films to his credit. But while he is a favorite at film festivals and among serious film devotees, Herzog is a complete unknown to most of the American audience. After *Nosferatu*, however, chances are that he will be "discovered" and become a world-class director in the 1980s.

Michael Gruskoff, producer of young *Frankenstein* and *Saint August*, the special-effects godparent of *Star Wars* was one of the first to pick up on Herzog's commercial potential. "About two years ago," Gruskoff recalls, "I went to see *Kaspar Hauser* at a small art theater in Los Angeles. I saw it on a Friday and called Werner on the following Monday. I told I wanted to do a film with him. He said I was crazy, but later I heard that he was going around afterward saying he'd had a call from a Hollywood producer. In his

mind, I'm sure, he looked on me as his ace in the hole for further financing on the bigger pictures he wanted to make.

"I invited him to come in and talk, and when people around the 20th Century-Fox studio heard he was coming over they got very excited about it. Milos Forman, Paul Mazursky and Bernardo Bertolucci all kept coming into my office and asking when he was going to arrive. As soon as we met, Herzog and I liked each other and although he had come in with Jack Nicholson to discuss another film, we made a deal on *Nosferatu*. Then 20th Century-Fox heard that a number of their leading directors had a great deal of respect for Herzog. They must have figured he had potential, because they gave him 200,000 for all distribution rights to the film outside the French-speaking countries of the world.

"The studio must have seen *Nosferatu* as a way to get in bed with an important young European director. They wanted to start working with him immediately, so that when he became more important he'd come to them with his projects when he didn't need them. My involvement with *Nosferatu* was more in the nature of a middleman. I am presenting the film. Werner was both producer and director and he'd already started preproduction on it when we made the deal."

Gruskoff was not entirely happy that Herzog had complete artistic control over the project, but Herzog believes that only one vision can prevail in a film. When it's his picture, that vision must be his, regardless of studio involvement. "There were certain things in the script that would not get the reaction in America that he was expecting," said Gruskoff. "Our consciousness has been with *The Addams Family*, *The Mummy*, *Andy Warhol's Dracula*, *The Rocky Horror Show* and *Young Frankenstein*. I saw that we'd have problems if he kept in such lines as 'How do I get to Transylvania?' That line would just get laughs in the U.S., and I told him so up front. But he went ahead and did it his own way. The film works most of the time, but there are a few things like that that stick out." **COVERED ON PAGE 25**



The most interesting cinematic adaptation of the Dracula story is Werner Herzog's film *Nosferatu*

THE ARTS

Thirty years ago, Dr. Claude Shannon of Bell Laboratories cut several hundred words out of a newspaper, threw them into a hat, and began picking them out one at a time, recording the very strange "sentences" that emerged from this randomization. This bizarre experiment led to Shannon's discovery that the English language is nearly 50 percent redundant, and offered him the clues that he later developed into the basic mathematical equations of information theory. He demonstrated that information is mathematically equivalent to negative entropy, and this helped to create the cybernetic age.

A new book, *The Third Mind* (Wkang New York) by psychodelic science-fiction novelist William S. Burroughs and painter Bron Gysin, represents an experiment in semantic reorganization at least as radical as Shannon's. Using processes of permutation and combination that they call Cut Up and Fold In, Burroughs and Gysin take a piece of writing by themselves or anyone else (their favorite sources appear to be Shakespeare, Rimbaud, T.S. Eliot, daily newspapers, and the last words of

such gentry as Dutch Schultz and Billy the Kid), tear it apart like a bulldozer hacking into a junkyard, weld it together totally at random, and produce a kind of hallucinatory prose that is simultaneously hilarious and disquieting.

If previous Burroughs books (in which these randomization techniques were used only occasionally) seemed like journeys into dream, *The Third Mind* is even further removed from the linear logic of the daytime mind. Or, as *The Third Mind* impersonally explains itself: "The Burroughs Machine, systematic and repetitive, simultaneously disconnecting and reconnecting—it disconnects the concept of reality that has been imposed on us and then plugs normally dissociated zones into the same sector—eventually escapes from the control of its manipulator, it does so in that it makes it possible to lay down a foundation of an unlimited number of boxes that end by reproducing themselves. "It is typical that this passage itself appears to be a Cut Up—perhaps some critique of Burroughs's earlier books mixed with a description of his grandfather's famous

adding machine. The message of art and technology could hardly go further."

The results of this Machine Age yoga—in which the mind, ego, and viewpoints of the author are totally suspended, and processes as random as quantum decay determine the juxtapositions of word and image—can be as funny as Groucho Marx getting loose in the typesetting room of the *New York Times*: "A petite blue-eyed blond streaked across the sky and clashed with Glasgow police. She had welded the gavel with a walrus mustache and was thrown overboard." Other times it sounds like the Freudian unconscious escaping from the control of its Mad Avenue explorers: "No fat OS ANGELES taste—AN FRANCISCO so mindily, effective, genres the smoke makes it unmade in the sanctity of a joint. We can't do that yet. You can light either end, beat your mother to death with a boozed bag." It can even look like a demented and anarcho-surrealist haiku: "God damned floating whorehouse! Death is the navigator." And, more often than not, it is just downright creepy: "The razor inside, set Jerk the handle."

Where do these gnomic and not quite human sentences come from? Not from the original authors, who certainly never intended them, and not from the conscious decisions of Burroughs and Gysin. Where then? From the "third mind," Burroughs says, from a mind that appears as a synergistic new entity when two minds—the technician performing the Cut Up and his original source—are allowed to interact without conscious control by either. This is akin to the "no mind" that fires the arrow for the Zen archer or the signal transmitted by an I Ching reading (also generated by random processes). More significantly, according to Burroughs, the voice that speaks in these Cut Ups is also an aspect of the linguistic unconscious suggested by Korzybski, Whorf, and Chomsky. Indeed, Burroughs—who has spent a lot of time studying hieroglyphic languages such as Meyer and Egyptian—suggests that these eerie messages come from Korzybski's "preverbal" or structural



Bron Gysin (left) and William Burroughs, authors of *The Third Mind*

UFO UPDATE

By James Oberg

According to reports in UFO magazines and newsletters, the United Nations has begun an intensive examination of what former UN secretary general U Thant called "one of the most important problems facing the world," the origin and intention of flying saucers. This high-level UN effort was reportedly sparked by the terror of a small Third World country and fueled by expert UFO testimony from the United States, France, Mexico, Japan, and other countries.

The actual story, as is so common in UFO-related matters, differs substantially from these widely publicized versions. The UN's role has been exaggerated, while other participants have not been described in complete honesty.

A dynamic interaction between two very different groups, each with their own goals and methods, has led to the current situation. Leading UFOlogists Dr. J. Allen Hynek and Dr. Jacques Vallee are eager to obtain official support for their UFO activities and to share in a measure of the UN's respectability. A group of political leaders from Grenada, a small Caribbean island nation (situated just the side of Trinidad and Tobago) populated mainly by descendants of free slaves, evidently sees the UFO issue as a means of attracting worldwide attention and respect. But these two groups appear to be trying desperately to stand on each other's shoulders, which leads to some awkward postures.

Grenada was granted its independence from Great Britain in 1974. Sir Eric Gairy, a longtime UFO enthusiast and self-styled "mystic" (he has seen UFOs over the Caribbean on two occasions) became the island's first prime minister. From his position as head of state, Sir Eric has been urging the United Nations to pay attention to the UFO question. Early in July 1978, he brought his UFO enthusiasm to Secretary General Kurt Waldheim.

The meeting was a normal diplomatic courtesy extended to the head of state of any one of the 150 UN member states, but Gairy pushed it on to the attention of the news media by inviting, as part of his

official delegation, a number of UFO experts and enthusiasts. Hynek and Vallee were there, along with Dr. Claude Pöhr of France and ex-astronaut Gordon Cooper.

Secretary Waldheim listened courteously as the guests expounded fruitfully on the need for UN support of UFO studies; then made some general remarks of polite encouragement, thanked them for their time, and walked them to the door. "The most important meeting in the history of UFOlogy!" crowed UFO publications.

On November 27, 1978, the UFO contingent of Gairy's team was back at the UN again, in force. The Grenadan delegation had requested time to address the UN Special Political Committee on the issue of UFOs, and committee officials, as they must for all requests from member states, put the matter on the agenda.

Gairy meanwhile commissioned New York UFO expert Lee Spiegel (who established his reputation through a popular nightly "UFO news report" on WNBC radio) to organize an audiovisual presentation and arrange for the return visits of Hynek, Vallee, and other UFO personalities.

Spiegel's presentation included both

"classic" and never-before-seen UFO material designed specifically to impress delegates with the seriousness of the UFO phenomenon. "We won't necessarily be presenting a balanced picture," Spiegel remarked before the meeting. "Whenever that's been done, the result is clouded."

Prior to convening the UN committee meeting, Grenada had passed down its original proposal of a special seven-man UN UFO subcommittee—to a three-man ad hoc committee. Their mission was reduced from solving the entire UFO mystery to simply assessing the impact of the UFO phenomenon on world society. But from the moment the presentation began, marked by New York's first heavy snowstorm of the winter (reducing attendance to only one-third of the member delegations), the Grenadan proposal was clearly in trouble. No delegation gave any indication of willingness to spend a dime, a drachma, a kopeck, a peseta, or a penny on the proposed UFO project.

Spiegel's presentation, however, went quite well. It was highlighted by the personal appearance of Lawrence Coyle (whose 1973 UFO encounter was described in this column in January)



New Mexico UFO sighting in 1963 formed part of audiovisual presentation at UN conference

Gary Valco and Hynek also made speeches, along with Stanton Friedman, former nuclear engineer and currently a popular UFO lecturer. Professor Friedman was evidently intended by Gary to replace the absent Cooper and Pater.

In the afternoon, a planned press conference was preempted by Gary, who took the occasion to harangue the gathering about the need for adopting Grenada's UFO proposal. After several hours of this, an embarrassed Valco was heard to ask an equally uncomfortable Hynek if there was any way they could get out of there. But the day finally ended, and with that came the announcement from Grenada's education minister that the UFO show had cost his country \$16,000. The bill was being forwarded to the UN.

In response to Grenada's presentation, the Special Political Committee adopted a "consensus," which in UN legalese is far less formal than a "resolution." The committee recommended that the General Assembly do four things: first, tell the people from Grenada that the UN "has taken note" of their proposal; second, invite member nations to conduct their own research concerning "extraterrestrial life, including unidentified flying objects"; third, pass the Grenada requests to another committee, the one on Peaceful Uses of Outer Space; and fourth, allow Grenada to make another presentation to that committee the following June.

While these recommendations seem insubstantial and primarily a bureaucratic way of mollycoring Grenada, UFO specialists were moderately pleased to see that UFOs had at last been officially acknowledged by the UN. The UN's response, however, falls far short of even the weakest UFO proposals, and even farther short of the "high-level UN

UFO-study project" widely described in the UFO press. It the uttermost silence of other UN delegations is any indication (since, ordinarily, dozens of delegates rush to express their opinions on nearly any topic), a UN-sponsored UFO study will never be approved.

Grenada, meanwhile, may be expected to host the "Second

International UFO Conference," this coming November. The "First International UFO Conference" was held in Acapulco in April 1977 and is universally considered to have been a complete farce. Similar fears are being raised about the second conference. UFO experts, disheartened by the lack of any real progress at the UN and dismayed by what some view as Grenada's exploitation of the UFO issue, are now seeking the sponsorship of other UN states, which have allegedly expressed vague stirrings of interest. The secret hope is that France will sponsor a new resolution, but more realistic observers regard Bulgaria or Nepal as the likely choice.

(Next month Omni will present a UFO proposal based on the UN presentation.)

• • •

There is one famous story about the UN and UFOs, and it comes courtesy of the main office of the UFO Education Center (UFPEC) in Welby Center, California (near Mount Palomar Observatory). Center director Charlotte Blab once boasted of having two branch offices, one in Acapulco, Westport, and one in Guadalajara, Mexico.

According to UFPEC, a 180-meter (600-foot) diameter spaceship settled over a small mountain near Guadalajara in October 1976, causing widespread electrical failures. Soon after the sighting, a being who claimed to be a pilot from the spaceship appeared at a local doctor's clinic, seeking an examination.

"I was shocked at the appearance of the being," the doctor later testified. "His features were the same as a regular human's, but his skin was as white as milk. He insisted that humans on this planet were very low on the scale of evolutionary development."

Later, the physician (elsewhere identified only as "Doctor Diaz") was brought to New York by officials of the UFPEC. A meeting was arranged at the United Nations, at which Diaz was introduced to Ambassador Francis Redhead of Grenada and to a representative of the UN's Technology Applications Section. Somebody then

leaked the story to sympathetic newsmen. TOP UN PROBE WHO MURKOUSLY ENCOUNTERED WITH SPACESHIPS, headlined the weekly tabloid National Star in its April 25, 1978 issue. The article went on to describe how "high-ranking United Nations officials have joined top scientists in a secret investigation of a startling report about a real life encounter of the third kind."

The story was apparently endorsed by leading UFO experts, although the "top scientists" could not be identified.

However, over the following months, some disturbing rumors began to appear. No UN probe was apparently ever launched, and the UN officials whose politely encouraging remarks were widely quoted as having endorsed the sighting refused any additional comment on it, evidently wanting nothing further to do with the episode. Diaz, the eminent forty-five-year-old Mexican doctor, with "impeccable credentials," turned out to be Charlotte Blab's husband, an improbable coincidence of the first magnitude. According to UN insiders, Diaz as much as admitted to them that he had been pressured into going along with a publicity stunt concocted by his wife. And Grenada's ambassador Redhead, whose country has been urging the UN to get into the UFO act, denied that the original meeting had any official status: "It may have been at the UN, but it was not sponsored by the UN." Redhead could not recall who had invited him in the first place.

The most curious coincidence of course, was that the saucer and its pilot had appeared in Mexico next door to the last surviving branch of the "UFO Education Center"; additionally, the fact that the witness had such a close but covered-up relationship with the director of the UFPEC also tended to raise suspicions. What's most significant about the Diaz affair is that nobody in the UFO community seems to have questioned its authenticity—or if they did (and many are now claiming they were skeptical all along), they kept their suspicions to themselves. The tabloid press and the UFO pulp monthlies were left to make the most of it, which they sagely did. □□

CONTINUUM

SPACE FOR POETS?

In six short months, on September 28, the Space Shuttle is scheduled for its first launch. Next year it will begin carrying into Earth orbit payloads for science, government, industry and the general public.

Yes, the general public. For the first time, largely through the medium of the Small-Package Payload (commonly known as the Get-Away Special), for only a few thousand dollars outer space will be within the potential grasp of just plain folks. Larger payloads are similarly dirt cheap. In fact, one can charter the entire shuttle for one flight for \$50 million—less than the budget of the movie *Superman*. In addition, even though the shuttle is not designed to carry passengers, it will regularly carry nonastronaut payload specialists—usually scientists tending projects.

But suddenly, because of the unprecedented availability of cheap, generous payload space and the option of flying nonastronauts, all kinds of unexpected people are applying to get into space—filmmakers desiring to shoot everything from documentaries to weightless romances, artists wanting to experiment with blown-glass sculptures in the unique environment of free-fall, musicians desiring to record their emotional expressions of outer space, journalists wanting to cover the experience for posterity. The demand, in fact, exceeds the shuttle's capacity.

And suddenly according to Jon Michael Smith, director of marketing for the shuttle, for the first time the decision makers at NASA are faced with a remarkable dilemma. Just exactly who should fly aboard the shuttle? Should the shuttle be open to humans as well as scientists? And if so, when should a poet be given priority over a medical researcher experimenting with a cure for cancer?

Up to this point, payloads flown in space have been chosen because of their evident scientific, technological or pragmatic importance. Most people's initial reflex might be to retain those same priorities for the shuttle. But why should they be retained?

First, the initial priorities were set when payload space was precious and launches were costly single shots. Each reusable shuttle, however, will be treated like an airplane—flown, checked, cleaned, and launched again and again—each time lifting a cargo bay the size of a six-story building and capable of holding 30,000 kilograms.

Second, although our twentieth-century world runs on prag-

matic science and technology, these are by no means the be-all and end-all of existence. Human life is enriched with stirring Homeric passages, the sweet, wordless piano notes of a Chopin polonaise, the silent living marble of Michelangelo—absolutely none of which is necessary for eating, sleeping or procreating, but all transforming barren existence into vibrant life. It is easy to think of the humanities and the arts as divorced from the technological feats of space, but perhaps the shuttle program needs the humanities and the arts—in order to survive.

A century ago, long after the gold had been sluiced out of the California riverbanks, the romantic lore of the frontier West kept invigorating human vision. Yet just a decade ago, the landings of men on the moon—the most momentous and romantic adventures of human history—were handled so (dis-)tastefully after the initial triumph of Apollo 11 that by Apollo 17 much of the general public was bored, and that boredom eventually secured its bitterness as to what it was all about. It would be all too easy for the shuttle, through repetition, to become regarded as a humdrum trucking company instead of being cloaked in the exotic mystique of a freighter bound for parts unknown. Perhaps only the serenity of an artist can freshly capture and sustain that vigor.

If the shuttle should indeed welcome humanists as well as scientists, how should we evaluate the projects? Remember, the shuttle is built and operated by public funds—our tax dollars. It is a large public trust. And a public trust demands—and deserves—public return.

There are at least two components to the value of any humane enterprise. The first is its intrinsic worth, its quality—graciously tough to define even by peer review. The second is its public worth—that is, its accessibility to the public both physically and conceptually. During the first few critical years of the shuttle's operation, it might be wise to place particular weight on those projects that can be both widely disseminated through a major forum (be it theater, museum, recording company or publishing house) and widely appreciated—a tricky criterion since it involves personal taste in judging whether something is too esoteric or obscure to be of public worth. Above all—unless after a certain indecisive point we choose to select projects simply by lot—any good policy should be sufficiently flexible to allow us just to play a hunch.

—TRUDY E. BELL

CONTINUUM

DESERT CREEP

Each year thousands of square miles of land are taken over by slowly expanding deserts. This phenomenon of "desert creep" is both the effect and the cause of droughts and climatic changes that can mean starvation for millions of people.

Recently however, two U.S. scientists have developed for the State Department a plan to actually reverse desert creep in Mauritania, on the western end of Africa's Sahara.

Plant scientist Howard L. Mills of Marshall University and his colleague, engineer Warren E. Grabau, recommend that plant nurseries be established in the problem areas. The nurseries would raise sand- and drought-resistant plants ranging from tough

American mesquite and oak to sturdy Arabic gum trees. When the plants were large enough, they would be arranged in vital hedgerows in and around towns and fertile lands. Such green belts would be the beginnings of naturally expanding ecosystems and would also serve as barriers against the howling Ma. hidden winds and driven sand.

Because the recommended plants would require two years of watering before their roots could tap underground sources of water, the Mauritanians must conserve water. One method Mills and Grabau suggest is to construct grids to underground cisterns. Another proposal is to cover the surfaces of reservoirs with polystyrene balls to reduce the amount of water lost through evaporation.

—Wilma Y. Whitley



Sandy, rocky growth plants placed in hedgerows around fertile areas may hold the key to turning the desert into an oasis.

PLANT VACCINE

Plants can be immunized against destructive fungi in much the same way that humans are given protection



A vaccine in the form of a spray immunizes Kuc's plants against diseases—by vaccination.

Using what he calls "leading new techniques," Dr. Joseph Kuc at the University of Kentucky has devised a plant vaccine that may soon lead to a natural means of safe pest control.

The plants are vaccinated not by injection but by spraying them with a concoction of infectious organisms that have been weakened or "defused." The vaccination causes the plant's immune system to release sticky substances known as lectins that trap the infectious organisms in clumps on the surface of the plant. The plant then produces antibodies that destroy the clumps, thus

conferring on the plant a greater immunity to subsequent attacks by virulent organisms.

Kuc and his colleagues at the University of Kentucky's College of Agriculture at Lexington have already successfully vaccinated cucumber, watermelons and muskmelons in field trials. They report that both the immunized plants and cuttings grown from them remain healthy despite applications of virulent fungi to their leaves.

—Phyllis Wolman

WHALING RECORDS

Ironically, records of the slaughter of whales during the last two centuries may prove to be the salvation of those whales alive today. In the meticulously drafted logbooks and journals of the whaling era, he dates that could indicate the size, abundance, and age distribution of the whale population for 200 years. That data, when compared to similar estimates of today, might support the theory that the great mammals are indeed nearing extinction, thus providing a definite basis for a ban on whaling by the International Whaling Commission.

At the tip of this informational iceberg is Stuart C. Sherman, professor of bibliography at Brown University and author of *The Voice of the Whales*. Assisted by Brown University's IBM 360/67 computer and a grant from the Marine Mammal Commission,

Sherman is culminating some thirty years of work to produce a bibliographic guide to "every (whaling) log and journal known to be in existence."



Sherman displays whaling log and other seafaring artifacts.

Of the 13,627 voyages known to have been made by U.S. vessels, Sherman has located about 4,000 logbooks and has uncovered an additional 400 foreign records. He is hoping to hear from others who could perhaps provide some long-forgotten journal handed down from a seafaring ancestor.

—William F. Allman

CHEAP DRUNKS

Did you know that you could drink yourself into a stupor—with water? According to physician R. Emery, writing in the *British Medical Journal*, two female psychopaths encouraged by reading a newspaper

article on water intoxication promptly proceeded to satisfy their longing for alcoholic oblivion by these insipid means. Alas, results were less than gratifying—and clearly affirm the virtue of moderation. One of the women had to give up after her sixteenth glass of water because of headache. The other one drank herself into a coma and had to be treated for convulsions.

This rare but fascinating phenomenon is known as polydipsia (from the Greek word *dipsa*, "thirst") and is produced by the migration of water from the vascular space into the brain tissues owing to osmotic pressure. Polydipsia is not always caused by overindulgent consumption of water. Hans Langgurd and William O. Smith explain in the *New England Journal of Medicine* that it may often result from sodium depletion in the body. Persons with renal insufficiency or those who work in high-temperature conditions are thus more susceptible to this affliction. But for some obscure reason, the syndrome has most commonly been observed in schizophrenic patients.

Although there are few less expensive ways of getting drunk, the odd effects of headache, blurred vision, ataxia, coma, and convulsions that often accompany water intoxication make it an undesirable method of achieving the goal. So much for cheap highs.

—Ercel L. Nergovskis

MAGNETS IN BEES

Scientists have long suspected that birds, sharks, and even some mud bacteria can detect the earth's magnetic field. Now James Gould, a biologist at Princeton University, thinks he has found evidence that bees may also have this capability.

Past researchers have noted that the bee dance, the distinct movements by an individual in a hive that conveys information as to the location of food, becomes more accurate when the bees are in an environment in which the earth's magnetic field is eliminated. They have also observed that bees that must dance when the hive is turned on its side become disoriented at first but then orient their dances to the four cardinal points of the magnetic compass. Furthermore, bees seem to

set their behavior to the regular daily variations in the earth's magnetic field.

Gould thinks that the capability to perform these behaviors may lie in the fact that bees have been found to contain tiny magnetic crystals called magnetite in their abdomens that perhaps act as permanent magnetic detectors that can react with relation to the field and influence the animal's behavior.

Although bees may use a magnetic mineral to orient themselves in space, Gould is still a bit skeptical. "It could easily be a gravity detector," he says, "or it may not be a detector at all. It may be that the magnetic mineral has nothing to do with a detection system."

To find out the exact role of magnetite in bee behavior, the biologist has further studies planned.

—Kathleen Jon Rose



Maybe bees may use a magnetic mineral, magnetite, to detect the dance for communicating the location of food sources.

CONTINUUM

PLANT POLLUTION

Plants, rather than vehicles or industry may be the major source of smog. Several years ago it was

estimated summer vegetation levels on the basis of rainfall the preceding two winters.

By calculating the amount of vegetation in this manner, the BAAPCD was able to



Divers upset by their obstructed view may be surprised to learn that plants could be a big source of photochemical smog.

shown that plants emit hydrocarbons which, under appropriate conditions, may result in photochemical smog. However, this finding was not widely appreciated until recently when the Bay Area Air Pollution Control District (BAAPCD) in San Francisco revealed data suggesting that in many suburban as well as rural areas, plants make a larger contribution to measured ozone levels (a smog indicator) than do human activities.

In the San Francisco Bay area, as in much of California, rainfall is the primary factor limiting plant growth. In California, most rain falls in the winter, it is therefore reasonable to

show that plants accounted for three quarters of the year-to-year difference in hydrocarbon levels at two suburban monitoring stations and for two thirds at a station directly downtown from Oakland and San Francisco. They even account for a third of the variation in smog levels near a major petrochemical complex in downtown San Francisco. Furthermore, since plants release more hydrocarbons on hot days than on cool ones, it is now clear why smog alerts usually occur on stiflingly hot days.

In view of these findings, smog control programs will need careful reevaluation.

—W. A. Thomason

WOLF SONG

When musician Paul Winter recently performed before a group of gray wolves for his new album, *Common Ground*, featuring the sounds of the humpback whale and the Alaskan fish-eagle, it was not just the wolves that were interested. Apparently, after Winter played several howl-like phrases on his saxophone, the wolves responded with howls of their own, in the same shape and length of phrase and in the same key as Winter's music.

It has been known for some time that wolves howl either in order to keep the pack together or to avoid other packs. But the howl serves far more intricate purposes as well. Fred Hamington, an expert on wolf behavior at Mount Saint Vincent University in Canada, believes the howls

are on specific that wolves can tell each other apart by them. He also believes that howls may express the animals' frame of mind.

As for the wolves' response to Winter's music, Hamington sees some important work coming out of it. The structure of the howl seems to be somehow meaningful in wolf behavior, and the scientist believes that harmonics and not the actual pitch also play an important role in inter-species language. Hamington is fascinated by one of the female wolves who kept howling long after Winter had stopped playing and the other wolves had stopped howling. Though he is not altogether sure what this means, he does offer one explanation: Her duet with the musician may have been sexual in nature. She wanted to mate with him.

—K. J. R.



Winter's music turned to this howl, with the wolf responding with howls of their own in the same key and length of phrase.

DIET COMPUTER

Overweight Americans have a new ally in their fight against fat—the computer.

At Beth Israel Hospital in Boston, a PCP-15 computer has been playing diet counselor for two and a half years. In conference with the patient, the computer cross-examines the individual about his general eating and exercise habits, diet, weight, and medical history. These questions appear on its cathode-ray screen. The patient answers by typing his responses on the keyboard.

The computer helps the patient analyze a typical day's calorie intake, then draws up a custom-made diet plan. The computer suggests techniques for behavioral control of eating as well as ways to increase activity and, on completion, generates a printed summary for use by the patient and nutritionist.

—Timothy Boy

FINGERPRINTS

Every individual, even an identical twin, has his own unique fingerprint that remains unchanged his entire life span. But what determines the pattern? Is it due solely to factors in the upper layer of the skin, the epidermis, where the ridges actually form, or does it reflect an underlying pattern in the lower skin layer, the dermis?

Two MIT biologists, Howard Green and Judith Thomas, have developed a tissue-culture method that,

for the first time, permits human epidermal cells to grow in the absence of other growing cells—cells whose growth pattern might determine that of the



Epidermal cells grown alone like fingerprints have epidermal cells. To their surprise, they noted that the growing skin cells clumped together into ridges, and the ridges wound themselves into whorls closely resembling those found in human fingerprints. This strongly suggests that whatever the ultimate origin of the fingerprint pattern, its explanation must lie in properties of the epidermal cells themselves.

—W. A. T.

"Literary intellectuals at one pole—at the other scientists. Between the two a gulf of mutual incomprehension."
—Charles Percy Snow, *The Two Cultures and the Scientific Revolution* (1959)

SKIN FLICKS AND EXERCISE

If you're not physically fit, your physiological reaction to an erotic film may be greater than that of some one more fit. So report psychologists Joanne Canton, Dali Zilman, and Kenneth Day in the journal *Perceptual and Motor Skills*.

In an experiment involving some sixty students, subjects were given ratings of fitness based on physiological response and recovery after exercise, and then were shown an erotic movie. Less fit subjects displayed increased blood pressure and lower skin temperature while the more fit people experienced a lower physiological response.

The students' own perceptions of their arousal, however, did not correlate with their actual response. In fact, the less fit the subject,

the less accurate was his or her awareness of the reaction.

The implications of the experiment reach into the relationship between emotional stress and physical condition. Previous studies have shown that a person already aroused by one stimulus will experience a more intense reaction to a second stimulus. Noting that the duration of arousal is related to fitness, Dr. Carter believes: If you are physically less fit and you do something arousing physically or emotionally, you are more susceptible to overreacting to a subsequent emotional arousal. This would imply that people in good physical condition are better able to recover from emotional stress, lending scientific credence to the adage: A sound body is a sound mind.

W. F. A.



Erotic film gave unvigorous medical men. Less fit subjects displayed increased blood pressure, lower skin temperature.

CONTINUUM

NOISE AND DEATH RATES

Two neighborhoods similar in socioeconomic and age distributions but differing in proximity to the Los Angeles International Airport and thus in background-noise levels, were recently studied by Dr. William C. Meecham of the University of California at Los Angeles, an engineering professor specializing in aerodynamics. The one closer to the airport, he discovered, has a 19 percent higher mortality rate than the one farther away. Although further analyses are needed in order to establish the reliability of the work, Meecham's research has been delayed until freedom-of-information litigation against the Los Angeles Department of Health restores public access to health records.

Meanwhile, according to Meecham, other research on the incidence of disease in areas adjacent to airports has demonstrated greater frequencies of nervous breakdown and birth defects for those populations than for ones in quiet areas.

Convincing evidence pinpointing noise as the cause of health problems is difficult to find. Skeptics argue that health problems are related to socioeconomic levels—a factor that has not been ruled out in neighborhood-noise studies. Nonetheless, Meecham's results show small but consistent increases in mortality rates for all cause-of-death categories, and if similar mortality patterns were found in several major cities, the argument that loud noise is harmful to one's health would gain strength.

—Phyllis Burns



Noise may be a serious health threat. Higher death rates and disease have been reported in people who live near airports.

WEATHER ARCHAEOLOGY

Thompson Webb is not a conventional weatherman. He doesn't predict the



Pollen makes some parts of our lives colorful.

future. Rather, he is concerned with reconstructing the past by analyzing fossil pollen embedded in lake sediments.

The dustlike pollen grains accumulate by the tens of thousands per square centimeter in lake beds, glowing an average of one meter deep every 1,000 years. Since the composition of the pollen reflects that of the local vegetation, Webb, an associate professor of geology at Brown University, has been able to piece together climatic changes over the 11,000-year period since the last ice age.

J. Christopher Bernabo, a fellow with the American Geophysical Union, has worked intimately with Webb

on a climatic study of the Great Lakes region and New England. The result of their work is a series of maps that show rapid changes (geologically speaking) in the climate of North America.

For 4,000 years after the retreat of the glaciers, the spruce, or Boreal forest, that is now found in southern Canada also retreated from a position well south of the Great Lakes and was gradually replaced by oak and pine—an indication of a warming trend. About 7,000 years ago, however, the warming ceased, and the spruce began a slow advancement on their former border. If this cooling trend continues, the spruce may eventually return to areas where soybeans and corn are now growing.

Like most people who deal with the weather, Webb is cautious about predicting the future. "In the short term," he says, "our data indicate only that things will vary. We don't have the knowledge to predict long-term trends, but we should perhaps consider decelerating our industrial-growth rate until we better understand the consequences of our actions."

—W. F. A.

"Science is built up with facts, as a house is with stones. But a collection of facts is no more a science than a heap of stones is a house."

—Jules Henri Poincaré, *La Science et l'Hypothèse* (1908)

ELECTRONIC MAIL

Although electronic mail originated 130 years ago with the invention of the telegraph, it is doubtful that in 1845, Samuel Morse envisioned today's electronic message system (EMS), in which messages are stored and forwarded from one city to another via computer. With EMS, it is now possible to convert data into digital form and transmit it from terminal to computer to terminal (final destination) in seconds using telephone lines.

Sender and recipient do not have to be present at the same time to communicate by using EMS. In addition, rapid and reliable service is guaranteed—not delays the case with the postal service.

President Carter and Vice-President Mondale first employed EMS in 1976 to coordinate their election

campaign; now it is being used on an experimental basis in the executive office of the president to enhance the decision-making process.

A more sophisticated EMS experiment is being conducted by the U.S. Postal Service, in which a message will be sent via satellite from one room to another in a Washington laboratory. If experimental trials are successful, EMS antennae beaming signals via satellites may soon become as ubiquitous as rooftop tv antennas.

The cost of sending an electronic message from Washington, D.C. to London, England, is estimated at \$10.

In only five years, some 25 billion pieces of mail, or one quarter of today's mail volume, could be delivered electronically.

—Pender M. McCarter

BABY DINOSAURS

The discovery sent shock waves through the scientific community. For years, it was assumed that dinosaurs did

just merely meander away from the nest. Horner found the remains of an adult duckbill nine meters long. Now Horner is putting the pieces together to determine what



After comparing it to a baby duckbill dinosaur (in hand) with that of an adult, young only one meter's from duckbill nest.

to help in the upbringing of the young. But then John B. Horner, assistant curator of Princeton University's Natural History Museum, found the remains of a nest of baby duckbill dinosaurs giving support to the theory that some of these reptiles may have cared for their offspring in a way similar to that of modern-day birds.

The nest, discovered at the edge of a Montana prairie ninety-seven kilometers west of Great Falls, contained the fragmented fossils of fifteen baby duckbills and their eggshells that had been buried in the plain some 75 million years ago.

By itself, it was a paleontologist's dream. "It

relation the adult had with the young. It is theorized by many that the duckbill lived by the water but Horner goes one step further. "It appears that the environment that they were raised in was different from the one they matured in. They were raised in a more upland area as opposed to living later in life in a more river-valley situation."

As for the religion of the young to their mother, Horner thinks that they were quite like the ducks of today.

They were probably ready to get right up out of the nest with the mother and go for water, rather than sitting in the nest and having the parent bring them food.

—K. J. R.



The newest NSA satellite that will soon be used for transmitting and the speed electronic mail messages overseas.

CONTINUUM

ELECTRONIC MOUSETRAPS

Many claims have surrounded new electronic devices on the market for eradicating common household pests such as

Valley California. On finding that the devices had no effect on rodents, the agency banned their sale in March of last year.

But the repelling capability of these devices is far from a settled issue. One



Mousetraps may become obsolete if other rodents have the same stressful reaction to high-frequency noise as the rat above.

cockroaches, termites, rats and mice. These products emit ultrahigh frequencies far too high to be humanly audible, that purportedly "repel," stress, and "disorient" vermin while not affecting domestic animals and game. To date, the profit from sales of these devices has produced at least one millionaire. One company reports having sold 12,000 electromagnetic repellers at \$350 to \$1,000 each.

The Environmental Protection Agency (EPA) recently investigated the claims made on two models of electromagnetic devices put out by Mrs. Manufacturing Company in Pine

of Mrs.'s customers, the U.S. Marine Base at Camp Pendleton, reports using two of Mrs.'s devices to clear a four-hectare paradise field of gophers. A San Diego chicken farmer said the device cleared the farm of 10,000 mice, which were bothering his chickens within four or five days.

To find out whether the nation's most prevalent pests are really disturbed by alterations in their electromagnetic field, the EPA has awarded five nationwide grants to universities for conducting tests on a variety of devices sold under different brand names.

CHOLESTEROL RECONSIDERED

A new test is available to the public that may take some of the worry out of the word cholesterol and bring eggs, shellfish, and liquor back into the diet.

In contrast to conventional determinations of cholesterol levels, which indicate only the total amount of cholesterol present in the blood, this test gives values for the amount of high-density lipoproteins (HDL) present.

HDL, one of several particles which transport cholesterol in the blood, has been found in high levels in people—particularly women—who are considered to have a low risk of coronary attack. This correlation has led some doctors to believe that HDL helps remove cholesterol from the arteries, cholesterol deposited there by low-density lipoproteins (LDL), a far more dangerous type of carrier. It is the cholesterol from LDL that tends to accumulate in the arteries and can lead to heart disease. The female hormone, estrogen, increases the blood level of HDL. There are only two other things known to increase HDL: exercise and moderate drinking.

According to Dr. Peter Herbert at Rhode Island's Miriam Hospital, there is no such thing as good or "bad" cholesterol. It is present in every cell in the body and is produced and regulated in the liver. Contrary to the advice of

organizations such as the American Heart Association, Dr. Herbert believes that a reduction in the diet of cholesterol-laden foods such as eggs and shellfish is of little benefit. "The liver controls the cholesterol level," he says. "If the diet does not supply enough, the liver will simply produce more."

What is dangerous, it seems, is an excessive intake of foods containing great amounts of saturated fat, such as whole milk, butter, lard, and fatty meats. This can lead to a high level of LDL.

With this test, people previously considered prone to heart attacks may be shown to be at low risk.

—W F A



Low density lipoprotein, top; high density lipoprotein, bottom.

TICKET TO SPACE

By the 1990s a trip to an orbiting resort may cost the same as a cruise on the Queen Elizabeth II

BY G. HARRY STINE

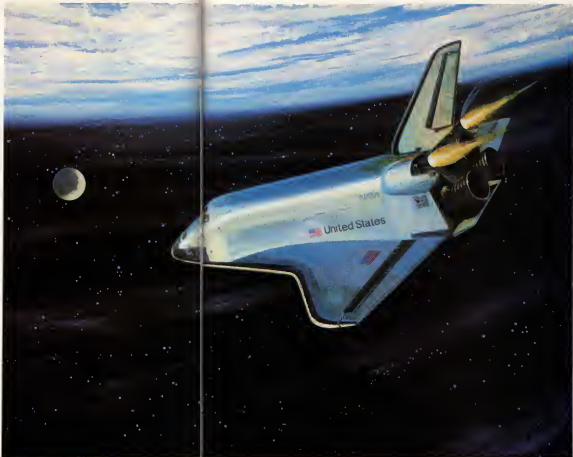
Here the old and the new mingle," the travelogue narrator intones majestically. "People traveling to far-off and unusual places for whatever reason compels them—vanity, boredom, to get away from it all, or just to see and experience something new—that's the old of space travel. The new factor is space itself—the sensation of weightlessness that you cannot obtain anywhere else and the overwhelming vista of planet Earth sliding past the window. So, as the space station sinks slowly in the West.

Yes, it can't come to pass some day and not that far in the future. You may indeed be able to buy a ticket to fly to a space station or space resort in Earth orbit for a price you can afford. Your children will almost certainly be able to do so.

But don't stand in line to buy your ticket yet. As a matter of fact, don't write to NASA about it. Even though NASA has the Space Shuttle, such things as commuter services and group tours to orbit are not in the NASA "mission mode."

Thus, the Space Shuttle promises regular flights to Earth orbit and back every week, provided the government's Office of Management and Budget or the General Accounting Office does not decide in its infinite technical wisdom that the Space Shuttle isn't cost-effective, causing NASA to store the Space Shuttle orbiters in a hangar somewhere like the Hughes Spruce Goose. Even if everything goes according to NASA plans, you probably couldn't afford a ticket to orbit on the Space Shuttle even if you could purchase one.

In fact, the majority of us could not afford the price even if we mortgaged everything we own. The Space Shuttle was supposed to be an inexpensive way to get into orbit, when the system was originally designed more than a decade ago, but





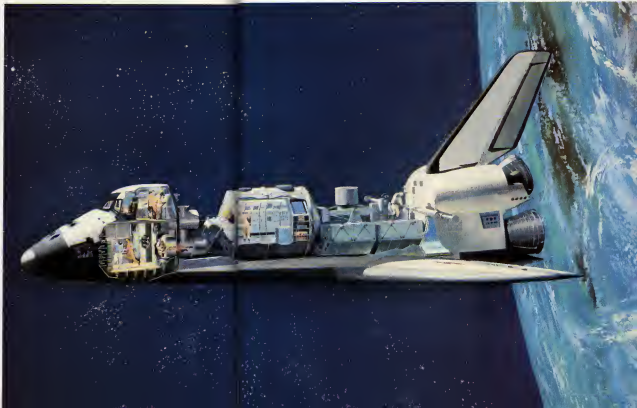
• NASA has arrived at a preliminary figure of \$21,000,000 for a Space Shuttle flight •

political compromises resulted in technical trade-offs that raised shuttle costs by at least a factor of three, even taking inflation into account. Remember that an elephant after all, is a mouse built to government specifications.

NASA has arrived at a preliminary figure of \$21,000,000 for a Space Shuttle flight, basically by adding up the cost of all the solid and liquid rocket propellants consumed, the costs of the expendable items such as the big external tank, the main-power costs of the crew and the ground personnel, and the pro rata share of the total research-and-development costs of the entire program spread out over the 100-flight lifetime of each Space Shuttle orbiter. A cost analysis indicates that NASA may also be adding in a lot of "overhead," including the salaries of nearly all NASA employees. For a 30,000 kilogram payload, this amounts to about \$700 per kilogram. (A passenger is considered to weigh seventy-five kilograms, in accordance with standard commercial-airline practice, this makes a ticket worth about \$55,000. There may be other costs involved, too—life-support consumables, on-orbit power, or utilities costs, and radio-communications charges, all of which would make your monthly home utility and telephone bills look minuscule in comparison.

But all of that really doesn't make any difference, because nobody can buy a Space Shuttle ticket at any price. For one thing the shuttle has not been certificated by the Federal Aviation Administration (FAA). Everything that flies in the air in the United States of America carrying one or more passengers must possess a "certificate of airworthiness" issued by the FAA when the particular flying machine is built. The FAA and NASA got together on this for the Space Shuttle some years back, and NASA managed to convince the FAA that the Space Shuttle was not an airplane, would not be carrying passengers for hire, and therefore did not need to be certificated. Although this is not 100 percent correct, the FAA bought it: it gave the FAA a compromise and easy way out, because they didn't have the slightest notion how to

Cutaway of NASA's Space Shuttle Orbiter (right) shows SpaceLab, carrier airframe, and multipurpose laboratory that will enable scientists to experiment in the gravity-free environment of space.



test a spacecraft in order to assure it a certain state of airworthiness. In the not too distant future, however, the FAA is going to have to figure out how to certify a spaceship like the Space Shuttle or suffer the ignominious bureaucratic shame of abrogating jurisdiction over spacecraft.

It is indeed a problem, however, because there is a market for flights into space, and as technology progresses there will be a response to this market desire. Back in 1962 the Hayden Planetarium of the American Museum of Natural History in New York began signing up people who wanted to buy a ticket to go to the moon. It was an excellent publicity gimmick, but the Hayden Planetarium was totally unprepared for the deluge of requests that came in from all over the world. They still get requests even today, more than a quarter of a century later.

If there is a market out there, how many people would like to take a ride into orbit and back? Can these people be characterized? And what would they be willing to pay for going on such a trip? This is a job for market research, and some pretty solid numbers can be generated. Furthermore, these numbers are reasonably reliable now and will become more firm in the future.

Since space tourism doesn't exist yet, we have to look at current tourism and travel data. From this, we may be able to derive some information by analogy.

Obviously the first assumption that can be made is that space travel is going to be

expensive. "Expensive" is a relative term whose magnitude changes with time. Automobiles and airplanes were once affordable only by very very wealthy people until Henry Ford and William Piper got busy.

The most expensive form of travel today is overseas travel. In 1972, there were 6,700,000 Americans who traveled overseas, a respectable 3.38 percent of the population. Of these, 73,000 people went overseas the expensive way—by ocean-going ships. Total expenditure for ocean-going travel in 1972 was \$7,716,000, an average of \$1136.36 per person in 1972 dollars. This is a surprisingly large market both in dollar volume and in number of people. Obviously there are more than 50,000 people in the United States who are willing to spend more than \$1,000 every year just to do something different and to go somewhere for fun. They are not necessarily members of the jet set, but have upper-middle class or upper-class incomes. We should not use the jet set as a characteristic market, although the jet set may indeed look onto space travel as an "in-thing" to do once it becomes available. A much more reliable market analogue is the ocean-going cruise market, which is roughly 50,000 people per year willing to spend from \$1,000 to \$5,000 for a trip.

We are comparing apples and oranges, however. Ocean-going travel is based upon distance and time. Space travel is based upon dollars per kilogram. Distance means very little in space travel, although time may

be a factor. We can reconcile apples and oranges here by looking at two analogous markets: The first of these is airline transportation and the historical development of the commercial-airline travel market. We can use it to determine the lower limit of the space-travel market.

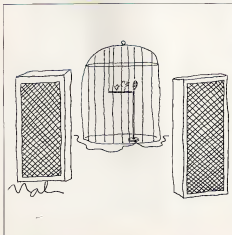
In 1935, the airlines put the first commercially and economically feasible airplane, the Douglas DC 3, into service and began to make money hauling people rather than mail. Air travel costs were 22.4 cents per mile in 1976 dollars. Today air travel costs have dropped as low as 8 cents per mile and probably will go even lower with airline deregulation. Air terminals are now as busy as railroad stations used to be. To make a sound apples-to-oranges conversion, consider a flight halfway around the world—New York City to Sydney, Australia—which consumes about the same amount of energy as a trip into orbit and which costs roughly \$1,000 one way in space-travel terminology, considering the average seventy-five-kilogram passenger: the airline trip works out to \$12.94 per kilogram one way and \$25.88 per kilogram round trip. So there is a market for travel at \$20 per kilogram. It costs, it is proven, it is very large, and it is expanding.

The other end of the scale is the round-the-world trip on an ocean-going ship. The lower-limit cost of going around the world on the H.M.S. Queen Elizabeth II runs about \$4,000, give or take a few hundred bucks. In space-travel terminology, this works out to \$90 per kilogram. So there is also a market for travel at \$50 per kilogram, albeit a smaller market.

These numbers tell us this: (a) If costs can be brought down to \$30 per kilogram in 1976 dollars, there is a market for perhaps 5,000 people per year. (b) If costs can be brought down to \$20 per kilogram, there is a potential market for about 50,000 people per year. These numbers are based upon current overseas-travel data and are constant 1976 dollars.

This does not sound like a very big market, even at \$20 per kilogram, until one looks more closely at it. We are talking about a ticket price of \$1,700 paid by 50,000 people per year. That amounts to a gross revenue from ticket sales alone of \$85,000,000 per year. It means putting 8.5 million pounds of payload into orbit per year. Putting 50,000 people per year into orbit means 962 people per week or 137 people per day!

Today, when we are used to putting two, three, or even seven people into orbit at a time, usually months apart, this sounds like an incredible possibility. But please don't lose perspective. In 1926, when the Kelly Bill was passed and the transportation of air mail was taken from the Post Office (who had their own mail planes) and given to commercial operators under contract, a milestone that marks the beginning of the commercial-airline system of the United States, a grand total of 5,782 airline passengers was flown. By 1934, that had risen



1.



2.



3.



4.



5.



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— il l ee



FICTION

UNACCOMPANIED SONATA

He was an artist, so he had to be kept under close control

BY ORSON SCOTT CARD

When Christian Harokiden was six months old, preliminary tests showed a predisposition toward rhythm and a keen awareness of pitch. There were other tests, of course, and many possible routes still open to him. But rhythm and pitch were the governing signs of his own private zodiac, and already the reinforcement began. Mr. and Mrs. Harokiden were provided with tapes of many kinds of sound and instructed to play them constantly, whether Christian was awake or asleep.

When Christian Harokiden was two years old his seventh battery of tests pinpointed the path he would inevitably follow. His creativity was exceptional, his curiosity insatiable, his understanding of music, an intense that on top of all the tests was written "Prodigy."

Prodigy was the word that took him from his parents' home to a house in dense deciduous forest where winter was savage and violent and summer a level, desperate eruption of green. He grew up, cared for by winging servants, and the only music he was allowed to hear was bird song and wind song and the crackling of winter wood, thunder and the hard cry of golden leaves as they broke free and tumbled to the earth, rain on the roof and the drip of water from eaves, the chatter of squirrels and the deep silence of snow falling on a moonless night.

These sounds were Christian's only conscious music. He grew up with the symphonies of his early years only distant and impossible-to-remember memories. And so he learned to hear music in unusual things—for he had to find music, even when there was none to find.

He found that colors made sounds in his mind. Sunlight in summer was a blaring chord, moonlight in winter, a thin, mournful wail. New green in spring, a low murmur in almost (but not quite) random rhythms, the flash of a red fox in the

PAINTING BY EVELYN TAYLOR

leaves, a gasp of sudden startlement.

And he learned to play all those sounds on his instrument. In the world were various trumpets, and clarinets, as there had been for centuries. Christian knew nothing of that. Only his Instrument was available. It was enough.

Christian lived in one room in his house, which he had to furnish most of the time. He had a bed (not too soft), a chair and table, a silent machine that cleaned him and his clothing, and an electric light.

The other room contained only his instrument. It was a caracol with many keys and strips and levers and bars, and when he touched any part of it, a sound came out. Every key made a different sound, every point on the strips made a different pitch, every lever modified the tone, every bar altered the structure of the sound.

When he first came to the house, Christian played (as children will) with the instrument, making strange and funny noises. It was his only playmate, he learned it well, could produce any sound he wanted to. At last he delighted in loud, blaring tones. Later he began to learn the pleasure of silences and rhythms. And soon he began to play with soft and loud and to play two sounds at once and to change those two sounds together to make a new sound and to play again a sequence of sounds he had played before.

Gradually the sounds of the forest outside his house found their way into the music he played. He learned to make winds sing through his instrument, he learned to make summer one of the songs he could play at will. Green with its intricate variations was his most subtle harmony, the birds cried out from his instrument with all the passion of Christian's loneliness.

And the word spread to the licensed Listeners:

"There's a new sound north of here, east of here, Christian Haralocan, and he'll tear out your heart with his songs."

The Listeners came, a few to whom vanity was everything first, then those to whom novelty and vogue mattered most, and at last those who valued beauty and passion above everything else. They came and stayed out in Christian's woods and listened as his music was played through perfect speakers on the roof of his house. When the music stopped and Christian came out of his house, he could see the Listeners moving away. He asked and was told why they came, he marveled that the things he did for love on his instrument could be of interest to other people.

He felt strangely even more lonely to know that he could sing to the Listeners and yet never be able to hear their songs.

"But they have no songs," said the woman who came to bring him food every day. "They are Listeners. You are a Maker. You have songs, and they listen."

"Why?" asked Christian, innocently.

The woman looked puzzled. "Because that's what they want most to do. They've been tested, and they are happiest as Lis-

teners. You are happiest as a Maker. Aren't you happy?"

"Yes," Christian answered, and he was telling the truth. His life was perfect, and he wouldn't change anything, not even the sweet sadness of the backs of the Listeners as they walked away at the end of his songs.

Christian was seven years old.

FIRST MOVEMENT

For the third time the short man with glasses and a strangely inappropriate mustache dared to wait in the underbrush for Christian to come out. For the third time he was overcome by the beauty of the song that had just ended, a mournful symphony that made the short man with glasses feel the pressure of the leaves above him, even though it was summer and they had months left before they would fall. The fall was still inevitable, said Christian's song, though all their life the leaves held within them the power to die, and that must color their life.

• *"You have broken the law. You were put here because you were a genius, creating new things with only nature for your inspiration. Now you're derivative. You'll have to leave."*

The short man with glasses went—but when the song ended and the other Listeners moved away he hid in the brush and waited.

This time his wait was rewarded. Christian came out of his house, walked among the trees, and came toward where the short man with glasses waited. The man admired the easy, unpostured way that Christian walked. The composer looked to be about thirty yet there was something childish in the way he looked around him, the way his walk was aimless and prone to stop so he would just touch (and not break) a fallen twig with his bare toes.

"Christian," said the short man with glasses.

Christian turned, started. In all three years, no Listener had ever spoken to him. It was forbidden. Christian knew the law. "It's forbidden," Christian said.

"Here," the short man with glasses said, holding out a small black object.

"What is it?"

The short man grimaced. "Just take it. Push the button and it plays."

"Plays?"

"Music."

Christian's eyes opened wide. But that's forbidden. I can't have my creativity polluted by hearing other musicians work. That would make me imitative and derivative, instead of original.

"Reckless," the man said. "You're just reciting that 'The Ja Bach's music.' There was reverence in his voice."

"I can't," Christian said.

And then the short man shook his head. "You don't know. You don't know what you're missing. But I heard it in your song when I came here years ago, Christian. You want this?"

"It's forbidden," Christian answered, for to him the very fact that a man who knew an act was forbidden still wanted to perform it was astounding, and he couldn't get past the novelty of it to realize that some action was expected of him.

There were footsteps, and words being spoken in the distance, and the short man's face became frightened. He ran at Christian, forced the recorder into his hands, then took off toward the gate of the preserve.

Christian took the recorder and held it in a spot of sunlight coming through the leaves. It gleamed dully "Bach," Christian said. Then, "Who the hell is Bach?"

But he didn't throw the recorder down. Nor did he give the recorder to the woman who came to ask him what the short man with glasses had stayed for. He stayed for at least ten minutes.

"I only saw him for thirty seconds," Christian answered.

"And?"

"He wanted me to hear some other music. He had a recorder."

"Did he give it to you?"

"No," Christian said. "Doesn't he still have it?"

"He must have dropped it in the woods."

"He said it was Bach."

"It's forbidden. That's all you need to know if you should find the recorder, Christian, you know the law."

"I'll give it to you."

She looked at him carefully. "You know what would happen if you listened to such a thing?"

Christian nodded.

"Very well. We'll be looking for it, too. I'll see you tomorrow, Christian. And next time somebody slays after, don't talk to him. Just come back in and lock the doors."

"I'll do that," Christian said.

There was a summer rainstorm that night, wind and rain and thunder, and Christian found that he could not sleep. Not because of the music of the weather—he'd slept through a thousand such storms. It was the recorder that lay against the wall behind the instrument. Christian had lived for nearly thirty years surrounded only by the wild, beautiful place and the music he himself made. But now—

Now he could not stop wondering. Who was Bach? Who is Bach? What is his music? How is it different from mine? Has he discovered things that I don't know?

CONTINUED ON PAGE 100



"That's wonderful, Leonardo! Now show us those stewardess uniforms you've designed!"

EINSTEIN'S LEGACY

Electric eyes, lasers, invisible molecules, solar cells—mere by-products of his goal of completely understanding the universe

BY ROBERT L. FORWARD

Albert Einstein was born 100 years ago this month. There was no indication at the time that the few kilograms of gray matter in the mewling infant would grow into an intellectual rocket whose mighty blast would shake the very foundations of physics and illumine the farthest reaches of space and time.

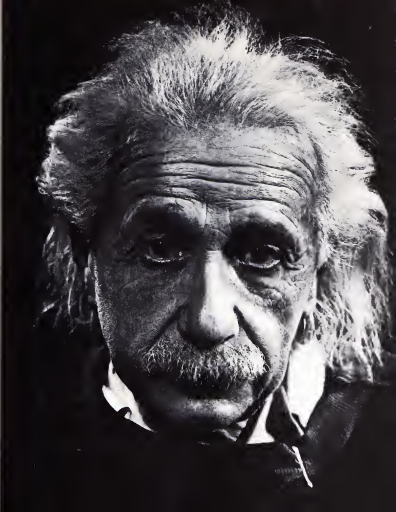
Most people are aware that Einstein had something to do with the invention of nuclear energy (because of his famous equation $E = mc^2$ [one of the few equations you will find in newspapers]). Others may know of his special theory of relativity, which brought us the famous twin-paradox, or of his general theory of relativity, in which curved space replaces the more familiar notion of gravitation. Any one of these would have guaranteed his place in history, but Einstein contributed far more to our understanding of the physical world.

Indeed, Einstein's Nobel Prize was not awarded for either one of his relativity theories—the Nobel Committee thought them too speculative at the time. Rather, Einstein won the prize for explaining the operation of electric eyes, those gadgets that sit in the doorways of small shops and ring bells or open doors when you approach.

The eminent physicist began his professional career by publishing an amazing series of four scientific papers in 1905. Barely twenty-six years old—before he had obtained his Ph.D.—Einstein explained the photoelectric effect, calculated the dimensions of invisible molecules, demonstrated the existence of a fundamental limit to the sensitivity of any signal detector, and in 9,000 words outlined the entire special theory of relativity.

Now 100 years after his birth, we see evidence of Einstein's contributions all around us. His theories of atomic noise have taught electrical engineers how to develop more sensitive FM stereo receivers. Nuclear power plants demonstrate Einstein's ideas for converting mass into energy. His laws of light have given us the laser now used to cut

PHOTOGRAPHS BY PHILIPPE HALSMAN



◆ Einstein showed that light does not exist in waves but rather as bundles of wave energy called photons ◆

men's suits, line up tunnel bores, and read videodisks. Weather and communication satellites in orbit cells above us are powered by Einstein photoelectrons from solar cells, while scientists search the heavens for Einstein-begotten black holes using ultratensive Einstein masers and detectors of Einstein gravitational waves.

His body may be dead, but the products of Einstein's brain are alive and well. Those insights are the very tools we shall use to explore the future.

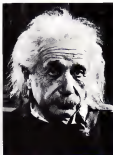
Imagine it is 2079—the two hundredth anniversary of Einstein's birth. New constellations sparkle the sky—dotted chains of gigantic solar-power stations in synchronous orbit. They deploy novel types of solar cells consisting of thin, layered photosensitive material, carefully designed to extract maximum energy in accordance with Einstein's photoelectric equations. This energy is converted into powerful beams of light by laser arrays using Einstein's laws for stimulated emission of radiation. Some laser light is sent down to power aircraft, ships, and electric-conversion stations on the earth's surface. Other beams shoot outward, impinging upon the following light sails of interplanetary freighters and interstellar spacecraft.

Radio messages from deep-space probes, red-shifted by the velocity effects of Einstein's special relativity theory, are picked up by new receivers, using the latest low-noise master techniques. Except for deep-space work, however, radio-communication systems on Earth are becoming obsolete. New gravitational-wave transmitters now allow direct point-to-point communication anywhere on Earth. Another Einsteinian equation!

Out in the asteroid belt, scientists are playing with a miniature black hole they found trapped in the center of an asteroid. By applying the theory of gravity they will soon learn how to convert a scientific curiosity into a highly efficient power plant that can use any form of matter as fuel.

As we look around us in the year 2079 Einstein's legacy remains all-pervasive. We will continue to reap the benefits from that intelligence for centuries to come.

Now go back in time. Seventy-five years ago, Einstein is twenty-five and has just finished his college education in Switzerland. The normal procedure for a new graduate is to obtain employment as an assistant to a former professor. In this shel-



tered first job, the new graduate can gain experience while carrying out research, publishing papers, or writing a Ph.D. dissertation. However, Einstein was a scientific ugly duckling. Although all of his cohorts obtained positions in the school, no one wanted Einstein.

But then, young Albert himself may have been partly to blame. Einstein knew he was smaller than all of his contemporaries and his professors. Being a brash young man, he did not disguise this fact; did not even bother to attend many of his classes. He preferred to read scientific journals by himself in his room. Later, just before an exam, he would read over the class notes of his friends. The response of Albert's professors was understandable. Why should they go out of their way to accommodate a smart aleck who considered himself above coming to class?

Einstein's former teachers neither wanted him nor were willing to give him a strong recommendation. As a result, the young genius was unable to obtain a position at any university. Finally, through family friends, he found a job as a patent examiner (second-class). Traditionally a position for lesser mentalities, the job in the patent office turned out to be beneficial for Einstein. His work consisted of examining patent applications and extracting from the confused writing of the inventor the essence of the invention. From this he learned

to peel back the surface of a physical concept and arrive at the principles underlying the idea. He would later use this ability to ask similarly penetrating questions of nature. The patent office also taught Einstein how to express complex scientific and engineering concepts in clear language (he often rewrote applications for the inventor), an ability that can be seen in all his writings.

The patent office gave Einstein sufficient money to live on and eight hours a day and weekends free to spend thinking about physics. It was during these off-hours that he developed the ideas that were later to shake the world.

Although automatic door openers had not even been invented in 1905, the basic concept was under study in many physics laboratories. Physicists were investigating what they called the "photoelectric effect." It was found that when a light beam fell upon certain metals, particles of electricity, called electrons, were emitted. If these electrons came flying off the surface, the material was called photoemissive. If the electrons stayed in the material, so they do in solar cells, the material was called photoconductive, for under the influence of the light, a voltage would appear across the photoconductive material, turning it into a miniature battery.

However, there were features to the behavior of these devices that made no sense to physicists of that time. They knew that to knock the electrons loose from the metal required energy. It was obvious that the light beam supplied the energy. By using more light in the beam, they reasoned, they could generate more energy. With more energy being put into the material, the electrons would come flying out at higher speeds. But it didn't work that way.

If you used a beam of green light, scientists eventually discovered, all the electrons came out at the same speed. If you changed the color to blue or ultraviolet without changing the intensity there would be fewer electrons, but they would come out at higher speeds. If you increased the intensity of the beam, the speed of the emitted electrons would stay the same, but the number of electrons would increase.

Two other features were even more puzzling. If you changed the color of the light beam more and more toward the red end of the spectrum, the electrons would come out with slower and slower speeds until at some color in the deep red or infrared spec-

● All it took to invent the laser was some understanding of Einstein's ideas on stimulated emission of radiation ●

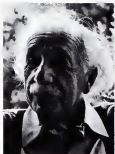
trum, no electrons would be emitted at all, regardless of how much energy there was in the beam. If you decreased the intensity of a green beam until the energy in the beam was so low that only one electron was emitted every second, and then spread the beam over a meter-wide plate of material so that any portion of the plate received only a small fraction of the total energy needed to emit an electron, you found that still one electron would be emitted every second!

None of this made sense to the experimentalists of that time, who still visualized light as a wave. Some theorists were on the right track, especially Planck, who proposed that nature acted by using "quanta" of energy. But it was the young, unknown Einstein who explained everything and started the field of quantum mechanics with his paper on the photoelectric effect.

Einstein showed that light does not consist of continuous waves, nor of small, hard particles. Instead, it exists as bundles of wave energy called photons. Each photon has an energy that corresponds to the frequency of the waves in the bundle. The higher the frequency (the bluer the color) the greater the energy carried by that bundle. Instead of spreading out as it travels, as an ordinary wave would, the waves in a photon stay bunched together. When the photon hits the photoelectric surface, all of its energy is delivered to one place. Using these very novel concepts, Einstein was able not only to explain the behavior of photoelectricity but also to give mathematical formulas that others could use to calculate other features of the behavior of light.

His ability to observe nature and correctly deduce the sometimes very bizarre behavior of the physical world made Einstein a Natural Philosopher. Those insights alone would have been a great contribution. However, Einstein went even further. He was able to translate his insights into the cold, rigid, logical system of thought we call mathematics. Once the beautiful ideas were in that form, they could then be manipulated by ordinary people and their calculating machines.

The next two 1905 papers by Einstein were on the theory of atoms and molecules and their behavior. There were still many scientists in 1905 who did not believe in atoms or molecules! Matter to them was a continuous but porous substance, and heat was a weightless fluid that moved



through the pores. Einstein, with his unique insight, observed that a solid melted into a liquid. The liquid then evaporated into a gas. The gas then behaved like a collection of small particles or molecules that bounced around in the otherwise empty space of a container holding the gas. When you changed the volume or the temperature of the container, the pressure of the gas would change by a simple law that had been deduced from empirical facts many decades before by the inventors of steam engines.

Einstein took these pieces of ideas and put them together into a coherent picture of all matter consisting of tiny indivisible atoms or molecules. Heat to Einstein was just the random motion or vibration of those atoms exchanging energy according to the mathematical laws that Einstein had previously worked out for photons. In a mathematical tour de force, he concluded one paper by calculating the size of the invisible molecule! (According to Einstein's 1905 calculations, the diameter of a sugar molecule is 9.8 angstroms, or about a billionth of a meter.)

In a third paper, Einstein used his new knowledge of atoms to explain a puzzling macroscopic phenomenon. In the earliest days of the compound microscope, nearly fifty years before Einstein was born, the botanist Robert Brown had found that tiny grains of pollen floating in a drop of water

never stopped moving!

Normally, you might expect that when you slipped a freshly prepared slide under a microscope, the water would swirl around and the pollen grains would move along with the tide. After a while, friction would slow the motion, and eventually the water and pollen would come to a stop. But it was found that even though one waited a very long time—one experimenter waited a whole year between peeks—the motion of the pollen never stopped. It was as if the pollen had an inexhaustible supply of energy.

Einstein explained the "Brownian motion" by demonstrating that the continuous random motion of the pollen grains was caused by heat in the water. Heat was not an invisible, weightless fluid but rather the rapid motion of each of the tiny water molecules rushing back and forth, bouncing off each other and the pollen grain, exchanging energy in a random way with each collision (but never losing energy). The energy was always conserved—as motion of one particle or another. "Friction" did not cool at the atomic level.

Although the water molecules were thousands of times smaller than the pollen, there were a lot of them. At any one instant there would be 100 million water molecules bouncing off one side of a pollen grain and 100 million (plus or minus 10,000) molecules bouncing off the other side. Although one water molecule could not budge a pollen grain, the pushes from the random 10,000-molecule differences could move the grain far enough for one to see it move under the microscope.

Again, Einstein not only explained a puzzling phenomenon but wrote down a mathematical equation that described it. The equation predicted that the size of the jumps made by the pollen grain would increase as the grain was made smaller, the liquid less viscous, and the temperature greater. All of these premises were verified by experiment. The same formula, with suitable modifications, is used today to explain noise in radio, radio, and telephone systems. It shows us that at any given temperature there is an ultimate limit to the sensitivity of any detector or amplifier. This limit is caused by the random motion of the atoms and electrons that make up the apparatus itself!

Although Einstein had a strong hand in

giving quantum mechanics, the mechanical theory of atoms and light, its mathematical base had not contributed significantly to its full development. For one thing, he was dissatisfied with the philosophy implied by his own mathematical inventions to explain the behavior of atoms and light. Einstein had to use the theory of statistics, which he loathed. The theory of statistics assumes that everything happens by chance. There is no direct relationship between cause and effect. This view was repugnant to Einstein, who is often quoted as having said, "God may be subtle—but He does not play dice." To Einstein, the idea that God created a universe that was not run according to strict rules (which he someday hoped to discover) was unacceptable. He always felt that underneath the seemingly random behavior of atoms and light there was a more logical, predictable basis.

Another reason Einstein left the field of quantum mechanics to others was that he had set himself a more important task. That was to deduce the nature of (and write down the mathematical laws for) everything in the entire universe! He began studying those four elements that seemed to make up everything: space, time, matter, and energy. When he finished, the four elements had been reduced to two.

Einstein's special theory of relativity can be called the Einstein theory of mechanics at high velocities. The old Newtonian laws of mechanics describe how matter moves through space and time. Matter gains and loses energy as various forces act upon it. The Newtonian laws work very well for objects moving at ordinary speeds, but Einstein realized that they weren't going to be adequate when mass velocities began to approach the speed of light.

Thinking unthinkable thoughts, as usual, Einstein asked himself, "What would I see if I could travel at the speed of light and were to look at a photon traveling beside me?" One answer was that he would see the electromagnetic fields in the light standing motionless. Yet it was the vibration of the fields that gave the light its frequency and energy as you experience it. He asked other knotty questions: "Suppose I were traveling at nearly the speed of light and I sent out a beam of light ahead of me. Being light, it would seem to move away at the speed of light, but since I am sending it from a moving platform, would not some other observer see the light beam moving faster than the speed of light?"

To Einstein the only consistent answer to any of these questions was "No. No matter how fast or slow I am going, to me a beam of light is always traveling at the same speed."

According to any reasonable extrapolation of Newton's laws, this was impossible. Different observers should measure different velocities of light, depending upon whether their own motion is added to or subtracted from the motion of the thing being observed. Yet Einstein accepted his

"impossible" answer and then derived mathematical equations describing space, time, matter, and energy that would produce the desired result. These implications are astounding in the abandonment of common sense, yet all of them have proved true time and time again. They are:

- Space can be converted into time, and vice versa.
- Mass can be converted into energy, and vice versa.
- As you travel near the speed of light, space shrinks, time expands, and mass increases.
- If you travel at the speed of light, space shrinks to zero, time increases to eternity, and your mass, if you had any to start with, increases to infinity.

Since it would take an infinite supply of energy to move an infinite mass, it is impossible for any material object (like Einstein himself) ever to attain the speed of light. Light, being a form of pure energy, has no rest mass per se and so can—and to coast,

◆ *In trying to solve the unified-field theory that would unify space-time, matter-energy, Einstein's intellect finally met its match in the game he played with his God* ◆

must—travel at the speed of light. Yet what a queer universe the photon lives in. Since its space has shrunk to zero and its time has expanded to eternity, the photon exists everywhere along its trajectory at all times.

The fact of Einstein's special theory of relativity hardest for people to accept is the slowing down of time at high velocities. This is best illustrated by the famous twin paradox:

There are two astronauts who are twins. One astronaut travels off on an interstellar spacecraft and spends a long time traveling at nearly the speed of light. When he returns, he will find that his stay-at-home brother has aged considerably while he himself is still young.

This time-dilation effect is real and is used to advantage every day in large particle accelerators. The debris from a typical experiment often consists of elementary particles that exist for only a billionth of a second. If time did not slow down for these particles, they would travel less than a millimeter before complete decay—but far enough for them to get out of the target chamber and into the detectors. However, such particles are traveling so close to the

speed of light that their time is slowed by factors of 10,000 or more. They then live long enough in our frame of reference to travel many meters to the detectors, where they can be detected.

After Einstein's success with the special theory of relativity he turned to the mechanics of acceleration and gravity. A thought experiment Einstein used to explore gravitation and acceleration was to imagine himself in a small elevator with no windows. If the elevator was stopped but sitting on the earth, he would feel his weight on his feet. If he dropped a ball, it would fall to the floor.

Now suppose the elevator were set in space away from the earth's gravity, but it was being lifted at a constant acceleration equal to the earth's gravity. He would not be able to tell the difference.

Einstein then made the philosophical leap. Not only would he not be able to tell the difference—there would be no difference!

In one stroke of genius, Einstein threw away the Newtonian concept of gravity as a force by which one large mass attracts other masses. Einstein said that it is not such things as a "gravely force." Rather, a large mass "curves space" near it, and other masses move in that curved space in force-free orbits.

Now one might think that all Einstein did was to produce a complicated description for the more simple Newtonian picture of gravity. But Einstein, as usual, had a complete mathematical structure to back up his philosophical ideas, and mathematical predictions can be checked by experimentalists. The first of these was the calculation of the anomaly in the orbit of Mercury.

For centuries, Newton's law worked well for predicting the behavior of the planets. Of course, as observations improved, theorists had to put in more and more correction terms (the effect of Jupiter's gravity on Saturn, for example) to reconcile certain realities with Newton's theory. One minute-curve effect—the orbit of the next insignificant planet, Mercury—seemed to escape them.

The orbit of Mercury is quite elliptical. Whereas most other planets have nearly circular orbits, Mercury's is visibly egg shaped. Because of the perturbation of the other planets, especially Venus, Earth, and Jupiter, you expect the major axis of Mercury's orbit to precess around the sun, and it does—something like 5,600 seconds of arc (about 1.6 degrees) per century. Try as they might, the theorists could only calculate something less than that. For some strange reason not predicted by the Newtonian law of gravity, the precession of the orbit of Mercury was 43 seconds of arc per century (one revolution every 3 billion years) more than it should be. When Einstein used mathematics to predict the effect of the curving of space by the sun on the orbit of Mercury, he found that his equations predicted 43 seconds of arc per century more precession than Newton's laws

Exactly the amount unaccounted for!

Yet another prediction of the general theory of relativity is that clocks should run more slowly in a gravitational field. That means that if you have a clock on the surface of the earth and another on the top of a mountain or in orbit, the one on the ground will tick more slowly (by a longer) than the higher one.

As one of the better-justified boondoggles in the annals of science, nothing could beat paralyzing a lot of Einstein's theories of relativity into a hoop around the world.

In 1971, American physicists Hafele and Keating borrowed two identical, very accurate portable time standards from the U.S. Naval Observatory and obtained a grant from the Office of Naval Research to pay for three first-class tickets around the world (one seat for each of them and one seat for the clock). The two clocks were set to the same time in Washington, D.C. One clock stayed in Washington, where it was subjected to the slowing down of time owing to its position in the gravity field of the earth. The other clock took off at 960 kilometers per hour and went around the earth at an average height of nine kilometers.

The time as measured by the moving twin was slowed down by the fact that it was moving at a velocity close to that of light (Well, at least it was closer to the speed of light than the clock in Washington.) The time as measured by the stay-at-home twin was slowed by the fact that it was subjected to a much greater gravitational field than the elevated twin. (It was 1,001 times greater.) However, the velocity effect was larger than the gravitational effect, so upon return to Washington, the moving clock was found to be slower by exactly the amount predicted by the two theories of relativity. Just to check, the scientists and the by now blasé world-traveling clock went back around the earth the other way where the rotational speed of the earth subtracted from the airplane's speed rather than adding to it. Again the scientists got the correct result! (This was probably the cheapest test of general relativity ever made. It cost only \$8,000, of which \$7,600 was spent on air fares.)

With the confirmations of his theory in the early 1930s, Einstein became world renowned. As part of his duties he was called upon again and again to give lectures and write about his discoveries. Unlike many other scientists, who find it impossible to speak without using the familiar (and safe) jargon of mathematics, Einstein was a true genius who could explain his ideas to nonspecialists.

Despite the demands of fame, Einstein was not finished with his self-imposed goal of completely understanding the universe. He began work on a unified-field theory that would unify space-time, matter/energy and electromagnetism.

Einstein's intellect finally met its match in the game he played with his God. God had set up a puzzle. Deduce the rules of the universe, human. When you do, then you

shall know Me! Einstein had had more success than any physicist before him, and though he gave his best efforts until his death in 1955, he was unsuccessful!

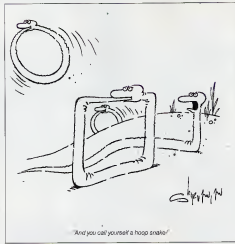
Yet, while treading the long, eventually fruitless, path of his search for the unified-field theory, Einstein was still able to contribute enormous insights in ways too subtle for many to appreciate. In 1924 he received a paper from Indian physicist S. N. Bose that described light as a gas consisting of photons. This photon gas was a strange type of gas, for the particles in it did not obey the common-sense statistical laws that billiard balls do. If you randomly roll a number of perfectly elastic billiard balls on a frictionless table, sooner or later they will all end up in one pocket or another. If you checked by repeated experiments, you would find that all the balls had an equal probability of falling into any one of the pockets. But if the billiard balls behaved like photons, you would find that if one of the pockets already had a ball in it, the rest of the balls would have a tendency to fall into that pocket. In fact, the more balls already in a pocket, the more likely another ball would choose to join its identical mates.

Now, there is no force or attraction involved in this effect. It is just a statistical tendency that causes photons to prefer to huddle together. This phenomenon, developed and mathematically expressed by Bose and Einstein, is what makes a laser!

Although Einstein did not invent the laser, he work led the foundation. It was Einstein who pointed out that stimulated emission of radiation could occur. He used his photon mathematics to examine the cause of a large collection of atoms full of excess energy and ready to emit a photon at some random time in a random direction. If a stray photon passes by then the atoms are stimulated by its presence to emit their photons early. More remarkably the emitted photons go in the same direction and have exactly the same frequency as the original photon! Later as the small crowd of identical photons moves through the rest of the atoms, more and more photons will leave their atoms early to join in the subatomic parade.

All it took to invent the laser was for someone to find the right kind of atoms and to add reflecting mirrors to help the simulated emission along. Remember the acronym LASER means Light Amplification by Stimulated Emission of Radiation.

So on this hundredth anniversary of his birth, Einstein is rightly remembered for his special and general theories of relativity and all the wondrous things, like nuclear energy and black holes, that came from these works. But let us not forget that he also measured the atom, explained the solar cell, described the limits to our senses, and nearly invented the laser. Quite an accomplishment! **DD**



The urban landscape of the future—fully automatic and utterly fantastic

SPACE CITIES

BY HARRY HARRISON

Science fiction has presented bigger, better and more exciting cities than any others ever seen on the face of the Earth. Only recently have writers begun to see cities as places of oppression for mankind; after all, there have been more rural halls than urban ones in our history. Memory is fading, so we should keep reminding ourselves that right up to the end of the twentieth century, all the real action

—intellectual, artistic, social, financial—took place in the cities. The creative people left their bucolic backgrounds and made their way to London or New York or the major city of their choice. Emily Dickinson wrote that she never saw a train, going anywhere, that she did not want to board. This is meaningless to a happily ensconced city dweller but elicits a depth of response from someone of intellectual ambitions who is bored in Boonville.

So writers who loved cities designed bigger and better ones for the future. Wells in *The Sleeper Awakes* had the sleeper wake up in a city full of gadgets and transportation and communication wonders. Almost all the book-length utopias have been crafted utopias. Then, when the pupa began churning along, cities grew in complexity and design. Just as with the spaceship, a universal

Don't miss *Science Fiction* by Harry Harrison. Paperback, \$10.95. *Star Wars* Publishing, in U.S. by Bantam Books.



super-city come into existence: a concept shared by writers and illustrators. A writer could get a story in this city without going into too much background or detail. The reader accepted eagerly and read on.

But city growth has its limits, reached in Asimov's *Foundation* series with the planet-wide city of Trantor transformed to Helio and examined in some depth in



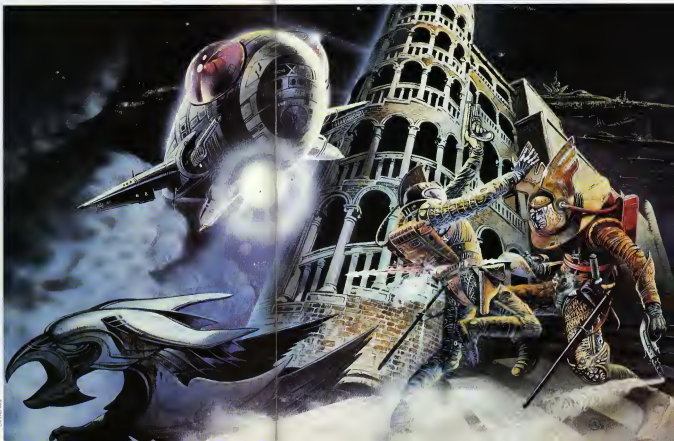


Harrison's Bit, the Galactic Hero.) There is a natural limit to this kind of growth, once you have the supercity built you can either keep it running or destroy it. Or move it to a new dimension.

Factories power generating satellites spaceship stations, war satellites—all of them have to be built in space, with the exception of James Bleth's Coles in Flight. Here, great, anti-gravity machines called

● Writers who loved cities designed bigger and better ones for the future. ●

spindazzles are put into position around Manhattan Island — and lift the entire heart of New York City into space. A dazzling concept indeed—New York followed by other cities that leave the tired economies of Earth for the excitement of the stars. For many years, the biggest city in space was in Clifford Simak's *Leviathan Factor*, where the speciemer discover an artificial metal world that is so big that when they explore it, they can make no sense of it at all. However, this world, and all the others, are small-time when compared with the concept of physicist Freeman Dyson. He speculated that if all of the planets of the solar system were ground up and melted down, there would be enough material available to form a thin sphere about the sun, a giant shell that could be inhabited on its inner surface. This design was first used by Bob Shaw in *Oxleyville*, which, though written earlier, was not published until 1979. Here the Earth explorers zip into the sphere and must spend years getting back to the entrance they originally



came in through Dyson's design was also used by Larry Niven in *Annealed* (1970) though he limited himself to a single band in space rather than to a sphere. For every inhabited alien city we find in SF there must be a dozen ruined ones. Exploring them is fun—as well as being dangerous—and rarely so well done as by Beam Piper in *Omniqual*, where our scientists learn

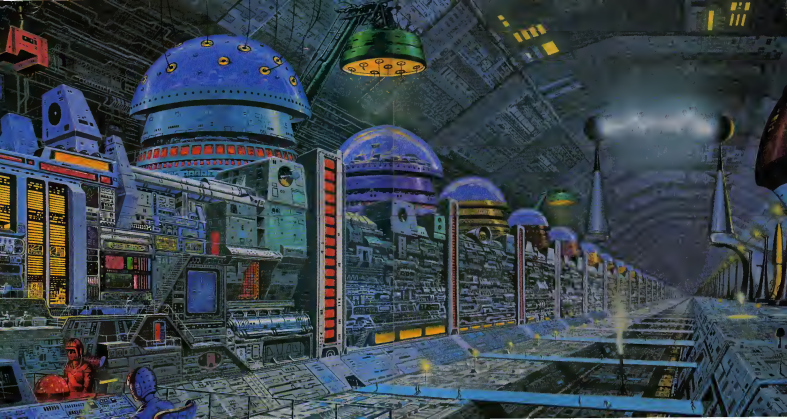




to translate the records of a vanished alien race. Sounds impossible—until the author explains logically just how it can be accomplished.

On a much larger scale is Arthur C. Clarke's wandering planet in *Rendezvous with Rama*, where an entire abandoned world-city comes whirling through our solar system.

Now inter-city violence seems to have put an end to the day of the



really "super" city. Authors are now returning to nature, the village, and the isolated house in the hills. The great cities are either dismantled or allowed to fall into jungle, warnings to the youth of the future of the

error of their ancestors' ways. SF is basically a literature of entertainment. The imitations are only those of the author if you think big you write big. The open-minded philosophy of SF is a reflection of the best thinking in social and scientific man. ☐

THE GREAT MONEWAY JAM

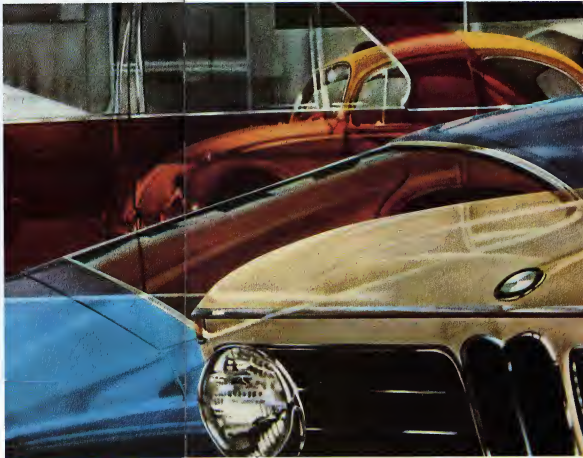
*For months they waited to be
rescued from the mammoth traffic jam.
Then the copters came!*

BY JOHN KEEFALVER

Editor's note: The majority of readers will remember, of course, the Great Fourteen-Month Moweway Jam near Moweway City, California, during 1966-69, which, at the time, was the longest and largest traffic jam in the history of mankind. But what most readers cannot know is that it was not for an unassuming, grim, and frightened little man—Henry Littlefinger—the world today would not now have the opportunity to learn of at least part of the terror of Jam-ees who were stuck that prairie of unMoving automobiles on an unMoving Moweway in a jam that extended from San Diego to Santa Barbara, and from the Pacific Ocean eastward to points reaching some seventy-nine miles inland. Carefully, patiently, calmly Jam-ee Littlefinger for more than a year grided into an ever-thickening notebook the incidents that went on around him in Jamland. The world should well be thankful that he, as a stationery salesman, had in his Jammed-in blue panel truck an ample supply of paper, pens, and ink that lasted a day in May 1968, when all traffic stopped for fourteen months.

What remains of the Littlefinger Notebook was discovered quite by accident when the only known survivor of the Great Jam tried to pawn it in a shop in downtown Des Moines in 2002, three years after the Jam was brought to its gruesome ending by Moweway Engineers. The man, who carried no papers and was never identified, was one of the worst cases of Jambreakdown, or Jam Psychosis, on record, ac-

PAINTING BY DON EDDY



ceding to the U.S. Board of Jam Surgeons. When taken into custody he was in such a state of advance Jambreakdown that unfortunately he was unable to answer coherently the simplest questions.

It should be noted, however, that officials of the Moweway Historical Society and other interested parties never had a chance to question the man since while he was being taken from the powerstop to the Des Moines General Hospital the ambulance became snagged in a routine jam (three days), and he died below it could be broken up. Thus, it has never been learned how he came into possession of the last pages of the Notebook. My hunch, including P.T. Townsend, Chief, U.S. Bureau of Moweway Investigation, is that the short, skinny middle-aged man took it from Littlefinger's outstretched, Heless hand immediately after the "end" of the Jam. This is pure guesswork, of course. That the man was a Jam escapee has been verified, however largely on the testimony of Jam Surgeons; they reported that his body, upon examination, demonstrated overwhelming physiological characteristics of complete Jambreakdown, including symptoms of exhaust fumes in the blood, gasoline in the urine, and oil in his armpits. The Jam escapee, evidently not realizing the value of the pages from the Littlefinger Notebook, failed to bring it to the attention of the authorities. It is indeed sadly ironic to note that if a Jam-crashed man had not needed money, the world today would not now have the opportunity to read such a startling report of life as lived in the last few days of the Great Fourteen-Month Moweway Jam.

The unknown possessor took excellent care of the few pages of the Notebook, however. They were well wrapped in strong brown paper when he brought them to the powerstop. Only a few pages were in any way damaged, although rain soaked, they were legible and shed much light on the final days of the Jam when Moweway Engineers arrived in Jam Helicopters and put into effect their chilling solution to the massive problem.

Unfortunately the vast bulk of the Notebook was never recovered. Littlefinger left it behind when he and a group of Jam-ees began their march to The Wall, which Moweway Engineers had built around the Jam in order to stop motorists from deserting their vehicles and escaping the Jam on foot. Fortunately, however, the part of the Notebook recovered contains the account of the march.

According to the Moweway Historical Society Littlefinger and other Jam-ees began their march from the only part of the Jam where there was some semblance of order and civilization, an area which they had ironically named Mowevilla. Strutting ahead of the ragged, hungry group (made up of about twenty-five percent of the population of Mowevilla) were about thirty miles of what they called Unincorporated Jamland where wild, starving Jam-ees

roamed, as the notebook shall reveal.

By the time they began their march Jam-ees were in a state of insurrection against Moweway authorities; after fourteen months of frustration, they were in no mood to accept any further announcements from hovering Moweway Engineer helicopters that the Jam was about to be broken, especially when the copters gradually decreased the number of amnesty food deliveries and began dropping more and more suicide capsules. Utterly despondent, then, they decided that some of the stronger Jam-ees would try to reach and climb over The Wall and at least let the world know of their plight.

Who was Henry Littlefinger? Little is known. Frigate-yet-tough, unimpressive yet of a nature that attracted people and their confidences, small, very downright slinky toward the end, with a beaklike nose and steely, owl-like eyes, he was born about 1950 on a Moweway (in those days, of course, called a freeway) in the middle of

● We began to roll a rusty
Chevrolet Whoosh! up to The
Wall. With 140 men
trying to lend a hand, it was
over before it
started. The car hit The Wall
with a great
rusty, dusty crunch. ●

Moweway City (then with the name of Los Angeles) while in a car going eighty-five miles an hour. From that day on, according to his parents, Harry and Hilda Littlefinger, son of Farbanks, Alaska, he was scarred to death of, and had a hatred for, Moweways.

And ironic, too, is that Littlefinger never knew the cause of the Jam that killed him. A little old lady, signaling for a right turn in Ventura, made a left turn instead.

THE LAST PAGES OF THE LITTLEFINGER NOTEBOOK

July 10, 1958—We are now camped an estimated eleven miles from Mowevilla, our group of 167 exhausted men sprawled about in an area roughly the size of half a city block. I write this by shaded flashlight, fortunately among my provisions in my blue panel truck when the Jam began was a large supply of batteries. (Unfortunately I left my Notebook in Mowevilla, I write on pages scavenged from the men with me.) We did not light campfires. We ate away this morning so we "marched" away from Mowevilla at dawn as Moweway Engineer helicopter darted in over us, flustered this moment, then sped back toward Mow-

way City. And twice during the day we were observed by other copters. We ran for cover, squirming under and in the rubbing cars all about us. I'm afraid, however, that we were seen.

Although the Boy Scout movement in the United States has in recent years been severely handicapped because of the absence of wooded areas, they being covered by cement, we are fortunate in having with us an Eagle Scout, George Bamstrong, who with his trusty compass and other directional gadgets, of which I know absolutely nothing, has mapped out the most direct route to that point of The Wall which we think is nearest Mowevilla. We have no way of knowing exactly, of course, since our sole source of information has been the two scouts we sent out a few weeks ago, neither of whom returned and we assume are dead. However, we are of the opinion, based on pre-Jam observation, that Jams are usually larger than they are wide. Thus, we are moving in a south-westerly direction, mostly across over and through cars, from side to side—sometimes actually opening the door, sliding across the seat, and leaving by the other side often to the surprise of the "un-civilized" motorists who make up the inhabitants of the unincorporated areas of Jamland. This, plus the fact that most cars are Jammed-in bumper to bumper plus that today was trying hot, plus our weakened condition, has resulted in our exceedingly slow rate of travel—too—and with great sadness I report this—we lost thirty men today. Adzbe James, William Furhouse, and Nicholas Furk. They collapsed one by one during the day. We could not bury them, of course. We could hardly dig our way through at least a foot of Moweway without proper tools even if we had the strength. We placed their bodies on tops of deserted autos; we hope that helicopter hoaxes will pick them up, thinking they are the "unloaded."

We move in more or less a westerly direction—like pioneers of old, we tell ourselves somewhat grimly—because, in addition to hoping that it is the shortest route to the Jamland, we hope that Moweway Engineers have not built The Wall along the Pacific. (We hope to reach the ocean at a point about four miles north of Laguna Beach.) Certainly they think the ocean will sustain us! Too, I suppose the sea attracts us just as it beckoned to those plodding pioneers of a bygone era. (Bygone?) How joyous it will be to see something—water!—besides automobiles! How lovely it will be to see girls wearing something—bikinis!—besides Jam Survival Suits.

The unincorporated area of Jamland that we passed through today was in chaos. Rubbing cars of all descriptions, windows broken, tires and seats missing—for "time-worn." More ghastly, though, are the skeletons—the human skeletons. They are everywhere, in, under, on top of, and beside automobiles. Bones of children are extremely pathetic.

July 7, 1999—We made only about six miles today and are now camped, by rough estimate about seventeen miles from Moseville. Our progress was slowed considerably by helicopters. We saw the first one about 10:15 A.M. as we were passing through disjuncts similar to that which I wrote about yesterday. We saw the copter before he saw us, as soon as we sighted him in the distance, we dived beneath the rusting cars until he flew over and away. He was flying very slowly and low, obviously looking for us. As soon as he disappeared, we came out from under the cars and continued our march. This second copter delayed us considerably however. He saw us. We had stopped for lunch, were sprawled about, when suddenly one of the smaller and speedier Moseway Engineer helicopters—fitted with a noise abater—darted over us hardly ten feet off the Moseway. We clearly saw the pilot looking down at us through the bottom of the control bubble. Nevertheless, we dived under the surrounding automobiles, staying there for exactly one hour and forty-seven minutes before we crawled out and continued on our way. A number of our group had fallen asleep under the cars, and another fifteen minutes were wasted waking them up. One James Lupo, was dead.

We had hardly started our weary march again though, when another copter, the speedier type again, zoomed over our lunchspot and dropped a small parachute, the kind used for communication purposes. It was a communication, all right! Bill Smith and I rushed to the chute, opened the small pouch attached, and read the following letter, which I copied in full. It read:

Federal Bureau of Moseway Engineers,
Western Division
12643 Moseway Avenue
Moseway City, California 90029
July 11, 1999

To The Insurrectionists
Subject: Insurrection

Gentlemen:

You are hereby notified that by departing your vehicles in Moseville on or about July 10, 1999, you are in direct violation of Federal Moseway Law 73, Section 3, Paragraph 14, which reads: "Any operator of a motor vehicle or person capable of operating a motor vehicle in which he is a passenger who leaves said vehicle without express authority of the Federal Bureau of Moseway Engineers, while said vehicle is entering, within, or leaving a Moseway Jam shall be executed by the means most available."

You are also hereby notified that by the power vested in me as Chief of the Bureau of Moseway Engineers, Western Division, I am obligated, and do cheerfully accept the obligation, to enforce all laws under my jurisdiction.

You are observed, gentlemen. You are in

danger. Return to your vehicles at once or be prepared to accept the consequences.

Very truly yours
(Signed) P. T. McSniffle, Chief
Federal Bureau of Moseway Engineers
Western Division
c/o Hospitals, M.E., Washington, DC
Rm. 114
Moseway City Mortuary Jam Div.

July 12, 1999—Five more men died the day before yesterday (William Snoddy, Norman Mendicut, John Brumfield, Peter Downey, and George Moundtop) and seven died today (Harry Flow, Nathan Foutprie, Samuel Week, Philip Dugan, John Downside, James Peters, and Mike Thomas). Fifteen dead so far. Our original 167 men are now down to 152, we have lost nearly a man a mile.

We voted on what action to take after we received McSniffle's letter yesterday. I'm proud to report that to a man we decided to

● We are moving in a
southwesterly direction, over
and through cars,
sometimes sliding across the
seat, to the surprise
of motorists who inhabit the
unincorporated
areas of Jamland. ●

continue the March, which we did immediately, our eyes on the sky as much as on the Moseway. We saw only one more helicopter and that from a distance. Knowing we were observed, we did not attempt to hide.

This morning (I write this, as usual, at our overnight campsite) we started out as soon as it was light. Most men did not sleep well. They are weary, they are afraid. We had hoped to reach the Pacific—or The Wall—today, our scout leader had estimated it to be about thirteen miles from last night's campsite. We didn't make it. It happened this way.

A few minutes after three we heard the roar of approaching helicopters; a glance showed us that there must have been at least a dozen and that they were coming from all directions. We slid under and into any vehicle within reach. They roared over and a thunderous armada. Caustically I inched my head out from under the auto I was under. The first thing I saw were the guns. Each copter had at least two, front and back. They pointed Mosewayward. After tearing over us, one by one, their guns, still silent, aimed at us, they flew out-

ward about 100 yards, grouped, and then in a great circle flew around the area where we were hidden—as if they were flying in circles and we were in a circled wagon train.

Then we heard the guns.
At their first chatter I—and I'm sure every man—ducked back for protection. Then not seeing—or feeling—any bullets around me, I got up enough nerve to inch my head back out from under the car. The copters, still flying their circle, were shooting not at us but in an area directly below them—sort of a Jamland version of firing over your head. They were literally tearing up that portion of the Jam with machine guns. The wait on for about 10 minutes, it was an extremely terrifying experience. At any moment, I expected them to move in over us with their guns.

Then abruptly the firing stopped. They all flew off except one. The one made a dart over us and as he sped off I saw a parachute floating down toward us. I was one of the first to reach it. It was another letter from McSniffle. In somewhat flowery language, it warned us that if we did not immediately turn back we could expect the same murderous fate that you have witnessed today to be directed unerringly at your insurrecting bodies.

We voted at once. We decided to go on. We waited until darkness, then after a cold meal we continued the March. Although there were no casualties from the guns, two men had died during the firing, probably from heart attacks (New Sack and Joe Newhouse).

We stopped a little after midnight. I write this by shaded flashlight from our moose campsite. Around me men sleep fitfully.
Tomorrow the Pacific!
Or The Wall!

July 13, 1999—We started out this morning before dawn, hoping to reach our destination by daylight. A count in the darkness revealed that three men were missing. A hasty search uncovered only one—dead (George Hoston). We moved on. To track down the others would have taken up our so important time. They are probably dead anyway (Nick Appleton and Francis Bowen).

By dawn our hopes had been smashed. As we roared the Pacific just north of Laguna Beach, as we began to actually hear the surf and as the darkness faded we saw it—The Wall. A monstrous fang of gray stone at least a dozen feet high, with barbed wire along the top. And as we reached it, we saw one... two... three... four skeletons slung to base, evidently poor wretches who had tried to scale the thing. I say our hopes were smashed. Not actually for we would climb The Wall. Yet we had so hoped to see the Pacific. It seemed to be right behind The Wall. The Moseway, of course, extends right up to the waterline (as it does on the Atlantic and Gulf coasts too), so there was no sand beneath our feet even though we were probably standing where sand ought to have been.

CONTINUED ON PAGE 114

THE CLONE DOCTOR

Doc Shettles claims that cloning is not only possible—it's easy

BY WILLIAM K. STUCKEY

Up in the state of Vermont, in a town called Randolph, there's a good ol' country doctor who can take out my gizzard any day. His name is Landrum B. Shettles, and he knows more about bedside manner than anybody, even though he sometimes

PHOTOGRAPHS BY DAN MCCOY



● I've been able to take the nucleus out of three human eggs and replace them with nuclei from other cells ●

drops remarks that, as they say in his native Mississippi, "if you sight upside the head."

Doc Shettles got his gentle touch by doctoring ladies for thirty years, helping them with their female contraceptives and birthing their babies. Moreover, if they have trouble having their babies the usual way he might just go and whip one up in a test tube. As a matter of fact, that test tube of Doc Shettles's might just put Randolph, Vermont, on the map, because he plans to use it to knock people with, if he doesn't get too many complaints, which I suspect he will.

Doc Shettles wants to be a clone. Now that would be the biggest medical event to hit Randolph since 1841, when a healer named Jehiel Smith, who claimed he could cure people of all sorts of ailments by putting them in hot water with vegetables in it, accidentally made soup out of a fellow one day and had to leave town.

Doc Shettles and his associate, Dr. Ramon Velez, would like to set up a fertility clinic right in Randolph, at the Gilford Memorial Hospital, if they can raise the money and don't get lynched. They would like to help women have babies, women who have blocked fallopian tubes and thus cannot conceive in the normal fashion. They would like to do this by using one of the woman's eggs with her husband's sperm in a test tube and then implanting the result in the woman's womb to carry off the usual nine-month procedure. Doc Shettles thinks this is a good thing to do. As he puts it, "If the bridge is out, why not use a helicopter?"

If you have been reading the newspapers, you know that this technique of starting a baby in a test tube has been successfully accomplished both in England and in India. Doc Shettles claims he would have done it back in 1973 if he boss at Columbia University's Presbyterian Medical Center hadn't got upset and tugged the doc's test tube, contents and all, into his deep freeze.

As far as I can tell, the people in Randolph like Dr. Shettles and Dr. Velez and generally approve of their plans for the fertility clinic. Of course, you can find one or two who wonder about that cloning business, even though it might be good for the local economy, what with all these rich tourists coming up to have themselves carbon-copied.

Doc Shettles is nobody's fool, but he likes to play little jokes on people, so you have to be careful about swallowing everything he says. Some Randolph residents remember the time a lady brought Shettles a potter



plant, and while she and the doc were having a serious conversation about gardening, he took the plant out of the pot and replanted it upside down without baring an eye. Nevertheless, I believed him when he told me that he knew how to clone people but would not do it except for the benefit of mankind. In other words, if you said, "Doc Shettles, I want you to make a full-legged carbon copy of me, and here is the money," he wouldn't do it if he thought you were crazy, mean, wanted your name in the papers, or had capital-gagging tendencies. But I want you to decide whether or not he was taking me the truth on that fall day in Randolph, when the leaves were yellow as cashew eyeballs and as red as hog blood.

"Do you think a person ought to have the right to be cloned?" I asked.
"I think so," he said. "I feel that if I wanted to be cloned or transplanted that's my choice too, isn't it? Some people would rather be cloned than cloned."

"You mean to tell me you'd attempt a cloning operation?"

"I wouldn't have any hesitation about it," he answered.

"You think it would work?"

"It'd be a lot of fun, and I'd try to make it successful. Why not?"

Of course, that "why not" of the doc's is a question as big as a particle accelerator, and I Shettles is taking the bush, and I think he is, he'll be spending the rest of his life answering it, as will he seven kids and the rest of us.

Now cloning has been talked about for a long time, not only by such science-fiction writers as Arthur C. Clarke (in *Firefall to Earth*), for example) but also by such Nobel

Prize winners as James Watson and Joshua Lederberg. And of course there was J. B. Gurdon, the English scientist who actually cloned a whole slew of identical frogs from the gut cell of a single frog. But Doc Shettles talks about cloning in a different way. He says it is easy to do. That's right, easy. It's easy, it won't be long before we see the neighbors coming home with Multiple Me kits.

I have to admit that I had little intention of talking about cloning when I went to see Doc Shettles in Randolph with my daughter, her Marie (who is obviously no clone because she is pretty). I went up to Vermont to see him about the Del Zio case, the recent trial in New York City that put the phrase "test-tube baby" on the front page of every newspaper in the country that was not then on strike. Shettles was an expert witness for Mrs. Diane Del Zio, who was suing Columbia University's Presbyterian Medical Center for the destruction of a test tube that she claimed contained her baby. Shettles was, in fact, the expert witness, for he had performed the *in vitro* fertilization that was to provide Mrs. Del Zio with the child she wanted.

Although Mrs. Del Zio won her case—she was awarded \$50,000 in damages—Doc Shettles had been strongly criticized for his part in the whole affair and, he told me, was obliged to find that his patients in Randolph still liked him enough not to switch to another gynecologist. Still sensitive about all the things that were said about him during the trial, he showed me his wins-a-lot biography, his various awards and Ph.D. thesis (Kappa notice—as well as a number of letters from other doctors who said that he was far from being the biggest nut in the fruitcake. Mrs. Del Zio's lawyer had asked him to collect these documents, and they were indeed impressive. One letter, from Dr. Houston Merrit, the former dean of the Columbia University College of Physicians and Surgeons, called Shettles "an excellent clinician and teacher and one of the finest investigators in the country in the field of human reproduction... highly respected by his colleagues." [Shettles was on the staff at Columbia for twenty-six years.] Moreover, I couldn't help noticing from the journals and clippings that he was the first man ever to report the fertilization of a human-female egg outside of the body—that was in 1953—and also years ago made the discovery that there are two types of sperm, one carrying blueprints for a female and



the other for a male. He also spent more than twenty years at Columbia with no complaints—that is, before his boss flushed his Del Zio project, and now he has a connection with nearby Dartmouth College's medical school.

And he is not one of those doctors ordered by some California ten-dollar diploma firm. Doc Shettles got his MD as well as a Ph.D. in cell genetics from Baltimore's famous Johns Hopkins Medical School. He's been to more places than Mississippi and Randolph, too, as you can tell from his memberships in several English medical groups with "Royal" in front of their names. Doc's paper collection also includes a 1973 letter from a big man in the National Institutes of Health saying that it is just as legal to do in vitro egg experiments in a test tube as it is to do in lady studies of the same subject. In other words the Del Zio experiment was okay by Washington.

I was looking at him sideways while he was telling me all this, and I can tell you he is an interesting-looking man. He's about as high as a magnet fence post, and he looks just as nice as your uncle, although some folks say he looks and talks like Truman Capote. He's still got that southern accent, which sounds a little funny there in Randolph, Vermont, and when he says "I don't know" it comes out "Iunno," but the Randolph folks don't hold that against him. Often his talk wanders around a bit, and trying to get his point is like trying to chase down a rabbit barefooted, but when he makes his point he does make it.

You think that writer David Rorvik was telling the truth when he wrote that book in *His Image* claiming that a funny old milkmaid had herself cloned back in 1975? I asked

"Well, I've been able to take the nucleus out of three human eggs and replace them with nuclei from other body cells."

It might not sound to you as if old Doc was answering my question, but he sure as Robert E. Lee was. What he was saying was that Rorvik was probably telling the truth, or at least that it was possible to take these first steps toward cloning a human person, because he, Doc Shettles, had taken those steps himself. Moreover, he had been taking them since 1975, right there in his little down-the-block laboratory in Randolph, regardless of what the neighbors might think.

Now getting more information from Doc Shettles on his country cloning was like pulling chicken teeth. Because he wanted the official report of it to come out first in the *Journal of Obstetrics and Gynecology*, but then I found he'd already applied some of his beans to America's finest backwoods science writer, old Charlie Segrest of Randolph's White River Valley Herald (Shettles delivered Charlie's daughter). So I figured it was all right to poke around a little more, and I did. But now you'll need a little science lesson on this—as I did—before you'll appreciate old Doc's claims, and I promise not to make it hurt.

Now your ordinary dive-bombing sperm cell has only twenty-three chromosomes in it, which sounds like a lot but is only half what you need to get a baby nine months later. Each one of those chromosomes holds about two yards of DNA, which stores up lots of information in little molecules for things like how big your brain is going to be, what color of skin you are stuck with, and even the shape of your toenails, as well as guarantees that you will be a human being, not a watermelon. What that sperm does when it meets a female egg is add its twenty-three to the egg's twenty-three, and when you get that magic forty-six the egg automatically begins to divide into all kinds of other cells, and you wind up with something that might look like you, me, or Landrum B. Shettles. Life has done it again.

John Gurdon spooked the pants off all of us in the 1960s when he took out the nucleus of a frog's intestine cell and piped it into a lady frog's egg cell that had had its nu-

“I guess I've made more photographs of the human egg being fertilized and in its early stages of cleavage than anyone else alive. . . . I don't like to work with laboratory animals like rats. The rats bite.”

cleus pulled out, and that egg started dividing then and there, and, before you knew it, there was an exact croaking copy of that other frog who had had his gut played with. Gurdon had cut the boy frogs out of the whole sack and did this over and over again. Before long, Doc heard about it and figured he'd try something like that with human eggs.

"You mean you went ahead and tried that with human eggs before testing the idea out in all kinds of other animals?" I asked.

"I started out with human-egg studies way back when almost everybody else was playing around with sea-urchin and rabbit eggs," he said. "I guess I've made more photographs of the human egg being fertilized and in its early stages of cleavage than anyone else alive, and those photos are hanging in science museums in New York, Boston, and other places. I don't like to work with laboratory animals like rats. The rats bite."

Now I don't know if that was the real Landrum B. Shettles talking. I believe it could have been Landrum A. or Landrum C., or whichever one puts plants upside down in a flower pot. Anyway he went look-

ing for just the right cell with just the right forty-six, and he found it in the tissue involved in manufacturing sperm, which is pretty logical now that I think of it. Now you're going to say he cheated and skipped in one handy old sperm, but remember that sperm has only twenty-three chromosomes, while that sperm maker has the whole forty-six. The next thing Shettles did was to get an egg—Shettles doesn't say how he gets the eggs, but *New York* magazine once suggested he gets them any way he can and they called him an "egg poacher"—and suspend it in a mixture of fluids. All right, now Shettles faced the problem of how to get that sperm-maker nucleus out of its cell and into the poached egg. When Mr. Rorvik wrote his cloning book about that milkmaid who wanted to be timeographed, he said that the high-powered doctors involved figured it was too hard to do nuclear transplanting by hand, so they used a virus to snip out the one nucleus and swim it into the egg. That is called the "fusion" method as opposed to microsurgery. But wait right there: Doc Shettles learned quite a bit about microsurgery way back in the thirties at Johns Hopkins, when he was sticking little glass needles into cells even without using that expensive automatic hand-assembled micro-equipment, since he and nobody else had any money then. What he said to himself was "I'm going to do this live-hand" and use my old Bursian butter to make up a small, hollow glass needle to go fishing for nuclei with, and he did. That would be quite a feat for anyone, especially for a man about seventy and particularly when some Nobel Prize winner said it was too hard to do without damaging everything, since a human egg is much smaller than a frog's.

"I noticed in one of your last months that another big doctor complimented you for your fingers." You must be pretty good with your hands, I said.

"Well, I grew up on a farm and I was good with my hands," he said. "I was a blacksmith and I was a carpenter and one summer I fixed the steam on a locomotive. I made a pipeline out of bamboo for an artisan waterworks. I studied at night by coal-of-lamp. When I was making, I'd squirt milk right into a calf's mouth. Once, I trained a chicken how to catch corn."

Well, Doc Shettles made up his pipette and went fishing, and three times, he says, he pressed a rubber bulb on the end of the pipette and sucked out those sperm-maker nuclei and squirted them into those female eggs. Right before his eyes, those eggs not only began to divide, but divided six or seven times, producing a little probably with some seventy or so cells. In other words, they were big and normal enough to transplant into a woman in test-tube baby style.

Now you have every right to ask whether the doc has any women lined up for this part of his cloning operation, and he'll say he hasn't been looking for any and won't until the hospital gives him permission. But



FICTION

The space habitat was the perfect planned colony. But people kept disappearing—until the disaster struck

DOWN & OUT ON ELLFIVE PRIME

BY DEAN ING

Responding to Almqvist's control, the life utility tug walked from the north dock port and made its gentle prowl. Ellfive Prime Colony seemed to fall away. Two hundred thousand kilometers distant, blue-white Earth swam into view, crisscrossed of mankind, cage for too many Almqvist turned his long body in its outstuds and managed an obligatory smile over iron lines. If that won't satisfy you, hornbeak, Mr. Weston nothing well.

The tall man gazed, looking not at the planet he had deserted but at something much nearer. From the widening of Weston's eyes, you could tell it was something big, closing fast. Tom Almqvist knew what it was. He eased the tug out, watching his radar, to give Weston the full benefit of it.

When the lip of the great solar mirror swept past, Weston blanched and cried out. For an instant, the view port

was filled with cables and the mirror pried mechanism. Then, once again, there was nothing but Earth and sharp pinpoints of starlight! Weston turned toward the engineering manager, writhes at his jawline trembling. "Stupid bastard," he grated. "If that'll be your standard pike on new arrivals, you must cause a lot of colonines."

Abashed, disappointed. A mirror comes by every fourteen seconds. Mr. Weston! I thought you'd enjoy it. You asked to see the casting facility and this is where you can see it best. Besides, if you were tested as a heart case, I'd know it. And the hell with you, he added silently. Almqvist revealed into an impersonal apoll he knew by heart, moving the tug back to gain a panorama of the colony with its yellow legend, L-5, proud and unnecessary on the hull. He moved the controls gently, the blond hairs on his

forearm masking the play of tendons within.

The colony hung below them, a vast shining metal the length of the new Hudson River Bridge and nearly a kilometer thick. Another of its three mirror strips, anchored near the opposite South end cap of Ellfive Prime and spread like curved petals toward the sun, hurtled silently past the view port.

Almqvist kept talking. Prime was the second industrial colony in space, dedicated in 2007. These days it's a natural choice for a retirement community. A fixed population of twenty-five hundred—plus a few down-and-out burrs hanging here and there. Nowhere near as big a place as Orbital General's new industrial colony out near the asteroid belt.

Almqvist droned on, backing the tug farther away. Beyond the South end cap, a tiny more sparkled in the void and Weston squinted, waving it

"The first Ellfive was a General Dynamics Loran Brothers project in close orbit, but it got snuffed by the Chinese in 2012 during the war."

"I was only a cub then," Weston said, relaxing a bit. This colony took some damage, too, didn't it?"

Almqvist glanced at Weston who looked older deeper his bland flesh. Well, living Earthside with seven billion people tended to age you. "The month I was born," Almqvist nodded, "a nuke was intercepted just off the centerline of Ellfive Prime. Thermal shock knocked a tremendous dent in the hull, lost needs, of course, it looked like a dome poking up through the soil south of center."

Weston clapped pudgy hands, a gesture tagging him as neo-Africaner. "That's be the hill, then. The one with the pines and spruce, near Hikon Prime?"

A nod. "Stress analysts



PAINTING BY VINCENT DI FATE

swore they could leave the dimple if they patched the hull around it. Cheapest solution—and for once a pretty one. When they finished bringing new lunar topsoil and distributing it inside, they saw there was enough dirt on the slope for spruce and ponderosa pine roots. To balance thousands of tons of new processed soil, they built a blister out on the opposite side of the hull and moved some heavy hardware into it.

The fat man's gaze grew condescending as he saw the great metal blister roll out. He saw like a humor on the hull. "Looks slapdash," he said.

"Not really; they learned from DynLever's mistakes. The last Elvive colony was a cylinder heavier than an aircraft like ours." Almqvist pointed through the view port. "DynLever designed for a low ambient pressure without much nitrogen in the cylinder and raised hell with water transpiration and absorption in a lot of trees they tried to grow around their living quarters. I'm no biologist, but I know Elvive Prime has an Earthside ecology—the same air you'd breathe in Paris, only cleaner. We don't coddle our grass and trees, and we grow all our crops right in the North and cap below us."

Something new and infinitely pleasing shifted Weston's features. "You used to have an external crop module to feed fifty thousand people, back when this colony was big in manufacturing—"

"Sold it," Almqvist put in. "Detached the big rig and towed it out to a belt colony when I was new here. We didn't really need it anymore—"

Weston returned the interruption pointedly. "You didn't let me finish. I put that deal over OroGen made a grand sum on it—which is why the wife and I can retire up here. One hand washes the other, ah?"

Almqvist said something noncommittal. He had quit wondering why he dicked so many newcomers. He knew why it was a sting-catch: sorry that he, Elvive Prime's top technical man, did not have enough rank in OroGen to be slated for colony retirement. Tom Almqvist might last as Chief Projects Manager for another ten years, if he kept a spotless record. Then he would be Earthside in the crowds and smog and would eat fish cakes for the rest of his life. Unlike his ex-wife, who had left him to teach in a belt colony so that she would never have to return to Earth. And who could blame her? "Siv."

"I beg your pardon?"

"Sorry, I was thinking, 'You wanted to see the high-g casting facility?' It's that sphere strapped on to the mirror that's swinging toward us. It's moving over two hundred meters per second, a lot faster than the colony float being a kilometer and a half out from the spin axis. So at the mirror tip, instead of pulling around one standard g, they're pulling over three g's. Nobody spends more than an hour there. We balance the sphere with storage masses on the other mirror tips."

Restive, only half-interested. "Why? It doesn't look very heavy."

"It isn't." Almqvist conceded, but Elvive Prime has to be balanced just so if she's going to spin on center. That's why they filled that blister with heavy stowed equipment opposite the hull—though a few tons here and there don't matter."

Weston wasn't listening. "I keep seeing something like bean doors flipping around past the other end, ah, and cap." He pointed. Another brief sparkle. "There," he said.

Almqvist's arm tipped the control stick and the tug slid farther from the colony's axis of rotation. "Stacking mirror cells for shipment," he explained. "We still have slag left over from a retroplan rich asteroid they towed here in the old days. Fused into plates. The slag makes good protection against solar flares. With a mirror face, it can do double duty. We're bundling up a pallet load, and a few cargo men are out there in P-suits—pressure suits. They—"

● *Streaking out of the ecliptic, a brief nova flashed against the stars . . . Weston saw Almqvist's eyes blink hard . . . the manager's face seemed aged by compassion and hopelessness.* ●

Weston would never know and have cared less, what Almqvist had started to say. The colony manager clapped the fingers of his free hand against the wireless speaker in his left ear. His face stiffened with cold intensity. Fingers flicking to the console as the tug rolled and accelerated. Almqvist began to speak into his throat mike—something about a Code Three. Weston knew something was being kept from him. He didn't like it and said so. Then he said so again.

" . . . happened before," Almqvist was saying to someone, "but this time you keep him contained, Radar Prime. I'll haul him in myself. Just talk him out of a panic, you know the drill. Please be quiet, Mr. Weston," he added in a too-polite aside.

"Don't patronize me," Weston spat. "Are we in trouble?"

"I'm swinging around the hull, give me a vector," Almqvist continued, and Weston felt his body sag under acceleration. "Are you in voice contact?" Pause. "Doesn't he acknowledge? He's on a work-crew-scrambler circuit, but you can patch me in. Do it."

"You're treating me like a child."

"If you don't shut up, Weston, I will." Oh, hell, it's easier to humor you." He flicked a toggle and the cabin speaker responded. " . . . be okay I have my explosive nerve," said an unfamiliar voice, adult male, thin and tight-fledged by larvae. "Staring to retro-flew now."

Almqvist counted back at the muffled sharp bursts. "Not too fast, Versky," he cautioned. "You overbeat a next gun, and the whole load could detonate."

"Jeez, I'm overwinding," Versky cut in. "Hang tight, guys." More bursts, now a staccato hammer. Versky's monologue gave no sign that he had heard Almqvist, had all the signs of impending panic:

"Versky, listen to me. Take your goddamn finger off the trigger. We have you on radar. Relax. This is Tom Almqvist. Versky, I say again—"

But he didn't. Far beyond streaking out of the ecliptic, a brief nova flashed against the stars. The voice was cut off instantly. Weston saw Almqvist's eyes blink hard, and in that moment the manager's face seemed aged by compassion and hopelessness. Then, very quietly, "Radar Prime, what do you have on scope?"

"Nothing but conflict, Mr. Almqvist. Going everywhere at once."

"Should I pursue?"

"Your option, sir."

"And your responsibility."

"Yes, sir. No, don't pursue. Sorry."

"Not your fault; I want reports from you and Versky's cargo-team leader with all possible speed." Almqvist flicked toggles with delicate savagery, turned his little vessel around, arrowed back to the dock port. Glancing at Weston, he said, "A skilled cargo man named Yves Versky. Experienced man, should've known better. He floated into a mirror support while hosing those slag cells around and got grazed by it. Bashed him hell to breakfast." Then, whispering viciously to himself, "God-damn those big fuck guns. They can't be used like control jets. Versky know that."

Then, for the last time, Weston realized what he had seen. A man in a pressure suit had just been blown to meat-pieces before his eyes. It would make a lovely anecdote over sherry. Weston decided.

Even if Almqvist had swung past the external hull blister he would have failed to see, through a deflected view port, the two shabby types looking out. Nobody had official business in the blister. The younger man gunched nervously, heavy cords bunching at his neck. He was half a head taller than his companion. "What'd you think, Zier?"

The other man yielded a lopsided smile. "Sounds good." He unslung a pocket communicator from the wall and stuffed it into his freeseab coveralls, then leaned forward at the view port. His chunky muscular torso and short legs (it-ranched the extraordinary arms that reached halfway to his knees, giving him the look of a tall dwarf) "I think they bought it, Yves."

"What if they don't?"

Zen swung around, now grinning outright, and regarded Yves Wersky through a swath of brown hair that was seldom cut. "Hey, do like boss Almqvist told you. Relax! They gotta buy it."

"I don't follow you."
"Then you'd better learn to look if they recover any pieces, they'll find human flesh. How can they know it was a poor nummy's body thawed after six months in deep freeze? And if they did decide it's a scam, they'd have to explain how we planted him in your P-51. And out him loose from the blast, when only a few people are supposed to have access here, and press the audio tape and the explosive, and coax a decent performance out of a lunk like you, and, he spread his apologetic arms wide, his face comically ugly in gloe, "nobody can afford to admit there's a scam counterfurniture on Elvive Prime. All the way up to Tom Almqvist there'd be just too much egg on too many faces. It ain't gonna happen, Wersky."

The hulking cargo man found himself infected by the grin, but "I wonder how long it'll be before I see another egg?"

Zen snorted. "First time you lug a carton of edible garbage out of Hilton Prime, me lad. Jean Nerud's half-blind when you put on the night cover, he won't know he has an insect in his recycling crew and after two days you won't mind pickin' chicken out of the slop. Just off light in your basement hatch-hole when you're off duty for a while. Stay away from crews that might recognize you until your beard grows. And keep your head shaved like I told you."

Wersky heaved a long sigh, sweeping a hand over his newly bald scalp. "You'll drop it on me? I need a lot of tips on the scam life. And—and I don't know how to repay you."

"A million ways. I'll think of a few young fellas. And sure, you'll see me—wherever I like."

Wersky chuckled at the term young fella. He knew Zen might be in his forties, but he seemed younger. Wersky followed his mentor to the air lock into the colony hull. "Well, just don't forget your friend in the garbage business," he urged, fearful of his own future.

Zen paused in the conduit that snaked beneath the soot of Elvive Prime. "Friendship," he half-joked, "comes directly with mutual benefit and inevitably with guilt. Put another way," he said, lapsing into scam language as he trotted toward the South end cap, "a friend who's willing to be understood is a py. One that demands understanding is a pain in the ass."

"You think too much," Wersky laughed. They moved softly now, approaching an entry to the hotel basement.

Zen glanced through the spy hole, paused before punching the wall in the requisite place. "Just like you work too much. He flashed his patented gargoyle grin. "That me. Gave your heart a rest."

Wersky much too tall for his borrowed clothing, inflated his barrel chest in char-

gerne. "Do I look like a heart thumper?"

A shrug. "You did to OrbGen's doctors, not their souls—which a why you were due to be Earthside next week. Don't lay that on me, of scam, I'm the one who improved you to a low-g colony, if you'll just stay in low-g areas near the end caps." He opened the door.

Wersky saw the hand signal and whispered, "I got it. Wait thirty seconds." He chuckled again. "Sometimes I think you should be running this colony."

Zen slipped through, left the door nearly closed, waited until Wersky had moved near the slit. "In some ways," he stage-whispered back, "I do. Wink. Then he scuttled away."

At mid-morning the next day, Almqvist arranged the accident report and its supporting documents into a neat sequence across his video console. Slouching behind his desk with folded arms, he regarded the display for a moment before

Weston paused half-way into his harness, staring up. Suddenly he was scrambling away from it, mindless with the fear of rising into a synthetic sky. Screaming, he fled down the slope.

lifting his eyes. "What've I forgot, Emory?"

Emory Berek cocked his head sparrow-like at the display Almqvist growled a quick, watching the soufl of Renna's eyes dart back and forth in sober scrutiny. "It's all there," was Renna's verdict. "The only safety infraction was Wersky's. I think."

"You mean the tether he should've worn?"

A nod, Renna started to speak but thought better of it, the furrows dark on his olive face.

"Spit it out, demmit," Almqvist goaded. Renna usually thought a lot more than he talked, a trait Almqvist valued in his assistant manager.

"I am wonderin'," the little Brazilian said, "if it was really accidental." Their eyes locked again, held for a long moment. "Elvive Prime has been orbiting for fifty years. Decoupling early casualties throughout the war, the colony has had twenty-seven fatal mishaps among OrbGen employees. Fourteen of them occurred during the last few days of the victim's tour on the colony."

"That's her dead?"

Another nod.

"You're trying to say they're suicides."

"I am trying not to think so." A devout Catholic, Renna spoke heartily.

Maybe he's afraid God's a disaster, I wish I thought He would. "Garnj say I'd blame some of them," Almqvist said about remembering. "But not Yves Wersky. Too young, too much to live for."

"You must account for my pessimism," Renna replied.

"It's what we pay you for," Almqvist said, trying in vain to make it airy. "Maybe the insurance people could convince OrbGen to sweeten the Earthside trip for returning people. It might be cheaper in the long run."

Emory Renna's face said that was bloody likely. "After I send a repair crew to fix the drizzle from that nan pipe, I could draft a suggestion from you to the insurance group," was all he said.

"Do that," Almqvist turned his attention to the desk console. As Renna padded out of the low Corer building into its courtyard, the manager committed the accident report to memory storage, then paused. His fingers twitched nonchalantly over his computer-terminal keyboard. Oh, yes, he'd forgotten something, all right. Conveniently.

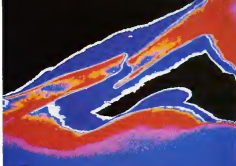
In moments, Almqvist had queried Prime memory for an accident report ten years past. It was an old story in more ways than one. Philip Elroy Hazen, technical editor born 14 September 2014, arrived on L-5 for first tour to write modification work orders 8 May 2039. Earthside on 10 May 2041, a standard two-year tour for those who were skilled enough to qualify. A colony tour did not imply any other bonus. The tour was the bonus. It worked out very well for the owning conglomerates that controlled literally everything on their colonies. Almqvist's mouth twitched well, maybe not literally.

Hazen had wangled a second tour to the colony on 23 February 2045, implying that he'd been plenty good at his work. Fatal injury accident report filed 20 February 2047.

Uh-huh! Uh-huh! Yes, by God there was a familiar ring to it, a mall in Hazen's radio while he was suited up, doing one last check on a mod-sock on the casting facility. Flung off the tip of the mirror and—Jesus, what a freakish way to go—straight into a mountain of white-hot slag that had radiated like a dying sun near a temporary processing module outside the colony hull. No recovery attempted, they'd all asthma?

Phi Hazen, Zen, they'd called him. The guy they used to say needed roller skates on his hands, but that was envy talking. Almqvist had known Zen slightly and the guy was an absolute terror at sky-bike racing along the zero-g axis of the colony. That he own fly-wing craft, even gave it a Maltese cross scarlet polymer whipstaples, and a funny name. The Red Baron had looked like a joke, just what Zen had counted on. He'd worn a year's pay before other sky bikers realized it wasn't a stroke of luck.

Hazen had always made his luck. With



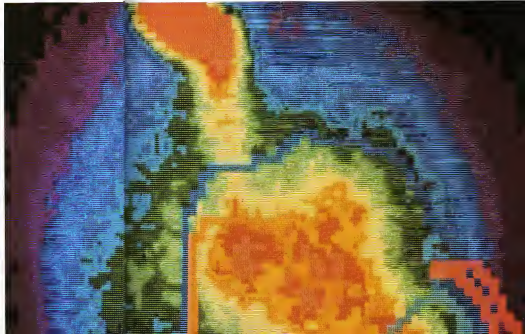
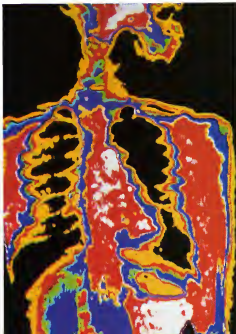
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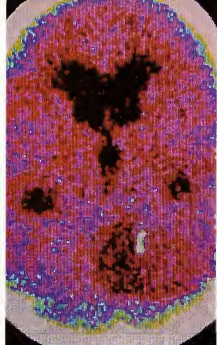
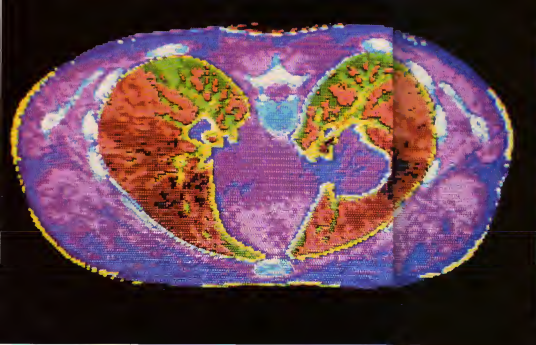
Medical Eyes of the Future See Today's Disease

BY HAL HELLMAN

One day in the future, your visit to the doctor's office may go like this: After a short interview to determine whether you have a specific complaint, you will step into a special room. Nobody will touch you. But a series of silent eyes will probe your body inside and out. Any or all of a variety of different "lights" will be used—visible light, ultrasound, infrared rays, radio and microwaves, and, if necessary, x rays and particle beams. If there is suspicion of trouble, super-senses

Clockwise from below: Nuclear study of heart in motion (fibers indicate "regions of interest"); x rays of torso and broken bone, with color added to enhance contrast; thermograph uses heat from this child's body to take this picture, highlighting warm and cool regions.

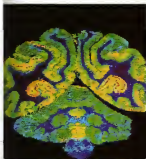




will roam in an suspected tissue. Perhaps samples of one or more body fluids—saliva, blood, or urine—will be called for. Perhaps not. The machine will be so refined that it will be able to determine what is normal for you and whether anything is out of order.

How far has medicine come along that road? Surprisingly far, as we can see from the techniques illustrated here.

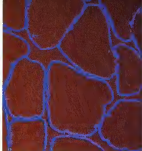
Medical diagnosis is tricky at best. Much of what the family doctor does today is based on inference—an attempt to determine from external symptoms what is going on inside the body. The surprise is not that such diagnoses are sometimes wrong, but that they are right as often as they are. Often a disease is in process and



Computer tomographic (CT) scanning uses a ray in a new way: it provides cross-sectional views of the body (top left) and head (below). Brain tumor in combination shows clearly in lower portion. Actual brain slice (left) from monkey injected with radioactive substance looks its own picture, red and orange portions show increased activity when vision is stimulated.

• No physician will touch you, but a wide array of silent eyes will probe your body, inside and out. •

Use of computer to analyze picture of muscle-fiber cells. Lower right original picture read into computer. Right boundaries determined. Below single cell isolated and enlarged, with tissue enhanced. X-ray plates and photographs can also be analyzed for signs of unseen pathologies.

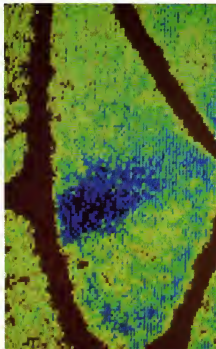


◀An astounding collection of "lenses" has been developed in recent years for diagnostic imaging ▶

there are no external signs, yet the only hope for successful treatment lies in early and precise diagnosis. Generally, the best way to do that is to "see" inside the body.

Prior to the discovery of x rays in 1895, the only way to see what was going on inside the body was to cut it open. Still today exploratory surgery is done when all other methods of diagnosis fail. But with the astounding collection of "lenses" developed in recent years for imaging the inside of the body, exploratory surgery always risky, is needed less and less. Some of these methods are also useful in medical research (see page 89).

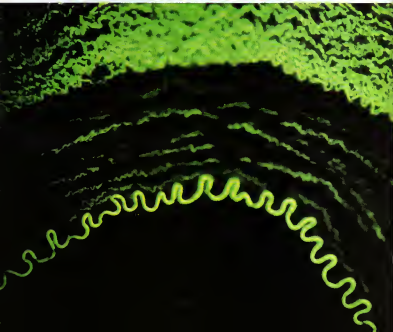
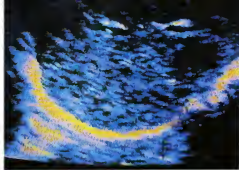
A number of them depend on the computer. Simple computers can introduce color into diagnostic shots to help distinguish what would otherwise be similar gray



Powerful computers can "read" the images and extract amazing amounts of information from them.

areas (e.g., page 88). More-powerful computers can "read" the images produced and can extract amazing amounts of information from them (pages 90 and 91). In combination with ultrasound and radioactive substances, computers have made it possible to see the heart, lungs, and other body organs in action (pages 87 and 93). But the main application so far has been in head and body scanners that can already provide information beyond the wildest dreams of diagnosticians. ☐

Clockwise from right: Nuclear heart-motion study shows coronary-artery disease in this patient; computer view of ultrasonograph of liver (inside yellow curve); CT scan of skull even shows squabbling dog's femoral artery in cross section (right); muscles contract (near wall).



DEEP QUEST

With only map markings to guide them, three psychics try to find a ship sunk deep in the ocean

BY STEPHAN A. SCHWARTZ

In recent years, in an effort to lend needed credibility to investigations of the so-called "paranormal," its researchers have begun to adopt the techniques and procedures of traditional science—an important advance in this fledgling, volatile field of endeavor. Thus, we at *Omni* were excited when Stephen Schwartz came to us with Project Deep Quest, a 1977 experiment in which a team of psychics was asked to discover a new underwater archaeological site. Admittedly, some of us were (and still are) skeptical about the results of this experiment, but we were nonetheless impressed by Schwartz's efforts to document and control his research. Though not perfect, Project Deep Quest sets the stage for other work in this area and underscores the careful attention that must be paid to the design and execution of all research that attempts to go beyond the bounds of normal science.

The Editors

Sunlight flickered on choppy Pacific waters as the cabin cruiser *Sea Witch* cut through the ocean on her way to the University of Southern California's Marine and Coastal Studies laboratory on Santa Catalina Island. But this was not the normal twice-a-week supply run. The crew sensed something unusual about this trip.

By overhearing snippets of conversation, they had deduced that *Sea Witch* was carrying a unique team of psychics and researchers, known as The Mobius Group, which would attempt something over the next three days that much of science cried out was impossible.

With little more to guide them than the markings on maps sent out months before, The Mobius Group, using a submarine, would try to locate specific artifacts contained within a site ninety meters (300 feet) beneath the surface. The idea was preposterous, and several researchers on



PAINTING BY INGO SWANN

the institute's staff, including members of the Sea Watch crew were briefing that three days hence, a very embarrassed project director would return empty-handed.

Since I was that individual, the planner "putting it all on the line" could not have been clearer. It had taken eight years to finally get the submarine for this experiment, and that was made possible only through the friendship of old Department of the Navy colleagues at now van the USCG institute. However, if the experiment did not come up with clear-cut results, there would be no second chance. Too much money and too many reputations were at stake, not the least of which was my own.

I had learned—first as an editorial staff member at National Geographic, then as an investigative reporter later as a scientist, as special assistant for research and analysis to the Chief of Naval Operations (the controversial Admiral Elmo Zumwalt and his successor, James Holloway), and finally and finally at the Psychophysical Research Society in Los Angeles—that if one gets ahead of the power curve, but into areas where there is controversy and dissension, one had damn well better have his act together.

The experiment was simple enough on paper. I had sent a standard navigation chart to three psychics months before this warm July day. Accompanying the chart were almost childishly worded questions asking the psychics to locate something man-made on the sea bottom, describe it in as great detail as possible, explain how it had gotten there and how old it was, and finally to please sketch a picture of anything they "saw."

It was all so easy—except that the psychics were in some cases thousands of kilometers away, the target they were seeking was lying beneath hundreds of meters of seawater, none of them had ever been to Santa Catalina Island, and there was nothing to see but seemingly endless stretches of blank ocean surface.

I looked out at that green water and wondered: The task would have been difficult enough if the target had been known. But to make matters worse, the target all the psychics had settled on was completely unknown. Indeed, one of the submarine's crew members had told me some weeks before that in five months of diving on an almost daily basis he had seen nothing resembling the sunken sailing ship that my psychic respondents had described, let alone the detailed renderings of cargo and winches that had been sent back to me along with the maps. Only one crew member, submarine pilot Al Witcombe, had been supportive: "You can never tell, there are lots of things hidden on the sea floor. But another of the crew had given the majority opinion of everyone at the marine laboratory: "It's damn odd, I can tell you, damn odd!"

My gray rhino was broken when film-production supervisor Bob Dixon (I wanted to make a complete real-time film record of

the experiment) and Dr. Ann Kahle came forward to ask when that three-day take place. Dr. Kahle is an intrinsically kind geophysicist and expert on remote-sensing observations—those marvelous pictures that Mariner sent back from Mars being one example.

My research colleague, nuclear physicist and parapsychologist Dr. Edwin C. May and I had invited Dr. Karlieto observe each phase of the experiment and to take control of all documentation, original results and answers to the questions. The Marine Institute had appointed a second observer, associate director Brad Webb.

"Do you really think this thing is going to work, Stephen?" Ann Kahle asked without preamble—a perfectly legitimate question.

"The truth is, it should, at least the theory says it should." I couldn't think of much else to say. "The research done by controls over the last seventy-five years says it should work, I want to say. God knows, but no, I don't know for sure that we will do anything more this weekend than get a good surm and possibly a terminal case of embarrassment."

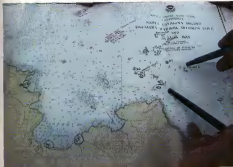
"Just thought I'd ask," Kahle said and turned to talk with psychic Hala Harnessed, who was beginning to look distinctly green as the boat cut through the Pacific chop.

"You didn't tell me we'd be on top of the water," the psychic called to me as she and Kahle went below. But she smiled with the same gameness that had led her to try an experiment at the prestigious Stanford Research Institute at Palo Alto, California. Researchers had been looking for now a subject in their psychic experiments. It was termed a "uncanny" success at seeing things hidden by hundreds of kilometers of sea water, specially shielded Faraday cages, and doubly sealed, randomly selected targets, that had first attracted my attention when I was putting The Mobius Group together.

The idea for a research team comprised of accomplished scientists and psychics previously well tested working together as equals (not in the traditional subject-scientist relationship), gradually evolved in my mind from the stimuli of two sources, the research I had done for my book on psychic archaeology, The Secret Worlds of Time, and the published papers of Russian scientists. The Soviets were considered by most parapsychologists to be anywhere from five to ten years in advance of Western researchers, thanks to vast infusions of government money. They believed, as I had come to believe, that the relevant question to ask about psychic phenomena was not "Does it exist?" but rather "Let's assume it exists, now what can we do with it as a practice?"

But not even the Soviets had tried anything as adventurous as Project Deep Quest; and that was the rub upon which my mind remained stuck.

Standing on the gritty were physicist May and one of the best-tested psychics in the



With little more than a map (right) to guide them, the psychics and scientists of The Mobius Group set out to find a sunken ship, wrecked about a century ago, by bumping and blowing up anvils. The research submarine Taurus (left) was used to reach the site. Once there, the evidence was all around them, including a defuncte encrusted which (top) whose discovery had been psychically predicted.

wild Ingo Swann. Like Harrod, who was a well-respected professional photographer in real life, Swann too was an accomplished artist (his painting decorates the opening page of this article). But Swann's persona as psychic was only a small part of his total personality. This was no accident. Professional psychics, who must always be on "call" have too many financial and emotional involvements with their paranormal abilities to do well in rigorous scientific experiments.

Ingo and I had been friends for a long time and had often discussed the development of an experiment so tightly controlled that the intervention of psychic data to achieve the desired result. The contractual impulse led me to write the seventeen-page protocol of controls that Dr. Kahle was monitoring.

For Swann it was the latest in a sequence of increasingly more demanding challenges. He had already demonstrated that he could stop a magnetic field shielded by nine meters (thirty feet) of concrete, two specially shielded cages and a variety of other controls. (One observer of this experiment at the Varian Hall of Physics at Stanford, a respected physicist, had broken into uncontrollable nervous laughter upon seeing his perception of what constituted reality destroyed. What Swann was doing was clearly impossible.)

Ingo Swann has also psychically gone to Mercury, Jupiter and Mars months prior to the arrival of NASA's mechanical spacecrafters Mariner, Viking and Pioneer. One astrophysicist compared the previously recorded (and not-remembered) statements provided by Swann and another psychic, Harold Sherman, to what the spacecraft sent back. He pronounced that Swann's words contained nothing that the voice capsules contradicted and, in fact, that Swann's descriptions were more detailed than NASA's.

For all that, Deep Quest made Swann nervous. He and Dr. May had flown over his previous plans a day earlier to facilitate Swann's adjustment to his surroundings and get himself "up in my nose" so that I will be ready."

The alarm went off at the ungodly hour of 5:30 A.M. For me, a night person, whose normal working schedule calls for waking between 10 P.M. and 2 A.M., it seemed the middle of the night.

To make it worse, we had been up in my room until 2 A.M. talking with Brad Webb, from the institute and the submarine's chief officer and designer, Al Tisca, who had founded the Canadian firm International Hydrodynamics Company Ltd., builders of the submarine.

Tisca, Tisca had explained was the first of a class of specially designed deep-diving craft, usually called submarines by those who know the difference. She was battery-powered, ten meters (thirty-four feet) in length, with a large plastic window to afford those at board a clear view—if it

diver could go as deep as *Aurus*, which he could not without bizarre gas mixtures and special equipment. Moreover, *Aurus* had a manipulator arm to reach out into the depths and pick up samples.

The device was particularly important, since it was my hope that artifacts could be brought back from the sea floor either to support or to destroy the psychic reconstruction I had conceived.

As we had discussed the following days a dive, Veek had been openly skeptical and had made jokes while I told the submarine story was good-naturedly tolerant. Veek listened carefully as Dr. May and I explained that through some process that was only dimly understood, Helia Hamad, Irigo Sween hunting and fishing guide George McMullen (a fellow Canadian) then an instigator on an archaeological expedition and a psychic who for the past five years had worked with the late Professor J. Norman Emerson, president of the Canadian Archaeological Association and, until his death in November, that country's most senior archaeologist), and three supposedly unpsychic "controls" (of whom I was one) had provided a detailed description of an event that had happened almost a century before.

As they told the story a sailing ship, possibly with a steam plant or steam-powered winches, made of wood, had sunk off Santa Catalina between eighty-three and ninety years ago because of a fire and an explosion amidships. Having sunk to the bottom, the ship's wooden hull was eaten away by marine organisms, but the psychics felt sure that a long list of specific artifacts, including anchor-chain and rope-handling gear, would be found.

Then, Veek, and the *Aurus* crew found it "certainly difficult to believe that somebody thousands of miles away can see such stuff on the sea bottom. They were even more incredulous when we told them that we believed anyone could perform such psychic feats although, obviously just as some people play the violin better than others, some individuals are better psychics."

I went on to explain that for the last seventy-five years archaeologists all over the world have been very quietly working with psychics to make locators of previously unknown sites, to locate artifacts within a site, to explain what the site was used for and occasionally to provide complete reconstruction of the culture that made use of such artifacts.

So seriously was this work taken, although it is by no means the majority opinion that psychics and archaeologists have anything to say to one another, that in 1974 the American Anthropology Association of the American Academy for the Advancement of Science began regular seminars at its annual convention on parapsychology (the preferred term of researchers in the field) and anthropology (of which archaeology is a subdiscipline).

The record is clear to anyone who doubts that psychics can aid practical research.

Additionally, archaeological fieldwork can do much in return to help us understand psychic functioning and, by extension, human consciousness. It is, after all, a very clean experiment when a psychic tells you first to go to a place, then tells you what you will find there, perhaps even describes in what position the artifacts will be discovered. The stuff is either there or it isn't. It cuts through all the smoke screen about magic tricks and fraud. The objects we were looking for could not have been sailed, because it takes a given number of years for marine growth to build up on such objects and for silt to occur. Nor could the psychics have come out here one day and agreed on a site. The depth alone militates against such collusion. If we found anything it would mean more than an archaeological jackpot.

As we sat taking, psychic Helia Hamad came in and drove me and Dr. Kahlia aside. She explained that she had been reaching out with her psychic sense to the site on the

“I had sent a standard navigation chart to three psychics asking them to locate something man-made on the sea bottom, describe it in as great detail as possible, and to draw it, too.”

sea bottom and that she had seen a large block of stone that showed signs of having been worked by man. Also, she sensed that some kind of wheel would be found, with a shaft protruding from its center. She handed Kahlia pictures of the block and the wheel she had drawn, apologizing, "I'm a photographer not a draftsman, then, turning to me, "but I think you'll find these things on the bottom."

Her comments pitted us like a charge of electricity. We soon explained the incident to "Ipe" and the crew. "It is logical to suppose that if something is on the sea bottom, it might well be a ship, and if it's a ship, you expect to find debris. But Helia has given us a target you could not expect. Why, after all, would there be a block of stone such as she describes in the midst of a ship's wreckage?" The wheel is interesting for another reason. Okay, the mention of the wheel might be explained, although frankly identifying a specific object from the thousands of pieces that make up a ship is pretty impressive. But, add that there was a shaft coming out of its center! Well, I didn't know about the others, but that plus the description of a Y-shaped metal object this

meter long and heavily encrusted with knots on the end, and the deck winch I personally had "seen"—the entire concept tended to fry my circuits. There was not the only one to agree with that evaluation.

In the early morning after a minimal breakfast (others, I realized, also had light stomachs) the crew and the *Mobius* members gathered at the submarine's hangar to look May the stubby white-and-red craft located like a friendly spacecraft, and the pilot, Al Wilcombe, agreed. "There are a lot of correlations between deep-ocean craft and space probes—only diving is more technically complex and in a sense more dangerous, owing to the enormous pressures that build up with all that seawater on top of you."

Selected for the first archaeological deep-ocean dive in history were Bob Dixon, me, and, of course, the non-*Mobius* independent observer Ann Kahlia. Before entering the craft, Kahlia, I, Veek, and Wilcombe had reviewed the target, an area about 81 by 108 meters (calculated from a local area measuring about 3,900 square kilometers) that lay about a kilometer and a half off Blue Geyser Point. As we stood around the chart table, Wilcombe again cautioned me not to be disappointed if nothing turned up. "Except for an old wreck off Bird Rock about a half-mile away that was sunk for a 1930s movie, we haven't seen anything like what you are looking for. The bottom is very clean in that area. Permission to go to bottom. Over."

For the next three hours *Aurus* would roam the strange horizon of the sea floor, her passengers increasingly desperate as the sought-for targets failed to materialize.

The problem, Al Wilcombe explains, is that "we can't find the exact location. It's easy to mark something on a map, hard to find it when there is no familiar landscape by which to take one's bearings."

As he explains this, Kahlia leans forward, row herself caught up in the search. "Is that something over there?"

"Nothing on the sonar, but we'll take a look," Wilcombe alters the sub's course.

It takes almost five minutes to get on location, and during that time, I'm becoming more depressed. It's not just looking stupid, although no one likes to look the fool, particularly when the people to whom one appears foolish have already predicted this outcome. It is the embarrassment of disappointing a group of respected scientists who, if suddenly drawn on me, have participated or provided equipment largely on the basis of my past reputation as a responsible researcher and friend.

It is obvious that the others are discreetly aware of my anguish, because, like good friends, they start making supportive noises. "Well, you knew it wasn't going to be easy . . ." Wilcombe begins.

"Look, Al, I really can't see break for lunch? I think we should put one of the psychics aboard. It's obvious we can't even

find the location on the map, and if we don't we can't even test the information.

Woombe agrees and calls to the surface on the special wireless underwater phone. It is agreed that Swann will come out in the tubular transfer boat so that a minimum amount of daylight will be lost.

As Woombe asks permission to surface, his copilot speaks up.

Look, why don't you get the surface to take a fix on the target point and then have them drop a pinger [radio homing device] over the side? It will send out a signal we can zero in on. That way we will at least find the site. Whether there is anything there now... that's another matter.

Woombe enthusiastically agrees and calls to see whether a pinger is available. Several of the small devices (which look like old-fashioned doorbell batteries) are on board, but nearly all are mechanically unsound. After some consideration, we locate a working pinger and make the arrangements. Meanwhile Ingo Swann replaces Bob Quon for the next trip down.

Swann dives again. The pinger's beep-beep-beep is loud over the cabin speaker as Swann suggests: "A little more to the left. Al."

"Okay, we're in the area now, Ingo. My God, what is that?"

Suddenly the cabin temperature, atmosphere, and everything around me seem to change. There, clearly before us, as if "Neptune had dressed it for our arrival," is the deck winch seen by one of us in that strange daydream state which is psychic perception. Fish swim in and out of its openings, their yellow and white stripes a contrast to its encrusted orange.

"Swann, can you calm down? What's going on down there?"

"A hit. We've done it. There's stuff all over the bottom here."

In the hours that follow, we find Hella's wheel exactly as she drew it and soon locate the Y-shaped object. With the help of the manipulator arm and a wired-on Knudsen yogurt crate, we pick up the Y-shaped object and bring it to the surface, as the day's dive ends in exultation.

In the next two days we hit every single target. Nothing is missed, including the strange block of stone Hammoth had predicted. Looking like the manolith in Arthur C. Clarke's 2001, it rears up from the muck of the ocean floor, a final testimony to Deep Quest's successful exploitation of man's psychic powers.

When we board Sea Watch for the trip back to the mainland an older scientist not involved with the experiment asks Dr. May, "What is the probability that you were just lucky that it was just chance?" For May who has been working on statistical analyses of psychic experiments for several years, the query is to be taken with utmost seriousness. After a pause, during which he is almost visibly thinking through the factors he must consider, the physicist responds:

"With an experiment such as this, there are so many things one must account for



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"There's a tremendous amount of space travel going on around the universe. When a vehicle arrives here, we'll know about it."

INTERVIEW

ARTHUR C. CLARKE

In 1945, a young English technical officer who had spent World War II helping to develop radar systems for the Royal Air Force published a remarkably prescient article in the British journal *Wireless World*. The article showed in detail how artificial satellites could be used to relay electronic communications around the world. The writer was Arthur C. Clarke.

Thus began the most remarkable marriage of far-fung imagination and realistic scientific fact in the history of English letters, for as much as anyone, Clarke has been a founder of the Space Age. In his writings, both fiction and nonfiction, Clarke has been the Space Age's prophet and one of its chief movers.

His books are world renowned, and his writing has earned international awards. Less well known is the fact that he helped to push a doubting scientific community into serious consideration of space flight—back in the days when "shooting for the moon" was synonymous with attempting the impossible.

As chairman of the British Interplanetary Society, Clarke en-

couraged scientists and engineers to look at the real possibilities of space travel. His invention of the communications satellite was a natural outgrowth of his ceaseless search for the practical realities that would bring the dream of space flight into useful life.

In his science-fiction stories and novels, he painted future scenarios in which space travel was an integral and irreplaceable part of human life in the very near future. In his nonfiction articles and books, he presented powerful arguments for exploring space—and the inner depths of Earth's oceans.

His nonfiction works include such classics as *Interplanetary Flight*, *The Exploration of Space*, *Profiles of the Future*, *Voices from the Sky*, and *The Phoenix of Space*; his science-fiction novels are, if anything, even better known around the world. Perhaps Clarke's most stunning contribution was his screenplay (with Stanley Kubrick) and novel, 2001: *A Space Odyssey*.

Clarke now resides in Sri Lanka, where he was interviewed exclusively for *Omn* by journalist-photographer Malcolm Kirk.

Omn: I understand you have given up writing for good. About any subject whatsoever or simply about science fiction?

Clarke: I will! I don't write a one-sentence blurb for the jackets of books for my best friends. I mean, I have to be absolutely fair because once you've made exceptions, you know you can't stop. I've said all I want to say in both fiction and nonfiction, at least at this point. But that doesn't mean in 10 years or so I won't rechange my batteries and start writing again. I may get involved in controversy from time to time. In fact, in the local papers I'm having a controversy with some astrological people who think that the planets are going to be lined up at Christmas 1982 and all hell will break loose. And I had fun pointing out that this is utter nonsense. The planets aren't lined up in '82. So occasionally things like this will trigger me off, but I don't expect to do anything.

In *The How from Senecap* I have put all my recent nonfiction essays, and particularly Sri Lanka articles, and sort of wrapped that all up. On the fiction side, I'm sure I'll never do anything as good as *The Phoenix of Paradise* (Harcourt Brace Jovanovich). Everything came together in it—the locale, the theme. I got the biggest theme I've ever tackled: a serious real theme which may involve the large-scale exploration of space on a scale never dreamed of, even by people like Gerard O'Neill with his space colonies. And yet this is real hard engineering. All sorts of things have come together—religion, philosophy—in this one book.

Also, I want to enjoy my declining years and have some time for skin diving. I've learned to play the piano, a second ambition I've had all my life and never dreamed I'd have the chance of realizing. I've got a library of videotapes I'm building up.

Omn: On what subjects?

Clarke: Mostly science. It started with a commercial I did for the Bell Telephone System when they made a two-hour version of *The Man in the Iron Mask*—a fine performance with Louis Jourdan, Ralph Richardson, and the star Richard Chamberlain—a very fine actor. Then the Bell System flew a team out here to film me in Sri Lanka, and they gave me a video system so I could see the result. So now I'm building up a library with a lot of science programs, and also, I've got a 16mm library that I'm building up.

Omn: Do you film or photograph much yourself?

Clarke: We used to do quite a bit of filming. A partner of mine and I made a film called *Beneath the Seas of Ceylon* for the Ceylon tourist board. A thirteen-minute 16mm film. Then we did a two-hour Ceylonese epic that was a smash hit and is still one of the best films ever made on the local market—in color original sound, original music, a really first-rate film. We restaged it after more than ten years, and it is packing them in.

And the next thing I did was *2001*.

Omn: Have you ever intended, after 2001, to get involved in anything else on a major scale like that?

Clarke: No, because when one starts at the top like that, where do you go from there?

Omn: Was there at one point any talk of doing a film version of *Childhood's End*?

Clarke: There's always talk of doing a film version of *Childhood's End*. I started the movie more than twenty years ago, and at the moment there's a cease-and-desist order out from my agent to Universal Studios, who claim they're making a television version of it. I don't know what's going on. About five of my books have been sold to the movies.

Omn: Bob Guccione was very interested in working on some film with you if you showed any interest at all. Do you think you would be interested or not?

Clarke: Well, I've spread the word around that if anyone wants to film any of my books, I'm willing to talk to them for a few days here in Sri Lanka, or on the telephone. If they call at a reasonable hour, And I'll own back all scripts, although I hate scripts, movie scripts are terrible, they're meaningless.

☛ *Space brought me to Sri Lanka. I was interested in diving here simply because it is the only way of reproducing the condition of weightlessness, which is characteristic of space flight.* ☛

loss, except to directors. But I'm quite willing to cooperate within limits. What I won't do is sit down at the typewriter for long periods of time when the sun is shining and the waves are sparkling at the reef.

But I'm willing to talk to anybody in general terms about projects and discuss things. I've got a stunning new opening for *Childhood's End* if anybody does want to film it.

Omn: Are there any other kinds of projects that you might be interested in working on—underwater or anything like that?

Clarke: On the underwater side, my partner, Heclor Ikoniasika, and his fiancée Valena Fuller are taking divers out from all over the world; in fact, our most distinguished clients were the Apollo 12 team when they came back from the moon. We took them diving in Trincomalee. So I'm surrounded by diving activities, and I hope to spend some time underwater. I have a bungalow on the south coast of the island in the most beautiful bay you can imagine and a lovely reef outside it.

Omn: What brought you to Sri Lanka in the first place? For how long are you here, and what keeps you here?

Clarke: Space brought me to Sri Lanka. I suppose, if you go back to the beginning, I became interested in underwater exploring and diving simply because I realized that it was the only way of reproducing the condition of weightlessness, which is characteristic of space flight. You aren't quite weightless, strictly speaking underwater, but it's the nearest approximation you can get for any length of time. So that's why I learned diving.

Omn: How long ago was that?

Clarke: That was in the late forties. I went to the Great Barrier Reef in Australia, and on the way I passed through Sri Lanka and went out by the old Himalays one afternoon and met some local divers and

Omn: Excuse me, what's the Himalays? Is that an old P and O (Pacific and Orient) ship?

Clarke: Yes, it's broken up now. And during the course of this I got more and more interested in the country. I met many friends and kept coming back and eventually settled down here. I just hate being anywhere else.

Omn: It seems an odd place to find a science-fiction writer. One would imagine you to be in Cambridge or Palo Alto, London or New York, and instead you've chosen a sort of chaotic estate here.

Clarke: I've been to all those places. I have friends in all. But because it is quiet here I have time to read all the material that's been sent me. I have at least twenty journals of various kinds and a vast correspondence, and everybody passes through Sri Lanka eventually. My friends come here. Bucky Fuller was here a few months ago and we flew him around and showed him the locales of my new novel.

And these are also emotional, inner reasons for being here. It's a very nice way of living, as you can see. I finally got everything organized in this house, which I moved into four years ago. The only nightmare I've had is about leaving Sri Lanka.

Omn: Are you here all year at this point?

Clarke: I haven't been out of the country for a year. I don't plan to go out for another year, and then it will only be for a brief visit to England. And if I never leaves again, that's fine with me. I know in fact I shall be going. Something very important may come up that I can't possibly turn down. But I've said half-jokingly or maybe quarter-jokingly that as much as I love America—and I have a great many friends there—the only thing that will get me back is when there's a seat in a space shuttle for me. I told the NASA administrator that.

Omn: How do you occupy yourself in a typical day here?

Clarke: Oh, my goodness. I've often tried to answer this question, and I found there's no such thing as a typical day. But I get out at six-thirty and hear the Voice of America news, then at seven have breakfast and hear the BBC. Then my day starts about eight. My working day starts about eight o'clock. I've always got about twenty books waiting to be read. I count that I have about

thirty-six hours of reading for every twenty-four hours. The mail bombs me out. And then I try to get in at least an hour on the piano. I have anything up to ten visitors a day.

Omni: What are they usually here to see you about?

Clarke: Sometimes they just come for autographs. A lot of diving people, of course. I normally never leave the house at all, except at four o'clock in the afternoon, when I go to the local swimming club and play a vicious game of table tennis for a couple of hours. That's my only recreation. I am a table-tennis addict. I can still beat most of the amateurs there. Then I come back and make a film show, may listen to some music and get to bed quite early around nine o'clock. I never go to receptions, cocktail parties, dinners, simply because they're so time-consuming.

Omni: No more bathing away at the typewriter?

Clarke: No, I haven't used a typewriter since January. I suppose I'm thinking of taking the typewriter down to the reef and photographing it surrounded by fish.

Omni: You're not active in the scuba diving or the school?

Clarke: I haven't been active in that way for a long time. I became totally paralyzed in 1962 as a result of a spinal injury and I was a basket case for many months. I'm lucky to be alive, let alone to be able to move around. And I never recovered my strength, so I've got to take things rather carefully. But I still enjoy snorkeling when I have a chance of doing it. I can still stay underwater for a minute by my own power if I have to. I used to be able to stay underwater for nearly four minutes, even though I don't take up diving until I was nearly thirty.

Omni: Hyperventilating?

Clarke: Yes, which is dangerous, a stupid thing to do.

Omni: Are you actively involved in any programs connected with the ocean?

Clarke: Yes. I am fighting to save the reefs here. The coral reefs have been smashed up to make inlets and around the tourist centers you'll see hundreds of people smothering up the beautiful reefs, right beside the hotels. It's incredible. It's against the law but there's such an economic pressure to do it that no one is able to stop it. I'm also trying to set up marine sanctuaries.

Omni: Do you see exciting developments in the future of oceanographic exploration, work with dolphins—things along those lines?

Clarke: Well, I've always been fascinated by dolphins, and I have written a couple of books about them. Dolphin Island, I mentioned, is being filmed by Reditz Productions. I've had to get them to come here, although the story takes place on the Great Barrier Reef. Of course, the ocean is the other great frontier as everybody says. I mean, this is a cliché now. The most important thing in the ocean at the moment is probably oil and deep-sea mining, which is now held up with the problem of getting

international agreement. The other thing I'm interested in, which is rather speculative, is ocean thermal power. That's the use of the temperature differential in the tropical oceans, where it is always about eighty degrees [F] or more on the surface and thirty-five or so a mile down. I wrote "The Shining Omni" on the theme. It was set in Trincomalee, in Sri Lanka—there was a deep canyon coming right in close to land, so you had deep water very close to land and this is an ideal place for it.

I wrote this story partly to alert people to the possibilities I've done that several times, although as a rule I'm very much against writing fiction to teach people. According to Sam Goldwyn, "If you got a message, use Western Union." But that is one story that I did go for that purpose, to make people think of ocean thermal power. But the classic case is my story "I Remember Babylon." That was about the possibility of communication satellites, before there were any communication satellites. Al-

◀ We should only be concerned with close encounters either they exist or they don't. If anyone reported a Tyrannosaurus rex loose in Central Park I'd verify it quite quickly, same with flying saucers. ▶

though that story is, I hope, worth reading as a story, it was a deliberate attempt to say communication satellites are possible—they can make a big difference to your world.

Omni: Someone mentioned that you have the only TV set in Sri Lanka. Is that true? You can't receive any image can you?

Clarke: This video system here is, of course, closed and when we do get to here, which will be next year, it will be a different system anyway. But I did have in fact the only television receiver in the country two years ago and, as far as I know the only privately owned Earth-satellite station in the world.

In 1976, the Indians had the very important experiment, broadcasting educational programs from a satellite loaned by NASA. It was called the Satellite Instructional Television Experiment. And to my delight and surprise, the Indian Space Research Organization flew in a complete ground station, set it up on my roof, and gave it to me so I could see the programs. For one year, I had the only set on the island. And everybody, from the president down, came to see the television programs.

Omni: Is there going to be any follow up on that? Have they stopped it altogether?

Clarke: Well, the satellite was only on loan for one year and now it's gone back and is doing much the same thing for the Eskimos and over the western United States. The Indians will have to follow on fairly quickly with their own satellite.

Omni: Do you think the current interest in science fiction is a passing fad? Or do you think it indicates a wider interest among the population at large in the near future?

Clarke: There's always been a background of interest in science fiction. It's always been popular, whether it's been called science fiction or not. Right back to Verne and Wells and then to the modern era with the science-fiction magazines. Almost any number of well-known writers have had their hand at science fiction at some time or another, some with disastrous results, some with good results. H. Bruce Franklin wrote a book, *Future Perfect*, claiming that every major American writer had written some science fiction, and his anthology which is an interesting one, tries to prove his point. The first robot language in English fiction was written by Herman Melville, for instance, something not generally realized. I'm afraid the pulp magazines tended to degrade science fiction in many ways and ghettoize it. And now it's becoming slowly recognized and respected, and people are not turned off by it. Obviously, judging by *Star Wars* and *Close Encounters of the Third Kind*, which I haven't yet seen.

Omni: I was just going to ask you about that.

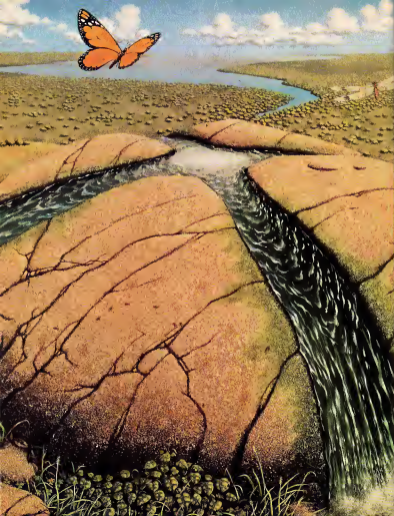
Clarke: I am dying to see *Close Encounters*. I've seen *Star Wars* twice and thoroughly liked it like everybody except a few tough-minded characters. I think it's a marvelous film. At its level, I don't see how it could be improved. I do appreciate George Lucas's saying that 2001 is better. Well, you can't really compare the two. It's like comparing steak-and-kidney pudding with strawberries and cream. *Close Encounters* I've not yet seen. Obviously this is a new phenomenon. There's a great deal of interest in the universe and great possibilities, and of course I'm very happy about that.

Omni: How do you think *Omni* fits into this by the way?

Clarke: I was really very impressed. The contents were uniformly interesting. There was none or very little of the nonsense I'd rather leered. I mean, you can't keep the UFO people out. The treatment of that sort of thing in the fringe sections was very sensible. I felt in many ways that it was the sort of magazine I'd like to have designed for myself.

Omni: What else would you like to see in *Omni*?

Clarke: I would like to see a hard-nosed treatment of some of the cranks who are littering the scene and fringes of science. Some of my friends, like Martin Gardner and James Randi, are trying to put some sense into the public about Uri Geller who I



FICTION

THE EYES ON BUTTERFLIES' WINGS

*They wanted to break free of this
controlled society,
but fear kept them all prisoners*

BY PATRICE DUVIC

Everybody sat and waited. Maybe the butterfly would go away.

The butterfly with the eyes on its wings, watching. But, deep inside, they knew it would stay. Or would pretend to go away and then sneak back, unnoticed. So they didn't say anything. Didn't even talk about something else.

And were highland that their silence would give away what they were thinking. If they were thinking.

They tried not to. Succeeded more or less. Less. More. But couldn't keep themselves from watching one another. Asked themselves, Why is he moving his fingers? Why is he looking at me? Why is he thinking? Why won't he stop thinking? I can't tell he's thinking. With that butterfly here in the room? Why won't he STOP thinking? Why can't I stop thinking?

Watching one another would reveal too much. And without being positive that they were deceiving the butterfly or that it was gone, they didn't dare close their eyes.

So they stared at the eyes on the butterfly's wings. And let themselves be hypnotized into oblivion. Oblivion was safe, and after all, tomorrow would be another day.

A very slow fluttering of the wings. And you wait for it to cease, and it almost does, but it doesn't. It slackens, pauses, and then starts again. Over and over.

Then, after a while, the butterfly left the room. So did they. Anyway, they didn't feel like talking any more. More like sleeping.

Dreaming
Colors.

He was on the point of waking up, and images were still lingering before his eyes. Colors. As if he were in deep forest. And under the trees, flowers that were not really flowers but more like butterflies on a stem, butterflies made of loathers.

He tried to go asleep or, rather, to find a state between sleep and awakening. To remain in his bed for a while. And to remember his dream.

To remember a dream, one of his friends had once told him: you've got to go backward. You've got to try to remember the image just before the one you have in mind. Never let yourself get trapped by the scene that comes next, because then you'll find out very soon that you're wide awake and the whole dream's fading away. The scene that comes before, once you've got that, just go on backward, always backward.

My ladder hurts.

I'm walking in the forest, looking for some kind of castle. No. In fact, it's not exactly a castle, more like a very large house, a colonial mansion but somehow very Arabic. Arches, colored tiles arranged in an intricate Escher pattern underfoot.

Nearby there is a swimming pool. The water is green with tiny floating plants. But they've emptied it. And the ladder doesn't reach down to the concrete bottom. I'm playing there with my balloon. I often do. And I'm telling myself stories, inventing imaginary adventures. Can't remember which.

PAINTING BY BILL MARTIN

I'm a kid, and my parents are up there, in front of the colonial mansion. They can't see me from where they are. My bladder's hurting, worse and worse, and I don't want to jump to catch hold of the ladder, climb the ladder and walk to the house, to the tiled bathroom.

The concrete bottom of the swimming pool is still wet in places, green with algae. It wouldn't show. And I have to pee.

Wake up! You know what kind of dream this is, where you dream you're pissing. But it's not just a dream, and you're going to wake up and find the sheets wet and cold.

So he got to the bathroom, still half asleep, with a vague memory that he'd been dreaming. Pretty soon, though, he couldn't say what the dream had been about. Just that there'd been colors in it.

After a while, he wasn't even sure of that. He got to the kitchen, put some water in a kettle, fumed on the electric stove, and opened the window.

A few butterflies flew past him out of the open window. Who knew how long they'd been hiding in the apartment?

And how many were still in it, behind one piece of furniture or another.

There were strange and terrifying stories told on the subject of butterflies, the sort of rumors that no one really dared talk about but that everyone had heard at one time or another. And you'd wonder why such stories spread so easily. But they did.

It was said that these stories began as facts taken from old entomology books. Supposedly taken from old entomology books. But no one dared to go to a library and ask for an entomology book any more. It would have looked very very suspicious.

Was there some legitimate reason to try to learn more about insects? For what reasons would one be interested in entomology? Except . . .

So it was difficult to know if the rumors were reliable or not. They sure looked like pseudoscientific panicles. But . . .

Anyway, below they all died, when you could still find them outside natural history museums, birds used to feed on insects, all kinds of insects, including butterflies. At least certain species of birds did. Because there were also birds of prey that fed on smaller birds, the very birds that led on the butterflies.

So to protect themselves, the butterflies learned (or maybe they didn't learn, maybe it was just some kind of Darwinian selection, but that wouldn't change anything either way) to mimic birds of prey.

A sparrow would try to catch a butterfly and, suddenly, find itself faced with an eagle and fly away. But the eagle would not really be an eagle, just a small butterfly pretending to be an eagle, a butterfly with eyes on its wings. And that kind of butterfly would survive and reproduce and spread all over the world. Millions, billions, of butterflies with eyes on their wings.

Butterflies, you see, really had a knack for survival. But sparrows were not their

only problem, because before turning into winged adults, imagoes, butterflies were caterpillars, and farmers thought of the caterpillars that ate their crops as a plague. So the time of pesticides came. And at the beginning, they were very effective.

Except that insects, and especially butterflies, adapted very quickly. And caterpillars not only began to find pesticides very nice seasonings, they became addicted to them and got to the point where they needed greater and greater quantities.

And where do you think they could find these very high concentrations?

Ever hear about food chains? The highest concentration of pesticides can be found in the vital organs of carnivorous animals. Men, for example.

As you can see, these stories very much resembled the kinds of stories parents always tell their children to lighten them. "If you don't stop it, if you don't drink your soup, if you keep on being naughty, the butterfly is gonna come. He's gonna lay his

There were strange and terrifying stories told on the subject of butterflies, the sort of rumors that no one really dared talk about but everyone had heard at one time or another.

eggs in your liver and in your kidneys and in your brain. And the caterpillars will eat you. And you'll be very very sorry . . .

"But there'll be nothing we can do. It'll be too late. We'll be very sorry for you, but it'll be too late."

"But Daddy, the butterfly won't know if we're bad. If you don't tell him, he won't know."

"Oh, he'll know. You see, he's got eyes on his wings."

But grown-ups are no longer kids. And for one thing, they know that it would be nearly impossible—no, quite impossible—for a butterfly to lay its eggs in a human brain and for a caterpillar to survive in a human body.

Unless they get help. Now sometimes when you need help, and even if you're a butterfly, you'll find people willing to help you. Especially when they've got something to gain from it.

And if people could use these butterflies to spy on everyone, they'd have something to gain from it indeed.

When he looked for the cigarettes in his pocket, he found the carefully folded sheet

of paper. He was supposed to Xerox it. Twenty copies, more if he could make them. As long as he took the necessary precautions to spread revolutionary thinking all over the world. He hadn't even read it which, he had to admit, was very significant. A year earlier, when he'd joined the Movement, he really hadn't been able to wait to read the things, would even take risks to read them as soon as possible. To him, then, they had had tremendous importance. But he didn't care for them anymore. Not for the meetings.

He didn't even know why he was still attending them, and he got the definite impression that they never did anything except to more meetings. Meetings that, like the last one, would stop in the middle of a sentence, as soon as a butterfly appeared in the room.

Strange thought, but, in a way, we really need to believe that they're watching us, and we'd be—there'd be—very disappointed if we found out that they don't, because it confirms our belief that we're important, that we constitute some kind of part for the System. That we're dangerous and that we're working in the right direction.

Maybe that's what the butterflies are for, not only to spy on us but also to convince us that we can be dangerous to the Establishment.

But why?

So that we go on doing the same thing that we've always done? Twenty Xerox copies of Xerox thinking . . .

Xerox thinking. The idea made him smile.

The problem was, he didn't know what else he could do.

As he entered the photocopy room, with the labels hidden in the middle of a bunch of other documents, he saw that someone was already there, which was quite unusual for that time of day. He decided to come back later.

"No, wait! I'm nearly finished. Five minutes at most. But if you're in a hurry you can make your copies now. I'll wait. Really."

"No, no hurry. But I've got a lot of documents to Xerox, so you'd better finish yours first."

"Okay."

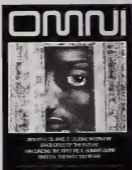
He didn't know precisely why, but there was something about the guy that he didn't like. Just a little too friendly and there was too much interest and curiosity in his eyes. He made you think of a friendly spider.

Exactly the kind of situation he was afraid of. Especially now that he had made his decision. The next Movement's meeting would be the last for him. And the traps he was going to Xerox were the last he would do. It would be too stupid if after a year of clandestine Xeroxing it was precisely this last time that he got into trouble.

But he had to do it. He didn't want the others to think he was quitting out of cowardice. He wanted that to be quite clear. In fact, the ideal would be to make a huge number of copies, ten times what they asked for, two hundred copies—throw

continued on page 101

YOUR PASSPORT TO INFINITY



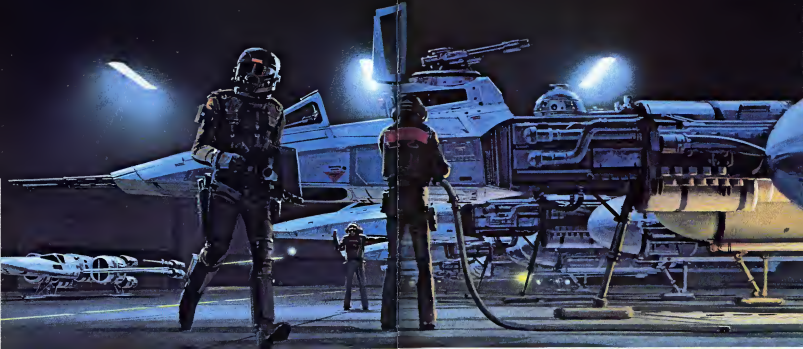
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HELL CREATURES OF THE THIRD PLANET

FICTION

Out of deepest space they came! Bullets couldn't stop them; fire couldn't kill them. All Earth lay at their mercy! But what did they really want?

BY STEPHEN ROBINETT

They came out of the night sky like something out of *Close Encounters of the Third Kind*. No organ music but plenty of lights and a big mother of a mother ship. I was on duty at the time, making sure no one stole trucks, the mechanical anek on the studio tour. I had just looked up the set for *The San-Mon-Dollar Man* and was walking through Six Points, Texas, the Western town left over from silent days—I think I was in front of the saloon—when I saw it. At first I thought it was the freeway spacer helicopter in trouble. There's plenty of room on the back lot for a helicopter in trouble to land. Then those lights came

on—flick—and the sky lit up like a forest of Christmas trees. I couldn't see one real star on either side, not that you can see real stars through the L.A. smog, but the point is, like I said, the mother ship was a big mother.

I stood there in midair, not making a sound. That grabbed the night away. This mirrored thing just as a cat on a pipe. When my eyes and my mind started getting used to what they were looking at, I began to make out parts of the ship, metal plates, and little windows with people—or something—moving around inside, just like in *Saturn 5* or *Galaxica*. (I get them confused) or 2021. Okay probably you've guessed it by now

I'm a film buff. I'm also a cinematography student at UCLA. That's why I took the summer job as a studio night watchman to be near the business I love and maybe learn something.

Eventually my mind started working again, and I figured I should notify someone. After all, they were trespassing, and I was responsible for things like that. I rushed to the phone behind the facade at the marshal's office and called the police. Okay, okay, I know it was dumb. But who else was I supposed to call? The President? Maybe. They say he saw one once. Still, I admit it was a dumb thing to do. What could the police do against beings who had body guns where no alien had gone before, right? What could a few black-and-whites throw against a big mother of a mother ship that had crossed the infinite void of space unscathed, right? I guess I wasn't thinking. I just ran to the phone and called.

The first black-and-white showed up in about three minutes. The two kids in it got out and stated at the ship, their faces a sickly shade of green. I still don't know whether the green came from them or the lights on the ship. One of them almost broke his neck diving through the open car window to get at his radio. He screamed into the mike, saying I wasn't a nut after all and to send every unit in L.A.—in the state!

That's when we heard something for the first time, a sort of buzzing, crackling hum like the light bridge in Flash Gordon followed by a scraping tumble as if a hundred-ton stone door were opening above us. I think they had a nose like it in *The Mummy*. We looked up. The bottom of the mother ship was opening.

Blinding light spilled out of the widening rectangle and lit up the entire back lot like a klieg light. A second ship, materializing dimming the light from the belly of the mother ship, appeared in the rectangle of light and began a slow almost imperceptible descent out of the bay. It looked like your basic flying saucer from *Invasion Earth 2150 A.D.*

Now black-and-whites were pouring into the back lot, sensors waving, lights flashing, full of cops turning a sickly green. They sidled to stops on Six Points, Texas, the set of *Thoroughly Modern Millie* in front of the Psycho house, anywhere and everywhere. A black van rolled up in front of Uncle Tom's cabin, and a tac squad spilled out, just like they used to do on *SWAT*.

Then everyone froze.

Dead silence, except for the Flash Gordon—light-bridge noise. The small ship was about halfway to the ground, mechanical arms popping out, devices—who knows what they were—minutely panning back and forth on the ends of the arms.

Someone yelled, "Response!" and the cops opened up. They blasted it with everything they had: pistols, shotguns, automatic weapons. The SWAT team used to kick leg gas into the open bay of the mother ship.

The canisters fell back and passed a half-dozen policemen.

About this time, the cops figured out they were doing about as much good as Richard Carlson in the first half of *The Magnificent Seven*. Still, the mechanical arms did pop back into the saucer, and the hatches did snap shut. The saucer backed off, fast, disappearing through the hole in the mother ship. We heard the immense stone door sound, and the mother ship closed up tight, plunging the back lot into darkness. The mother ship lifted—slowly at first, then faster—and streaked off toward the Pacific in a wink.

The cops went crazy cheering, yelling, showing their hats in the air. One man was injured when a motorcycle helmet came down. They were all as happy as the crew of the *Enterprise* after rescuing Captain Kirk from a tight spot. They figured they had won. All of them but one, Lieutenant McGraw, a pot-bellied, thirty-year veteran of the LAPD. He came over to me, flipped open the cylinder on his .38 police special, ejected the spent casing on the ground at my feet, and began reloading, stuffing each new cartridge into its chamber with grim determination. He finished loading, flipped the cylinder closed, and looked at me, saying, "They'll be back."

He was right. Six hours later, after the governor had ordered out the National Guard and the President had down in the Great Combat Troops he could find (the Big Red One all the way from Fort Branning, complete with tanks and artillery support), the mother ship came back. The door in the belly sumbled open, light flooded the back lot, the saucer its arms already out and moving, began its slow descent.

Nobody waited. The National Guard cut loose with bazookas, the Big Red One with rocket launchers, the cops with handguns. A wing of F-15s from March Air Force Base thundered in and blasted both ships, mother and child. It was the most stupendous display of the power since the battle scenes in *The Cosmic Man* or *Invasions from Mars*. Flash! Bang! Boom! It was something! I was proud of our boys.

In spite of our best efforts, the saucer kept coming, settling smoothly to the ground. A door in the side slid open, and a ramp extended like the alien ladder in *The Day the Earth Stood Still*. A robot—the thing must have been six meters tall!—appeared at the head of the ramp and lumbered toward us. Bullets, rockets, bazooka shells whirring off its tough hide without leaving a scratch.

I stepped at the foot of the ramp. Its view wrinkled up. A beam of blue light zapped out from the eye-slit, and our weapons were useless. You think I'm kidding, I'm not. That's the part that blanked out on TV and that no one will talk about. That robot had awesome, unheard-of power.

Behind it, a bunch of transparent fleshy-looking creatures like a cross between something out of *Invasion of the Hot Creepies* and *Gavel of the Space Monsters*

scattered down the ramp, slung all over with funny-looking equipment. The Big Red One fired bayonets and charged. The creatures paid no attention to them what-so-ever. Halfway to the saucer the screaming, psych-ed-up GIs ran square into the force field. Like the one in *Forbidden Planet*. The bayonets went in and stuck, spidery blue sparks bursting out at the points of impact. The GIs couldn't get their weapons unstick and had to retreat without them, leaving the rifles sticking out of the force field like toothpicks in cheese.

The creatures trotted around, setting up equipment, their bodies constantly changing colors, subtle, nipping hues like light seen through quartz. Evidently they talked that way. Finally they settled down. Since we couldn't do much of anything, we settled down too. Lieutenant McGraw pressed me a doughnut and a cup of coffee.

At the top of the ramp, two creatures appeared, one fatter and more translucent-looking than the others. I could see the skeleton and maybe an internal organ or two in the light from the docility of the saucer. They promaded slowly down the ramp, reached the foot of it, next to the robot, and began changing colors, pink, blue, green, orange, like a beer sign. McGraw said he thought it was real pretty. They had no more than started changing colors when a shot, one ran out from behind the equipment, jumped up and down in front of them, and turned scarlet. He waved a zipper at the ramp. The two turned, hurried back up the ramp, and disappeared inside.

They reappeared almost immediately and started the slow promenade down. This time, the fatter one tripped and fell off the ramp, landing on a bunch of equipment. The other scarlet one, once it saw the fatter one was okay, jumped up and down again. They started over.

The fourth time they showed up, the military finally got it through their heads that the aliens were invulnerable. They stacked sites (and bazookas and rocket launchers and F-15s) and just watched.

That caused the shot alien to go apologetic, it ran over to the edge of the force field and lamed at us in bright crimson. It waved its floppy arm and clenched a little fist on the end of the flipper. Then it flinched dead away. Other aliens rushed in, examined it, and carried it back up the ramp and into the saucer. The others poked up their equipment and got aboard. The saucer disappeared into the mother ship. The mother ship went straight up, dwindling to a point of light and vanishing—all in the blink of an eye.

Lieutenant McGraw came over to me, frowning, puzzled, shaking his head, saying, "I don't get it. I just don't get it."

He never did. Almost no one did. The police, the Pentagon, all the thousands of scientists who worked on it under government grants—none of them got it. Most of us around the lot got it. We're film buffs. We know the value of location shooting. **OO**

TREASURES IN THE DUST

EXPLORATIONS

By Roy A. Gallant

The next time you find yourself nodding behind the wheel from the monotony of turnpike driving, pull off beside a road cut where highway engineers have blasted the rock outcrop. Your reward will be not only a well-earned rest, but the possibility of finding some of those exquisite treasures in the dust that we call fossils.

Road cuts in many states, such as northern Kentucky, Michigan, and others listed on pages 112 and 113, are a sure bet for the fossil hunter. Other excellent hunting grounds for fossils include old rock quarries, coal and metal mines, canal and river banks, mountain slopes, beaches, and the rock dump heaps in areas where strip mining is practiced. In short, wherever the bedrock of the earth's crust has been exposed, you have a good chance of finding fossils. If you're not successful the first time you go fossil browsing by a road cut, don't be discouraged. Try another, farther down the highway. Eventually you are bound to strike pay dirt. Soon you may find yourself joining the hundreds of amateur fossil collectors, many of whom have built impressive collections, and in the process developed a keen appreciation for the geology of certain areas.

You may even strike it rich another way. One beginner collector, Francis Tully, now a seasoned veteran with an enviable collection of more than 3,000 animal fossils, began by breaking open rust-brown ironstone nodules heaped beside his favorite fishing spot in the strip-coal-mining region south of his home in Lockport, Illinois. One day he turned up a real prize—the fossil of a strange and grotesque thirteen-centimeter-long creature unknown in the paleontological records. He brought it to the attention of experts and eventually was rewarded by having the long-extinct animal named after him—*Aukmonstrum gregarium* ("common Tully monster").

HOW FOSSILS ARE FORMED

Fossils are the remains, or imprints, of animals or plants that have been preserved in rocks. They predate the

withdrawal of the last glacier about 10,000 years ago. Thus, a fossil can be as young as 10,000 years. The oldest known fossils—microscopic bacteriophage organisms found in Swaziland, Africa—date back to 3.6 billion years ago.

Don't expect to find fossils in all exposed rock. Virtually all fossils are found in sedimentary rock. Sedimentary rock is composed of mud, lime, or sand deposited on the floors of ancient, shallow seas, or it may be the dried and solidified remains of mud left behind by long-vanished rivers, lakes, or swamps. Over the vast stretches of geologic time, untold billions of animals and plants lived, died, and were fortuitously buried in such soggy heaps of sediment. Slowly the sediments were compacted, the water gradually squeezed out of them, and the individual particles eventually cemented together by minerals that acted as glue. The slow inexorable process that converts soft sediments into solid dry rock is called lithification.

There are at least three ways animals or plants have become fossilized. First, if an organism, or part of it, was tough enough—such as bone, shell, or hard wood—it may have been preserved more or less intact if conditions were dry enough and if the area was protected from erosion. But hardness alone is not enough. The

hard part must have been buried quite quickly after the organism died (or while it was still alive), or it would have decayed, as did the soft parts of the organism. Also, the plant or animal must have remained undisturbed during the entire time it was being fossilized.

In a few unusual and rare cases, some very special condition has helped preserve almost the entire animal—either extreme cold or extreme dryness, for example. Almost entire fossil mammoths have been found preserved in frozen ground, refrigerated for more than 29,000 years in Siberia and Alaska. And in dry regions of South America, parts of mummified ground sloths have been found preserved in dry and protected caves. But these cases are not the norm.

A second way in which many plants and animals have been fossilized was by being petrified. Their bone, shell, or other hard parts were changed into a different substance. Mineral-bearing water slowly seeping downward through the sediments was soaked up by the porous bones, shells, or wood. Gradually as the water evaporated when the sediments dried, the minerals left behind filled the small open spaces within the bone or shell. The addition of minerals tends to make bone, shell, or wood even harder. Very often the actual bone or shell was dissolved by the groundwater. When that has happened, the minerals in the water have slowly replaced the bone, shell, or wood as they are being dissolved. Brightly colored silica, calcite, or orange and red iron compounds often become part of fossil bone or shell. In some petrified wood, silica has not only filled in small hollow spaces but has replaced the once living woody tissue so perfectly that the individual cells and annual-growth rings show up exactly and clearly many millions of years later.

A third group of fossils are mostly traces—leaf or foot impressions in stone—of once-living organisms. After the plant or animal died, it was quickly buried in the sediments. Gradually the hard parts as well as the soft parts dissolved or decayed. Only a cavity was left in the



Fossilized ammonite (Perry/Parsons)

sedimentary rock where the shell or other hard part once lay. The walls of such cavities then became a natural copy, or mold, of the shell or other skeletal part. Millions of years after the cavity was formed, minerals seeped into and filled the cavity. In this way a natural cast of the original mold was formed. Millions later many such casts can be dug up by lucky fossil hunters. Molds and casts are very common fossil forms, particularly for invertebrates (animals lacking backbones).

Occasionally, the hard outside skeleton and any appendages of insects have been discovered in amber, which is the hardened and fossilized resin of ancient trees. Sometimes plants and small soft-bodied organisms living in the seas have been buried in mud that hardened into shale. But in these cases, the only remains are a thin film of carbon showing the delicate details of their appearance. Sandstone casts showing in remarkable detail the texture of dinosaur skin have been found in western Canada.

HOW TO FIND AND PREPARE FOSSILS

You do not need much in the way of special equipment to prepare yourself for a fossil hunt. Because most fossils are found in sedimentary rocks, you'll find it helpful to learn to identify the common fossil-bearing sedimentary rocks: limestone, dolomite limestone, coal, and shale. A rock-identification guidebook is an invaluable tool, as is a geological map of the area in which you plan to search. Other tools you should take are a geologist's hammer or a bricklayer's hammer, one or two medium-sized tempered-steel chisels, a knapsack, some old newspapers, masking tape, a small notebook, a ball-point pen, a small magnifying glass, and a few plastic pill bottles, which often hold small or delicate specimens.

When you are searching for specimens, avoid rummaging quickly from one spot to another. Instead, spend some time looking carefully either by crawling slowly on your hands and knees or by just sitting in one place. Turn over loose pieces of rock and carefully examine all sides of them. You will be surprised at what you may find. With your hammer and chisel, carefully split the sedimentary rocks parallel to the layers, not across them. It is on the broad, flat surfaces between layers that you will find fossils.

When you find a specimen, wrap it in newspaper and tape the ends together. On the tape, number each fossil and the date on which you found it. In the notebook, record the number and the date for each fossil, a short description of it, the kind of rock you found it in, and where you found it. This will allow you to return to the spot, or guide others to the spot, with a minimum of frustration, even years in the future.

After you have brought your specimens

home, clean them by placing each one in water with a mild detergent and letting it soak overnight. Excess rock and soil can then be removed with a stiff toothbrush. You can use long needles, tweezers, or old dental picks to clean around the smaller structures of your fossil. With the dental pick you may even remove much of the rock around the fossil, but work cautiously wherever you pick away at the rock next to the fossil. If a specimen is found in a stained condition, soak it in Clorox overnight.

If you are a serious collector after cleaning and drying each fossil you should label and catalog it. One way of arranging your specimens is to group the fossils from one collecting area. You should designate each collecting area by a different letter, then print the letter and specimen number on the fossil. Much of the information you find out about the fossil should go on a special label, together with the catalog number, and be placed beneath the fossil in its storage tray. This information, plus all the additional data you have in your field notebook and any information you get from other sources, should all be transcribed on a file card. These catalog cards, one for each fossil, can then be arranged in numerical order with each group and kept in your files. A fossil without such information is little more than a curio and is of no scientific value.

A word of warning: If you plan to do any fossil hunting on private or public property, be sure to get permission. Although most public property is "open," it may be temporarily closed to rock and fossil collecting because it is under a mining claim, or for some other reason. And don't risk getting a ticket by stopping to explore a road cut when juxtapike signs warn you that you may stop only for an emergency. Happy hunting!

WHERE TO FIND FOSSILS

Some excellent general guides identifying fossil-bearing rocks and giving more details on collecting techniques are *An Illustrated Guide to Fossil Collecting* by Richard Casanova (Holtsburg, Calif. Naturegraph, new edition, 1975), *Discovering Rocks and Minerals* by Roy A. Gallant and Christopher J. Schubert (New York: Natural History Press/Doubleday, 1967), and *Fossils for Amateurs: A Handbook for Collectors* by Russell P. McFall and Jay C. Wolf (New York: Van Nostrand, 1972).

For more detailed information about the locations of specific fossil sites and the kinds of fossils you may expect to find, write to the source listed for each state noted below. States not included tend to be relatively poor sites for fossil collecting. ALABAMA Mollusks and bryozoans abundant in road cuts, especially in south and central Alabama. Geological Survey, P.O. Drawer O, University 35486. ARIZONA Numerous dinosaur remains, turds, fish, and other vertebrate fossils.

much petrified wood, especially around Holbrook. Bureau of Mines, University of Arizona, Tucson 85721.

ARKANSAS Good collecting over most of state. Geological Commission, State Capitol, Little Rock 72119.

CALIFORNIA Excellent fossil hunting in most parts of state. Road cuts, rocky hillsides, and the Pacific coast are excellent collecting sites. Division of Mines and Geology Resources Building, Room 1341, 1416 North Street, Sacramento 95814.

FLORIDA Another good state for fossils. Limestone pits or phosphate mines are particularly good sites. Geological Survey, Box 631, Tallahassee 32304.

ILLINOIS Another good state for fossils. Numerous plant fossils, especially around Mazon Creek in Will County. Far north and northeast: animal fossils in dolomite limestone.—Itolobes and crinoids. Geological Survey, Natural Resources Building, Urbana 61801.

INDIANA Another excellent state for collectors. Eastern Indiana rich in animal fossils. Prime collecting site along spoil banks of railroad cuts around Westport and Crawfordsville. Geological Survey, 611 N. Walnut Street, Bloomington 47401. IOWA Large variety of fossils around Rockford. Excellent crinoids in quarries near Le Grand and Burlington. Geological Survey, Geological Survey Building, Iowa City 52240.

KANSAS Especially fossil-rich state. Central Kansas famed for Nebraskan chalk deposits with splendid marine and land vertebrates. Geological Survey, University of Kansas, Lawrence 66044.

KENTUCKY Highway and railroad cuts, quarries, streambed cliffs are excellent fossil sites in northern part of state. Department of Natural Resources, 208 St. Clair Street, Frankfort 40601.

MARYLAND Another excellent area, especially along Atlantic coast from Chesapeake Beach south. Geological Survey, Latrobe Hall, Johns Hopkins University, Baltimore 21218.

MICHIGAN Another excellent area with many outcrops and abundant fossils. Department of Natural Resources, Stevens T. Mason Building, Lansing 48926.

MINNESOTA Excellent fossil collecting around St. Paul. Rud Wing, St. Croix Geological Survey, University of Minnesota, Minneapolis 55414.

MISSISSIPPI Good collecting among Cretaceous outcrops. Geological Survey, 2525 North West Street, Jackson 39205. MISSOURI Good state for fossils; best hunting being among the Mississippian Age beds. Division of Geology Survey and Water Resources, Box 250, Rolla 65401.

NEBRASKA Many Pennsylvanian Age outcrops provide good collecting. Conservation and Survey Division, University of Nebraska, 113 Nebraska Hall, Lincoln 68508.

NEVADA Eureka region provides good collecting. Bureau of Mines, University of Nevada, Reno 89507

NEW JERSEY Many fossil-bearing outcrops of Cretaceous and Cenozoic Eras. Department of Conservation and Economic Development, Bureau of Geology and Topography, Box 1899, Trenton 08625

NEW YORK Fossil collecting in this state. Due west of Albany north: Cambrian, Ordovician, Silurian, and Devonian outcrops in the country. University of the State of New York, State Museum and Science Service, Albany 12224

NORTH CAROLINA Good state for fossil collecting. Raleigh-Durham area, northwest of Wilmington, Craven County, and along Cape Fear River. Mineral Resources Division, Department of Conservation and Development, Raleigh 27607

NORTH DAKOTA Both Dakotas famous for abundant fossils. Many dinosaur remains. State Geologist, University of North Dakota, Grand Forks 58202

OHIO A state rich in fossil-bearing rocks. Areas around Cincinnati, Hamilton, Cleveland, Clevelerville. Coal beds around Cleveland excellent. Fossils in virtually all counties. Geological Survey, 155 South Oval Drive, Ohio State University, Columbus 43201

OKLAHOMA Another good state for

fossils. Arbuckle Mountain region excellent. Texas-Oklahoma line also good. Geological Survey, University of Oklahoma, Norman 73069

OREGON North central part of state good in John Day River valley. Department of Geology and Mineral Industries, 1069

State Office Building, Portland 97201

PENNSYLVANIA Mines throughout state also good collecting areas. Also Lancaster and Susque counties. Bureau of Topographic and Geologic Survey, Main Capitol Annex, Harrisburg 17120

SOUTH CAROLINA Excellent collecting along the Intracoastal Canal. Areas north, west, and south of Myrtle Beach good.

State Development Board, Division of Geology, Box 927, Columbia 29902

SOUTH DAKOTA (See North Dakota.) Geological Survey Science Center, University of South Dakota, Vermillion 57069

TENNESSEE Excellent Paleozoic outcrops. Department of Conservation, Division of Geology, G-5 State Office Building, Nashville 37219

TEXAS Excellent collecting throughout state. Many surface outcrops, especially along line south from Oklahoma to central Mexico, also east-west line from Anaraska

line to El Paso County Highway. Department, 11th and Brazos Street, Austin 78711

UTAH Road cuts along new mountain highways provide excellent collecting

areas. House Range of Millard County excellent, also Blackfoot Fork section in Northern Utah; also Confusion Range also very near town of Tooe, and Wasatch and Uinta ranges. Geological and Mineralogical Survey, University of Utah, Salt Lake City 84102

VERMONT Northwestern part of state near Highgate Springs for trilobites, especially. Geological Survey, East Hall, University of Vermont, Burlington 05401

VIRGINIA Good collecting along coast, in southwest part of state, and in Blind Rockledge, and Smyth counties. State Geologist, Division of Mineral Resources, Box 3667, Charlottesville 22903

WASHINGTON Good collecting on coastal slope. Department of Natural Resources, Box 168, Olympia 98501

WEST VIRGINIA Excellent collecting throughout the many talings and rock dumps of shale and sandstone found in this state. Geological and Economic Survey, Box 879, Morgantown 26505

WISCONSIN Excellent outcrops along Yellow River near Hudson. From Green Bay to the Illinois line also good.

Geological and Natural Survey, 1815 University Avenue, Madison 53706

Roy A. Galton, former editor in chief of The Natural History Press, is the author of more than forty popular science books for general audiences, particularly in astronomy and geology. ☐

GAMES

ANSWERS TO GAMES (page 144)

How Much Wine? With the ruler measure the inside diameter of the bottle's base and the height of the liquid in the standing bottle. The wine fills a cylinder of those dimensions, so its volume is easily calculated. Now turn it upside down. The air space now fills a cylinder and the same procedure can be followed. The volume of the air space, added to the wine's volume, gives the total capacity of the bottle, and the percentage is easily determined.

Circle Round The radius is 8 inches. Note that one of the diagonals of the rectangle is 8 inches and that the other diagonal, of the same length, is the radius.

Cube Cutting No. Six is the minimum number of cuts required, no matter how the pieces are restacked. Consider the small cube that will be cut out from the very center of the large cube. Since none of its 6 sides touches the outside surface of the large cube, each side will require a separate cut.

The Suspended Egg First fill the glass half full of water and dissolve enough salt into it to make it dense enough for the egg to float on top. Then add more unsalted water to the top, filling to the brim.

Water and Whiskey Place a card over the water glass and invert it over the whiskey

glass. Now slide the card so that there is a fraction-of-a-centimeter opening between it and the inside edges of the 2 glasses. The water, the denser of the 2 liquids, will seep down into the bottom glass, and the lighter whiskey will rise into the upper glass to replace it.

Weigh in The filled balloon weighs more, because the air in it is pressurized, making it more dense.

Cold Storage The room will be hotter. There is energy coming into the room in the form of electricity, but no energy leaves. Thus increasing the temperature. **A Red Hot Problem** They are all the same temperature, since temperature directly determines the frequency of electromagnetic radiation, and thus the color. **The Great Round Roll-Off** The ball will reach bottom first because it has less of its mass on the outside, which gives it less angular (turning) inertia.

Close the Door Nothing, since there is no oxygen in the room.

Milk or Cream Cream rises to the top, therefore, milk weighs more.

One Two Both bullets will hit the ground at the same time. Horizontal velocity doesn't affect downward acceleration.

Three in a Row Ace of diamonds, king of hearts, and two of spades.

A Puzzle Cassio Ed is 16½ years old.

Birds and Beasts Seventeen beasts, 26 birds.

Junior's First Case The arguments cannot

be reconciled because they are self-contradictory. This puzzle is similar to the tale of the witless barber who shaves all and only those who do not shave themselves. There cannot be such a barber! **Body Parts** Arm, ear, eye, lat, hip, jaw, leg, lip, rib, toe.

The Fur Store Ten puppies, 2 kittens, and 85 goldfish.

Caféine Quota Thirty-three and a third cups.

How Many Children Four boys, 3 girls. **Target Practice** No. Hank and Lem's overall shooting accuracy is the same. The only way to compute an accuracy rating is to find the ratio of hits to attempts. Hank's rating was 25/84 and Lem's was 25/75, so the 2 men had for the day by each hitting one third of their shots.

To the Centers The most southern state is Hawaii. All of the rest are Alaska, since the Aleutian Islands chain extends through the 180° meridian, making Alaska simultaneously the most eastern and most western state.

Save the Birds! Thanks to Martin Gardner for alerting us with this one. The key lies in the available material mentioned in the first sentence: sand. By pouring sand slowly into the hole, the baby bird may be raised to the top.

Word Wise Each word contains 3 consecutive letters from the alphabet. **Disassembly Line** The meat-packing industry. ☐

MOVEWAY

CONTINUED FROM PAGE 72

With the immediate prospect of finally being on the Outside plus that it was dangerous to deny we soon overcame our initial disappointment and eagerly began to roll the closest automobile—a rusty Chevrolet Whoosh!—up to The Well. With some 140 men trying to lend a hand, the task was over before it had hardly started. The car hit The Well with a great rusty, dusty crunch. Immediately Bill Smith and Lawrence Lawndown climbed up on its roof, this put them about seven feet below the edge of The Well. "Come up one by one, men," said Smith. "We'll boost you over. You Honk! fig! Use your chopers on the wire" (Honk Lawndown, a metal smith.)

What we would have done once over The Well I don't know—swim, I suppose. As it turned out, that problem never plagued us.

Lawndown had got on the car and was being boosted up toward the edge of The Well when the helicopters came—by the dawn's early light. Their machine guns began chattering immediately. The first few bursts rapped into Smith and Lawndown. They fell to the Moveway. More bullets poured into the cluster of men waiting to climb onto the car. Many fell, screaming. Some dragged themselves off toward the surrounding automobiles. Most did not move. The remainder panicked: they ran in

all directions. The helicopters continued firing—there must have been five or six of them. They pumped bullets into the running men senselessly. It was pure slaughter. They fell like flies. I was some seventy-five feet from Smith and Lawndown—maybe less—when the firing began and somewhat apart from the men grouped around the car. This is what probably saved me—and that I was by pure luck standing next to a fatbed truck still partially loaded with concrete blocks. I don't remember actually jumping under it, but I watched the slaughter from under its protection. The whole area was filled with screaming, cursing, groaning, and blood. If any of our men fired what weapons they had, I did not see it. Bullets of course went right through the automobiles that most of the men hung themselves under. The copters came back again and again, they raked the area with our leap. One man crawled under the truck with me. Blood poured from his foot. He groaned, looked at me with eyes glazed with shock, then collapsed, dead. Then I saw blood spewing from his chest.

Suddenly the firing stopped. A great moaning silence took its place, except for the clatter of choppers. I peeked out from under the truck. The sky was thick with copters, more had arrived. And guns protruding from their bellies, they began to settle down toward what was left of us.

How I escaped undetected I'll never know. God must have been with me. I sim-

ply crawled out from under the truck, in the direction that took me away from The Well, and wormed my way under a car. Then I felt that car poked the one closest to it, and crawled to and under that one, avoiding open spaces as much as possible for I felt sure that the copters would land in them. How long I kept this up I'm not sure. I only know that I stopped only when I was too exhausted to go on and when I could no longer hear any sounds from the Moveway Engineers. I lay there panting.

I must have dozed, because the sun was high when I looked out from under the car. My hands were scraped and bruised from my flight, the front of my Jam Survival Suit was torn. The sky was clear of copters, I heard not one sound. I crawled on senselessly staying under vehicles as much as possible. I saw not one living soul, although there was an occasional skeleton. I suppose the firing scared all the "bums" of Unincorporated Jamland away. My throat was sore, a blazing sun had broken through the usual smog. My weakness was nearly overpowering. I had lost all food and water. I had to stop after having crawled only a very short distance.

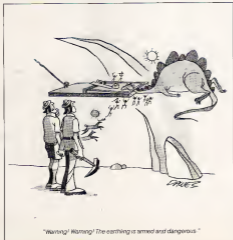
I must have dozed again. The next thing I remember was that the sun was nearly down. Quickly, before darkness fell, I began to write the day's horrible happenings, which I now have just done. Now I am trying to think what to do. Shall I try to make it back to Moveway? I doubt it. I could make it, with no food, no water, and nothing in between except a parade of rusting automobiles and childlike "savages." If I went back to The Well, how could I get over it? I cannot bring myself to return to the scene of the massacre, even if the Chevrolet is still next to The Well, even if I had strength to climb it, and somehow go over the top of The Well. Probably the Moveway Men have moved the car away anyway. And they would certainly be there for the next few days, cleaning up the mess they made. I think the best thing for me to do is to head back toward The Well to a point some distance from where we first encountered it. In the morning I shall risk a climb to the top of a car here, find The Well (I have not crawled far from it, I'm sure), and start crawling toward it. Perhaps I can find some method to get over it.

Or under it?

July 14, 1969—This will be hard to read (Editor's note: This portion of Littlefinger's Notebook was almost illegible, the reason for which will be shortly known.) I am hardly in a position to write well-formed words and well-formed sentences. I write feverishly. There is so little time left:

To go back—

I was awakened last night by the clattering sound of many helicopters, some passing over me and others some distance away. At the same time I heard a different noise, a mystifying patter similar to the sound of falling hail, although not as intense. Crawling out from inside the au-



"Warning! Warning! The earthing is armed and dangerous."

trouble I was sleeping in to investigate. I was immediately struck by two or three small lightweight objects I heard others hit the Moweway around me. One bounced from a ladder and landed right in front of me. I could see it in the moonlight. When I picked it up I was chilled to my very soul—and after I had examined it by the best angle of moonlight and noted its color I knew I was not mistaken, although I swore to God that I might be.

Mowway Engineers were showering Jantland with thousands of suicide capsules!

And by morning I knew why.

I barely slept from that point on. At dawn I crawled out from inside my car. All around me were suicide capsules—dozens of them in my immediate area, in all their green malvolence. I was seized with an indescribable fury. Cursing I began to grind every capsule I could see underfoot. It was as if fourteen months' worth of frustration burst out of me, concentrated into one minute of fury. I was soon exhausted. I am very weak. As I sprawled out to rest I saw one capsule nearby hidden behind a wheel. At that I thought I would mash it, too, as soon as I had regained my strength. But when I got up in a few minutes, I found myself pulling the capsule in the pocket of my Jam Surviving Suit reserved for just such pills of instant death. Jantland's note: These suits were dropped from helicopters in the early days of the Jam.

When with painful effort I climbed to the top of the car I had slept under I saw that The Wall was about a mile away. I was about to climb back down to the Mowway when I took one quick glance in the direction of Mowway City. I saw a dark mass and then heard the beginning of a deafening roar. Then—I could not believe what I saw Approaching Jantland were hundreds of helicopters.

I hunched down and scrambled under the automobile. The ground literally shook as they approached. The roar was overpowering. I peeked a peak out. The sky was black with the whirling monsters. They were all the large KILs—the biggest helicopter made, large enough to lift two tanks. As I watched—and as they passed over The Wall—I saw a stream of something fall from the leading copter, and then as each machine passed over The Wall it, too, dropped a stream of what appeared to be a grayish, sticky substance. As soon as each copter dumped its load, it turned back toward Mowway City. In following the return of one for a second, I saw a second great cloud of helicopters approaching. Then, looking off to north and south, I saw more gigantic clusters of the machines all coming toward Jantland. And as I watched, each of these copters also dropped something—a load of something—onto the Jantland cars as soon as it passed over The Wall.

Jantland was being covered up by something dropped by hundreds—thousands—of helicopters! No wonder suicide capsules were dropped during the night.

In a matter of minutes the copters were dropping their loads a goodly distance from The Wall—in my direction. Each dropped load evenly equaled that of a large dump truck. In the spot where each load was dropped a mound of a gray sticky substance appeared, then settled a bit until it was nearly level with the tops of the cars. I watched, horror-stricken. Closer and closer they dumped. I could not stay under the car. I would be covered by the muck. There was no firing in fact. I saw no guns protruding from the copters.

Then I realized what I was seeing. These copters were the specially made ones used in Mowway construction. They had probably been assembled from various parts of the United States for the job they were doing now.

And as one dropped his load, another's fell from me! I realized what they were dropping and what they were doing.

They were dropping wet cement. They were making a new Mowway over the old Mowway.

I quickly climbed from beneath the car and got inside it. Fortunately it was a sedan and in relatively good condition. I ran up all the windows, but one—and just in time. With a tremendous slushing thump a load of cement hit the top of the car and the surrounding area. As it mounted up the side of the car, I shot through the open window and onto the roof again, just ahead of the rising wet goo. It leveled off just

below the top of the car. As I reached my new position, another copter dropped a load so close to me that I was splattered and nearly knocked over by it—

I whipped out my Notebook and began to write furiously. It was obvious that a second assault would put the cement over my head. They probably intended to make the new Mowway level with the top of The Wall. I thought fleetingly of trying to make it to The Wall by jumping from car-top to car-top. There were many spaces, though, where no load showed, where the spaces were too great to jump over. Those damn sports cars! Could I swim in wet cement? I decided I could not. So I sat on top of my car and wrote and wrote and wrote—which is what I'm doing at this exact moment.

Thousands of helicopters are now overhead coming and going dumping their loads and flying back for more. Such a gigantic effort (it looks as if they want to finish in time for lunch) must have been the result of a congressional investigation. After all, this Jam has been the longest on record, and something just had to be done—and done fast.

The cement is creeping over the roof of my car now. I am now sitting in it. It feels most disagreeable. I stand up. I write while holding my Notebook on my chest. It is the only thing I have left.

In the distance I see a few Jantlands also on tops of cars. Not many. A half a dozen or so. The other poor creatures are probably



too weak to climb onto the rails. I try not to think of my friends in Mowley's.

By the thousands! Never have I seen so many helicopters. The sky is a black fury of them. Tons and tons of cement falling.

Another wave approaches me, dropping cement as they come, peeling back. More coming.

The cement is rising, constantly landing its own load. There are so many tons of it in this area of Jaramed now that every load, no matter where dropped, causes the local a fraction. And tons are being dropped.

The level is now just below my knees. What can I see? There is nothing now. I just saw a man who was on a car some 100 yards from me disappear. A load of cement hit him squarely.

And another just toppled over. Suicide? Here comes a load. (Editor's note: This sentence was scrawled out so badly it is assumed Littlefinger wrote it as he was actually ducking. Spots of cement were found on this page.)

It hit about 100 feet from me. Cement is now at my waist. I must raise my hands to work.

Suicide?
Another load is approaching. Here it comes.

Just missed me. Hit about fifty feet. A Cement up to neck now.
Write with Notebook over head.
At chin.
Can't do like this.
I am going.
At lips.
I have taken the capsule.
It is gone.
Good b.

(Editor's note: It may well be assumed, although there is no supporting evidence, that Henry Littlefinger died holding the pages of his Notebook over his head above the cement; and that some one later it was thus found in his death grip. One must imagine that that unknown man, that finder of the Notebook pages, that only known survivor of the Great Fourteen-North Mowley Jam somehow escaped the onslaught of the dump-truck helicopters; that fateful day. One must also imagine him for some reason cautiously creeping out over the just-hardened, or hardening, cement the next morning, or later that same day, and coming upon Littlefinger's Notebook pages and hand. As readers may know Mowley Engineers ceased dumping cement at a level corresponding roughly to the height of a man standing on the roof of a Jaramed car plus about one foot. And since the Notebook pages were not encrusted with cement, it would appear that they were not buried in it. Later, of course, after the original cement had entirely hardened, Engineers dumped the final layer which brought the level of the new Mowley up to the edge of The Well—and covered Littlefinger's hand, whenever it may be, that hand that wrote so much for the enlightenment of so many.) ☐

QUEST

CONTINUED FROM PAGE 88

that it would be very hard to put a specific one-in-a-thousand kind of framework to the answer. However, it is safe to say that the probability would be one in millions, particularly when you remember the number of specific things we found. I think the best thing I can say at this point is that I sure would like to be the one to defend the idea that this was all some sort of good-luck coincidence, that explanation would be harder to sustain than the psychic model as a hypothesis.

My's inquirer almost as obviously as May himself, is working through this answer. He has the mathematical training to appreciate how impossible it would be just to guess correctly that blocks of stone, Y-shaped objects, and wheels with shafts sticking out would be found. By the time he reaches his conclusions he has been jared enough to leave the cabin interior walk to the deck area at the foot of the bridge, and approach me. I had come here for solitude and some time to think things through.

As we stand silently side by side for several minutes the older man introduces himself as a marine biologist doing some work at the institute's labs.

"I just heard about your experiment. It's very interesting. Not my field, of course, but it's clear that there are implications here for every discipline in science.

Almost a year would elapse before the first chapter of Deep Quest was closed. During that time, we arranged for a metal-furter to examine recovered metal fragments. Using a ray emission, Scott Hubbard, an expert in the field working out of Berkeley, reported back to me: "We cannot say anything absolutely conclusive, but there is highly suggestive evidence, based on the lack of chromium (present in all steel smelted by modern processes), that this metal was produced at least seventy-five years ago." The psychics had placed the wreck as occurring eighty to ninety-three years ago.

Thomas Cooke, marine-sites expert for the Bureau of Land Management (the government agency charged with keeping track of marine wrecks) analyzed the site selected by all respondents and offered these comments: "Based on an intensive study of sites in southern California waters, I must conclude that the area selected by Schaefer's psychics was previously unknown and could not have been found by going through old papers, books at the library, or that sort of thing." This is critical, because it rules out cheating by checking old records or soliciting secret advice from oceanographic experts.

The encrustation on retrieved metal objects also turned out to be important. Marine organisms grow at a known rate, and the over-one-inch thickness found on several artifacts clearly demonstrates that

they lay on the ocean floor for many decades. Similarly, the growth of seaweed proves that objects have been in the area, undisturbed, for a period of time far greater than when I first learned from institute director Don Keach that I would have access to a submarine and that it would be in the waters of Santa Catalina. This defuses the charge that the psychics all got together, decided on the site, found the objects we discovered, pulled them up from somewhere else, and then dumped them overboard—in essence the old trick of setting the mine.

Our psychic trio also predicted a wooden ship. When the debris was later brought up and sorted, a fragment of wooden hull was clearly identified. And finally the psychic reconstruction of how the ship sank "by burning and blowing up smokestacks," was vouchsafed by Will-combe, who in going back through the keel logs and drawing a map of the actual locations, concluded:

"By the distribution of wreckage it is clear that this ship did not just settle to the bottom. She appears to have suffered an explosion in midlife, probably owing to fire and, only then, to have sunk."

For the personality touch, the most gratifying comments to come out of the postwriting research were those of the two friends who had lent me the submarine in the first place.

Don Welsh and Don Keach would be at the head of anyone's list of experts in deep-ocean technology; its problems and its promise. Welsh as a young lieutenant in the navy took the submersible *Bevée* to what is literally the bottom of the sea. Callinger Deep in the Marianas Trench over 145,000 meters to the bottom. Keach would later succeed Welsh as the crafts officer-in-charge and locate the nuclear submarine *Thresher* when she was lost at sea. For decades these two men had headed or had a hand in virtually every US program having to do with deep-ocean research.

When I first approached them they listened carefully but indulgently. I was an old friend with a fresky interest. But, as Keach would tell me later, "We know as you know just how difficult locating something on the sea floor can be. Frankly I felt nothing but skepticism about this psychic experiment. But in talking it over and listening to the research you mentioned, Don Welsh and I both felt that if we were going to call our selves scientists we had to let the facts lead where they would. The experiment was rigorous and its results clear cut. Anyone who will look at the open mindfully has to feel that something happened down there that can't be explained in the old ways. I don't know exactly what it was, but I think we had better take a long, hard look."

Coming from this expert and skeptical Marine man, it meant a lot. This is the position of the true scientist and neither I nor anyone else in parapsychology can—or should—ask for anything more. ☐

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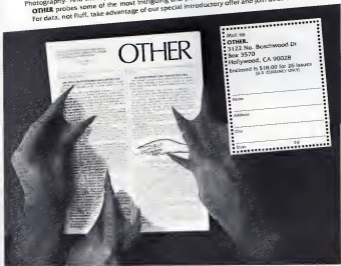
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TICKET

CONTINUED FROM PAGE 41

to 461,763. In potential commercial space travel, we can foresee a potential \$85-million-per-year market. This is attractive.

But can we do it from the technical point of view? Right now, space travel costs are more than thirty times higher than the magic \$20 per kilogram. Is it technically feasible to try to get these costs down to the \$20-per-kilogram target figure? Unfortunately not with the NASA Space Shuttle, since it was designed to be a space truck, not a space bus. And it was designed with 1970 technology as a pioneering effort. All early pioneering technologies are expensive and crude, but they become inexpensive and highly refined in a surprisingly short period of time if there is a market with a price goal to be met.

Even though the NASA Space Shuttle holds center stage today, a lot of advanced planning and conceptual design work has been going on to define the space-launch vehicles that would be required in the late 1980s. Independent aerospace engineers such as Robert Salsfeld, as well as the advanced-design groups at Martin-Marietta Boeing, McDonnell-Douglas, and Rockwell International, are already laying the groundwork for the space shuttles of 1990. And these plans are not totally along the lines of making bigger and heavier space shuttles.

First of all, a 1990 space shuttle capable of meeting the cost goal of \$20 per kilogram will not be as large as the current NASA Space Shuttle. It will be a "space DC-3" (SDC-3) with a much smaller payload. It will not be a space 747 or DC 10.

If the DC-10 had preceded the DC-3, no airline in the world in 1935 could have filled the DC-10 to the break-even load factor, even if only one trip per week had been offered. In order to have profitable operations so that they could develop and expand, the fledgling airlines needed an airplane with two important economic features: (a) it had to carry the right number of passengers for the existing and anticipated market, and (b) its operating costs had to be low enough that it could make money flying passengers only. The airlines got that airplane in the Douglas DC-3.

There were some bigger airliners that followed on the heels of the DC-3: The Handley Page H.P. 42, the Armstrong Whitworth A.W. 27, the Junkers Ju-90, and the Boeing SA 307B "Stretliner" could each carry almost double the payload of the DC-3, but the airlines could not fill these planes.

The SDC-3 of 1990 will not have the 30,000-kilogram-payload capability of the NASA Space Shuttle, and it will also operate differently. Carrying twenty-five passengers and a crew of three, the SDC-3 will take off horizontally from an airport runway and climb into orbit under the thrust of rocket engines using liquid oxygen and liquid hydrogen, propellants that produce

only steam as an exhaust. It will glide back to a landing on any 3,000-meter runway.

These characteristics are not impossible to achieve with technology that is either currently in hand or possible within five years. Remember that a 1990 operational date is more than ten years away. The first commercial jet-airliner services began almost seven years to the day after the end of World War II in Europe (World War II had seen the first operational use of jet aircraft).

Engineers do not like to make big leaps but prefer to take gentle, evolutionary steps, building slowly on what they know how to do. Don't blame them for being conservative; they are responsible for designing transportation devices that are not only economical but also very reliable because flesh-and-blood people are going to ride in them. Therefore, we can reasonably anticipate a cost reduction of about ten, which in itself may appear to many engineers to be a big leap.

But the SDC-3 is not going to cost as

●When we begin planning for 137 people per day into orbit, we must begin to think of something more than a primitive space station with crude facilities. There will have to be a "space hotel" with all the amenities ●

much as the NASA Space Shuttle for two reasons: (a) it is not as radical a departure from existing space systems as the NASA Space Shuttle is, and it can therefore utilize much of the advanced technology of the Space Shuttle, and (b) the SDC-3 has roughly one tenth the gross lift-off weight of the NASA Space Shuttle, because the SDC-3 is sized to a specific market.

This market, by the way, is more than merely booking tourists to orbit and bringing them back. The SDC-3, like its namesake DC-3, can and will do many jobs. It will lift scientists to space telescopes and space laboratories, engineers to space factories and solar-power-satellite construction sites, and maintenance technicians to malfunctioning unmanned satellites in low Earth orbit. The seats will be yanked out for certain flights, and the SDC-3 will haul 2,250 kilograms of cargo that, for a wide variety of reasons, can't be launched by the big "Heavy Lift" launch vehicles of the time (that all freighters, air or sea, are the same size).

Something like the SDC-3 can be built and flying by 1990. It is interesting to note that the concept of the SDC-3 isn't really

new. The "Orion" space shuttle depicted in the Kubrick-Clarke film 2001. A Space Colony was designed for thirty-two passengers plus a crew of three, according to a study of the photographs of the vehicle.

Orbiting 5,000 people per year is no small operation. It requires 200 fully loaded SDC-3 flights, or roughly four flights per week—Monday Wednesday and twice on Friday. This is four times the projected NASA Space Shuttle schedule frequency. According to the traffic model, ten to twelve SDC-3 ships would be required. Proportions? Third World countries today own and fly nearly a hundred Boeing 707's but of nearly 1,700 that have been built to date. And the 707 costs more than six times as much as a propeller-driven airliner.

Designing, building, and operating the SDC-3 will undoubtedly pave the way for its successor of 1995-2000 that will bring costs down from \$50 per kilogram to the target of \$20 per kilogram. Such a cost reduction is going to make space travel attractive to a much larger market—50,000 people per year. This traffic model cannot be handled by the SDC-3 anyway and when we have reached this point in space travel, we are "over the hump." Space travel becomes a totally different sort of operation. When we begin planning for 137 people per day into orbit, we must among other things, begin to think of something more than a primitive space station with crude facilities. There will have to be a "space hotel" with all the amenities. Handling 50,000 people or more per year in a completely closed ecological system means oxygen, water purification, sewage disposal, food handling, garbage disposal, sleeping accommodations, medical facilities, and a host of other travel services in orbit. Facilities on the ground and in orbit must be geared to handle the throng. And at \$20 per kilogram, the throng is going to grow rapidly.

This is not—repeat, not—"Buck Rogers stuff" suitable only for science-fiction stories, to science and Sunday-supplement material. It is, at the very most, only twenty years down the road. Many of you will be paying off your home mortgage.

It's going to happen because most of the technology to permit it is almost in place. The schedule will not slip by more than ten years at the very most. If the market is there, if people are able to pay for it, and if someone can make a profit, it will go down.

Our terrestrial civilization is growing and progressing. There are no long-term trends to indicate otherwise in spite of glitches in the trends and localized Malthusian crises. My grandfather couldn't consider owning an automobile, my father owned several automobiles but couldn't consider owning an airplane. I own automobiles and an airplane but cannot consider flying into space today, my children will do all of these things, including flying into space. Perhaps my grandchildren will own spaceships of their own. When that happens, we can truly say that space travel has come of age. □

SPACE

CONTINUED FROM PAGE 20

massive enough to become supernovae themselves a few million years later. Perhaps some kind of chain reaction of such supernova explosions is responsible for creating the spiral patterns.

THE COMPUTER MODEL

By making a computer model of a galaxy, Drs. Gerola and Selden have considered what would happen if supernovae were indeed responsible for spiral-arm formation. Any model of a physical object or process must include mathematical expressions that describe how things happen. Calculators are made, and the results are shown as a pattern of dots—representing stars—on a grid. Since the first rule of computing is GIGO, ('Garbage In, Garbage Out,' the model must correspond to reality as closely as possible. You want to consider as many fine details as possible in order to mimic the real world, yet you must reset the Binner dial of trying to put in too much or you will exceed the capacity of the computer.

The IBM astronomers model the galaxy as a disc made of forty-nine rings of stars. Each ring, at a different distance from the center, can be made to revolve around the nucleus at a different rate, just as stars do in a real galaxy. The rates of revolution are

taken from actual observations of galaxies.

Each ring is divided into cells of equal size. Each cell is allowed to have a star or star group in it, and at any time there is a probability that a star will become a super nova. If it does, it will induce the formation of other stars in a neighboring cell. In addition, throughout the "galaxy" the scientists allow for a very small number of spontaneous star formations.

They begin by randomly populating their galaxy with about 1 percent of the cells having stars. Then they move time ahead one step—about 15 million years—and see what happens. Some of the first stars explode, causing new stars. At the next time step, some of those new stars explode. And so on. After each step, they look at where the bright stars are located in the galaxy. The computer models have run for up to 2,000 time steps, equivalent to some 30 billion years of real time.

The differences between galactic types are important. In the model, each a different in the way that the speed of revolution of the rings changes with distance from the center of the galaxy. Significantly the type of galaxy that results from the calculations is the same as the type of galaxy from which the motion data were taken. Motion data from a galaxy with patchy irregular arms produce a patchy, irregular galaxy, motion data from a smooth galaxy produce a smooth galaxy. The fact gives Gerola and Selden reassurance that their model does

indeed correspond to reality. Furthermore, their model also shows that the spiral patterns persist over the entire lifetime of the galaxies. Of course, many of the spiral segments wind up and disappear but new ones form and join with older ones to maintain a constant pattern.

The results indicate that the different forms of spiral galaxies are not due to any evolution from one type to another but are fixed at the time of formation by the way in which they rotate.

So what will the galaxy look like in the future—a billion or 5 billion years hence? The light from the galaxy some 20 billion years from now will come from different stars not yet born, descendants of the bright ones now shining. The arms will be in different places, and details of the design will be quite different. But overall it will be the same.

Someday in the far future, however, the gas in the galaxy may begin to be used up. New stars can no longer be formed and eventually there will be no supernovae. Then the spiral arms will fade from view leaving only the nucleus of the galaxy visible across the vast reaches of intergalactic space. Eventually the nucleus too will pale as the stars consume their thermonuclear fuels and the sky will become devoid of galaxies. Within our galaxy our far descendants will see only a few lackluster red stars and then nothing.

What comes next, we don't know. ☐

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SONATA

CONTINUED FROM PAGE 2

What is his music? What is his music?
What is his music?

Wondering. Until dawn, when the Christian was abating and the wind had died. Christian got out of his bed where he had not slept but only tossed back and forth all night, and took the recorder from its hiding place and played it.

At first it sounded strange, like noise odd sounds that had nothing to do with the sounds of Christian's life. But the patterns were clear, and by the end of the recording which was not even a half-hour long, Christian had mastered the idea of fugue, and the sound of the harpsichord stayed on his mind.

Yet he knew that if he let these things show up in his music, he would be disappointed. So he did not try a fugue. He did not attempt to imitate the harpsichord's sound.

And every night he listened to the recording, learning more and more until finally the Watcher came.

The Watcher was blind, and a dog led him. He came to the door, and because he was a Watcher, the door opened for him without his even knocking.

"Christian Haroldson, where is the recorder?" the Watcher asked.

"Recorder?" Christian asked, then knew it was hopeless. So he took the machine and gave it to the Watcher.

"Oh, Christian," said the Watcher and his voice was mild and sorrowful. "Why didn't you turn it in without listening to it?"

"I meant to," Christian said. "But how did you know?"

"Because suddenly there are no fugues in your work. Suddenly your songs have lost the only Bach-like thing about them. And you've stopped experimenting with new sounds. What were you trying to avoid?"

"This," Christian said, and he sat down and on of his first try duplicated the sound of the harpsichord.

"Yet you've never tried to do that until now have you?"

"I thought you'd notice."

Fugues and harpsichord, the two things you noticed first—and the only things you didn't absorb into your music. All your other songs for these last weeks have been timid and colored and influenced by Bach. Except that there was no fugue, and there was no harpsichord. You have broken the law. You were put here because you were a genius, creating new things with only nature for your inspiration. Now of course you're derivative, and truly new creation is impossible for you. You'll have to leave."

"I know," Christian said, afraid yet not really understanding what life outside his house would be like.

"We'll train you for the kinds of jobs you can pursue now. You won't starve. You won't die of boredom. But because you broke the law, one thing is forbidden to you now."

"Music."

"Not all music. There is music of a sort, Christian, that the common people, the ones who aren't Listeners, can have. Radio and television and record music. But live music and new music—those are forbidden to you. You may not sing. You may not play an instrument. You may not tap out a rhythm."

"Why not?"

"The Watcher shook his head. "The world is too perfect. Too at peace, too happy for us to permit a man who broke the law to go about spreading discontent. And if you make more music, Christian, you will be punished drastically. Drastically."

Christian nodded, and when the Watcher told him to come, he came, leaving behind the house and the woods and his instrument. At first he took it calmly, as the inevitable punishment for his infraction, but he had little concept of punishment, or of what exile from his instrument would mean.

When two hours he was shouting and striking out at anyone who came near him,

●Once, Joe went to the piano and lifted the lid and played every key on the piano. And when he had done that he put his head down on the piano and cried . . . It was like . . . losing his bar ●

because he had never craved the touch of the instrument's keys and levers and strips and bars, and he could not have them, and now he knew that he had never been lonely before.

It took six months before he was ready for normal life. And when he left the Retaining Center (a small building, because it was so rarely used), he looked tired and years older and he didn't smile at anyone. He became a delivery-truck driver because the tests said that this was a job that would least grieve him and least remind him of his loss and most engage his few remaining aptitudes and interests.

He delivered doughnuts to grocery stores.

And at night he discovered the mysteries of alcohol, and the alcohol and the doughnuts and the truck and his dreams were enough that he was, in his way content. He had no anger in him. He could live the rest of his life, without bitterness.

He delivered fresh doughnuts and took the stale ones away with him.

SECOND MOVEMENT

"With a name like Joe," Joe always said,

"I had to open a bar and grill, just so I could put up a sign saying 'Joe's Bar and Grill.' And he laughed and laughed, because after all, Joe's Bar and Grill was a funny name these days.

But Joe was a good bartender and the Watchers had put him in the right kind of place. Not in a big city but in a small town, a town just off the freeway where truck drivers often came, a town not far from a large city, so that interesting things were nearby to be talked about and worried about and bached about and loved.

Joe's Bar and Grill was, therefore, a nice place to come, and many people came there. Not fashionable people and not drunks, but lovely people and friendly people in just the right mixture. "My clients are like a good drink. Just enough of this and that to make a new flavor that tastes better than any of the ingredients." Oh, Joe was a poet, he was a poet of alcohol, and like many another person these days, he often said "My father was a lawyer, and in the old days I would have probably ended up a lawyer too. And I never would have known what I was missing."

Joe was right. And he was a damn good bartender and he didn't wish he were any thing else, so he was happy.

One night, however, a new man came in a man with a doughnut delivery truck and a doughnut brand name on his uniform. Joe noticed him because silence clung to the man like a smell—wherever he walked, people sensed it, and though they scarcely looked at him, they lowered their voices or stopped talking at all, and they got reflective and looked at the walls and the mirror behind the bar. The doughnut deliveryman sat in a corner and had a milked-down drink that meant he intended to stay a long time and didn't want his alcohol shake to be so rapid that he was forced to leave early.

Joe noticed things about people, and he noticed that this man kept looking off in the dark corner where the piano stood. It was an old, out-of-tune monstrosity from the old days (for this had been a bar for a long time), and Joe wondered why the man was fascinated by it. True, a lot of Joe's customers had been interested, but they had always walked over and slunked on the keys, trying to find a melody, fiddling with the out-of-tune keys, and finally giving up. This man, however, seemed almost afraid of the piano, and didn't go near it.

At closing time, the man was still there, and, on a whim, instead of making the man leave, Joe turned off the piped-in music, turned off most of the lights, and went over and lifted the lid and exposed the gray keys.

The deliveryman came over to the piano. Chris, his name tag said. He sat and touched a single key. The sound was not pretty. But the man touched all the keys one by one and then touched them in different orders, and all the time Joe watched, wondering why the man was so intense about it.

"Chris," Joe said.
Chris looked up at him.

"Do you know any songs?"

Chris's face went tummy

"I mean, some of those old-time songs, not those fancy pop-twisters on the radio, but songs... in a little Spanish town. My mother sang that one to me." And Joe began to sing. "In a little Spanish town, there on a night like this. Stars were peek-a-booming down, 'twas on a night like this."

Chris began to play as Joe's weak and toneless baritone went on with the song. But his playing wasn't an accompaniment; it was instead, an opponent to his melody, an enemy to it, and the sounds coming out of the piano were strange and unharmonious and, by God, beautiful. Joe stopped singing and listened. For two hours he listened, and when it was over he soberly poured the man a drink and poured one for himself and clinked glasses with Chris, the doughnut deliveryman who could take that rotten old piano and make the damn thing sing.

Three nights later, Chris came back, looking hunched and afraid. But this time Joe knew what would happen (had to happen) and instead of waiting until closing time, Joe turned off the piped-in music ten minutes early. Chris looked up at him pleadingly. Joe misunderstood—he went over and lifted the lid to the keyboard and smiled. Chris walked stiffly perhaps reluctantly to the stool and sat.

"Hey, Joe, one of the last five customers shouted, 'closing early!'"

Joe didn't answer. Just watched as Chris began to play. No preliminaries this time, no scales and wanderings over the keys. Just power, and the piano was played as pianos aren't meant to be played: the bad notes, the out-of-tune notes, were fit into the music so that they sounded right, and Chris's fingers, ignoring the structures of the twelve-tone scale, played, it seemed to Joe, in the cracks.

None of the customers left until Chris finished an hour and a half later. They all shared that final drink and went home, shaken by the experience.

The next night Chris came again, and the next, and the next. Whatever private battle had kept him away for the first few days after his first night of playing, he had apparently won it or lost it. None of Joe's business. What Joe cared about was the fact that when Chris played the piano, it did things to him that music had never done, and he wanted it.

The customers apparently wanted it, too. Near closing time people began showing up, apparently just to hear Chris play. Joe began starting the piano music earlier and earlier, and he had to discontinue the free drinks after the playing, because there were so many people it would have put him out of business.

It went on for two long, strange months. The delivery van pulled up outside, and people stood aside for Chris to enter. No one said anything to him. No one said anything at all, but everyone waited until he

began to play the piano. He drank nothing at all. Just played. And between songs the hundreds of people in Joe's Bar and Grill ate and drank.

But the moment was gone. The laughter and the chatter and the camaraderie were missing, and after a while Joe grew tired of the music and wanted to have his bar back the way it was. He toyed with the idea of getting rid of the piano, but the customers would have been angry at him. He thought of asking Chris not to come any more, but he could not bring himself to speak to the strange, silent man.

And so finally he did what he knew he should have done in the first place. He called the Watchers.

They came in the middle of a performance, a blind Watcher with a dog on a leash, and an earless Watcher who walked unsteadily holding on to things for balance. They came in the middle of a song and did not wait for it to end. They walked to the piano and closed the lid gently, and Chris withdrew his fingers and looked at the closed lid.

"Oh, Christian," said the man with the seeing-eye dog.

"I'm sorry," Christian answered. "I tried not to."

"Oh, Christian, how can I bear doing to you what must be done?"

"Do it," Christian said.

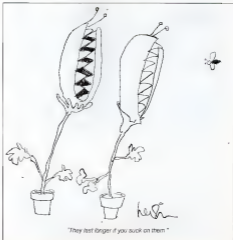
And so the man with no ears took a laser knife from his coat pocket and cut off Chris-

tor's fingers and thumbs, right where they rooted into his hands. The laser cauterized and sealed the wound even as it cut, but still some blood splattered on Christian's uniform. And, his hands now meaningless palms and useless knuckles, Christian stood and walked out of Joe's Bar and Grill. The people made way for him again, and they listened intently as the blind Watcher said, "That was a man who broke the law and was forbidden to be a Maker. He broke the law a second time, and the law insists that he be stopped from breaking down the system that makes all of you so happy."

The people understood. It grieved them, it made them uncomfortable for a few hours, but once they had returned home to their exactly right homes and got back to their exactly right jobs, the sheer contentment of their lives overwhelmed their momentary sorrow for Chris. After all, Chris had broken the law. And it was the law that kept them all safe and happy.

Even Joe. Even Joe soon forgot Chris and his music. He knew he had done the right thing. He couldn't figure out, though, why a man like Chris would have broken the law in the first place, or what law he would have broken. There wasn't a law in the world that wasn't designed to make people happy—and there wasn't a law Joe could think of that he was even mildly interested in breaking.

Yet. Once Joe went to the piano and lifted the lid and played every key on the piano



"They test finger if you suck on them."

And when he had done that he put his head down on the piano and cried. Because he knew that when Chris lost that piano, lost even his fingers so he could never play again—it was like Joe losing his bar. And if Joe ever lost his bar, his life wouldn't be worth living.

As for Chris, someone else began coming to the bar driving the same doughnut delivery van, and no one ever saw Chris again in that part of the world.

THIRD MOVEMENT

"Oh, what a beautiful moment!" sang the road-crew man who had seen Oklahoma! four times in his home town.

"Rock my soul in the bosom of Abraham!" sang the road-crew man who had learned to sing when his family got together with guitars.

"Lead, kindly light, amid the encircling gloom!" sang the road-crew man who believed.

But the road-crew man without hands who held the signs telling the traffic to Stop or Go Slow, believed but never sang.

"Why'n't you never sing?" asked the man who loved Rogers and Hammerstein, asked all of them, at one time or another.

And the man they called Sugar just shrugged. "Don't feel like singin'," he'd say, when he said anything at all.

"Why they call him Sugar?" a new guy once asked. "He don't look sweet to me."

And the man who believed said, "His initials are CH. Like the sugar. C & H, you know." And the new guy laughed. A stupid joke, but the kind of gag that makes life easier on the road building crew.

Not that life was that hard. For these men, too, had been tested, and they were in the job that made them happiest. They took pride in the plan of sunburn and galled muscles, and the road growing long and thin behind them was the most beautiful thing in the world. And so they sang all day at their work, knowing that they could not possibly be happier than they were this day.

Except Sugar.

Then Guillermo came. A short Mexican who spoke with an accent. Guillermo told everyone who asked, "I may come from Sonora, but my heart belongs in Miami!" And when anyone asked why (and often when no one asked anything), he'd explain: "I'm an Italian tenor in a Mexican body," and he proved it by singing every note the Puccini and Verdi ever wrote. "Caruso was nothing," Guillermo boasted. "Listen to this!"

Guillermo had records, and he sang along with them, and at work on the road crew he'd join in with any man's song and harmonize with it or sing an obbligato high above the melody a soaring tenor that took the roof off his head and filled the clouds. "I can sing," Guillermo would say, and soon the other road-crew men answered, "Damn right, Guillermo! Sing it again!"

But one night Guillermo was honest and told the truth. "Ah, my friends, I'm no singer."

"What do you mean? Of course you are!" came the unanimous answer.

"Nonsense!" Guillermo cried, his voice theatrical. "I am the great singer, why do you never see me going off to record songs? Hey? This is a great singer? Nonsense! Great singers they raise to be great singers. I'm just a man who loves to sing but has no talent! I'm a man who loves to work on the road crew with men like you and sing his guts out, but in the opera I could never be! Never!"

He did not say it sadly. He said it leniently, confidently. "Here is where I belong! I can sing to you who live to hear me sing! I can harmonize with you when I feel a harmony in my heart. But don't be thinking that Guillermo is a great singer, because he's not!"

It was an evening of honesty and every man there explained why it was he was happy on the road crew and didn't wish to be anywhere else. Everyone, that is, except Sugar.

"Come on, Sugar. Aren't you happy

◆ The blind Watcher took a company car with a company driver up the road, and at the end of it . . . the . . . Watcher got out of the car and heard a song that made even an eyesless man weep. ◆

here?"

Sugar smiled. "I'm happy. I like it here. This is good work for me. And I love to hear you sing."

"Then why don't you sing with us?" Sugar shook his head. "I'm not a singer." But Guillermo looked at him knowingly. "Not a singer? Not a singer? A man without hands who refuses to sing is not a man who is not a singer. Hey?"

"What the hell did that mean?" asked the man who sang folk songs.

"It means that this man you call Sugar he's a fraud. Not a singer! Look at his hands. All his fingers gone! Who is it who cuts off men's fingers?"

The road crew didn't try to guess. There were many ways a man could lose fingers, and none of them were anyone's business.

"He loses his fingers because he breaks the law and the Watchers cut them off! That's how a man loses fingers. What was he doing with his fingers that the Watchers wanted him to stop? He was breaking the law, wasn't he?"

"Stop, Sugar, stop."

"If you want," Guillermo said, but the others would not respect Sugar's privacy.

"Tell us," they said.

Sugar left the room.

"Tell us, and Guillermo told them. That Sugar must have been a Maker who broke the law and was forbidden to make music any more. The very thought that a Maker— even a lawbreaker—was working on the road crew with them filled the men with awe. Makers were rare, and they were the most esteemed of men and women.

"But why his fingers?"

"Because," Guillermo said, "he must have tried to make music again afterward. And when you break the law a second time, the power to break it a third time is taken away from you." Guillermo spoke seriously and so to the road-crew men Sugar's story sounded as majestic and terrible as an opera. They crowded into Sugar's room and found the man slumped at the wall.

"Sugar is it true?" asked the man who loved Rogers and Hammerstein.

"Was you a Maker?" asked the man who believed.

"Yes," Sugar said.

"But Sugar," the man who believed said, "God can't mean for a man to stop making music, even if he broke the law."

Sugar smiled. "No one asked God."

"Sugar," Guillermo finally said. "There are nine of us on the crew, nine of us, and we're miles from any other human beings. You know us, Sugar. We swear on our mother's graves, every one of us, that we'll never tell a soul. Why should we? You're one of us. But sing, damn man, sing!"

"I can't," Sugar said.

"I can't," Sugar said. "I can't when God intended," said the man who believed. "We're all doing what we love best, and here you are, loving music and not able to sing a note. Sing for us! Sing with us! And only you and us and God will know!"

They all promised. They all pleaded.

And the next day as the man who loved Rogers and Hammerstein sang "Love, Look Away," Sugar began to hum. As the man who believed sang "God of Our Fathers," Sugar sang softly along. And as the man who loved folk songs sang, "Swing Low Sweet Chariot," Sugar joined in with a strange, piping voice, and all the men laughed and cheered and welcomed Sugar's voice to the songs.

Inevitably Sugar began inventing. First harmonies, of course, strange harmonies that made Guillermo frown and then, after a while, grin as he joined in, singing as best he could what Sugar was doing to the music.

And after harmonies, Sugar began singing his own melodies, with his own words. He made them repetitive, the words simple and the melodies simpler still. And yet he shaped them into odd shapes and built them into songs that had never been heard of before, that sounded wrong and yet were absolutely right. It was not long before the man who loved Rogers and Hammerstein and the man who sang folk songs and the man who believed were learning Sugar's songs and singing them joyously or mourn-

fully or angrily or gaily as they worked along the road.

Even Guillermo learned the songs and his strong accent was changed by them until his voice, which had, after all, been originally become something unusual and fine. Guillermo finally said to Sugar one day: "Hey, Sugar, your music is all wrong, man. But I like the way it feels in my road! Hey, you know? I like the way it feels in my mouth!"

Some of the songs were hymns: "Keep me hungry, Lord," Sugar sang, and the road crew sang it too.

Some of the songs were love songs: "Put your hands in someone else's pockets," Sugar sang angrily. "I hear your voice in the morning, Sugar, sing tenderly. Is it summer yet?" Sugar sang sadly, and the road crew sang them too.

Over the months, the road crew changed—one man leaving on Wednesday and a new man taking his place on Thursday as different skills were needed in different places. Sugar was silent when each newcomer arrived, until the man had given his word and the secret was sure to be kept.

What finally destroyed Sugar was the fact that his songs were so unforgettable. The men who left would sing the songs with their new crews, and those crews would learn them and teach them to others. Crew men taught the songs in bars and on the road; people learned them quickly and loved them, and one day a blind Watcher heard the songs and knew instantly who had first sung them. They were Christian Haroldsen's music, because in those melodies, simple as they were, the wind of the north woods still whistled and the tall of leaves still hung oppressively over every note—and the Watcher sighed. He took a specialized tool from his file of tools and boarded an airplane and flew to the city closest to where a certain road crew worked. And the blind Watcher took a company car with a company driver up the road, and at the end of it, where the road was just beginning to swallow a strip of wilderness, he got out of the car and heard singing. Heard a piping voice singing a song that made even an eyesless man weep.

"Christian," the Watcher said, and the song stopped.

"You," said Christian.

"Christian, even after you lost your fingers?"

The other man didn't understand—all the other men, that is, except Guillermo.

"Watcher," said Guillermo. "Watcher, he does no harm."

The Watcher smiled wryly. "No one said he did. But he broke the law, you Guillermo, how would you like to work as a servant in a rich man's house? How would you like to be a bank teller?"

"Don't take me from the road crew, man," Guillermo said.

"It's the law that finds where people will be happy. But Christian Haroldsen broke the law. And he's gone around ever since,

making people hear music they were never meant to hear.

Guillermo knew he had lost the battle before it began, but he couldn't stop himself. "Don't hurt him, man. I was meant to hear his music. Swear to God, it's made me happier."

The Watcher shook his head sadly. "Be honest, Guillermo. You're an honest man. His music's made you miserable, hasn't it? You've got everything you could want in life and yet his music makes you sad. All the time, sad."

Guillermo tried to argue, but he was honest, and he looked into his own heart. And he knew that the music was full of grief. Even the happy songs mourned for something, even the angry songs wept, even the love songs seemed to say that everything dies and confinement is the most freeing of things. Guillermo looked in his own heart, and all Sugar's music stared back up at him, and Guillermo wept.

"Just don't hurt him, please, Guillermo murmured as he cried.

"I won't," the blind Watcher said. Then he walked to Christian, who stood passively waiting, and he held the special tool up to Christian's throat. Christian gasped.

"No," Christian said, but the word only tormented with his lips and tongue. No sound came out. Just a hiss of air. "No."

"Yes," the Watcher said.
The road crew watched silently as the Watcher led Christian away. They did not

sing for days. But then Guillermo forgot his grief one day and sang an aria from La Bohème, and the songs went on from there. Now and then they sang "one of Sugar's songs" because the songs could not be forgotten.

In the city the blind Watcher furnished Christian with a pad of paper and a pen. Christian immediately gripped the pencil in the crease of his palm and wrote: "What do I do now?"

The blind Watcher laughed. "Have we got a job for you? Oh, Christian, here we got a job for you!"

APPLAUSE

In all the world there were only two dozen Watchers. They were sensitive men who supervised a system that needed little supervision because it actually made nearly everybody happy. It was a good system, but like even the most perfect of machines, here and there it broke down. Here and there someone acted madly and damaged himself, and to protect everyone and the person himself, a Watcher had to notice the madness and the best to fix it.

For many years the best of the Watchers was a man with no fingers, a man with no voice. He would come silently wearing the uniform that named him with the only name he needed—Authority. And he would find the kindest, easiest, yet most thorough way of solving the problem and curing the madness and propping the system that made



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the world, for the first time in history a very good place to live. For practically everyone.

For there were still a few people—one of two each year—who were caught in a circle of their own craving, who could neither adjust to the system nor bear to harm it, people who kept breaking the law despite their knowledge that it would destroy them.

Eventually, when the gentle moorings and deprivations did not cure their madness and set them back into the system, they were given uniforms, and they too, went out. Watching.

The keys of power were placed in the hands of those who had most cause to hate the system they had to preserve. Were they sorrowful?

"I am," Christian answered in the moments when he dared to ask himself that question.

In sorrow he did his duty. In sorrow he grew old. And finally the other Watchers, who revered the silent man (for they knew he had once sung magnificent songs) told him he was free. "You've served your time," said the Watcher with no legs, and he smiled.

Christian raised an eyebrow as if to say, "And?"

"So wander."

Christian wandered. He took off his uniform, but lacking neither money nor time he found few doors closed to him. He wandered where in his former lives he had once

lived. A road in the mountains. A city where he had once known the leading entrance of every restaurant and coffee shop and grocery store. And, at least, a place in the woods where a house was falling apart in the weather because it had not been used in forty years.

Christian was old. The thunder roared, and it only made him realize that it was about to rain. All the old songs. All the old songs, he mourned inside himself, more because he couldn't remember them than because he thought his life had been particularly sad.

As he sat in a coffee shop in a nearby town to stay out of the rain, he heard four teenagers who played the guitar very badly singing a song that he knew. It was a song he had invented while the asphalt poured on a hot summer day. The teenagers were not musicians and certainly were not Malesis. But they sang the song from their hearts, and even though the words were happy, the song made everyone who heard it cry.

Christian wrote on the pad he always carried and showed his question to the boys. "Where did that song come from?"

"It's a Sugar song," the leader of the group answered. "It's a song by Sugar."

Christian raised an eyebrow making a straggling motion.

"Sugar was a guy who worked on a road crew and made up songs. He's dead now, though," the boy answered.

Christian smiled. Then he wrote (and the boys waited impatiently for the speechless old man to go away). "Aren't you happy? Why sing sad songs?"

The boys were at a loss for an answer. The leader spoke up, though, and said, "Sure, I'm happy. I've got a good job, a girl I like, and man, I couldn't ask for more. I got my guitar. I got my songs. And my friends." And another boy said, "These songs aren't sad, mister. Sure, they make people cry, but they aren't sad."

"Yeah," said another. "It's just that they were written by a man who knows."

Christian scribbled on his paper. "Knows what?"

"He just knows. Just knows, that's all."

And then the teenagers turned back to their clumpy guitars and their young, untrained voices, and Christian walked to the door to leave because the rain had stopped and because he knew when to leave the stage. He turned and bowed just a little toward the singers. They didn't notice him, but their voices were all the applause he needed. He left the ovation and went outside where the leaves were just turning color and would soon, with a slight inaudible sound, break free and fall to the earth.

For a moment he thought he heard himself singing. But it was just the list of the wind coasting madly through the wires over the street. It was a frozen song, and Christian thought he had recognized his voice. **DO**



ELFIVE PRIME

CONTINUED FROM PAGE 42

his sky bike—) was with young seasoned pros and the team polymer line engineering and better craftsmanship, all disguised to lure the suckers. And all without an engineering degree. Zen had just picked up expertise, never seeming to work at it.

And when his luck ran out, it was—Almquist checked the display—only days before he was slated for Earthside. Ugh!

Torn Almquist knew about the shadowy wrecks who somehow dropped from sight on the colony; to be caught later or to die for lack of medical attention or, in a few cases, to find some scam—some special advantage—to keep them hidden on Elfive Prime. He'd been sure Zen was a survivor no matter what the accident report said. What was the phrase? A scam, not a burn—being on the scam wasn't quite the same. A scam wasn't down and out of resources; he was down and out of sight. Maybe the crafty Zen had engineered another fatality that wasn't his!

Almquist hadn't caught anyone matching the description of Zen. Almost, but not quite. He thought about young Yves Versky whose medical report hadn't been all that bad, then considered Versky's life expectancy on the colony versus his chances Earthside. Versky had been a sharp hard-worker too. Almquist leaned back in his chair again and stared at his display. He had no way of knowing that Reina's rampage crew was too late to ward off disaster.

A rain pipe had been leaking long before Grounds Maintenance realized they had a problem. Rain was a simple matter on Elfive Prime. You built a web of pipes with spray nozzles that ran the length of the colony. From ground level the pipes were nearly invisible, thin lines connected by crosspieces in a great cylindrical net surrounding the colony's zero-g axis. Gravity loading near the axis was so slight that the rain pipes could be anchored lightly.

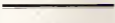
Yet now and then a sky bear would pedal foolishly from the zero-g region or would fail to compensate for the gentle-rolling movement generated by the air itself. That was when the rain pipes saved somebody's bacon and on rare occasions suffered a kink. At such times, Almquist was tempted to press for the outlawing of sky bikes until the robot sports association could raise money for a safety net to protect people and pipes alike. But the cost would have been far too great. It would have amounted to a flat prohibition of sky bikes.

The problem had started a month earlier with a mild collision between a sky bike and a crosspiece. The bike got back intact, but the impact popped a kink in the underside of the attached rain pipe. The kink could not be seen from the colony's axis; it might possibly have been spotted from floor level

with a good, powerful telescope.

Inspection crews used safety ladders which loaded the rain pipe just enough to close the crack while the inspector passed. Then the circle resumed for as long as the rain continued. Thereafter, the three-weekly afternoon rain from that pipe had been lessened in a line running from Elfive Prime's Hilton Hotel, past the paved hill, over the colony's one shallow lake, to work-stall apartments that stretched from the lake to the North end cap. Where crops were grown, rain was lessened, that is, everywhere but over the pine-covered hill directly below the kink. Local rainfall was unchanged, but the hill got three times its normal moisture, which gradually soaked down through a forty-year accumulation of ponderosa needles and humus, into the soil below.

In this fashion the hill absorbed one hundred thousand kilograms too much water in a month. A little water percolated back to the creek and the lake a feet. Some



• Almquist took a . . .
breath, then cantleaved a
forefinger in
warning. "Watch your tongue,
Hazen. When I pay
your salary, you pay some
respect." He saw
the sulfer look in Zen's eyes. •



of it was still soaking down through the humus overburden. And much of it—far too much—was held by the underlying slope soil, which was gradually turning to ooze. The extra mass had already caused a barely detectable shift in the colony's spin axis. Almquist had his best bombshotter Leo Shumway quietly checking the hull for a structural problem near the hull blaster.

Suzanne Nagel was a lissome widow whose second passion was for her sky bike. She had been idling along it zero-g, her chain-driven propeller a soft whirr behind her when something obscured her view of the hill far below. She kept staring at it until she was well beyond the look, then realized the obstruction was a spray of water. Sure! Sure!—she pedaled the rest of the way to the end cap, and two minutes later the rains were canceled by Emory Reina.

Thanks to Surey Nagel's storm, the slope did not collapse that day. But working from inspection records, Reina tragically assumed that the leak had been present for perhaps three days instead of a month. The hill needed something—a local vibration, for example—to begin the mud slide that could abruptly displace up to two hundred

thousand tons of mass downslope. Which would inevitably bring on the nightmare movie feast that meteorites by every colony manager's spinkquake. Small meteorites could only damage a colony, but computer simulations had proved that if the spin axis shifted suddenly a spinkquake could crack a colony like an egg.

The repair crew was already in place high above when Reina brought his electro-bus three-wheeler to a halt near a path that led up to the pines. His belt coffin set allowed direct contact with the crew and instant access to all channels, including his private scrambler to Torn Almquist.

"I can see the kink on your video," Reina told the crew leader, studying the belt-slung video. "Sleeve it and run a pressure check. We can be thankful that a leak that large was not over Hilton Prime," he added, laughing. The retired OrbGen executives who luxuriated in the hotel would have screamed raw murder of course. And the leak would have been noticed weeks before.

Scanning the dwarf apple trees at the foot of the slope, Reina's gaze moved to the winding footpath. In the forenoon quietude, he could hear distant swimmers cleaving in the slightly reduced gravity of the Hilton pool near the South end cap. But somewhere above him on the hill, a large animal thrashed clumsily through the pines. It wasn't one of the half-game deer, only metallic humans made that much commotion on Elfive Prime. Straining to locate the hiker, Reina saw the leaning trees. He blinked. No trick of eyesight; they were really leaning. That he saw the long shallow mud slide, no more than a portion of its potential that covered part of the footpath. For perhaps five seconds, he sank, grasping the implication of what he saw; Reina stood perfectly still. His mouth hung open.

"In deadly calm, coding the alarm on his scrambler circuit," Torn, Emory Reina, I have a Code Three on the hill. And I've swallowed hard, "potential Code One laay again, Code One mud slides on the main path-side of the hill. Over." Then Reina began to shout toward the pines.

Code Three was bad enough; a life in danger. Code Two was more serious still, implying an equipment malfunction that could affect many lives. Code One was reserved for colony-wide disaster. Reina's voice shook. He had never called a Code One before.

During the half-minute it took for Almquist to race from a conference to his office, Reina's shouts flushed not one but two men from the hillside. The first, a heavy individual in golf knickerbockers, identified himself hastily as Vonster Weston. He stressed that he was not accustomed to peremptory demands from an overall-clad worker. The second man emerged fast to Reina's right but kept hidden in a stand of mountain laurel behind him, surmising, sweating.

Reina was the voice of sweetness. "If you want to live, Mr. Weston, please lie down where you are. Slowly. The bees

below you are leaning outward, and they were not that way yesterday!"

"Damnation! I know that much." Weston howled. "That's what I was looking at. Do you know how well it is up here? I will not be down on this muck!"

The man in the laurels made a snip decision, cursed, and stood up. "If you don't two belly fill/shoot you here and now" came the voice of Philip Elroy Hazan. Zen had one hand thrust monastically into a coverall pocket. He was liberally smeared with mud, and his aspect was not pleasant.

"O dearest, another one?" Reina muttered. The fat man saw himself flanked, believed Zen's implied be a saw a weapon, and carefully lowered himself down to the blanket of pine needles. At this moment Tom Almqvist answered the Mayday.

There was no way to tell how much soil might slide, but though staccato interchanges Emory Reina described the scene better than his video could show it. Almqvist was grim. "We're already monitoring an increase in the off-center spin, Emory, not a severe shift, but it could get to be Affirmative on that potential Code One. I'm sending a full emergency crew to the blister now that we know where to start."

Reina thought for a moment, grimly pleased that neither man on the slope had moved. "I believe we can save these two by lowering a safety sling from my crew. They are directly overhead. Consent?"

An instant's pause. "Smart Emory. And you get your butt out of there. Leave the delectable man just go!"

"With respect, I cannot. Someone must direct the sling deployment from here."

"Is your bacon. I'll send another crew to you."

"Volunteers only" Reina begged, watching the slope. For the moment it seemed firm. Yet a bulge near cosmetically placed slag boulders suggested a second mass displacement. Reina then explained that predicament to the man on the slope to ensure their compliance.

"It's worse than that. Zen called down. There was a dugout over there," he pointed to the base of a boulder "where a woman was living. She's buried. I'm afraid."

Reina shook his head sadly using his comm set to his work crew. Over four hundred meters above, men were lashing tether lines from crosspoles to distribute the weight of a sling. Spore tethers could be linked by carabiners to make a line reaching to the colony floor. The exercise was timely to the crew but only as a drill unit now. And they would be toasting, not lowering.

Demeritically appalls from the hill, troublemakers converged on the blister where the colony's long-unused reactor and coolant tanks were stored. Their job was simple—in principle.

The reactor subsystems had been designed as portable elements, furnished with lifting and towing lugs. The whole reactor system weighed nearly ten thousand tons, including coolant tanks. Since the

blister originally had been built around the spread reactor elements to balance the full mass, Almqvist needed only to split the blister open to space, then lower the reactor elements on quartz cables. As the mass moved out of the blister and away from the hill, it would increase in apparent weight, balancing the downward flow of mud across the hull. Almqvist was lucky in one detail. The reactor was not in line with the great solar-warrior strips. Elements could be lowered a long way while repairs were carried out to redistribute the soil.

Almqvist marshaled forces from his office. He heard the colony-wide alarm wwoop in signal, watched monitors as the colony staff and two thousand other residents hurried toward safety in end-cap domes. His own P-suit, urgently and dust-covered, hung in his apartment ten paces away. There was no time to fetch it while he was at his post. Never again, he promised himself. He divided his attention among monitors showing the evacuation the bil-

● *Almqvist knew about the shadow wraiths who somehow dropped from sight on the colony, to be caught later or to die for lack of medical attention or, in a few cases, to find some scam* ●

ter team, and the immediate problem above Emory Reina.

Reina was optimistic as the sling snaked down. "South a bit" he urged into his comm set, then raised his voice. "Mr. Weston, a sling is above you, a little north. Climb in and buckle the harness. They will reel you in."

Weston looked around him, the whites of his eyes visible from fifty meters away. He had heard the alarm and remembered only that it meant mortal danger. He saw the sling tumbling gently on its thin cable as it neared him.

"Now steady as she goes," Reina said, then, "Stop." The sling collapsed on the surface near the fat man. Reina, fearful that the mud-covered stranger might lose heart, called to assure him that the sling would return.

"I'll take my chance here," Zen called back. The sling could mean capture. The fat man did not understand that any better than Reina did.

Vorster Weston paused halfway into his harness, staring up. Suddenly he was scrambling away from it, slipping in the sling, mindless with the fear of rising into a

synthetic sky. Screaming, he fled down the slope. And brought part of it with him.

Reina saw apple trees churning toward him in time to leap aloft his grabbaul and kept his wits enough to elect branches as the first great wave slid from the slope. He saw Weston disappear in two separate upheavals, swallowed under the mud slide he had provoked. Mauling by hardwood, mired to his knees, Reina spat blood and fury. He heaved one leg free, then the other, pulling at tree limbs. The second man, he saw had splintered against a thick pine and was now trying to climb it.

Still calm, voice indistinct through his broken jaw Reina directed the sling crew. The sling harness bounced upslope near the second man. "Take the sling," Reina bawled.

Now Reina's whole world shuddered. It was a slow perceptible motion, each displacement of mud worsening the off-center rotation and slight acceleration changes that could bring more mud that could bring worse. . . . Reina forced his mind back to the immediate problem. He could not see himself at its focus.

Almqvist felt the tremors, saw what had to be done. "Emory, I'm sending your relief crew back. Shumway's in the blister. They don't have time to cut the blister now, they'll have to blow it open. You have about three minutes to get to firm ground. Then you run like hell to South end cap."

"As soon as the man is in the sling," Reina mumbled. Zen had already made his decision, seeing the glistering ooze that had buried the fat man.

"Now! Right fucking now," Almqvist pleaded. "I can't delay it a millisecond. When Shumway blows the blister open it'll be a sudden shake. Emory, you know what that means?"

Reina did. The sharp tremor would probably bring the entire middle of the slope thundering down. Even if the reactor could be lowered in minutes, it would take only seconds for the muck to engulf him. Reina began to pick his way backward across fallen apple trees, wondering why his left arm had an extra bend above the wrist. He kept a running log of structures to the near-pipe crew as Zen untangled the sling harness. Reina struggled toward safety in pain, patience, reluctance. And far too slowly.

"He is buckled in," Reina announced. His last words were, "Haul away." He saw the mud-spattered Zen begin to reswinging in a broad arc, and they exchanged "OK" hand signals before Reina gave full attention to his own escape. He had just reached the edge of firm ground when Leo Shumway, moving with incredible speed in a full P-suit, ducked through a blister arlock and inggred the chaps.

The colony floor bucked once, throwing Reina off stride. He fell on his fractured arm, rolled, opened his mouth—perhaps to moan perhaps to pray. His breath was bottled by mud as he was flung beneath a viscous gray tide that rolled numberless

sons of debris over him.

The immense structure groaned but held Zen swayed ackenking as Elvive Pymastook around him. He saw Perna de watched helplessly as a retiree home across the valley sagged and collapsed. Below her, a covey of Quetzal birds burst from the treetops like jeweled scarabs in flight. As he was drawn higher he could see more trees slide.

The damage worsened too many people had been too slow. The colony was rattling everything that would rattle. Now it was all rattling louder. Somewhere, a shrill whistle keened as precocious air and more precious water vapor rushed toward a hole in the sunlight windows.

When the shouts above him became louder than the damage below, Zen began to hope. Strong arms reached for his and moments later he was attached to another tether. "I can make it from here," he said, calling his thranks back as he hauled himself toward the end-cap brace.

A crew man with a video cam set thrust it toward Zen as he neared a ladder. "It's for you," he said, noncommittal.

For an instant an ion Zen's body froze, though he continued to wait nearer. Then he shrugged and took the cam set as though it were video. He saw a remembered face in the video. Whapping an arm around the ladder, he nodded to the face. "Don Belows here," he said innocently.

Pause, then a snarl. "You wouldn't believe my mixed emotions when I recognized you on the monitor. Well, Mister Belows, Adol Hider here." Almost went on, "Or you'll think so damned quick unless you're in my office as fast as your knuckles will carry you."

The crew man was looking away but he was terse. He knew Zen cleared his throat for a while. "I'm scared—"

"You've been dead for ten years, Hazen. How can you be scared? Frizer there will escort you, his instructions are to bring you if he has to. I have sweeping powers right now. Don't come and don't argue. I need you right here, right now."

By the time Zen reached the ladders with their fellid, jumbled onops the slow shakes had subsided. They seemed to diminish to nothing as he trotted, the rangy Frazer in step behind, to an abandoned electsbot. Damage was everywhere, yet the silence was oppressive. A few electrical fires were kindling in apartments as they moved toward the Colony Center building. Some fires would be out, others out of control, in minutes. The crew man gestured Zen through the courtyard and past two doors. Toke Almost stood looming over his console display ignoring huge shards of glass that littered his carpet.

Almost adjusted a video monitor. "Thanks, Frizer, would you wait in the next room?" The crew man let his face complain of his idleness but complied silently. Without glancing from the monitors, Almost hunched the grumpy Zen. "I'll say the word, you're a dead man. If I say a different word,

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you go Earthside in minutes. You're still here only because I wanted you here all the time, just in case I ever needed you. Well, I need you now if you hadn't been dropped into my trap, we'd have found you on a Priority One. Never doubt that.

"If I stay a third word, you get a special assistant's slot—I can swing that—for as long as I'm here. All I'm waiting for is one word from you. If it's a lie, you're dead meat. Will you help Elvive Pym? Yes or no?"

Zen considered his chances. Not past that long-legged Frazer. They could follow him on monitors for some distance anyhow unless he had a head start. "Given the right conditions," Zen hazarded.

Almost's head snapped up. "My best friend just died for you, against my better judgment. Yes or no."

"Yes, I owe you nothing, but I owe this something."

Back to the monitors, speaking to Zen. "Lee Shumway's crew has recovered our mass balance, and they can do it again if necessary. I doubt there'll be more mud slides, though five minutes of sprinkles should've done it all."

Zen moved to watch over the tall man's bare arms. Two crews could be seen from the utility lug monitor rushing to repair window leaks where water vapor had crystallized in space as glittering fog. The colony's external heat radiator was in massive fragments, and the mirrors were jammed in place. It was going to get hot in Elvive Pym. "How

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soon will we get help from other colonies?"

Almost huffed. Then, "We won't unless we fail to cope. Or Zen can afford some other corporate prize will claim salvage rights. And when you're on my staff, everything I tell you is privileged data."

"You think the danger is over?"

"Over?" Almost barked a laugh that threatened to climb out of control. He looked items off on his fingers. "We're losing water vapor, we have to mask mirrors and repair the radiators, or we fry hell our crops are ruined and food stores may not last, and most residents are hopeless idiots who have no idea how to land for themselves. Now if you see why I diverted searches when I could've taken you twice before?"

Zen's mouth was a cynical curve.

Almost. "Once when you dragged a led from the lake filters, I could've had you at the emergency room." Zen's eyebrows lifted in surprised agreement. And once when a water tank you were securing food from the Hilton service elevator."

"That was somebody else you wasn't even close. But okay, you've been a real sweetheart. Why?"

"Because you've learned to live outside the system! Food, shelter, medical help. God knows what else you have another system that hardly affects mine, and now we're going to teach your kids to the survivors. This colony is going to make it. You were my experimental group Zen. You just didn't know it." He rubbed his chin reflect-

tively "By the way, how many guys are on the scam?" Couple of dozen? An optimist, Tom Alquist poked what he considered a high figure.

A chuckle. "Couple of hundred, you mean? Zen saw stock-piled dibblel and went on. "They ain't all guys. A few growing females. There's Wandering Mary. Maria Polyakova, our only registered nurse, but I found her dugout full of mud this morning. I hope she was sleepin' out."

"Can you enter their help? If they don't help, the colony can still die. The computer says it will, as things stand now. It'll be close, but we won't make it. How do you like to take your chances with a salvage crew?"

"Not a chance. But I can't help just standing here swappin' wind with you."

"Right. Eyes bared into Zen's assessing him. The thieves' argot, the be-damned-to-you gaze, suggested a man who was more than Hazen had been. "I give you a temporary pass. See you here tomorrow morning, for now, look the whole colony over and bring a list of problems and solutions as you see 'em."

Zen turned to leave, then looked back. "You're really gonna let me just walk right out? A statement of wonder, and of fact."

"Not without this." Alquist held scribbling on a plastic chit. He thrust it toward Zen. "Show it to Frazer."

Inspecting the cursive scrawl. "Doesn't look like much."

"Max que nada." Alquist smiled, then looked quickly away as his face lit. Better than nothing, his private joke with Emory Reina. He glanced at the retreating Zen and rubbed his forehead. Grief did funny things to people's heads. To deny a death you won't accept, you invest his character in another man. Not very smart, when the other man might betray you for the sheer fun of it. Tom Alquist massaged his temples and called Lee Shumway. They still had casualties to resuscitate.

Zen fought a sense of unreality as he moved openly in broad daylight. Everyone was lost in his own concerns. Zen hauled one scamtron his plastic bubble under the lake surface, half dead in stagnant air or mud from the creek, swamped his air exchanger. An entire family of scams, living as servants in the illegal basement they had excavated for a resident, had been crushed when the foundation collapsed.

But he nearly wept to find Wandering Mary safe in a secret conduit, lending to a dozen wounded scams. He took notes as she told him where her curative herbs were planted and how to use them. The old girl flatly refused to leave her charges, her black eyes flashing through weeps of gray hat and Zen promised to send food.

The luck of Sammy the Touch was holding strong. The crop compost heap that covered his half-acre loam shell seemed to insulate it from ground shock as well. Sammy patted his little round bummy, always a cheerful sign, as he ushered Zen into the bar where, on a good night, thirty

scams might be gathered. If Zen was the widest-ranging scam on Elfin Prime, Sammy the Touch was the most secure.

Zen accepted a glass of potato vodka—Sammy was seldom that easy to touch—and allowed a parody of the lute to be drawn from his. He'd offered his services to an assistant engineer, he said, in exchange for unspecified future privileges. Sammy either bought the story or took a lease on it. He responded after some haggling with the promise of a hundred liters of medicinal alcohol and half his supply of bottled methone. Both were produced from compost precisely under the noses of the crew and both were supplied on credit. Sammy also agreed to provision the hidden infirmary of Wandering Mary. Zen hugged the embarrassed Sammy and exited through one of the conduits, promising to pick up the supplies later.

Everywhere he went, Zen realized, the scams were coping better than legal ses-

● *Fung off the tip of the mirror and straight into a mountain of white-hot slag that had radiated like a dying sun near a temporary processing module outside the colony hull. No recovery attempted.* ●

cents. He helped a startlingly handsome middle-aged blonde dust the remains of her smoldering wardrobe. Her apartment complex had knelt into its courtyard and caught fire.

"I'm going to freeze tonight!" Suzy Nagel murmured philosophically.

He eyed her skimpy costume and doubted it. Besides, the temperature was slowly climbing, and there wouldn't be any night until the solar mirrors could be pivoted again. There were other ways to move the colony to a less reflective position, but he knew Alquist would try the direct solutions first.

Farmer Brown—no one knew his original name—wore his usual stolen agronomy-crow coveralls as he hawked his pack load of vegetables among residents in the lower level area. He had not assessed all the damage to his own crops, tucked and espalmed into containers over two square kilometers of the colony. Worried as he was, he had time to hear a convincing story. "Maybe I'm crazy to compete against myself," he told Zen, "but you got a point. I'll salvage outfit takes over. It's kayagag." KWAG. Kiss my ass good-bye. "I'll sell you

seeds, even breeding pairs of hamsters, but don't ask me to face the henchies in person. You remember about the vig slantes of scam?"

Zen nodded. He gave no thought to the time until a long shadow slipped a third of the colony floor. One of the mamots had been coaxed into proving. Christ, he was tired—but why not? It would have been dark long before on an ordinary day. He sought his sleeping quarters in Jean Neruda's apartment, hoping Neruda wouldn't insist on using Zen's eyesight to fill out reports. Their arrangement was a comfortable quid pro quo, but please thought Zen, not tonight!

He found a more immediate problem than scents. Yvra Vensky slumped trembling in the shambles of Neruda's place holding a standard emergency oxygen mask over the old man's face. The adjoining office had lost one wall in the earthquake, moments after the recycling crew ran for and cap doors.

"I had to hole up here," Vensky gasped exhausted. "Didn't know where else to go. Neruda wouldn't leave either. Then the old fool smelled smoke and dumped his goldfish bowl on a live power line. Must've blown half the circuits in his body. Like a spring-wound by Vensky's movements and voice diminished. Took me two hours of mouth-to-mouth before he was breathing steady Zen. Boy, have I got a headache."

Vensky fell asleep holding the mask in place. Zen could infer the rest. Neruda unwilling to leave familiar rooms in his advancing blindness, Vensky unwilling to abandon a life, even that of a half-electrocuted, crotchety old man. Yet Neruda was right to stay put. Earthquake swatted the Det-Gen employee whose eyes failed.

Zen lowered the inert Vensky to the floor, patted the big man's shoulder. More than unerring care, he had shown dexterity and first-aid expertise. Old Neruda awoke once, half-maniac, half-still disoriented. Zen nursed him through it with surface awareness. On another level he was cataloguing items for Alquist for survivors for Elfin Prime.

And on the critical level a voice in him jeered, bullshit. For yourself? Not because Alquist or Reina had done him any favors, but because Tom Alquist was right. The colony manager could find him eventually, maybe it was better to nudge the system now on good terms. Besides, as the only man who could move between the official system and the scam counterparty, he could really wheel and deal. It might cause some hard feelings in the conduits, but Zen sighed, and slept. Poorly.

It was two days before Zen made every contact he needed, two more when Alquist announced that Elfin Prime would probably melt. The ambient temperature had stabilized. Air and water losses had ceased. They did not have enough stored food to provide three thousand daily calories per person beyond twenty days

but crash courses in multicropping were suddenly popular and some immature crops could be eaten.

"It'd help if you could coax a few scams into instructing," Almquist urged as he slowed to match Zen's choppy pace. They turned from the damaged crop terraces toward the Center.

"Umh-hm," Zen intoned. "We still talk about wartime when vigilantes tried to clean us out. They ushered a couple of nice people out of artifacts, risked, which we think was a little brusque. Leave it alone, it's working."

A nod. "Seems to be. But I have doubts about the maturing rates of your seeds. Why don't my people know about those hybrid dandelion radishes and tomatoes?"

"You were after long-term yield," Zen shrugged. "This hot weather will open the stuff faster too. We've been hiding a dozen short-term crops under your nose, including dandelions better than spinach. Like hamster hunch is better than rabbit, and a lot quicker to grow."

Almquist could believe the eighteen-day gestation period, but was astonished at the size of the breeding stock. "You raised your one kilo hamsters could be more pet than protein?"

"Not in our economy, Zen snorted. "It's hard to be sentimental when you're down and out. Or stylish either." He indicated his frayed overalls. "By the time the rag man gets this, it won't yield three meters of dental floss."

Almquist grinned for the first time in many days. What his new assistant had forgotten in polite speech, he made up in the optimism of a young punk. He consoled himself: an old punk. "You know what turns? You're nearly my age and look ten years younger. How?"

It wasn't a specific exercise Zen explained. It was attitude. "You're careworn," he sneered. "Beat your brains out for diling plutocrats fifty weeks a year and then wonder why you age faster than I do." Wandering heads-hike.

They turned toward the Center courtyard. Amused, Almquist said, "You're a plutocrat?"

"Ain't rainin' my meters. Look at all the Indians who used to live past a hundred. A Blackfoot busted his ass like I do, maybe ten or twenty weeks a year. They weren't dumb, just silly."

Almquist forgot his retort; his desk console was leeching for attention. Zen wandered out of the office, returning with two cups of scam coffee. Almquist sipped it between sips, wondering if it was really brewed from ground dandelion root, considering how this incontinent troll was changing his life. Could change it further.

Finally he sat back. "You heard OrbGen's assessment?" he sighed. "I'm a God-damned hero, for now. Can't ask me about next year if they insist on making poor Errory a sacrificial goat to feed ravenous stockholders. I can't help it."

Impassive. Sure you could. You just let

em co-opt you. Zen sighed, then released a sad frog-like smile. "Like you co-opted me."

"I can unco-opt. Nothing's permanent."

"You said it, bubba."

Almquist took a long breath, then cantilevered a forefinger in warning. "Watch your tongue, Hazan. When I pay your salary you pay some respect." He saw the sullen look in Zen's eyes and bored in. "Or would you rather go on the scam again and get Earthed the first chance I get? I haven't begun to co-opt you yet, he glowered. "I have to meet with the Colony Council in five minutes—to explain a lot of things, including you. When I get back, I want a map of those continents the scams built, to the best of your knowledge."

A flood of ice washed through Zen's veins. Staring over the cup of coffee that he shook in his hands. "You know I can't do that."

Almquist paused in the doorway his expression smug. "You know the alternative. Think about it," he said, and turned and walked out.

When Torrin Almquist returned, his wastebasket was overturned on his desk. A ripe odor wrinkled his nose for him even before he saw what lay atop the wastebasket like an offering on a pedestal: a lavish gift of human excrement. His lover opened an armoire, protruded from the land. It skewered a plastic chit Zen's size. On the chit, in draftsman's neat printing, full caps: I SUGGEST ABOUT IT.

Well, you sure couldn't mistake his answer. Almquist reflected as he dumped the chit into his toilet. Trust Zen to make the right decision.

Which way had he gone? Almquist could only guess at the underground warrens built during the past fifty years, but chose not to guess. He also knew better than to mention Zen to the Colony Council. The manager felt a twinge of guilt at the choicely no choice at all that he had forced on Zen—but there was no other way.

If Zen knew the whole truth, he might get careless, and a low profile was vital for the scams. The setup benefited all of Elvive Prime. Who could say when the colony might once more need the counter-culture and its primitive ways?

And that meant Zen had to disappear again, genuinely down and out of reach. If Almquist himself didn't know exactly where the scams hid, he couldn't tell OrbGen even under drugs. And he didn't intend to tell Scanner or later OrbGen would schedule Torrin Almquist for permanent Earthed rotation, and when that day came he might need help in his own disappearance. That would be the time to ferret out a secret conduit, to contact Zen. The scams could use an engineering manager who knew the official system inside out.

Almquist grinned to himself and brewed a cup of dandelion coffee. Best to get used to the stuff now, he reasoned, it would be a staple after he retired, down and out on Elvive Prime. **DD**

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CLONE DOCTOR

CONTINUED FROM PAGE 20

he suspects he won't have any trouble

"You mean you've already had people ask you to clone them?" I asked.

See the folder right here? It's about an inch and a half thick, isn't it? Well, it's got all the letters I've received since the Del Zo trial publicity and maybe about fifty of them are asking me to help them have test-tube babies, and about half that number want me to try and reverse their tubal ligations, and, yes, I've got a few folks asking to be cloned. I have the facilities here to do anything I was able to do in New York.

"What are you telling them?"

"I tell them no for the time being," he said, "but that if things work out, I'll get in touch with them. I don't want to turn down any opportunities. Of course, I thought I might have had that opportunity back in 1975 when David contacted me."

"David? You mean David Rivnik?" I asked.

"I've known David since 1968, when he was writing for *Time/Life*," said Shettles. "He's written several articles about my work, and he helped me write that book *Choosing Your Baby's Sex*, and I can do that pretty good, although I doubt you want to hear about that now I looked David in the eye, and I decided he had integrity. He wouldn't have done that cloning book for a stunt or for money if he hadn't thought it was the God's truth. Well, he wrote me back in June, 1975 and told me about his cloning project. He said it involved a man from New Jersey, a millionaire in his mid-sixties, but he wouldn't give me his name, and he asked me for all the information I had on the subject. I sent him all the reports I could find and made some suggestions on how to do it with microsurgery mentioning that I would immobilize the nuclei with carbon dioxide so that they wouldn't squirm around while I fished for them. However, I never heard from David after that, so I guess they decided microsurgery wasn't as good as the fusion approach. Of course, I don't know anything about fusion except for what I've read."

"Tell me one more thing," I said. "What if a woman wanted herself cloned and wanted to use her own egg holding her own transplanted forty-six-chromosome body cell, and wanted to stick it back in and carry it herself for the nine months? Would that work?"

"I hadn't thought about it," he answered. "I don't see why not, though I bet you're going to tell people I'm a mad person. When you get older, you begin to hark on things I could go just like that. I try to appreciate today. I don't want to sound morbid, but I don't think I'm any happier by thinking about the different ramifications of life, such as cloning. Why not? I'd just like to see if it would work. Of course, there might be some unforeseen ramifications."

Well, before I did too much head work on

those unforeseen ramifications, I thought I'd take a walk around Randolph and admire those colored leaves and white church spires, and dropped into Wesley Hurung's Randolph Historical Museum, where I found out that Randolph had been named for the first chairman of the Continental Congress back in 1776 and barely missed becoming Vermont's capital in 1806. I wandered around, staring at some of the honest faces of the 4,500 Randolphians, who work mostly at making wood and dairy products, but who also make plastics, toys and dies, and work gloves. And if Doc Shettles has anything to do with it, these might be a new type of manufacturing industry in Randolph soon.

I walked over the kitchen table with Mrs. Edna Braun, a former mental-health worker who said that Shettles is lovable, tolerant, kindly and sharp as a tack, even though it might be a slightly odd-shaped tack. She thinks he ought to be left alone to work, even though she is an Irish Catholic from Boston

now there never had been any heart transplants until that South African fellow did it one day in the 1960s, and before you know it, everyone was doing it. And of course as far as we know the Russians, the Chinese and old Howard Hughes might have already done some cloning, if not a lot of it, and we've already heard what David Rivnik claims. Naturally, it gives me pause, as I don't know just how many more of me I could stand, not to mention not being needed to start off the whole daddy business anymore. Now how would I feel if I were a clone? Could my daddy' or 'mamee' claim I was a piece of property with no constitutional rights, the same way some folks have patented certain types of cloned grain or plant seeds or farm animals? Now wouldn't there be some folks who would claim I wasn't really human even though I felt as if I was? And wouldn't at least some of them want to wipe me out as has been done to "inferior" or "inferior" races over the years? And wouldn't I want to wipe them out in self-defense? As a matter of fact, I'd throw in what we'll probably be facing with computers in a few years, won't folks all over the world become downright confused over what being "human" is? If it is true that different types and races of folks breed stronger children when they get together behind the barn as the old folks claim, and if you get ones that are weak in the head when people too much alike, like cousins, intermarry, then what can you expect the result to be if someone makes his children from his own liver? If this cloning really gets to be serious business, I imagine that some countries are going to go and start passing laws controlling reproduction among the taxpayers—especially among those with no political clout.

Doc Shettles claims he would've done it back in 1973 if his boss at Columbia Medical Center hadn't got upset and tossed the doc's test tube, contents and all, into the deep freeze.

After a while I went on back to Gifted Memorial Hospital to say good-bye to Doc Shettles, but before he let me go, he took me around to see some of his egg photos, which he has taken in almost thirty years of being a laboratory caretaker. There was one with two sperm cells clasped over one another—one a boy sperm and the other a girl. They were, as the English biology experts say rampant upon a field of Egg.

"I call this one 'Man's coat of arms,'" but you'll note that the ladies make up two thirds of it," said Doc Shettles.

"I think you ought to be cloned," I announced.

"No, no, no," he said. "You know, one of my daughter asked me if I believed in reincarnation, and I said I didn't know and she said that if there was any such thing, I'd come back as a squirrel."

Way up there in Randolph there's a sight you ought to see: That good old country doctor is Xeroxing you and me.

I'M CLONED, I'M CLONED, I'M CLONED! I'VE COME TO GLORY NOW! But since there's all these Mss around, it's all the same somehow. **DC**

THE DELPHIC POLL

*The future as predicted by 20,000
Omni readers—the
largest survey of its kind*

BY DR. CHRISTOPHER EVANS

When Omni asked readers of its first issue to predict the future, we dug in for a blizzard of replies. But even the most ambitious of us were unprepared for the colossal response. More than 20,000 readers filled out Omni's Delphic Poll, making it the largest mass survey of its kind.

The response has been gratifying on the scientific level, too. Letters from futurists and other social scientists have poured into our offices, wishing us well and asking to see the results. Even the US Congress has gotten into the act. Through the courtesy of Rep. Charles Rosten (D-North Carolina) and the Congressional Clearinghouse for the Future, the results have already been distributed on Capitol Hill.

A Delphic Poll, to jog your memory is a method developed by the RAND Corporation to predict not the future but that which experts in a given field expect the future to be. Since you are the experts in your own lives, Omni adapted the Delphic Poll for the general public. We asked our readers to predict future events with far-reaching consequences.

The responses were overwhelmingly diverse: if any one theme can be said to predominate, it is optimism. Omni's readers are definitely optimistic about the future. They are even optimistic that there will be a future. Nearly two thirds feel that nuclear war will never erupt between the USA and the USSR. And the one-third minority that does expect nuclear configuration thinks it no more imminent than the twenty-first century—hardening news for at least the older generation.

Like a bad joke, the results contain good news for some and not so good news for others. Feminists are among those who can take heart. Almost everyone polled expects to see a woman president some day soon. (Nearly a third of all respondents picked the years 1992-96 for that event.) Any male candidate in 1992 should perhaps take heed. Balancing the ticket with a female

vice-president, according to Omni's readers, could mean being dumped four years later—if he lives out his term, that is.

There is good news, too, for those longing to journey to space. A vast majority of respondents expect tickets for space travel to go on the market perhaps by the 1990s. We didn't dare try to predict the laws. Furthermore, by the late 1990s some of us may be working in space as orbiting industry becomes a reality.

Even card-carrying Communists can find something to be grateful for. A majority of South American governments are expected to go leftist by the late 1980s, and the existing regime in the Soviet Union will stay in power for the foreseeable future. But the economic collapse of the West, predicted by Marxists for more than a century is still not considered imminent.

The bad news falls on a similarly wide range of people, among them:

- chess players, who can expect a computer to capture their world championship;
- butchers, who may face difficulties finding customers for their high-priced merchandise;
- imperialist oppressors, or those perceived as such by terrorists, who are expected to go nuclear;
- David Foren, whose claim to have already chronicled a human cloning is not widely believed;
- Puritans, who can expect the permissive morality of the sixties to continue indefinitely;
- libertines, who can expect the restriction of marriage to do likewise;
- Morians, who can expect to find Earthlings on their planet and possibly go the way of the American Indians; and
- Earthlings, who may one day be outsmarted by self-aware computers. The question remains: When will there be a computer smart enough to build one even smarter than itself? And will it be stupid enough to do so?

HOW TO READ THE RESULTS

Omni's readers were given a list of twenty possible future events and asked to predict the five-year period in which they would occur. The results, compiled and analyzed by computer, are given on the following pages. Each graph represents the range of response for a given event.

The percentages of readers choosing each five-year period are plotted along the curves. The solid lines up to the year 2000 represent actual percentages. But since the period in which it can be considered most accurate ends in that year, the post-2000 responses are shown with a dotted line extending toward the right. The vertical bar on the far right is the "never" vote—the percentage which predicted that a given event would not occur.

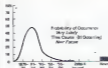
The highest point on each curve can be taken to be the consensus on that event's forthcoming date. A graph with a steep curve shows broad agreement among respondents. A flatter more drawn-out curve reflects a more scattered opinion. The graphs are arranged, roughly according to what might be called their "perceived imminence": from those that show strong consensus for the near future to those with near random results. The latter generally correspond with high "never" tallies. This indicates little agreement on when, if ever, that event will occur.

Each graph is accompanied by a summary of its contents. Two variables are judged—how likely an event is and when it will occur. The likelihood is calculated from its "never" response; its expected date from the shape of its time curve.

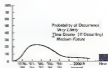
We hope the results make you stop and think, but it is worth pointing out that they shouldn't be taken too seriously. At best, as with all Delphic polls, they merely indicate the spectrum of opinion. We don't trust this any more than we do any other predictors. The only prediction we consider safe is that the future will turn out to surprise us all.

THE DELPHIC POLL

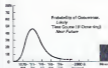
• A woman president, GIs in Africa, a computer chess champion, public space flight, nuclear terrorism —only part of what the future holds in store. •



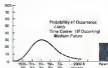
Gasoline reaches twenty-five cents per gallon. Would you believe 1982? That's what our readers think, but they may be in for a shock, considering the recent OPEC price hike. Fifty cents per gallon will be more like it.



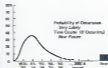
Extrasensory perception is accepted as fact by the majority of scientists. Our readers believe they're one step ahead of the scientists on this one. Over 90 percent foresee ESP as fact rather than fiction.



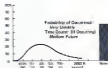
US commits troops to Africa to counter Communist incursions. One of the poll's big surprises. Most readers place GIs on the Dark Continent by 1985, although one fourth believes it will never happen at all.



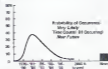
The majority of South American governments become Communist or ultra-Left Revolution is considered exportable south of the border. Most respondents color our southern neighbors red by the late 1980s.



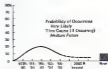
Computer beats world (human) chess champion. An electronic champion should be with us by 1985, predict our readers. Whether it will be less temperamental than Bobby Fischer is another question.



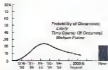
Return to pre-sixties standards of morality and end of "Permissive Society." "Never" cried *Omni's* readers, apparently enjoying their newfound lack of restrictions while looking forward to even more of the same.



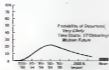
First terrorist use of nuclear weapons. A terrifying exception to the general optimism. Watch out for this in the 1980s, warned two thirds of our readers. Only one in ten thinks it's out of the question.



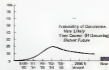
A human being is successfully cloned. No broad consensus appeared except that human cloning is eventually in store. The late 1980s seems most likely, but a substantial minority is waiting for next century.



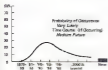
World shortage of animal protein makes meat too expensive for average American household to afford. According to four out of five readers, hamburger will be more costly than tuffies by and by.



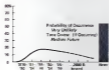
First public "paying passengers" on an orbital spaceflight! Space tourism is definitely in the cards, predict our readers. But probably not until the 1990s or later. Check with your travel agent for time of departure.



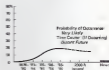
Average expectation of life to 100 years or more. 95 percent of our readers predict this goal will be attained. The bad news is that it won't happen until 1998 or later. Too late for all but the youngest among us to benefit!



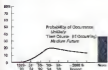
Manned landing on Mars! Look for the early 1990s—92 is the median date—although one of our live readers doesn't expect it before the year 2020. The "never" vote was the lowest in the survey—only 3 percent.



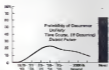
Economic collapse of the West as predicted by Marxist commentators. No need to invest your savings in gold bullion, says our optimistic readership. But, of course, we don't expect to convert any card centers.



Industrialization of space becomes important source of income. Again, instead of twenty readers voted yes, but not for the near future. Large profits are not expected any sooner than the twenty-first century.



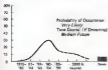
Revolution in USSR leads to overthrow of existing regime and replacement by liberal "pro-West" government. Don't hold your breath. The most optimistic readers don't foresee the Iron Curtain lifting before 1990.



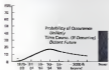
Nuclear war breaks out between USA and USSR. Our readers' optimism showed once again, as very few people seem to believe that the "final war" will ever take place. Are our leaders listening?



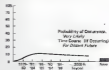
Computers have "self awareness" and intelligence greater than that of humans. Despite recent advances in machine intelligence, nearly half our readers expect never to be outwitted by a computer.



First woman elected president of the USA. The 1992 election will put a woman in the Oval Office, according to the majority of our readers. Interestingly, only 7 percent say it will never happen.



First asteroid or meteorite hits the Earth. Contact made with intelligent extraterrestrial life. Close encounters of the third kind will get no closer for a while, our wary readers say—at least not during the century. But they—and Gwyn—are waiting. **OO**



Contact made with intelligent extraterrestrial life. Close encounters of the third kind will get no closer for a while, our wary readers say—at least not during the century. But they—and Gwyn—are waiting. **OO**

BUTTERFLIES

CONTINUED FROM PAGE 126

them in their faces or tear all two hundred apart in front of them.

No. Let them have the fucking crowd and do whatever they want with them; better take what they've written and make corrections, add comments of my own, and bring them copies of that.

He did really like to do that.

But he knew what that would lead to. Accusations, speeches on the Right party line, on the dangers of political heresy, the dangers of individual thinking, individual initiative, of objective compromise with the Establishment, the dangers of leftism.

What about the dangers of stupidity?

Might as well talk to a brick wall. Endless discussions. They're so sure they know the truth. Always putting themselves in the role of the judge, always anxious to find you guilty. That precisely was what made him sick. The mere thought of it made his stomach twist. His throat was dry. He tried to swallow couldn't.

At a way the Movement looks almost exactly like the System. Mirrored?

Like the butterflies.

Trying to protect itself, to go unnoticed, the Movement begins to resemble what it's supposed to fight.

Or has it always been that way? Was I just too blind to see it?

The idea made him even more uneasy. Sweat was dripping from his forehead, and of course, the friendly spider saw it.

"It's really hot in here, isn't it? Something wrong with the heating."

"Yes." The second he said it, he knew it was a mistake. He knew what the guy would say next.

"I think I open the window. If you'd help me move that case over there, I'd climb on it and do it."

"Are you sure that—"

"Yes. I've got more work to do in here this afternoon. And if there's no one to help me—"

"Okay, I'll help you."

"Thanks."

Open the window. It seemed more and more like a nightmare. If he opens the window.

A minute later, there were at least fifteen butterflies flying around them.

"Oh, butterflies!" The guy was entranced. "They're so beautiful, aren't they? So beautiful. Those colors—"

"Yep."

"Creatures of God. Angels. You know I really think they are. Guardian angels. Messengers of peace and beauty, the very image of paradise on earth, helping men to follow the right path. We're all sinners, and every one of us is weak."

Who knows what would have happened to us if God hadn't sent them to help us? Mankind would have gone on to inevitable destruction. Violence, murder, riots, discord, anarchy.

And they're so beautiful. I can stay hours just watching them."

God, HE watches THEM! What did I do to deserve HIM? His insane!

His eyes were brilliant with inner conviction, with an obsessive drive. Probably the guy thought of it as joy convincing himself he was happy. But his eyes were just too brilliant for happiness, for anything but insanity.

Religious nut.

And he loves the butterflies.

How can someone love butterflies? We're not just there to watch us, to spy on people, and we would be supposed to love them?

But people loved God, didn't they? Where's the difference? When you think about it, God is the ultimate dictator, he universe the ultimate police state. He knows everything you can't hold from him. Everything you do, your most intimate thoughts. He kills, can kill (no, call back to her. Sweet euphemism) anyone, whenever he likes. Even in death you can't escape

◊ He didn't know precisely why, but there was something about the guy that he didn't like. . . . There was too much interest and curiosity in his eyes. He made you think of a . . . spider ◊

him. Just got his torture chamber. Hell where he can imprison you forever.

A good thing he didn't believe in God, at least in the kind of a God.

Am I really sure I don't?

In fact, police states use that resemblance—miracry again?—use our suspicion to control us, use our fear of God, even if it's so deeply buried in our brains that we don't think we have it, to manipulate us.

Butterflies everywhere. The Eyes of God everywhere. I liked. There was some logic in that.

"Cooler isn't it?"

"Excuse me, I'm just—"

"I said, Cooler, isn't it?"

"Yes indeed, yes."

"But I can see I'm interrupting your thoughts. What were you going to say?"

"No, nothing. I was just, you know, thinking about what you said, butterflies being angels—"

"They are, you know they really are. Many people don't like them, are afraid of them, but that's wrong. There's nothing to fear from them. I've heard stories you wouldn't believe about butterflies eating people.

That's absurd. They're so beautiful, and they love us, you know they really do."

"Like God does."

"Exactly."

And you know, I used to be afraid of the butterflies too. I didn't feel right, I wasn't comfortable in my skin. Doubts and so on. I couldn't communicate with other people, with my brothers. Life didn't have any meaning then. And I even thought of joining some of those underground political movements. Jesus, he knows. And I can't understand why people do that. I can't condemn them. He knows, that's for sure. Because they just haven't met God yet, and they don't know the truth. But I know the Truth now and I'm happy."

His eyes were more brilliant than ever.

He would hypnotize me if he could. He also thinks he knows the truth, the one and only Truth. They're all out from reality, all of them, imprisoned in their cocoon of truth.

"Well, I must go now." Nearly crushed his fingers, put something in his hand, and left. "Good-bye, Brother, and don't hesitate to call on us."

He found himself alone in the photocopy room. He and the Xerox machine, surrounded by butterflies. He was on the verge of a nervous breakdown, still wondering why he'd kept his mouth shut. With all the shit the guy had been pounding at him.

He took the thing that the guy had sloped in his hand, a sheet of paper, quite evidently a Xerox copy of a leaflet, a tract.

The friendly spider was also using the machine to make leaflets. That was probably funny, but he didn't feel like laughing.

There were now at least twenty butterflies in the room. They might have followed the guy who loved them so much, but they hadn't. They'd preferred to stay, obviously they'd preferred to stay with him, a poor little fellow with his problems and who didn't feel at ease. They were so full of love that they couldn't leave him alone.

Probably wanted to show him the way to God, to the ultimate Truth that would change his life forever.

Shit.

He didn't know why he did it. Just that he felt terrible afterward, terrible but better. All the tension released, suddenly gone.

Everything had added up together, his guilt toward the Movement, that guy who looked so satisfied with the System, his fear

and the butterflies fluttering all around him, everywhere. He was at the point where he would have made the copies anyway, even with the butterflies, hundreds of them, whatever the consequences might have been. Just to prove to himself that he wouldn't fall into paranoia, let paranoia get the best of him. Butterflies just couldn't read, even less when they could see just the back of the leaflet.

But they just wouldn't let him use the photocopier. There were always four or five of them on the glass. Waiting, making fun of him. When he tried to shoo them away more came.

Always the same hypnotic movement.

And they wouldn't leave, as if the situation amused them.

He saw himself, as if he were someone else, laid back the flap. Crush the butterflies under it. The barely perceptible noise of the crushed thoraxes. He didn't let them escape.

Set the switch of the copier on "color."

And pressed the button. A flash. A copy of the dead butterflies went out of the machine. The eyes on the wings, the yellow-green splashes of squeezed abdomens, a wing folded, as if one of the butterflies had tried to fly away at the very last moment.

A very impressive image.

He made one more copy, then another, then ten more.

He lifted the flap, put the leaflet very carefully on the dead things and set the machine on "automatic."

He sat and watched the copies coming out. Tchak, tchak, tchak. tchak. tchak. tchak. tchak. tchak. It looked like an animation film, as if the butterflies were still alive and trying to escape from the sheets of paper but failing. Try and fail. Over and over.

After a while, there was no more paper. The machine stopped. The Xeroxed butterflies froze forever.

He waited for the guy to come back and kill him, for lightning to strike him, for something to happen. Nothing did.

So, very quietly, so quietly it surprised him, he took the dead butterflies, put them in an envelope, threw it in the incinerator, cleaned the glass, took all the copies with him, and left.

He woke up screaming.

And this time it wasn't difficult to remember the nightmare. The images were so vivid he felt he would never forget them, even though, at first, they didn't seem to make sense.

He was walking on a transparent glass surface. It was huge and reached to the horizon. Under his feet, deep below there was a blazing light moving forward and back, forward and back.

The sky was uniformly red, except for a yellow cloud with a black lining. And the cloud was coming in his direction. There was a voice. Not a voice of thunder but a friendly voice, the sound of which reminded him of his father.

"We now have all the data we need to Xerox you. And that's what we are going to do, make a copy of you, a three-dimensional copy. And no one will ever notice the difference. The only person who'll know it's a copy will be you. But you won't be there anymore."

"It won't be a puppet or a robot or a zombie. It'll be something more and something less. An image."

And, just like you, this image will think, will love, will experience joy and fear. And the funny thing is that it will even be afraid to be replaced by a copy."

"Why? But why?"

His whole body was covered with sweat. Drops were falling to the glass surface,

splashing green oily splashes.

The voice answered.

"Change is Evil. That way things won't change. When everyone has been copied, the world will be perfect: a world of images in which no one will die anymore. A world that will last forever."

Then, more clouds came over the horizon. And suddenly all the sky was like black rubber, a gigantic flap that was going to crush him against the glass surface.

And that flap was made of butterflies, billions of them, with eyes on their wings.

So he tried to escape, to run away. Arrived in a deep forest, a jungle.

He knew that within the limits of the forest he would be safe. And he came to a very small primitive village, just a gathering of huts. The people were in the village square holding a meeting. He knew these people were the last Incas. And he thought that he should take a few photos of them and of the village. He pointed his camera. The people turned their heads, hid their faces behind their hats, behind their headaddresses made of colored feathers and tropical butterfly wings, blue and silver wings like mirrors.

That was something he'd heard about, that primitives didn't want to be photographed, that they were afraid you would steal their soul. How stupid, magical thinking. Afraid that some witch doctor would use their photos to cast spells on them. He felt pity for them and went to explore the village.

A little away from the meeting a man was sitting in front of his house. He wanted to take a picture of the man's face but the man's back was turned. He walked very quietly silently like a beetle, so as not to frighten him. Then ran, surprising him, and took the picture. The man didn't have the time to hide his face. In fact he didn't even try to. Just smiled.

Then came understanding and fear. The man was himself, or rather his double, his mirror image.

And he thought: "Now you haven't got a soul anymore, just a Xerox copy of a soul."

And that's when he woke up screaming.

Not too difficult to figure out where all the Xerox imagery came from.

But there was something more. Something that linked up with all his conscious and unconscious fears, with everyone's fears. The fear of not being me anymore, of being replaced by something that wouldn't even know it wasn't me anymore.

A fear as old as mankind, and maybe even more ancient.

There was the folk belief that you can see your double just before you die. Or rather that all through your life your double is part of you and that sometime before your death a month, a week, perhaps a few hours, he goes away.

The primitives who were afraid of the camera.

In a way, we share the same fear.



"We were made for each other, Melville."

No witch doctors any more. Computers. And we're afraid that a computer will get an accurate image of ourselves. Yes, accurate enough to be used for invasive magic. No more dolls with needles stuck in them, but magnetic tapes, video recordings, perforated cards, data banks.

He made his first attempt at the very beginning of the meeting, in a quite awkward way. Raised his hand and said, "I've got something to tell you about the butterflies. I've been thinking, and—"

"I'm sorry it's not on the agenda. No unscheduled matters. We can't afford to waste time. We don't know how long we'll be allowed to continue this meeting. So priorities first. Okay?"

So they got to priorities, until they noticed that, of course, there was a butterfly in the room.

Everybody sat and waited. Everybody but him.

That was the moment for which he'd been waiting.

"Well, as no one seems to have anything more to say, maybe I should tell you what I want to tell you."

They looked at him as if he were mad. Anxious glances in the direction of the butterfly.

He didn't feel too good himself and delivered his speech like an automaton, very quickly without looking at them.

"As I tried to tell you a little earlier this

evening, I've been thinking. You probably know that butterflies, I mean certain species of butterflies, have a particularly developed sense of smell, so that, for instance, a male butterfly can smell a female butterfly from more than fifteen kilometers away and go and find her.

"Now, when you're angry or anxious, when you don't feel okay and most of the time we don't, I mean, if you don't like society the way it is, and you want to change it, to do something about it, I mean, meetings like these ones, although I don't think they lead anywhere, in a way you're frightened right? You're filled with anguish, very anxious, and depressed. And when you are like that, you emit a very specific smell."

"You are right now. I can't smell it, but I know you are."

"Shut up. You're insane. What do you want? To compromise us all? We don't want to have anything to do with you. We don't even know you."

"Neither do I. But I won't shut up. Because I'm not afraid of the butterflies. And I don't think you should be either. I'm not afraid of them, and I don't think they're spying on us. I think they just come when we're afraid of being spied on, when we give off that specific smell that says, 'I'm afraid to be watched.' The Establishment, the dictatorship, whatever you want to call it, doesn't need to spy on us. It just needs to have us think it's spying on us. Because then we're paralyzed, don't dare do any-

thing, don't even dare think.

"And those eyes on the butterflies wings aren't there to watch us, but to make us think that we're being watched."

"Were just like mice, hypnotized by a snake, waiting to be devoured."

He looked at them. He knew it wasn't a good speech, but he'd hoped for some reaction. And they were doing their best not to see him, not to listen to what he was saying. It was exactly like addressing an assembly of salt sculptures.

"Well, sorry to have upset you. It's been a hard day. Good-bye."

He went to the door and opened it. No one moved. In a way he would have preferred to have them attack him, even kill him, but, ironically enough, the presence of the butterfly was protecting him.

The room must have been stinking with anguish and fear and hatred, because the minute he opened the door a hundred butterflies flew in.

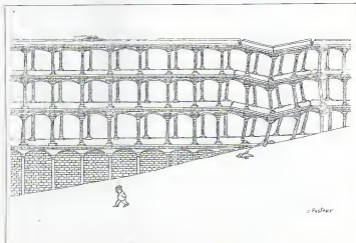
"Sorry again, I just forgot something."

He leaned all his knifets in the middle of the room, toward the ceiling, closed the door on his and Xeroxed butterflies fluttering together in an intricate, nearly surrealistic, aerial ballet. And left.

He didn't know what he was going to do next, or what the future would be like, but he felt better than he had in years.

Not a single butterfly followed him.

A wasp did, though. But maybe it was just an ordinary wasp. ☐



CONTINUED FROM PAGE 21

Apart from misinterpreted lines Gruszkoff feels Herzog's approach has been a sound one. "He regards the original version of *Nosferatu*, directed in 1922 by F.W. Murnau, as the greatest German film ever made," Gruszkoff explains. "Murnau was making a statement about the decay that was eating away Germany under Hitler. Herzog's version is homage to the original and closely resembles it, except ours has a twist at the end. He belatedly adds the twist to reflect the Germans' complicity about the ascendancy of Hitler during the Nazi era. People in our film just let the vampires come in and destroy their town. Once you get beneath the entertainment level of the film, it's apparent that the political inference was Herzog's prime concern. He wants people to see the Holocaust, not just a town infested with rats."

The town government of Dalt, Holland, seemed more concerned with the rats than with the feature's political overtones. Already resentful about the presence of a German film unit, the city council gave Herzog a particularly hard time when he announced his intention to film the plague of rats that follows Dracula into that town. "The Dutch had done a lot to clean up their own vermin," Gruszkoff says, "so they were very hesitant to have Wenner and his 5,000 rats extras running around their streets. Though he was using clean laboratory rats imported from Hungary, it took weeks to secure permission for a place to film them. Even then, the security was strict, and he was allowed very limited space in which to work, the assigned areas being cordoned off by nets just outside of camera range to keep all the rodents in bounds."

Police and rats aside, Herzog's approach to the subject matter is more subtle than that of his predecessors. "He didn't make *Nosferatu* to grab you by the way *The Omen* or *The Exorcist* did," Gruszkoff notes. "They were designed to frighten you out of your seat. He wants a more poetic approach. He makes you feel something for the vampire. It's much softer than a traditional horror movie. It's like a lullaby. You're made to understand that Dracula's been around so long that all he wants to do is be put to sleep and rest, but he's not in a position to do anything about it. It's only when he allows himself to be seduced by a beautiful woman (Isabelle Adjani) that you understand how tired he is. You actually have sympathy for this creature."

Sympathy for Dracula? Contempt, usually, fear always. But sympathy? Bela Lugosi would turn in his grave. Who could play an erotic, sympathetic, yet still horrific vampire?

For this seemingly impossible idea, Herzog chose Klaus Kinski, an established European actor with over 175 pictures behind him. Kinski has never been in a film that has scored a major success in the U.S.,

yet he is known to many of the same people who have followed Herzog for the past decade. The star of Herzog's *Aguirre, the Wrath of God*, Kinski now fifty-two, hopes that *Nosferatu* will establish him as a new Karloff or Lugosi or both.

"Kinski is a very sensual man," Gruszkoff explains. "He has a mouth like Nick Jaggers or Marlon Brando—you know the protruding lips. A very sensual mouth. On top of that, he's a very elegant man, so his sensuality played a big part in his casting. He really threw himself into the part. He shaved off all his hair and wore makeup that made him look really horrible. But he sees this as a stepping-stone to the world market. If he does well in this, he can be cast into a different strata of roles. He's usually the type of man who says, 'Send me the money now and the script afterward. Now he's starting to look after his career.'

Though politics and erotic vampires seem odd subjects for box office success, Gruszkoff was surprisingly relaxed in his approach to it. "We're not concerned about the film's really going over big," he says. "Since it only cost us \$800,000, it's going to make its money back in Europe, regardless of what we do. We want to give it the best possible release. Cut the best trailers, do the best advertising. Get Klaus here and Wenner. We're not putting it in bars, we're putting it in tiny cinemas that have played Herzog's films before."

"The studio isn't panicked, saying 'Holy shit! We've spent five million dollars on this picture! That means we have to spend another four or five to promote it!' Here, when you spend \$800,000 you can pitch around with a million and a half and still be assured of commercial success regardless."

What makes Herzog's version of the Dracula story all the more impressive is the extraordinary care he has taken in the cinematography of *Nosferatu*. Almost every frame of the movie could be exhibited along with fine-art photography and some of the shots actually look like paintings. Special care and attention in the lighting of each shot create a painterly illusion. Scenes flow from one to another using cinematographic effects not seen since Stanley Kubrick's production of *Berry Lyndon*. The total effect is one not often seen in films made for American release. Herzog may well be paving the way for more American financing of what used to be called European "art" films, movies that might never have been seen here.

The film will beat both the Gorey-Lingula *Dracula* and Hamfron's *Love at First Bite* to the theaters. But with its limited release pattern, they may surpass it at the box office. Regardless, this year's flock of vampire films will be the most extensive array of fantasy/horror in several decades, and Herzog's *Nosferatu*, judging by the accompanying photograph at any rate, will be the most visually stunning of the lot.

—James Deacon

CONTINUED FROM PAGE 30

unconscious, just as heroglyphs do, and take us into the areas of dream and myth that control us without our awareness.

While specialists may be expected to debate that thesis for some time to come, there is no doubt that *The Third Mind* takes us into the most amusing and startling world to be presented in literature since James Joyce's *Finnegans Wake*. Plot disappears; characters are reduced to vague and ghostly presences; words become the actors as they interact, copulate, separate and join new partners in a complex, chaotic process of disconnection and reconnection. Ultimately, the Third Mind itself appears as the "hero," endlessly sorting and rearing the fundamental elements of our individual minds. "By the time the Mind says near the end of the trip 'you will have gained some insight into the Control Machine and how it operates... The mechanism has no voice of its own and can talk indirectly only through the words of others... speaking through comic strips, news items, advertisements, talking, above all through names and numbers."

The enigmatic and inhuman voice of the Third Mind should be of equal interest to novelists, poets, linguistic philosophers, communication scientists, and perhaps even physicists looking for a semantic system adequate to discuss quantum mechanics. That is no small achievement for a technique that—because it removes the writer's consciousness from the creative process—is sure to be denounced as barbaric by traditionalists.

A new mythology is possible in the Space Age. William S. Burroughs has been talking interviewers lately. The future of writing is in Space! Simultaneously with the publication of *The Third Mind*, a group of Burroughs' advisers staged a Nova Convention in New York last November.

"William is always ten years ahead of the rest of us," psychologist-godfather Timothy Leary enthused in a panel discussion, praising Burroughs as both a literary innovator and a prophet of the Space Age. Lee Levine spoke warmly of the "great compassion" in Burroughs' early novels of dope addiction, political terrorism and brainwashing (*Waked Lunch*, *Nova Express*). The audience trooped from place to place, listening to heavy rock as interstellar as Burroughs' prose and looking at films edited with Cut Ups, voices taken from the actor who spoke and dubbed in on another actor sequences projected backward and other Burroughesque experiments in disconnection and reconnection.

Brian Gysin, coauthor of *The Third Mind*, seemed to speak for all when he said, "In France, William is recognized as both a great writer and an important philosopher. Why is he so little appreciated in his own country? Why indeed?"

—Robert Anton Wilson

INTERVIEW

CONTINUED FROM PAGE 102

think is now more or less discredited. Although like Uri I think he's a real charmer. And the Bermuda Triangle which is, of course, utter nonsense.

I think it would be a pity if there weren't some people like that around to liven up the world, but what does annoy me are the Von Danikens and the ancient-astronaut people, because I do take this very seriously. Because of their activities it's now almost impossible to get an important subject taken as seriously as it should be. I hope DMN can do something about this. Of course, there's nothing you can do about the complete nuts, the religious maniacs who believe in flying saucers landing all the time. I mean, they're just mad and that's all there is to it.

Orin: What are your feelings about things like telepathy and UFOs and faith healing?
Clarke: Well, you've put a bunch of different things together. In general, I've always been interested in ESP and of course, Childhood's End was about that. But I've grown disillusioned, partly because after all this time they're still arguing about whether those things happen. I suspect that telepathy does happen, partly because the evidence seems so overwhelming. On the other hand, you have to have a much higher level of evidence for this kind of thing than for anything else. Something strange is going on.

Obviously we don't know all about the universe. As far as psychokinesis, metal bending, and that sort of thing. I visited beside Geller when he bent my door key and I think I know how he did it. People like Randi are quite sure they know how he did it.

Orin: How do you think he did it?

Clarke: First of all, there's always chaos around Uri, and several things are happening at once. No one is quite sure what went on at any given time. You'd have to have three video cameras, X, Y, and Z, watching him. I've seen good computers do the same sort of thing that he does. And I've seen some computers do some things that I still, to this day don't know how they possibly could have done. Unless you're a professional computer it's utterly useless for a layman to even comment on this. And it's amazing how few scientists seem to realize this.

Orin: You do have an open mind, to a certain extent?

Clarke: It's getting less and less open. I suspect that telepathy occurs, and I suspect that some kind of precognition occurs, partly because I had some experience myself, but it's very hard to rule out coincidence.

Orin: We've talked on this trip to someone who said he's never suffered from headaches, and yet one particular morning he had the most splitting headache that he'd ever had in his life. Later that morning he

found out his son had died.

Clarke: There are so many examples of this that it's hard to get a statistical correlation. You forget the misses and remember the hits. So how can one prove that even the hits are significant, because anything, no matter how fantastic, can happen by pure coincidence. And it's difficult to quantify this.

One person you might get on to is Professor Louis Alvarez, the Nobel Laureate in physics at Berkeley. Louis is a man who invented ground-control-approach radar. Louis then assembled the first atomic bomb. Then he got the Nobel Prize for physics a few years ago, and has perhaps one of the most distinguished American physicist's. Well, he's tackled this problem of coincidences and the paranormal and has written a number of interesting letters to science about it.

Orin: What's your own opinion about UFOs?

Clarke: When I'm asked this question which I have been asked approximately a hundred thousand times, of course, I say when you've seen as many UFOs as I have you won't believe in them. And this is not entirely a lip answer. I've seen maybe ten now, and every one of them would have convinced the layman.

Having been through the mill, I'm totally uninterested in UFOs now. I'm as convinced as one can be that they're unimportant. But I can't be sure. I had an absolute

beauty the other night in back of my house, one of the best I've ever seen. It turned out to be the local net balloon caught by the sunlight, and I was able to prove this by getting the position of the MET balloon. But in other cases, of course, one can never find out what it is one saw, and so the mystery remains. The only UFOs I'm interested in now are ones where people see and approach an artifact and forget all about lights in the sky mystery things. We should only be concerned with close encounters. Either they exist or they don't exist. Forget all the others and let's just concentrate on the reports of close encounters. They're the only ones that matter if they do exist. If anyone reports that there's a Tyrannosaurus rex loose in Central Park, I'd be skeptical. But I'm quite certain that we'd know for sure very shortly. The same with living saucers.

Orin: Then you're skeptical, but you don't dismiss them out of hand?

Clarke: I take it for granted there's a tremendous amount of space traffic going on around the universe, and I'm quite sure that when one vehicle arrives here, we'll know about it. That's why I can't believe it's been going on in recent times. I think it's more probable that in the remote past, maybe even historic times, there may have been visitors, but the universe is so huge, it's hard to believe that there can be all that amount of traffic in the local area.

Orin: Do you think that everything that's



reported now has to be explicable in terms of current scientific understanding?

Clarke: Obviously there's a vast amount that we don't know. In fact, I'm very fond of quoting Helicaine's: The universe is not only queerer than we imagine; it's queerer than we can imagine.

Orrin: Have you personally seen any unusual phenomena besides the experiences you've just recounted?

Clarke: No, they all turn out to be sort of explicable in the long run, even though I'm sure that many of the astronomical and atmospheric phenomena I've seen would have fooled the average layman who didn't know what they were. I'm really fond of peering out Venus in the daylight. Venus is shining up there at the moment, and I could show you if it's worn closer. People don't realize you can see a bright star in the daytime. And they see Venus—it's easy to see, but once you've lost it, it's very hard to find it again, so they think it's sort of a shot off at an enormous speed. That's sort of a big old example.

Orrin: Looking back on it, how accurate do you think you were in *Profiles of the Future* and *Prelude to Space*?

Clarke: Well, of course. *Prelude to Space* was written in 1948, and in detail I wasn't accurate. I had a horizontally launched atomic-tailed spacecraft. But we're coming toward that sort of concept. The shuttle would look rather like my lunar spacecraft, even though the shuttle isn't atomically powered. I'm quite happy with my record as a whole, particularly with the communication satellite. Also, some of my other early ideas are now coming to the fore. The lunar-based electromagnetic launcher which Gerry O'Neill has made the basis of his scheme is one. He calls it the mass driver. This was worked out by me in 1950 or '51. It is the key to all these space-colonization plans.

Orrin: If you were to update either of those books, would there be any changes that you would make?

Clarke: What I have done, in fact, is to write a new preface to *Prelude to Space*. I wouldn't dream of updating in the sense of changing the text of the book, any more than I'd dream of updating H. G. Wells's *War of the Worlds*. They're period pieces and must be left untouched in their own time stream. But what I have done is to set them in a modern perspective by comparing the reality of the Apollo program with my ideas of almost twenty years before. *Profiles of the Future*, again, I've updated with a new preface and footnotes, pointing out where things have developed. In fact, I wrote *Profiles of the Future* with an eye to the pretty long-distance future, because I was fairly sure there'd be no major changes. And this has proved to be the case.

Orrin: So the future doesn't appear to you any different now than it did at the time that you wrote those?

Clarke: Not in general. Of course, a lot of things have turned out different. The

biggest surprise of all was the speed at which we got to the moon. Second biggest surprise was the speed at which we left the moon. No one would ever have dreamed that we'd have got to the moon by early 1969 and would have left it again by the early seventies, probably not be back again until the end of the century.

Orrin: In *Rendezvous with Rama*, you described an elaborate space settlement. Do you think human beings are ready psychologically and socially for such a break with nature?

Clarke: When you talk about a break with nature, I mean just look at New York City. A lot of people live there perfectly happily. My friend Isaac Asimov is a city boy. He won't travel at all. Certainly not by air. But people like Isaac seem perfectly happy totally out of their natural environment. Isaac's *The Cage of Steel* is a perfect example of this. The human being is incredibly adaptable. Look at Hong Kong.

Orrin: Yes, but there's this need to listen to

● *The biggest surprise was the speed at which we got to the moon. Second-biggest surprise was the speed at which we left the moon, probably not to be back until the end of the century.* ●

music or to expose your body to the sun or smelt. Even in that kind of artificial environment, we still need to get back to nature, don't we? We can't break that link.

Clarke: Yes. And I got the best of both worlds in fact. I'm surrounded by trees you see, and now some of these colonies they're being talking about are more back to nature than any of the cities. In fact, they're rather ridiculous. Parks transported into space—which is feasible. I'm sure but I think we'll do it different ways.

Orrin: What do you think of the possibility of placing our industry out in space and keeping Earth as a natural wilderness?

Clarke: I think that perhaps many of the heavy industries and production systems may go to space, or I suggest the planet Mercury, where you have all the power you need from the sun and probably all the heavy metals as well. I don't want to mess up the moon. I want to preserve the lunar wilderness.

Orrin: But you think that human beings can make that psychological break with Earth and live in those kinds of artificial environments?

Clarke: I'm sure that human beings can go

anywhere and do anything as long as they know what they're doing and perhaps have some means of relaxation—if they need it. But, incredibly some people don't seem to need it.

Orrin: What ideas do you have about trying to communicate with extraterrestrial civilizations? Do you think we're setting about it the right way?

Clarke: Well, there isn't any other way we can do it, at the moment except listen to the radio, and I'm appalled that Senator Proxmire has succeeded in destroying the first attempts to set up a listening system. He sort of got the SETI project thrown out of Congress, and in fact has even awarded it the Golden Fleece, which is his sarcastic term for the project which he thinks is least worthwhile. He doesn't seem to realize that with long-term imaginative projects you can never guarantee success. But unless you do have some of them, you'll never get anywhere. I'm sure Proxmire isn't such a fool as some of his statements suggest. I don't envy the congressman who has the problem of selecting different budgets for different things, especially in view of the fiscal stringencies. You see what's happened today. Jimmy Carter has put out all these projects for improving the economy and ending inflation, and the dollar drops to the lowest level ever.

Orrin: How do you think we ought to communicate with possible civilizations out in space? I'm reading an interesting little book called *Love of a God* that suggested music be our form of communication.

Clarke: That was the idea in *Close Encounters*, wasn't it?

Orrin: That's right.

Clarke: I think that's wrong, because I don't think music is the form of communication. You don't know how difficult it is to make any sense of Eastern music for Western ears. So I think music may turn out to be a very restricted thing.

Orrin: How would you do it, yourself?

Clarke: By logic and mathematics, which must be universal.

Orrin: What kind of information do you think we ought to send out?

Clarke: Well, it's too late. We've sent out so much now that that's all been settled years ago. Unfortunately, think of all the super-civilizations looking at *I Love Lucy*.

Orrin: What sort of speculations do you think there would be if we were to learn we are alone in the universe?

Clarke: Well, we can never learn that; of course, because the universe is so enormous that if we go on for the next hundred million years exploring it and finding nobody, we can't be quite sure that over the next half trillion that isn't someone. I admit that after the next hundred million years or so it will look more and more like there's nobody there. Just as at the moment on Mars, even though we've only looked at two landing sights, we found no trace of anything, and so it seems probable that there's no life on Mars. But we can't be sure by any means.

Orrin: What do you see as the most interest-

ing developments in the near future, technology oriented—social change?

Clarke: Hmmmm. I don't think anything unexpected. Well, obviously if it was unexpected I wouldn't be thinking of it. Usually it is the unexpected things which are the most important. But as far as one can see on the horizon at the moment, the coming computers and the communications revolutions. Maybe home computers. Not only home computers, but the computer revolution. Microprocessors are getting into everything. We won't be able to pick up a single piece of equipment in the near future, except maybe a broom, that hasn't got a microprocessor in it.

Orin: How will they affect our lives, in a very general sense?

Clarke: They'll take over much of the routine thought. Now what this is going to do to culture, to education, to art, is the big problem. A lot of people are very worried. Let's take a case that everybody knows about now—the hand calculator. No one's going to learn arithmetic, but does this mean they'll go on to learn more real mathematics? It could well be. Because one of the benefits of the hand calculator is that it encourages you to do all sorts of calculations that you would never dream of doing if you had to do them by pencil and paper because they would be too tedious. It can act as a wonderful toy and interest children in mathematics. On the other hand it may produce a generation of—what's the equivalent of illiterates?—enumerators who can't add up a grocery bill. So you have these two possibilities. And that's why we have a real challenge.

Orin: I seem to remember Huxley saying in *Brave New World* that the most decisive changes in the future would be biological changes rather than technological ones. Do you agree with that or not?

Clarke: I don't think biological changes in the sense of human biology. Obviously biology is going to be very important, and genetic engineering too. That's already starting. It's going to have a revolutionary impact on society. Now they've got the first patent for a new organism issued by the patent office. That would have been incredible a few years ago. We can produce you in now from purely biological, microbiological methods, and if anyone can succeed in getting a nitrogen-fixing organism, that will remove one of the main fertilizer problems. The impact on the Third World will be enormous. All sorts of terrific possibilities. Also some negative ones. People are worried about the recombinant-DNA work. I think that fear is greatly exaggerated, though I'm not an expert in the area.

Orin: Are you gloomy or optimistic about the future in terms of the way we're going to utilize information that we're receiving? Do you think we're going too far, too fast? Do you think it's time to pause?

Clarke: No, we can never pause. You fall flat on your face if you do. I'm an optimist. We have a 51 percent chance of survival. ☐

NEXT OMNI



SPACE SPARTAN



PROCEEDING



LOCH NESS



MASSIVE

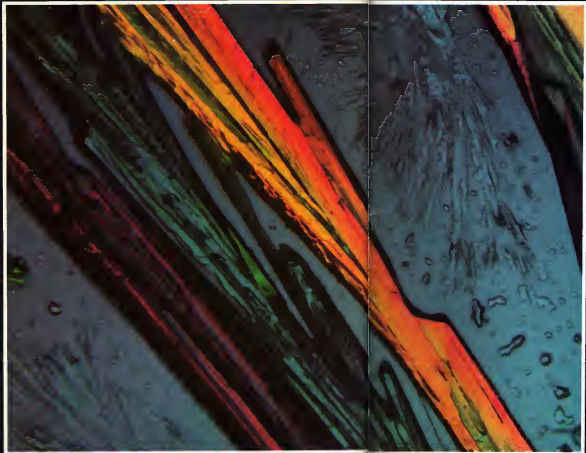
INDUSTRIALIZATION OF SPACE—In a follow up to "Ticket to Space," G. Harry Sims explores the implications of making space work for Earth. "We are on the verge of a new industrial revolution," writes Sims, "and it's all waiting for us out there." Commercial interests have already backed into on-shuttle flights. Corporate drawing boards are turning out plans for private communications satellites, orbital pharmaceutical labs, even a space-jewelry market. It is the greatest remaining challenge of the twentieth century—one that can be laid out in business fashion.

INTERVIEW DAVID LEVY—In 1968, David Levy, international master and reigning chess champion of Scotland, beat a number of scientists working in artificial intelligence that he would not be beaten by a computer in a chess match within the next ten years. The stakes were 1,000 English pounds, and last September in Toronto, Levy faced off with a computer and put his money on the line. Levy won the match—by the skin of his teeth, some say—but he's he won't hold the title for long. In the next *Omni*, join Levy in the fascinating world of computer chess and learn of the *Omni* Levy prize—\$5,000 to the first computer program that can beat Levy.

STATIC GRAVITY—For the first time, *Omni* reveals the long neglected work of Professor I. F. Tidmarsh, who decades ago propounded his theory of static gravity which holds that you can artificially generate gravity just as you can electricity. Any object moving across a gravitational field, said Tidmarsh in 1927, "acquires a charge of statics and thus escapes the effect of gravity." This explains why a running man "feels lighter" and thereby travels faster than a walking man (both of whom move infinitely faster than a man who is standing still). Frankly, we at *Omni* have found no mention of Professor Tidmarsh anywhere in the archives of science. Writer Christopher Priest explains why. Since World War I there has been a greater coverage of static gravity by an unnamed superpower and this warlike nation has been developing its static-projection devices, devices that may be bombarding our class with antigravity waves even as you read this!

RETURN TO LOCH NESS—As one of the great mysteries of all time, the Loch Ness monster has been pursued by everything from baby harpoons to yellow sub-marines, from kayaks mounted with machine guns to one-man autogyros. Those were the good old days. Now the loch and whatever monsters may be hidden there are to be pursued by a keen diving archaeologist and a subtle machine called TAD for Target Alarm Detector. John Cheeseman and Michael Marten file a full report.

ENERGY SCAM—True or false: In the next twenty years, we face the worst energy crunch this country has ever seen? If you answered "no," then you've been reading the papers or watching the news a bit too much. The answer actually is "false." And next month noted science-fiction writer Frederik Pohl explains why.



PHENOMENA

One of our most common household items, Epsom salts, is given a new dimension in the Paul Beverly photograph. Epsom salts, or hydrated magnesium sulfate, are made up of long, slender, needle-like crystals. A polarizing lens produced the spectacular array of colors seen here.

Polarization is the process of splitting white light into two separate components: one that vibrates horizontally, the other, vertically. Certain materials are able to transmit only one of these components; and when made into films and used in polaromicroscopy, they are able to highlight certain structures, forms, and colors not seen with conventional lighting.

Epsom salts, a mineral, has a characteristic color when exposed to this light. By taking thin sections of various minerals and analyzing their respective colors, scientists have been able to create a classification system for use in identification analysis. To record this image, Beverly used a Pottler SL 66 camera, with Professional Ektachrome film. To enhance the polarization effect, a retardation plate was placed in the microscope assembly. □□

Get out your scratch pads for this month's popcorn

GAMES

By Scott Morris

This month we bring you a popcorn of games that require you to look outside the problem for a solution. Or perhaps you should look inside. In any case, get out your scratch pads and pencils.

HOW MUCH WINE? The bottom three quarters of a wine bottle's total height is cylindrical in shape. The upper part is irregularly shaped. The bottle is filled about halfway up with wine. Using only a ruler and without opening the bottle, how can you find exactly what percentage of the bottle's total volume is filled?



CIRCLE ROUND What is the radius of the circle below?



CUBE CUTTING It is obvious that you can cut up a large cube of wood into 27 smaller cubes by making 6 cuts—as shown.



If you are allowed to restack the pieces after each cut, is it possible to produce the 27 cubes in fewer than 6 cuts? Explain.

THE SUSPENDED EGG A glass of water contains a raw egg, floating halfway between the surface and the bottom. How can this be done?



WATER AND WHISKEY The shot glass on the left is filled to the brim with water, and the one on the right, with whiskey. Without using another container (or your mouth), how can you transfer the contents of the two glasses?



WEIGH-IN Assume that there are 2 identical balloons on a balance scale. One balloon is empty; the other is blown up. Which weighs more?



COLD STORAGE In a perfectly insulated room (i.e., no heat can pass through the walls), a refrigerator is left plugged in, with its door open, for one year. At the end of that time is the temperature in the room higher, lower, or the same as it was the year before? (Thanks to Keith Selby and Curt Tabb for sending in this one.)

A RED HOT PROBLEM Consider a red-hot molten glass, a red-hot iron, and a lump of red-hot coal. They are all the same shade of red. Which one is the hottest, or are they all the same?

THE GREAT ROUND ROLL-OFF At the top of an inclined plane rest a ball, a disc, and a ring, each 10 centimeters in diameter. If all 3 objects start rolling down the incline at the same instant, which one will reach the bottom first? (Assume that they all roll off cleanly—i.e., no wobbling—and neglect any effect of air friction.)

CLOSE THE DOOR You are in a room filled with 100 percent methane gas. If you were to strike a match, what would happen?

MILK OR CREAM? Which weighs more: a cup of milk or a cup of cream?

ONE, TWO, THREE, FIRE! A man holds a rifle horizontally 2 meters above the ground. At the moment he fires it, another bullet is dropped from the same height, 2 meters. Ignoring the curvature of the earth, which bullet hits the ground first?

THREE IN A ROW Among 3 playing cards, a two is on the right of a king (but not necessarily next to it), a diamond is on the left of a spade, an ace is on the left of a heart, and a heart is on the left of a spade. What are the 3 cards?

A PUZZLE CLASSIC The sum of the ages of Mike and Ed is 44 years. Mike is twice as old as Ed was when Mike was half as old as Ed will be when Ed is 3 times as old as Mike was when Mike was 3 times as old as Ed. How old is Ed?

BIRDS AND BEASTS A zoo keeper has a number of animals, both birds and beasts. When you ask how many of each kind he has, he replies only that his menagerie contains 43 heads and 120 feet. How many beasts and birds are in the whole collection?

JUNIOR'S FIRST CASE A law student borrowed \$10,000 from his Uncle Ned to finance his legal education, with the stipulation that he would pay back the money after he had won his first case. After getting his degree, he delayed setting up his practice, so his uncle sued for the money. Uncle Ned reasoned: "If I win the suit I will collect my money. If I lose my nephew will have won his first case and must pay me in accordance with our agreement." The nephew, however, had a different viewpoint: "If I am the suit I will not have to pay, but if I lose I will still not have won my first case, so I still will not have to pay according to the agreement. How can the two arguments be reconciled?"

BOOY PARTS: Name 10 parts of the body that are spoiled with only 3 letters.

THE PET STORE: At a discount pet store, puppies sell for \$5 each, kittens for \$3 each, and goldfish for 50¢ each. A man bought 100 animals and paid \$100 for them. How many of each kind did he get?

CAFFEINE QUOTA: Quick, how many cups of "97 percent caffeine free" coffee would you have to drink to get the amount of caffeine in a cup of regular coffee?

HOW MANY CHILDREN? Each son in the Jones family has just as many brothers as sisters, but each daughter has twice as many brothers as sisters. How many boys and how many girls are in the family?

TARGET PRACTICE: Two marksmen, Hank and Lem, have a shoot-off to see which of them is the better shot. Each fires 50 rounds and hits the target 25 times. With the score tied, they take a break for lunch. Later they come back and shoot again, only this time they don't do as well. Hank gets only 3 hits in 34 shots, and Lem misses 25 shots in a row before giving up in disgust. Since Hank's record after lunch was better than Lem's, Hank argued that he needed for the whole day was better than Lem's. Was it?

TO THE CORNERS OF THE NATION: Of the 50 states in the USA, which is the most southern? northern? western? eastern? Be careful, now.

SAVE THE BIRDIE: Workmen are making mortar with sand and cement to lay the

foundation of a building. A baby bird has slipped into a 2-metre-deep hole in a large concrete block. The hole is too small for a hand to squeeze into it, besides, the bird is too deep to be reached by an arm. Grasping the bird between sticks would injure it. With what simple method can you get the bird safely out of the hole?

WORD WISE: James F. Fox, author of *The Complete Book of Riddles*, says that the following puzzle was one of the most popular in his book *Games for the Superintelligent*. What do these words have in common?—*deli, first, catmoss, canopy, laughing, stupid, crabcake, rick*

DISASSEMBLY LINE: Henry Ford, as almost everyone knows, revolutionized the industrial-manufacturing process in 1913 by introducing the assembly line. What most of us don't know, however, is that Ford acknowledged that he got the idea from another industry—an industry, curiously enough, that used the assembly line principle for disassembly rather than assembly. What industry was it?

AND NOW FOR SOMETHING DIFFERENT

Cryptograms are a morsel of war and peace—no government wants its top secrets known by either friend or foe. But there is also a group of people who enjoy figuring out cryptograms for themselves and who devise countless codes and signals to obscure their messages.

We have chosen a rather simple code for the first Dinn cryptogram—it is based on the ubiquitous telephone dial. The number/letter key may be found on any telephone: 2 = A, B, C, 3 = D, E, F, 4 = G, H, I, 5 = J, K, L, 6 = M, N, O, 7 = P, R, S, 8 = T, U, V, 9 = W, X, Y. For our purposes the numeral "1" will be used to designate the letters O and Z, and the number "0" will stand for the spaces between words and the internal punctuation. Now decode the message.

95094811478172633007756467622464460
40329522264463848604426262626262626
38887026277376226226264467772330
679453091444301917. Cryptogram answer
next month.

All other answers page 113

OMNI Competition #5

Occasionally an article appears with a title or sentence that when taken either in or out of context is so humorous that you wonder how it ever made it into print. For example:

- Development of hydro power in the desert of North Africa awaits only the introduction of water. *From Nuclear News*, No. 3, p. 29, March 1968.
- No, the devil does not sweat. His principal response to heat is panning. *From "Does the Devil Sweat?" by A. J. Hulbert and R. W. Rose, Comp. Biochem. Physiol.*, 43A, 219-222 (1972).
- The Evaluation and Parameterization of Stability and Safety Performance Characteristics of Two- and Three-Wheeled Vesicular Toys for Riding. *Title of an HEW-funded study on why children fall off bicycles.*
- It is interesting that the inventor of the champagne cork, a Benedictine monk by the name of Dom Pérignon, was himself blind, although the cause is not known. *From "Champagne Cork Injury to the Eye," by D. Archer and N. Galoway, The Lancet*, 1967, ii (Sept 2), p. 487.
- "Hazards of Living Floor Blades" by J. E. Wesenbaiger, *J. A. M. A.* 1969, 207 (9), 1719.
- "A Note on the Appearance of Wisdom in Large Bureaucratic Organizations" by K. N. Deutsch and W. G. Madow, *Behavioral Sciences*, 1961, 6, 1972.
- "Use of Telephones Interviews in a Longitudinal Fertility Study." L. Coombs and R. Freedman, *The Public Opinion Quarterly*, 1964.

The Competition: Find and submit one title or quote, from any publication, that might be sufficient to cause a reader or listener to do a double take while reading. If possible, please send a photocopy of the title or quote to insure accuracy. All entries must be postmarked by April 15, 1979. First-prize winner will receive \$100. Runners-up (2-10) will receive \$25 each.

All entries become the property of *Omni* and will not be returned. Send entries to **OMNI Competition #5, 909 Third Avenue, New York, N.Y. 10022.** ☐

THE COMPLETE MEMORY TEST

LAST WORD

By Daniel L. McEvor

An exhausting review of the literature on memory research indicates that most memory tests are extremely limited in scope. Ebbinghaus (1885) started the practice (for deep reasons known only to himself) of memorizing nonsense syllables. While he reported on his memory skills with nonsense, he did not report on his ability to recall dates, the color of the first horse he owned, addresses, and so forth. His ability to recall nonsense, however, has never been challenged.

More recently, researchers have designed models of memory that deal with encoding, storage, and retrieval (Keisler, 1973; Bent, 1974), but, again, such models are often derived from studies of nonsense syllables. While it may be true that most university freshmen and sophomores are capable of memorizing great quantities of nonsense, no one has ever adequately worked out in detail exactly what memory for nonsense has to do with anything else.

Learning nonsense syllables for a moment, why is it that most of us can remember at least the first name of the first person we were intimate with, while the name of the second person is more hazy? In all likelihood, the serial-position effect is in operation, but the extrapolation from the memory drum to the intimate situation seems weak, or in some ways uninteresting. And what about the more subtle types of memory? Remember not to ask John if he got that last promotion, because he didn't, and it's still sticking in his craw?

In my own research (McEvor, 1970), I have investigated the number of digits recalled, but not over days. I have studied stories of five sentences (McEvor, 1971), but not while the subjects were in the hypnotic state. I have also experimented with lists of words in cued and noncued recall, but not across language barriers (McEvor, 1973).

The list could go on, but it is hardly necessary: it appears that each researcher seems to have carved out a tiny one-could-almost-say-trivial, but interesting, niche in the auditory CVC in left-handed mechanics, the visual CVC in myopic air-traffic controllers, the

tactile CVC in a yoked-control crossover design associated with olfactory CVCs in ambidextrous civets. In the end, we are left with vast quantities of unrelated bits of information about different aspects of the same phenomenon.

In fact, we are presently in possession (possibly possessed) of a description of the elephant given by the three blind men who touched different parts of the animal. The philosopher who made up that story correctly implied that to adequately describe the elephant, a complete elephant touch was called for. He suggested the possible solution of 10,000 blind men touching the elephant at the same time and instantly yelling their findings (Smith, 1886), but I find such a solution lacking in finesse and experimental clarity.

In summary, no one has studied memory as a whole. What seems to be needed is a complete memory test. I would not suggest Smith's (1886) plan to get 10,000 examiners to yell "What do you remember?" at any one individual at any one time. The notion of having the entire population of the world count off by twos, then randomly selecting odd or even for each pair and having the selected persons simultaneously ask their partner what he or she remembers, has certain appeal, but the logistics in terms of grants for research assistants alone are staggering.

Rather, I offer the following test as a possible prototype for a complete memory test. Such a prototype is put forth at this time to stimulate discussion, inspection, criticism, and other heuristic techniques.

There are basically two forms of the test. Form I is a speed test. Form II is a power test. A third form, an integrated speed-power test, is still being synthesized at this time.

FORM I

Instructions: You will have two minutes to answer the following two questions.

1. Write down everything you can remember.
 2. Write down everything you have forgotten.
- Scoring: Add up the total number of things

remembered. Subtract the total number of things forgotten. Express the remainder as the numerator of a fraction, the denominator of which is the WAIS-I Q (Wechsler, 1960). In the case where the subject remembers more things forgotten than things remembered, the remainder is expressed as an imaginary number.

FORM II

Instructions: You will have fourteen days to answer the following two questions.

1. Write down everything you can remember.
 2. Write down everything you have forgotten.
- Scoring: Score as in Form I, but multiply the numerator by the constant 1/10,000. The purpose of using this constant is to compensate for the different time exposures for the tests. Since there are 1,440 minutes in a day and 720 two-minute intervals, there are $720 \times 14 = 10,080$ two-minute intervals in two weeks. Thus, the number of items remembered in a two-week period should equal about 10,080 times the number of items remembered in any given two-minute interval, other things being equal.

The unique clinical and experimental value of the Complete Memory Test (CMT) is that all aspects of memory can be assessed in one fell swoop. As a consequence, broad generalizations can be made from the CMT scores. For example, instead of saying, "This person can recall seven digits forward, but he can't remember where he parked his car" or "This person can pass his Ph.D. exams, but he can't remember whom he's supposed to sleep with at night," the examiners can now say with great clarity, concision, and confidence, "This person has a lousy memory."

Permission to use this test is voluntarily given by the author, and no copyright will be secured. It is proposed, however, that a new journal be henceforth initiated, to be called the *Journal of Universal Simultaneous Thought*. The purpose of such a journal will be to serve as a clearinghouse for all CMT users in the sure-to-be-coming future. ☐